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PACKAGE A:
THIS PACKAGE CONTAINS A SECURITY REQUIREMENT

Specifications | Devis

Project Name | Nom du projet : Building R13 Massey Hall - Elevator Replacement & Barrier Free Upgrades

DND Project File : 500621770 & 110593

DCC Project File : KN229958

Drawing Number | Numéro du projet : K-K74-7701/35

Date | Date : 23 March 2026

Location | Emplacement : Massey Hall, 7 Valour Drive, Royal Military College of Canada

Address | Adresse

Kingston

City | Ville

ON

Province | Province

Project Manager | Chargé de projet : LAUSCH, LINDA 100 Digitally signed by LAUSCH, LINDA 100 Date: 2026.06.11 15:10:17 -04'00'

Linda Lausch, Architect

Base Fire Chief | Chef des pompiers de la base : ST JOHN, STEVEN 376 Digitally signed by ST JOHN, STEVEN 376 Date: 2026.06.24 06:29:04 -04'00'

Steve St. John, Chief Fire Inspector

Approved by | Approuvé par : SANTOS, FERNANDO 989 Digitally signed by SANTOS, FERNANDO 989 Date: 2026.06.25 07:58:57 -04'00'

Fernando Santos, Engineering Officer

Consultant Identification | Identification Expert-Conseil :

Architect | Architecte :

NORR Architects & Engineers Limited
Name | Nom

55 Murray Street, Suite 600
Address | Adresse

Ottawa — ON
City | Ville — Province | Province

Civil Engineer | Ingénieur civil :

Name | Nom

Address | Adresse

City | Ville — Province | Province

Structural Engineer | Ingénieur structure :

NORR Architects & Engineers Limited
Name | Nom

55 Murray Street, Suite 600
Address | Adresse

Ottawa — ON
City | Ville — Province | Province

Mechanical Engineer | Ingénieur mécanique :

NORR Architects & Engineers Limited
Name | Nom

55 Murray Street, Suite 600
Address | Adresse

Ottawa
City | Ville — Province | Province

Electrical Engineer | Ingénieur électrique :

NORR Architects & Engineers Limited
Name | Nom

55 Murray Street, Suite 600
Address | Adresse

Ottawa
City | Ville — Province | Province

Heritage Consultant | Consultant en patrimoine:

Name | Nom

Address | Adresse

City | Ville — Province | Province

Consultant Identification | Identification Expert-Conseil :

Jonathan Hughes, COO Digitally signed by Jonathan Hughes, COO Date: 2026.03.19 18:19:15 -04'00'	Greg Allan 2026.03.17 08:56:16-04'00'	
ONOT23-0003 DATE: 2026-MAR-19		

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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 Contractor shall develop details by submitting a demolition plan prepared by a professional engineer employed by the Contractor.

1.2 DESIGNATED SUBSTANCES

.1 Project-specific Reports on the presence of Designated Substances and Hazardous Building Materials are appended at the end of the Specifications as information documents for review and use. Examine reports to become aware of locations where hazardous materials are present.

.1 Refer to the Table of Contents for complete list of information documents.

.2 Coordinate work of this Section with Division 02 specifications.

.3 Safely remove and dispose of designated substances and hazardous materials in accordance with governing legislation and the requirements of authorities having jurisdiction.

.4 Prepare the Site for safe construction operations prior to engaging in any other work, as required by governing legislation.

1.3 REFERENCE STANDARDS

.1 CSA Group (CSA):

.1 CSA S350 M1980 (R2003), Code of Practice for Safety in Demolition of Structures.

.2 Department of Justice Canada (Jus):

.1 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.

.2 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34, with Memorandum D19-13-5.

.3 Motor Vehicle Safety Act (MVSA), 1995

.4 Hazardous Materials Information Review Act, 1985 (R.S.C., 1985, c.24 (3rd Supp.), Part III)

.3 National Fire Protection Association (NFPA):

.1 NFPA 241-22, Standard for Safeguarding Construction, Alteration, and Demolition Operations

.4 National Research Council Canada (NRC):

.1 National Building Code of Canada 2015 (NBC), Second Printing Including Errata September 28, 2018.

1.4 DEFINITIONS

.1 Demolish: Detach items from existing construction and legally dispose of them off site, unless indicated to be removed and salvaged or removed and reinstalled.

.2 Remove and Salvage: Detach items from existing construction and deliver them to DCC Representative 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 Hazardous Materials Information Review Act including latest amendments.

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Adhere to the requirements of the Construction Waste Management plan as per Section 01 74 00 Cleaning and Waste Management.

.2 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.

.3 Coordination: Coordinate with DCC Representative for the material ownership as follows:

.1 Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain DCC Representative property, demolished materials shall become Contractor’s property and shall be removed from Project site.

.2 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, who will establish special procedures for removal and salvage.

.4 Pre Demolition Meeting: Conduct a pre demolition meeting at Project site to confirm extent of salvaged and demolished materials; and to review Contractor's demolition plan prepared by a professional engineer licensed in the Province of Ontario.

.5 Artifacts: For special instruction and procedures for historic items refer to Section 01 35 43 Environmental Protection.

.6 Carefully remove and re-install salvaged bronze wall sculpture as indicated on the architectural drawings.

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 16.19 – Construction Progress Schedule, and indicate the following:

.3 Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.

.4 Coordinate with DCC Representative ongoing site operations, and limit the number of interruptions during regular business hours.

.5 Interruption of utility services.

.6 Coordination for shutoff, capping, and continuation of utility services.

.7 Use of elevator and stairs.

.8 Locations of temporary partitions and means of egress, including for others affected by selective demolition operations.

.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 licensed in the Province of Ontario in accordance with requirements of Authority Having Jurisdiction, and as follows:

.9 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 DCC Representative ongoing operation.

.10 Comply with municipal noise bylaws. Adhere to requirements of Section 01 35 43 – Environmental Protection.

.11 Refer to Section 01 14 00 - Work Restrictions for restriction on work hours.

.12 Inventory: Submit a list of items that have been removed and salvaged after selective demolition is complete.

.13 Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

.14 Pre demolition Photographs: Submit still 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.

1.7 QUALITY ASSURANCE

.1 Regulatory Requirements: Comply with governing environmental notification requirements and regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction and in accordance with the following:

.1 Worker's compensation board of Ontario

.2 Workplace Safety Occupational Health and Safety Standards and Programs of Ontario.

1.8 SITE CONDITIONS

.1 Storage or sale of removed items or materials on site will not be permitted.

.2 Maintain existing utilities indicated to remain in service and protect them against damage 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 licensed in the Province of Ontario.

.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.

.4 Retain original installer or fabricator to patch the exposed Work listed below that is damaged during selective demolition, if possible. Engage another recognized experienced and specialized firm where it is not possible to retain original installer:

.15 Processed concrete finishes.

.16 Concrete Block Masonry.

.17 Matched veneer woodwork.

.18 Window wall system.

.19 Stucco and ornamental plaster.

.20 Terrazzo.

.21 Other type of exposed construction.

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 licensed in the Province of Ontario 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 Demolish and remove existing utilities and below grade utility structures

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.

.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 for DCC Representative to accept: 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.

.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.

.5 Refer to Section 01 35 43 Environmental Protection for additional requirements on pollution prevention.

3.5 SELECTIVE DEMOLITION

.1 Carry out demolition work in accordance with CSA S350.

.2 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.

.3 Comply with DCC Representative requirements for using and protecting elevators, stairs, walkways, loading docks, building entries, and other building facilities during selective demolition operations.

.4 Removed and Salvaged Items:

.1 Clean salvaged items

.2 Pack or crate items after cleaning

.3 Identify contents of containers

.4 Store items in a secure area until delivery to DCC Representative

.5 Transport items to DCC Representative storage area designated by DCC Representative. Protect items from damage during transport and storage

.5 Removed and Reinstalled Items:

.1 Clean and repair items to functional condition adequate for intended re use. Paint equipment to match new equipment

.2 Pack or crate items after cleaning and repairing

.3 Identify contents of containers

.4 Protect items from damage during transport and storage

.5 Reinstall items in locations indicated

.6 Comply with installation requirements for new materials and equipment

.7 Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated

.6 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

.7 Concrete:

.1 Demolish in small sections

.2 To begin demolition, first score the perimeter by cutting to a depth of 19 mm along the line separating the concrete to be removed from the concrete that will remain. Next, make a series of full-depth cuts: first along the same perimeter line, and then at regular intervals within the demolition area. Finally, break apart and remove the concrete sections between these full-depth cuts.”

.3 Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition

.4 Neatly trim openings to dimensions indicated

.8 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 DCC Representative where slab features interfere with core drilling.

.3 Notify the DCC Representative immediately for further instructions where coring or cutting will damage existing slab features.

.9 Concrete Slabs on Grade: Saw cut perimeter of area to be demolished, then break up and remove.

.10 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

.11 Brick removal:

.1 Remove salvageable brickwork as follows, taking care not to damage edges or face of bricks to be salvaged:

.1 Rake out face of mortar joints. Raking must not touch masonry units. Remove mortar without chipping, altering or damaging masonry units.

.2 Clean out voids and cavities encountered.

.3 Clean surfaces of joints by compressed air or with non-ferrous brush without damaging texture of exposed joints or masonry units.

.4 Flush open joints and voids; clean open joints and voids with low pressure water and if not free draining, blow clean with compressed air. Leave no standing water.

.5 Cut through unsupported load bearing brickwork in accordance with engineered shop drawings.

.6 Cut out non-load bearing brickwork in accordance with engineered shop drawings.

.7 During removal, protect sound areas to remain. Use mechanical hand methods of removal. Obtain DCC Representative's approval for use of power tools before commencing work.

.8 Remove adhered mortar from surface of adjacent bricks that remain in place.

.12 Brick salvage:

.2 Carefully clean, store and protect bricks for re-use.

.3 Place detached bricks on wood surfaces during handling. Prevent contact with metal.

.4 Store dismantled masonry units on wood platforms, protected from exposure to water, elements, and potential mechanical damage, fully covered under polyethylene.

.5 Store detached face bricks, back-up bricks and bricks showing evidence of soluble salts on separate pallets.

.6 When bricks are lowered to ground, place directly on wooden platform that will be used for transport or storage.

.7 Ensure that sharp edges of bricks do not come into contact with hard objects.

.8 Turn over any remaining salvaged bricks to DCC Representative at completion of contract, separated and labelled as face bricks, back-up bricks and bricks with soluble salts.

.13 Roofing: Remove no more existing roofing than can be covered in one day by new roofing. Refer to applicable Division 07 Sections for new roofing requirements.

.14 Air Conditioning Equipment: Remove equipment without releasing refrigerants.

3.6 PROTECTION

.1 Prevent debris from blocking drainage inlets and systems and ground draining, and protect material, systems and services that must remain in operation.

.2 Fire Safety Requirements:

.1 Implement a fire watch program in accordance with NFPA 25 and Authority Having Jurisdiction.

3.7 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 in accordance with Section 02 41 19.16 - Selective Interior Demolition.

.2 Demolition Waste 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 as follows:

.1 Promptly dispose of demolished materials.

.2 Do not allow demolished materials to accumulate onsite.

.3 Do not burn demolished materials.

.3 Adhere to the requirements of the Construction Waste Management plan as per Section 01 74 00 Cleaning and Waste Management.

.4 Transport materials designated for alternate disposal to 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.

.5 Dispose of materials not designated for alternate disposal in accordance with applicable regulations.

.1 Disposal facilities must be those approved of and listed in CWM Plan.

.2 Written authorization from DCC Representative is required to deviate from disposal facilities listed in CWM Plan.

END OF SECTION

PART 1 GENERAL

1.1 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 CSA Group (CSA)

.1 CSA S350 M1980 (R2003), Code of Practice for Safety in Demolition of Structures

.4 Department of Justice Canada (Jus)

.1 Canadian Environmental Assessment Act (CEAA), 2012

.2 Canadian Environmental Protection Act (CEPA), 2012

.1 SOR/2003-2, On-Road Vehicle and Engine Emission Regulations

.2 SOR/2006-268, Regulations Amending the On-Road Vehicle and Engine Emission Regulations

.3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34

.4 Motor Vehicle Safety Act (MVSA), 1995

.5 Hazardous Materials Information Review Act, 1985

.3 Canada Labour Code (R.S.C., 1985, c. L-2)

.5 National Fire Protection Association (NFPA)

.1 NFPA 241-2019, Standard for Safeguarding Construction, Alteration, and Demolition Operations

.2 NFPA 13-2019, Standard for the Installation of Sprinkler Systems

1.2 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.

1.3 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, signage within hoarding area, and other items of interest or value to DCC Representative that may be encountered during selective demolition remain DCC Representative 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, who will establish special procedures for removal and salvage.

.2 Pre-Demolition Meeting: Convene pre-demolition meeting 30 Calendar Dyas prior to beginning work of this Section 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 as specified in Section 01 11 00, General Instructions.

.4 Ensure key personnel, site supervisor, project manager, and subcontractor representatives attend.

.5 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.

1.4 ACTION AND INFORMATION SUBMITTALS

.1 Action Submittals: Provide the following submittals before starting any work of this Section:

.1 Schedule of Selective Demolition Activities: indicate the following information:

.1 Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.

.2 Coordinate with DCC Representative and building manager 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 DCC Representative continuing occupancy of portions of existing building and of DCC Representative 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 registered professional engineer, licensed to Practice in Ontario, 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 DCC Representative 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 wastes by a licensed landfill facility.

.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.

1.5 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.

1.6 SITE CONDITIONS

.1 DCC Representative will occupy portions of building:

.1 Conduct demolition so that DCC Representative's operations will not be disrupted.

.2 Provide minimum 3 weeks’ notice to DCC Representative of activities that will affect his 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 Hazardous Substances: Hazardous Substances are present in building.

.1 Coordinate with Abatement specification package.

.2 Do not disturb Hazardous Substances or items suspected of containing Hazardous Substances.

PART 2 PRODUCTS

2.1 TEMPORARY SUPPORT STRUCTURES

.1 Design temporary support structures required for demolition work and other supports necessary for the project using a qualified professional engineer registered or licensed in Province of Ontario.

2.2 DUST/WEATHER PROTECTION

.1 Prior to demolition Work proceeding in existing structures, temporarily enclose Work areas, supply and install dustproof partitions, and weatherproof partitions, in accordance with Section 01 56 00 Temporary Barriers and Enclosures. Design partitions to prevent dust and dirt infiltration into adjoining areas, prevent ingress of water, and to resist loads due to weather.

.2 Prevent dust, dirt and water from demolition operations entering operational areas.

.3 Adjust and relocate partitions as required for various operations of Work.

.4 Upon completion of Work, remove and dispose of partitions from Site.

2.3 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 Retain items indicated on drawings and carefully protect during demolition.

.3 Immediately remove from site materials not designated to be salvaged. Selling or sorting on site is not permitted.

.2 Coordinate the use of freight elevators with DCC Representative.

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 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.

.5 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 EXISTING CONCRETE SLABS

.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 DCC Representative where slab features interfere with core drilling. Refer to Section 01 73 00 – Execution for additional requirements on core drilling procedures.

.3 Notify the DCC Representative immediately for further instructions where coring or cutting may 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 Contain fibrous materials (e.g. insulation) to minimize release of airborne fibres while being transported within facility.

.5 Selling or burning of materials on the site is not permitted.

.6 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.

.7 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.

.8 Fill all openings in gypsum board walls with gypsum board and steel framing to match existing, skim coat to make wall smooth and even.

.9 Coordinate removal of existing carpet with supplier of new carpet for disposal through carpet reclamation program.

.10 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 00 – Cleaning and Waste Management.

.11 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

.12 Demolish ceiling panels and grid as indicated.

.13 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.

.14 Patch and repair all walls, floor and ceilings damaged during demolition with material matching adjacent walls, prepare ready for new finishes.

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 work so that interference with the use of adjoining areas by the DCC Representative and public 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 REMOVAL FROM SITE

.1 Transport and dispose of demolished materials from the site on a daily basis whenever possible.

.2 Separate from general waste stream each of following materials.

.1 Glass fibre ceiling tiles.

.2 Wood fibre ceiling tiles.

.3 Power source poles deemed unfit for reuse by DCC Representative.

.4 Wiring and conduit.

.5 Outlets/switches.

.6 Floor receptacles.

.7 Metal duct work, baffles, HVAC equipment.

.8 Demountable partitions.

.9 Drapes.

.10 Tracks and blinds.

.11 Insulation batts.

.12 Miscellaneous metals.

.13 Carpet.

.3 Supply separate, clearly marked disposal bins for categories of waste material.

.4 Transport material designated for alternate disposal using approved haulers to facilities in accordance with applicable regulations.

.5 Dispose of materials not designated for alternate disposal in accordance with applicable regulations.

3.9 CLEANING

.1 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.

.2 Maintain access to exits clean and free of obstruction during removal of debris.

.3 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.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Comply with requirements of this Section when performing following work:

.1 Removal of non-friable asbestos-containing material if the material is removed by breaking, cutting, drilling, abrading, grinding or vibrating, if the material is wetted to control the spread of dust and fibres, and the work is only done by means of non-powered hand-held tools.

.2 Refer to the Specification Section 01 14 25 – Designated Substances, for details on asbestos-containing materials.

1.2 RELATED SECTIONS

.1 Section 01 14 25 – Designated Substances

.2 Section 02 82 00.02 – Asbestos Abatement: Moderate Risk Precautions

.3 Section 02 82 00.03 – Asbestos Abatement: High Risk Precautions

.4 Section 02 83 00 – Lead Precautionary Measures

.5 Section 02 89 00 – Silica Precautionary Measures

1.3 REFERENCES

.1 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-1.205-03, Sealer for Application of Asbestos-Fibre Releasing Materials.

.2 Department of Justice Canada (Jus).

.1 Canadian Environmental Protection Act, 1999 (CEPA).

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Safety Data Sheets (SDS).

.4 Transport Canada (TC).

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.5 Underwriters' Laboratories of Canada (ULC).

.6 Canada Labour Code Part II, Section 124 and 125.

.1 Canada Occupational Health and Safety Regulations

.7 DND Asbestos Management Directive

.8 Ontario Dangerous Goods Transportation Act

.9 *Ontario Environmental Protection Act, R.R.O 1990,*

.1 General – Waste Management, O. Reg 347/90, as amended.

.10 National Joint Council (NJC).

.1 Part XI – Hazardous Substances.

.11 Ontario Ministry of Labour, Immigration, Training and Skills Development (MLITSD).

.1 Occupational Health and Safety Act, R.S.O 1990, c. O1 (OSHA)

.1 O.Reg. 278/05 – Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations, as amended

.2 Ontario Occupational Health and Safety Act, R.S.O. 1990, Regulation 490/09 "Designated Substances", as amended.

.3 O.Reg 213/91 - "Construction Projects", as amended.

1.4 DEFINITIONS

.1 HEPA vacuum: DOP tested High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.

.2 Amended Water: water with non-ionic surfactant wetting agent added to reduce surface tension of water to allow thorough wetting of fibres.

.3 Asbestos-Containing Materials (ACMs): materials that contain 0.5 percent or more asbestos by dry weight, 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: Departmental Representative, and representative(s) of regulatory agencies.

.6 Competent worker: in relation to specific work, means a worker who:

.1 Is qualified because of knowledge, training and experience to perform the asbestos work.
.2 Is familiar with the provincial laws and with the provisions of the regulations that apply to the work.
.3 Has knowledge of all potential or actual danger to health or safety in the work.

.7 Hazardous Material Workplan: A brief report identifying the location and quantities of hazardous materials and the methods that will be used to remove, store, transport and dispose of them.

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

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

.10 Polyethylene: rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.

.11 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Sprayer must have appropriate capacity for work.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit proof satisfactory to the Departmental Representative that suitable arrangements have been made to dispose of asbestos-containing waste in accordance with requirements of authority having jurisdiction.

.2 Submit Provincial/Territorial and/or local requirements for Notice of Project Form.

.3 Submit to the Departmental Representative necessary permits for transportation and disposal of asbestos-containing waste and proof that asbestos-containing waste has been received and properly disposed.

.4 Submit proof (certificate) 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.

.5 Submit proof satisfactory to Departmental Representative that employees have appropriate respirator fitting and testing (fit test certificates). Workers must be fit-tested (qualitative as a minimum) with respirator that is personally issued.

.6 Asbestos abatement section within Hazardous Material Work Plan.

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 these requirements or with these specifications, more stringent requirement applies. Comply with regulations in effect at time Work is performed.

.2 Health and Safety:

Safety Requirements: worker protection.

.1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:

.1 As a minimum, 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 (high-density polyethylene protective clothing (Tyvek or similar, as approved by Departmental Representative) 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 their 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 Remove all packaging materials from site and return to appropriate recycling facilities.

.2 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.

.3 Separate for reuse, and recycling and place in designated containers steel, metal, plastic waste in accordance with Waste Management Plan.

.4 Place materials defined as hazardous or toxic in designated containers. Location and transportation of all on-site waste containers must be approved by Departmental Representative in writing prior to work.

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

.6 Fold up metal banding, flatten and place in designated area for recycling.

.7 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, Territorial and Municipal regulations. Dispose of asbestos waste in sealed double thickness 0.15 mm thick bags or leak proof drums. Label containers with appropriate warning labels.

.8 Provide waste manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial. All waste landfill manifests are to be provided to the Departmental Representative at the end of the project.

1.8 EXISTING CONDITIONS

.1 Refer to the Specification Section 01 14 25 – Designated Substances for details on materials containing asbestos.

.2 Notify Departmental Representative of asbestos-containing material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material pending instructions from Departmental Representative.

1.9 SCHEDULING

.1 Hours of Work: perform work involving asbestos abatement located at the Building during hours specified by Departmental Representative. **The work schedule must be approved in writing by the Departmental Representative in advance of work.** Contractor shall be available to work continuously from beginning to end of project.

1.10 PERSONNEL TRAINING

.1 Before beginning Work, provide Departmental Representative with 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.

.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.

Part 3 Execution

3.1 SUPERVISION

.1 Minimum of one Supervisor for every ten workers is required inside the asbestos work areas at all times.

.2 Approved Supervisor must remain within Asbestos Work Area during disturbance, removal, or other handling of asbestos-containing materials.

3.2 PROCEDURES

.1 Before beginning Work, isolate Asbestos Work Area using, at a minimum, preprinted cautionary asbestos warning signs 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.

.2 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.

.3 Wet materials containing asbestos to be cut, ground, abraded, scraped, drilled, or otherwise disturbed unless wetting creates hazard or causes damage. If materials cannot be wetted, then more stringent risk precautions may be required (e.g., Moderate or High Risk).

.1 Use garden reservoir type low - velocity fine - mist sprayer.

.2 Perform Work to reduce dust creation to lowest levels practicable.

.3 Work will be subject to visual inspection.

.4 Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas.

.4 Clean-Up:

.1 Frequently during Work and immediately after completion of Work, clean up dust and asbestos-containing waste using HEPA vacuum or by damp mopping.

.2 Place dust and asbestos-containing waste in sealed dust-tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste; wet and fold these items to contain dust, then place in plastic bags.

.3 Clean exterior of each waste-filled bag using damp cloths or HEPA vacuum and place in second clean waste bag immediately prior to removal from Asbestos Work Area.

.4 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 guidelines and regulations for asbestos disposal are followed.

.5 Perform final thorough clean-up of Work areas and adjacent areas affected by Work using HEPA vacuum.

3.3 INSPECTION

.1 Perform inspection of Asbestos Work Area to confirm compliance with specification and governing authority requirements. Deviation(s) from these requirements that have not been approved in writing by Departmental Representative may result in Work stoppage, at no cost to the Departmental Representative.

.2 Departmental Representative may inspect Work at any time during the project 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 Departmental Representative may order Work shutdown.

.4 No additional costs will be allowed by the 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 the following work:

.1 The breaking, cutting, drilling, abrading, grinding, sanding, or vibrating of non-friable asbestos-containing materials if the work is done by means of a power tool that is attached to a dust-collecting device equipped with HEPA filters.

.2 Breaking, cutting, drilling, abrading, grinding, sanding or vibrating non-friable asbestos-containing material if,

.1 The material is not wetted to control the spread of dust or fibres, and

.2 The work is done only by means of non-powered hand-held tools.

.2 Refer to Section 01 14 25 – Designated Substances for details on asbestos-containing materials

1.2 RELATED SECTIONS

.1 Section 01 14 25 – Designated Substances

.2 Section 02 82 00.01 – Asbestos Abatement: Low-Risk Precautions

.3 Section 02 82 00.03 – Asbestos Abatement: High-Risk Precautions

.4 Section 02 83 00 – Lead Precautionary Measures

.5 Section 02 89 00 – Silica Precautionary Measures

1.3 REFERENCES

.1 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-1.205-03, Sealer for Application of Asbestos-Fibre Releasing Materials.

.2 Department of Justice Canada (Jus).

.1 Canadian Environmental Protection Act, 1999 (CEPA).

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Safety Data Sheets (SDS).

.4 Transport Canada (TC).

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.5 Underwriters' Laboratories of Canada (ULC).

.6 DND Asbestos Management Directive

.7 Canada Labour Code Part II, Section 124 and 125.

.1 Canada Occupational Health and Safety Regulations

.8 Ontario Dangerous Goods Transportation Act

.9 *Ontario Environmental Protection Act, R.R.O 1990,*

.1 General – Waste Management, O. Reg 347/90, as amended.

.10 National Joint Council (NJC).

.1 Part XI – Hazardous Substances.

.11 Ontario Ministry of Labour, Immigration, Training and Skills Development (MLITSD).

.1 Occupational Health and Safety Act, R.S.O 1990, c. O1 (OSHA)

.1 O.Reg. 278/05 – Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations, as amended.

.2 Ontario Occupational Health and Safety Act, R.S.O. 1990, Regulation 490/09 "Designated Substances", as amended.

.3 O.Reg 213/91 - "Construction Projects", as amended.

1.4 DEFINITIONS

.1 Amended Water: water with non-ionic surfactant wetting agent added to reduce surface tension of water to allow wetting of fibres.

.2 Asbestos-Containing Materials (ACMs): materials that contain 0.5 percent or more asbestos by dry weight, identified under Existing Conditions Article, including fallen materials and settled dust.

.3 Asbestos Work Area: area where work takes place which will or may disturb ACMs.

.4 Authorized Visitors: Departmental Representative, and representative(s) of regulatory agencies.

.5 Competent worker: in relation to specific work, means a worker who:

.1 Is qualified because of knowledge, training and experience to perform the asbestos work.
.2 Is familiar with the provincial laws and with the provisions of the regulations that apply to the work.
.3 Has knowledge of all potential or actual danger to health or safety in the work.

.6 Curtained doorway: arrangement of closures to allow ingress or 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 metres on each side.

.7 DOP Test: testing method used to determine integrity of Negative Pressure unit using Dispersed Oil Particulate (DOP) HEPA-filter leak test.

.8 Friable Material: material that when dry can be crumbled, pulverized or powdered by hand pressure and includes such material that is crumbled, pulverized or powdered.

.9 Hazardous Material Workplan: A brief report identifying the location and quantities of hazardous materials and the methods that will be used to remove, store, transport and dispose of them.

.10 HEPA vacuum: DOP tested, 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.

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

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

.14 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 INFORMATION SUBMITTALS

.1 Submit proof satisfactory to the Departmental Representative that suitable arrangements have been made to dispose of asbestos-containing waste in accordance with requirements of authority having jurisdiction.

.2 Submit Provincial/Territorial and/or local requirements for Notice of Project Form.

.3 Submit to the Departmental Representative necessary permits for transportation and disposal of asbestos-containing waste and proof that asbestos-containing waste has been received and properly disposed.

.4 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.

.5 Submit proof that supervisory personnel have attended asbestos abatement course, of not less than two days duration, approved by Departmental Representative. Minimum of one supervisor for every ten workers.

.6 Submit Worker's Compensation Board status and transcription of insurance.

.7 Submit documentation including test results, fire and flammability data, and Safety Data Sheets (SDS) for chemicals or materials including:

.1 encapsulants;

.2 amended water;

.3 slow-drying sealer.

.8 Submit proof satisfactory to Departmental Representative that employees have appropriate respirator fitting and testing (fit test certificates). Workers must be fit tested (qualitative as a minimum for Half-face respirator, quantitative for Full-face respirator) with respirator that is personally issued.

.9 Asbestos abatement section within Hazardous Material Work Plan.

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 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 Safety Requirements: worker and visitor protection.

.1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:

.1 As a minimum, air purifying 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 (Ontario) 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 (high-density polyethylene protective clothing (Tyvek or similar, as approved by the Departmental Representative) 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.

.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 hands and face shall be provided within or close to the 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.

.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 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.3 Separate for reuse, and recycling and place in designated containers steel, metal, plastic waste in accordance with Waste Management Plan.

.4 Place materials defined as hazardous or toxic in designated containers.

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

.6 Fold up metal banding, flatten and place in designated area for recycling.

.7 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, Territorial and Municipal regulations. Dispose of asbestos waste in sealed double thickness 0.15 mm thick bags or leak proof drums. Label containers with appropriate warning labels.

.8 Provide manifests describing and listing waste created. Transport containers by approved means to licenced landfill for burial.

1.8 EXISTING CONDITIONS

.1 Refer to the Specification Section 01 14 25 – Designated Substances for details on asbestos-containing materials.

.2 Notify Departmental Representative of asbestos-containing material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material pending instructions from Departmental Representative.

1.9 SCHEDULING

.1 Hours of Work: perform work involving asbestos abatement located at the Building during hours specified by Departmental Representative **The work schedule must**

be approved in writing by the Departmental Representative in advance of work. Contractor shall be available to work continuously from beginning to end of project. No additional costs will be allowed by the contractor to comply with scheduling requirements of the facility.

1.10 PERSONNEL TRAINING

.1 Before beginning Work, provide Departmental 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.

.2 Instruction and training related to asbestos and respirators includes, at minimum:

- .1 the employer's general obligations;
- .2 the effects of asbestos on health;
- .3 the standards applicable and the sampling to be carried out;
- .4 the worker's rights and obligations;
- .5 individual and common protective devices and equipment;
- .6 the tasks to be carried out and the equipment and tools to be used;
- .7 safe working methods and procedures;
- .8 prevention and verification methods.
- .9 Adjusting respiratory masks;
- .10 Inspection and maintenance of equipment;
- .11 Disinfection of equipment;
- .12 Restrictions on the use of materials.

.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.

.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: contain waste in two separate containers.

- .1 Inner container: 0.15 mm thick sealable polyethylene 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.

.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.

.1 Sealer: flame spread and smoke developed rating less than 50.

.6 Encapsulant: penetrating type conforming to CAN/CGSB-1.205.

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 Build a one (1) chambered Equipment/Access Room between entrance and work area(s), with two curtained doorways. Build equipment/access room large enough for at least one worker allowing him /her sufficient space to undress comfortably.

.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: "ASBESTOS (50 mm) DANGER (40 mm) Do not breathe dust (15 mm) Protective equipment must be worn (15mm), No admittance (15 mm) Inhaling asbestos dust may be harmful to your health (10mm)".

.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.

.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 Erect enclosure of polyethylene sheeting around indoor moderate risk work areas, establish clean room at entrance to enclosure, shut off mechanical ventilation system serving work area, and seal ventilation ducts to and from work area.

.3 Remove loose material 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.

.4 Use garden reservoir type low - velocity sprayer or airless spray equipment capable of producing mist or fine spray.

.5 Perform Work in a manner to reduce dust creation to lowest levels practicable.

.5 Work is subject to visual inspection and air monitoring. Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas at no additional costs to the Departmental Representative.

.6 Clean-up:

.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.

3.3 AIR MONITORING

.1 From beginning of Work until completion of cleaning operations, the Departmental Representative may collect air samples daily inside the Asbestos Work Area enclosures to ensure worker respiratory protection factors are not exceeded, in accordance with Provincial/Federal requirements.

.2 From beginning of Work until completion of cleaning operations, the Departmental Representative will collect air samples on a daily basis in the clean room and outside the enclosures.

.3 If air monitoring shows that areas outside work area enclosures or clean room are contaminated with asbestos fibers exceeding 0.05 fibers per cubic centimetre (f/cc), enclose, maintain, and clean these areas in same manner as that applicable to Asbestos Work Areas:

.1 Stop work and clean areas outside of Asbestos Work Areas when Phased Contrast Microscopy measurements exceed 0.05 fibres per cubic centimetre (f/cc) and correct procedures.

.2 All required cleaning, re-cleaning, additional air testing and/or inspections will be performed at no extra charge to the Client.

.4 The Departmental Representative will collect aggressive clearance air samples inside the enclosure following a final visual inspection of the Asbestos Work Area by the Departmental Representative. Samples will be analyzed and compared to applicable regulations.

.1 Final air monitoring results must show fibre levels of less than 0.01 fibres per cubic centimetre (f/cc).

.2 If air monitoring shows that areas inside the Asbestos Work Area enclosures are contaminated; enclose, maintain and clean these areas in same manner as that applicable to Asbestos Work Area at no additional cost to the client.

.3 Repeat as necessary until fibre levels are less than 0.01 f/cc

.4 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 SECTION INCLUDES

.1 Comply with requirements of this Section when performing the following work:

.1 The breaking, cutting, drilling, abrading, grinding, sanding, or vibrating of non-friable asbestos-containing materials if the work is done by means of a power tool that is not attached to a dust-collecting device equipped with HEPA filters.

.2 Refer to Section 01 14 25 – Designated Substances, for details on asbestos-containing materials.

1.2 RELATED SECTIONS

.1 Section 01 14 25 – Designated Substances

.2 Section 02 82 00.01 – Asbestos Abatement: Low Risk Precautions

.3 Section 02 82 00.02 – Asbestos Abatement: Moderate Risk Precautions

.4 Section 02 83 00 – Lead Precautionary Measures

.5 Section 02 89 00 – Silica Precautionary Measures

1.3 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.205-03, Sealer for Application to Asbestos-Fibre-Releasing Materials.

.2 Canadian Standards Association (CSA International).

.3 Department of Justice Canada.

.1 Canadian Environmental Protection Act (CEPA), 1999.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Safety Data Sheets (SDS).

.5 Transport Canada (TC).

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.6 Underwriters' Laboratories of Canada (ULC).

.7 Canada Labour Code Part II, section 124 and 125.

.1 Canada Occupational Health and Safety Regulations

.8 DND Asbestos Management Directive

.9 *Ontario Dangerous Goods Transportation Act*

.10 Ontario Environmental Protection Act, R.R.O 1990,

.1 General – Waste Management, O. Reg 347/90, as amended.

.11 National Joint Council (NJC).

.1 Part XI – Hazardous Substances.

.12 Ontario Ministry of Labour, Immigration, Training and Skills Development (MLITSD).

.1 Occupational Health and Safety Act, R.S.O 1990, c. O1 (OSHA)

.1 O.Reg. 278/05 – Designated Substance – Asbestos on Construction Projects and in Buildings and Repair Operations, as amended.

.2 O. Reg 490/09 – Designated Substances, as amended.

.3 O. Reg 213/91 - "Construction Projects", as amended.

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 surface tension of water to allow wetting of fibres.

.3 Asbestos-Containing Materials (ACMs): materials that contain 0.5 percent or more asbestos by dry weight, identified under Existing Conditions Article, including fallen materials, and settled dust.

.4 Asbestos Work Area: Area where actual removal and sealing and enclosure of spray or trowel-applied asbestos-containing materials takes place.

.5 Authorized Visitors: Departmental Representative, and representative(s) of regulatory agencies.

.6 Competent worker: in relation to specific work, means a worker who:

.1 Is qualified because of knowledge, training, and experience to perform the asbestos work.

.2 Is familiar with the provincial laws and with the provisions of the regulations that apply to the work.

.3 Has knowledge of all potential or actual danger to health or safety in the work.

.7 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.

.8 DOP Test: testing method used to determine integrity of Negative Pressure unit using dioctyl phthalate (DOP) HEPA filter leak test.

.9 Friable Material: material that when dry can be crumbled, pulverized, or powdered by hand pressure and includes such material that is crumbled, pulverized, or powdered.

.10 Hazardous Material Workplan: A brief report identifying the location and quantities of hazardous materials and the methods that will be used to remove, store, transport, and dispose of them.

.11 HEPA vacuum: DOP tested, 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. Negative pressure systems will require DOP testing on-site, regardless of whether exhausting to interior or outdoors prior to work operations. Include in contract sum costs due to this requirement.

.1 System to maintain minimum pressure differential of 0.02 inches of water 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.

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

.14 Occupied Area: 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 ACTION AND INFORMATIONAL SUBMITTALS

.1 Before beginning work:

.1 Ensure that dump operator is fully aware of hazardous nature of material being dumped, and proper methods of disposal. Submit proof satisfactory to the Departmental Representative that suitable arrangements have been made to receive and properly dispose of asbestos waste.

.2 Submit proof satisfactory to the Departmental Representative that every worker involved in a high-risk operation has successfully completed the Asbestos Abatement Worker Training Program. Submit proof of attendance in form of certificate.

.3 Submit proof satisfactory to the Departmental Representative that every worker who will be entering a high-risk asbestos work area, who will be using a respirator, has successfully completed **appropriate respirator fit testing,** for the respirator type personally issued to worker.

.4 Ensure supervisory personnel have attended asbestos abatement course, of not less than two days' duration, approved by the Departmental Representative. Submit proof of attendance in form of certificate. Minimum of one Supervisor for every ten workers.

.5 Submit layout of proposed enclosures and decontamination facilities to the Departmental Representative for review prior to work.

.6 Submit documentation including test results for sealer proposed for use.

.7 Submit Provincial/Territorial and/or local requirements for Notice of Project Form.

.8 Submit Worker's Compensation Board status and transcription of insurance.

.9 Submit documentation including test results, fire and flammability data, and Safety Data Sheets (SDS) for chemicals or materials including but not limited to following:

.1 amended water.

.2 slow-drying sealer.

.10 Asbestos abatement section within Hazardous Material Work Plan.

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.

.2 Health and Safety:

.1 Safety Requirements: worker and visitor protection.

.1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area includes:

.1 Appropriate respirator (minimum full face air purifying respirator) equipped with HEPA P-100 filter cartridges, personally issued to worker, and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial (Ontario) Authority having jurisdiction. This respiratory protection shall also be provided by the contractor for any visitor or Departmental Representative accessing the space. 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 is 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 (high-density polyethylene protective clothing (Tyvek or similar, as approved by Departmental Representative) 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 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.

.3 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.

.4 Ensure workers are fully protected with respirators and protective clothing during preparation of system of enclosures prior to commencing actual asbestos abatement.

.5 Provide and post in Clean Change Room and in Equipment and Access Room the procedures described in this Section, in both official languages.

.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 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.2 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.3 Separate for reuse, and recycling and place in designated containers steel, metal, plastic waste in accordance with Waste Management Plan.

.4 Place materials defined as hazardous or toxic in designated containers.

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

.6 Fold up metal banding, flatten and place in designated area for recycling.

.7 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, Territorial, and Municipal regulations. Dispose of asbestos waste in sealed double thickness 6 mil bags or leak proof drums. Label containers with appropriate warning labels.

.8 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.8 EXISTING CONDITIONS

.1 Refer to the Specification Section 01 14 25 – Designated Substances for details on asbestos-containing materials.

.2 Notify Departmental Representative of asbestos-containing material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material pending instructions from Departmental Representative.

1.9 SCHEDULING

.1 Not later than ten (10) days before beginning Work on this Project notify following in writing:

.1 Regional Office of Labour Canada.

.2 Provincial/Territorial, Department of Labour.

.3 Disposal Authority.

.2 Submit to Departmental Representative copy of notifications prior to start of Work.

.3 Hours of Work: perform work involving asbestos abatement located at the Building during hours specified by the Departmental Representative. **The work schedule must be approved in writing by the Departmental Representative in advance of work.** Contractor shall be available to work continuously from beginning to end of project.

1.10 PERSONNEL TRAINING

.1 Before beginning Work, provide to Departmental 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, and in use, cleaning, and disposal of respirators and protective clothing.

.2 Instruction and training related to asbestos and respirators includes, at minimum:

.1 the employer's general obligations;
.2 the effects of asbestos on health;
.3 the standards applicable and the sampling to be carried out;
.4 the worker's rights and obligations;
.5 individual and common protective devices and equipment;
.6 the tasks to be carried out and the equipment and tools to be used;
.7 safe working methods and procedures;
.8 prevention and verification methods.

.3 Instruction and training must be provided by competent, qualified person.

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 Departmental Representative mixed with water in concentration to provide adequate penetration and wetting of asbestos-containing material.

.5 Asbestos waste containers: Metal or fibre - type acceptable to dump operator with tightly fitting covers and 0.15 mm minimum thickness sealable polyethylene liners.

.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 Label containers in accordance with applicable Regulations. Label in both official languages.

.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.

.7 Encapsulant: penetrating type conforming to CAN/CGSB-1.205.

Part 3 Execution

3.1 PREPARATION

.1 Work Areas:

.1 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.

.2 Pre-clean moveable furniture and carpeting within proposed work area using HEPA vacuum and remove from work area to an appropriate temporary location.

.3 Pre-clean fixed casework, plant, and equipment within proposed work area(s), using HEPA vacuum and cover with polyethylene sheeting sealed with tape.

.4 Clean proposed work area(s) 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.

.5 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.

.6 DOP test negative pressure units on site prior to work operations. Provide documentation to Departmental Representative. Put negative pressure system in operation and operate continuously from time first polyethylene is installed to seal openings until final completion of work including final cleanup. Provide continuous monitoring of pressure difference using automatic recording instrument. The system to maintain a negative air pressure of 0.02 inches (5 Pa) of water, relative to the area outside the enclosed area. The system to be inspected and maintained by a competent person prior each use to ensure that there is no air leakage, and if the filter is found to be damaged or defective, it to be replaced before the ventilation system is used. Vent negative air units to the outdoors.

.7 Seal off openings such as corridors, doorways, windows, skylights, ducts, grilles, and diffusers, with polyethylene sheeting sealed with tape.

.8 Cover floor and wall surfaces with polyethylene sheeting sealed with tape. Use one layer 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 area(s) so that work area(s) 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: "ASBESTOS (50 mm) DANGER (40 mm) Do not breathe dust (15 mm) Protective equipment must be worn (15mm), No admittance (15 mm) Inhaling asbestos dust may be harmful to your health (10mm)".

.11 After work area isolation, remove heating, ventilating, and air conditioning filters, pack in sealed plastic bags 0.15 mm minimum thick and treat as contaminated asbestos waste. Remove ceiling - mounted objects such as lights, partitions, other fixtures not previously sealed off, and other objects that interfere with asbestos removal, as directed by Departmental Representative. Use localized water spraying during fixture removal to reduce fibre dispersal.

.12 Maintain emergency and fire exits from work area(s) or establish alternative exits satisfactory to Fire Commissioner of Canada.

.13 Where application of water is required for wetting asbestos-containing materials, shut off electrical power, provide 24-volt safety lighting and ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard. Ensure safe installation of electrical lines and equipment.

.2 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 area(s), with two curtained doorways, one to Shower Room and one to work area(s). Install portable toilet, waste receptor, and storage facilities for workers' shoes and protective clothing to be re-worn in work area(s). 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 and separate showers for male and female workers. Provide hot and cold water or water of a constant temperature that is not less than 40°C or more than 50°C. Provide individual controls inside the room to regulate water flow, and individual controls inside room to regulate temperature. Provide piping and connect to water sources and drains. Pump wastewater through 5 micrometre filter system acceptable to Departmental Representative 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.

.3 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. Equip 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 wastewater 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.

.4 Construction of Decontamination Enclosures:

.1 Build suitable framing for enclosures or use existing rooms where convenient, and line with polyethylene sheeting sealed with tape. Use one layer of FR polyethylene on floors, as applicable.

.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.

.5 Separation of Work Areas from Occupied Areas:

.1 Separate parts of building required to remain in use from parts of building or exterior used for asbestos abatement by means of airtight barrier system constructed as follows:

.1 Build suitable floor to ceiling lumber or metal stud framing, cover with polyethylene sheeting sealed with tape, and apply 9 mm minimum thick plywood. 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.

.6 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 Departmental Representative.

.7 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 wastewater.

.3 Work area(s) and decontamination enclosures and parts of building required to remain in use are effectively segregated.

.4 Tools, equipment, and materials waste containers are on hand.

.5 Arrangements have been made for building security.

.6 Warning signs are displayed where access to contaminated areas is possible.

.7 Notifications have been completed and other preparatory steps have been taken.

.8 Work area enclosure has been inspected and approved by the Departmental Representative.

.9 Locations for waste bins as designated by the Departmental Representative have been established. Keep bins covered and enclosed while at the site. Bin loading area shall be kept clean at all times.

3.2 SUPERVISION

.1 Minimum of one Supervisor for every ten workers is required.

.2 Approved Supervisor must remain within Asbestos Work Area during disturbance, removal, or other handling of asbestos-containing materials.

3.3 ASBESTOS REMOVAL

.1 Before removing asbestos:

.1 Prepare site.

.2 Spray asbestos material with water containing specified wetting agent, using airless spray equipment capable of providing "mist" application to prevent release of fibres. Saturate asbestos material sufficiently to wet it to substrate without causing excess dripping. Spray asbestos material repeatedly during work process to maintain saturation and to minimize asbestos fibre dispersion.

.2 Remove saturated asbestos material in small sections. Do not allow saturated asbestos to dry out. As it is being removed pack material in sealable plastic bags 0.15 mm minimum thick and place in labelled containers for transport.

.3 Seal filled containers. Clean external surfaces thoroughly by wet sponging. Remove from immediate working area to Staging Area. Clean external surfaces thoroughly again by wet sponging before moving containers to decontamination Washroom. Wash containers thoroughly in decontamination Washroom, and store in Holding Room pending removal to Unloading Room and outside. Ensure that containers are removed from Holding Room by workers who have entered from uncontaminated areas dressed in clean coveralls.

.4 After completion of stripping work, wire brushed and wet-sponged surfaces from which asbestos has been removed to remove visible material. During this work keep surfaces wet.

.5 After wire brushing and wet sponging to remove visible asbestos and after encapsulating asbestos containing material impossible to remove, 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 second 24-hour period under same conditions, clean these areas and objects again using HEPA vacuum followed by wet cleaning. After inspection by Departmental Representative or designate, 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.

.6 Work is subject to visual inspection and air monitoring by Departmental Representative. Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas.

.7 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 INSPECTION

.1 Perform inspection of Asbestos Work Area to confirm compliance with specification and governing authority requirements. Deviation(s) from these requirements that

have not been approved in writing by the Departmental Representative may result in Work stoppage, at no cost to the Departmental Representative.

.2 Departmental Representative 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, Departmental Representative may order Work shutdown.

.4 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.

3.5 AIR MONITORING

.1 From beginning of Work until completion of cleaning operations, the Departmental Representative may collect air samples daily inside the Asbestos Work Area enclosures to ensure worker respiratory protection factors are not exceeded, in accordance with Provincial/Federal requirements.

.2 From beginning of Work until completion of cleaning operations, Departmental Representative will collect air samples on daily basis in the clean room and outside of work area enclosure(s) in accordance with Canada Labour Code.

.3 If air monitoring shows that areas outside work area are contaminated with asbestos fibers exceeding 0.05 fibers per cubic centimetre (f/cc), enclose, maintain, and clean these areas in same manner as that applicable to Asbestos Work Areas.

.1 Stop work and clean areas outside of Asbestos Work Areas when Phase Contrast Microscopy measurements exceed 0.05 fibres per cubic centimetre (f/cc) and correct procedures.

.2 All required cleaning, re-cleaning, additional air testing and/or inspections will be at no extra charge to Departmental Representative.

.4 Final air monitoring to be conducted as follows: After Asbestos Work Area has passed visual inspection by Departmental Representative, and acceptable coat of lock-down agent has been applied to surfaces within enclosure, and appropriate setting period has passed, Departmental Representative will perform aggressive air monitoring within Asbestos Work Area.

.1 Final air monitoring results must show fibre levels of less than 0.01 f/cc.

.2 If air monitoring results show fibre levels in excess of 0.01 f/cc, re-clean work area and apply another acceptable coat of lock-down agent to surfaces.

.3 Repeat as necessary until fibre levels are less than 0.01 f/cc.

.4 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.

3.6 FINAL CLEANUP

.1 Following cleaning and air sampling by Departmental Representative shows that asbestos levels inside work area enclosure(s) do not exceed 0.01 fibres/cc, proceed with final cleanup.

.2 Remove polyethylene sheet by rolling it away from walls to centre of work area. Vacuum visible asbestos-containing particles observed during cleanup, immediately, using HEPA vacuum equipment.

.3 Place polyethylene seals, tape, cleaning material, clothing, and other contaminated waste in plastic bags and sealed labelled waste containers for transport.

.4 Include in clean-up Work areas, Equipment and Access Room, Washroom, Shower Room, and other contaminated enclosures.

.5 Include in clean-up sealed waste containers and equipment used in Work and remove from work areas, via Container and Equipment Decontamination Enclosure System, at appropriate time in cleaning sequence.

.6 Conduct final check to ensure that no dust or debris remains on surfaces as result of dismantling operations.

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Lead abatement procedures for the removal/disturbance/repair of lead-containing surface coating materials on various building components, or materials suspected of containing lead, if required to accommodate the project scope of work.

.2 In the absence of other more stringent requirements, lead precautionary measures for paints/surface coatings can be followed for the disturbance of mercury and chromium containing surface coatings. All work shall be subject to visual evaluation, surface wipe sampling, and air monitoring, at the discretion of the designated client representative.

.3 Refer to the Specification Section 01 14 25 – Designated Substances for details on lead-containing materials.

1.2 RELATED SECTIONS

.1 Section 01 14 25 – Designated Substances

.2 Section 02 82 00.01 – Asbestos Low-Risk Precautions

.3 Section 02 82 00.02 – Asbestos Moderate-Risk Precautions

.4 Section 02 82 00.03 – Asbestos High-Risk Precautions

.5 Section 02 89 00 – Silica Precautions

1.3 REFERENCES

.1 Department of Justice Canada.

.1 Canadian Environmental Protection Act (CEPA), 1999.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

.1 Safety Data Sheets (SDS).

.3 Transport Canada (TC).

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.4 Ontario Ministry of Environment, Conservation and Parks (MECP).

.1 R.R.O. 1990, Reg. 347, General – Waste Management, as amended.

.5 Ontario Ministry of Labour, Immigration, Training and Skills Development (MLITSD).

.1 Occupational Health and Safety Act, R.S.O. 1990, c. O.1 (OHSA).

.1 O.Reg. 213/91, Construction Projects, as amended.

.2 R.R.O. 1990, Regulation 490/09, “Designated Substances”, as amended.

.2 Guideline: Lead on Construction Projects, September 2004, as revised.

.6 Canada Consumer Product Safety Act Surface Coating Materials Regulations SOR/2016-193, as amended.

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 unless Site Conditions dictate otherwise.

.2 Authorized Visitors: Departmental Representatives or designated representatives, and representatives of regulatory agencies.

.3 Curtained doorway: arrangement of closures to allow ingress and egress from one room to another while permitting minimal air movement between rooms, typically constructed by placing two overlapping sheets of 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. Reinforce free edges of polyethylene with duct tape and weight bottom edge to ensure proper closing. Overlap each polyethylene sheet at openings not less than 1.5 m on each side unless Site Conditions dictate otherwise.

.4 Hazardous Material Workplan: A brief report identifying the location and quantities of hazardous materials and the methods that will be used to remove, store, transport and dispose of them.

.5 Lead-Containing Paint: Paint that contains lead in concentrations greater than 90 parts per million, that may result in elevated airborne lead exposure during operations that disturb the paint.

.6 Lead-containing materials: Materials that are assumed to contain varying levels of lead from their historic composition.

.7 Lead-containing equipment: Equipment suspected of containing lead through historic application or identified as lead containing through labels/tags.

.8 Occupied Area: any area of building or work site that is outside the Lead Work Area.

1.5 ACTION AND INFORMATION SUBMITTALS

.1 One (1) week prior to the start of abatement work, submit proposed methodology for abatement procedures for review by Departmental Representative. The proposed methodology shall include:

.1 Products to be used complete with SDS information.

.2 List of protective equipment to be used by workers.

.3 Plan identifying area(s) of work for abatement procedures.

.4 Requirements for engineering controls, ventilation, etc.

.5 Requirements for access to and egress from the Lead Work Area.

.2 A written Health and Safety Plan specific to work of this Section. As a minimum this document must include:

.1 Classification of all lead abatement work in accordance with the criteria used in the document Guideline: Lead on Construction Projects issued by the Ontario Ministry of Labour.

.2 The identity of the “competent person” who will, on behalf of the Contractor, perform regular inspections of the lead abatement activities to prevent

dangerous, unhealthy or unsafe conditions. The “competent person” must be on site at all times while lead abatement activities are in progress.

.3 A description of the equipment and materials, controls, crew size, job responsibilities, and operations and maintenance procedures for each activity involved in the work of this Section.

.4 A description of the specific control methods to be used in the lead-containing paint and surface coatings abatement processes.

.5 A strategy to ensure that personnel are not exposed to airborne lead or other contaminants in concentrations that exceed the current Time Weighted Average Exposure Value (TWAEV).

.6 A description of the medical surveillance program in place for lead abatement workers.

.7 Names of products to be used in lead abatement work.

.3 Before beginning work:

.1 Obtain from appropriate agency and submit to Departmental Representative all necessary permits for transportation and disposal of lead-containing waste. Ensure that dump operator is fully aware of hazardous nature of material being dumped, and proper methods of disposal.

.2 Submit proof satisfactory to Departmental Representative that employees have had instruction on hazards of lead exposure, respirator use, dress, use of showers, entry and exit from work areas, and aspects of work procedures and protective measures.

.3 Submit proof in the form of a certificate that supervisory personnel have attended a lead-containing paint abatement course, of not less than 1-day duration.

.4 For each load of waste that leaves the site, submit landfill weigh scale receipts, shipping documents, and lead-containing waste manifests, as applicable based upon waste characterization.

.5 Lead abatement section within Hazardous Material Work Plan.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: comply with Federal, Provincial/Territorial and local requirements pertaining to lead, 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 Safety Requirements: worker and visitor protection.

.1 Eating, drinking, chewing, and smoking are not permitted in the Lead Work Area.

.2 Washing facilities consisting of a wash basin, water, soap and towels shall be provided by the Contractor. All workers shall use these washing facilities before eating, drinking, smoking or leaving the work site. Washing facility areas are to be designated by Departmental Representative

.3 Protective equipment and clothing to be worn by workers while in the Lead Work Area includes:

.1 Disposable-type protective clothing that does not readily retain or permit penetration of lead dust, consisting of full-body covering including head covering with snug-fitting cuffs at wrists, ankles, and neck.

.2 Respirator, personally issued to worker and marked as to efficiency and purpose, and acceptable to Authority having jurisdiction as suitable for level of lead exposure in the Lead Work Area. If disposable type filters are used, provide sufficient filters so that workers can install new filters following disposal of used filters and before re-entering contaminated areas.

.3 Ensure that no person required to enter the Lead Work Area has facial hair that affects seal between respirator and face.

.4 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 the Lead Work Area.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 The results of the lead leachate testing confirmed that all sampled materials are not hazardous for disposal with respect to lead.

.2 Should additional materials be identified, representative sampling of lead-containing materials that is representative of the applicable waste stream (i.e. sampling to include substrate material as applicable) shall be performed by a competent person retained by the Contractor prior to disposal of lead-containing materials. Lead-containing waste streams are to be classified for disposal purposes using the Toxicity Characteristic Leachate Procedure at a certified analytical laboratory. All sampling procedures and submissions shall be approved of by the Departmental Representative.

.3 Place materials characterized as hazardous or toxic based upon leachate analysis in designated containers.

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

.5 Disposal of lead waste, including wash and rinse water, generated by removal activities must comply with Federal, Provincial, Territorial and Municipal regulations. Label containers with appropriate warning labels.

.6 Provide manifests describing and listing waste created. Transport containers by approved means to licensed facility for disposal.

.7 Contractor is responsible to obtain all necessary permits, licenses and approvals to conduct the abatement.

1.8 EXISTING CONDITIONS

.1 Refer to the Section 01 14 25 – Designated Substances for details on lead-containing materials.

Part 2 Products

2.1 MATERIALS

.1 All materials brought to project site must be in good condition and free of lead dust. Disposable items must be of new materials only.

.2 Lead Waste Container: An impermeable container acceptable to disposal site and Ministry of Environment. Labelled as required. Comprised of one of the following:

.1 A 0.15 mm sealed polyethylene bag, inside a second 0.15 mm sealed polyethylene bag.

.2 A barrel suitable for lead wash water and/or sludge. Container must be acceptable to the waste hauler.

.3 Lead Cleaning Agent: A cleaning agent suitable for lead dust. Acceptable products:

.1 Detergents with a high phosphate content (containing at least 5% trisodium phosphate).

.2 Phosphate-free lead dissolving agent.

.4 FR polyethylene: minimum 0.15 mm thick, woven fibre reinforced fabric bonded both sides with polyethylene.

.5 Tape: fibreglass - reinforced duct tape suitable for sealing polyethylene under both dry conditions and wet conditions.

2.2 EQUIPMENT

.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 Sprayer: Garden reservoir type, low velocity, capable of producing a mist or fine spray.

Part 3 Execution

3.1 PREPARATION

.1 Scaffolding

.1 Scaffolding in accordance with CAN/CSA-S269.2.

3.2 ABATEMENT WORK AREA PREPERATION

.1 Implement lead precautionary measures appropriate to the work completed in accordance with MOL Guideline: Lead on Construction Projects, as amended.

.2 Type 1 Work Areas:

.1 Install polyethylene drop sheets below lead operations which produce or may produce dust, chips, or debris containing lead.

.3 Type 2 Work Areas:

.1 Install polyethylene drop sheets below lead operations which produce or may produce dust, chips, or debris containing lead.

.2 Post signs in sufficient numbers to warn of the lead hazard. There shall be a sign, at least, at each entrance to the Lead Work Area. The signs shall display the following information in large, clearly visible letters using both official languages:

.1 Lead dust, fume or mist hazard.

.2 Access to the work area is restricted to authorized persons.

.3 Respirators must be worn in the work area.

.4 Type 3 Work Areas:

.1 Post signs in sufficient numbers to warn of the lead hazard. There shall be a sign, at least, at each entrance to the Lead Work Area. The signs shall display the following information in large, clearly visible letters using both official languages:

.1 Lead dust, fume or mist hazard.

.2 Access to the work area is restricted to authorized persons.

.3 Respirators must be worn in the work area.

.2 Barriers, Partial Enclosures and Full Enclosures: Barriers, partial enclosures, and full enclosures shall be constructed to separate the Lead Work Area from the rest of the project. Barriers shall only be used where full and partial enclosures are not practical, including during exterior masonry work.

.1 Barriers:

.1 Ropes or barriers do not prevent the release of contaminated dust or other contaminants into the environment. However, they can be used to restrict access of workers who are not adequately protected with proper PPE, and also prevent the entry of workers not directly involved in the operation. Ropes or barriers shall be placed at a distance far enough from the operation that allows the lead-containing dust to settle. If this is not achievable, warning signs should be posted at the distance where the lead-containing dust settles to warn that access is restricted to persons wearing PPE.

.2 Barriers for lead-containing work areas are to prevent staff who are not equipped with PPE from working within 6 metres of lead-abatement work areas.

.2 Partial Enclosures:

.1 Partial enclosures allow some emissions to the atmosphere outside of the enclosure. Partial enclosures may consist of vertical tarps and floor tarps so long as the tarps are overlapped and securely fixed together at the seams. A partial enclosure is not a suitable containment system if significant dust is being generated.

.3 Full Enclosures:

.1 Full enclosures are tight enclosures (with tarps that are generally impermeable and fully sealed joints and entryways). Full enclosures allow minimal or no fugitive emissions to reach the environment outside of the Lead Work Area. For full enclosures, the following requirements shall be met:

.1 The enclosure shall be constructed of windproof materials that are impermeable to dust.

.2 The enclosure shall be supported by a secure structure.

.3 All joints in the enclosure shall be fully sealed.

.4 Entrances to the enclosure shall be equipped with air locks.

.5 The escape of abrasive and debris from the enclosure shall be controlled, at air supply points, by the use of baffles, louvers, flap seals and filters.

.3 Worker Decontamination Enclosure System: Worker Decontamination Enclosure System includes Equipment and Access Room, Shower Room, and Clean Room, as follows:

.1 Construct Worker Decontamination Enclosure System as close to the work area as possible in area specified by Departmental Representative. Submit layout of proposed enclosures and decontamination facilities including location to Departmental Representative for review.

.2 Equipment and Access Room: build an Equipment and Access Room between Shower Room and Lead Work Area, with two curtained doorways, one to Shower Room and one to Lead Work Area. Install a waste receptor and storage facilities for workers' shoes and protective clothing to be reworn in Lead Work Area. Build Equipment and Access Room large enough to accommodate specified facilities, other equipment needed, and at least one worker allowing him /her sufficient space to undress comfortably.

.3 Shower Room: build a 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 or fewer workers. Provide constant supply of hot and cold, or warm (between 40°C and 50°C) potable water. Provide piping and connect to water sources and drains. Provide soap, clean towels, and appropriate containers for disposal of used respirator filters.

.4 Clean Room: build a 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 a mirror to permit workers to fit respiratory equipment properly.

.4 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.

.5 Do not begin lead abatement work until:

.1 Arrangements have been made for disposal of lead-containing waste.

.2 Arrangements have been made for containing, filtering, testing and disposal of waste water.

.3 Work areas, decontamination enclosures and parts of project site required to remain in use are effectively segregated.

.4 Tools, equipment, and materials waste containers are on hand.

.5 Arrangements have been made for building security.

.6 Warning signs are displayed where access to contaminated areas is possible.

.7 Notifications have been completed and other preparatory steps have been taken.

.8 Departmental Representative has reviewed preparatory work and provided written approval for lead abatement work to proceed.

3.3 SUPERVISION

.1 Minimum of one Supervisor for every ten or fewer workers is required.

.2 Approved Supervisor must remain within Lead Work Area during disturbance, removal, or other handling of lead-containing paint and other lead contaminated materials.

3.4 LEAD REMOVAL

.1 The removal or disturbance of asbestos-containing materials coated with lead-containing coatings must also be performed using appropriate asbestos and/or silica precautions as outlined in the specifications.

.2 Before removing lead-containing paint or disturbing other lead containing or contaminated materials:

.1 Prepare site.

.2 Spray surfaces to be disturbed, that are finished with lead-containing paint, with water using airless spray equipment capable of providing a “mist” application to prevent the release of dust.

.3 Lead-containing paint, and surface coating removal:

.1 Methods of lead-containing paint and surface coating removal/disturbance must be approved in writing by the approval from the Departmental Representative.

.4 At completion of lead-containing paint and surface coatings removals, perform the following clean-up:

.1 Wait at least 1-hour after active lead abatement work has ceased to allow airborne lead particles to settle.

.2 HEPA vacuum all surfaces within the Lead Work Area. Start vacuuming at the highest levels furthest from the Decontamination Facilities and work progressively downwards towards the Decontamination Facilities.

.3 Wash all surfaces with Lead Cleaning Agent and rinse with clean water. Start washing and rinsing at the highest levels furthest from the Decontamination Facilities and work progressively downwards towards the Decontamination Facilities.

.4 Repeat HEPA vacuuming, washing and rinsing as required to achieve clearance criteria.

3.5 INSPECTION

.1 Perform inspections of Lead Work Area to confirm compliance with specification and requirements of authorities having jurisdiction. Deviation from these requirements that have not been approved in writing by the Departmental Representative may result in Work stoppage, at no cost.

.2 Departmental Representative 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 a leakage of liquid, dust or fume from the Lead Work Area has occurred or is likely to occur the Departmental Representative Construction Manager may order Work shutdown.

.1 No additional costs will be allowed by Contractor for additional labour or materials required to provide specified performance level.

3.6 AIR MONITORING AND SURFACE WIPE SAMPLING

.1 From beginning of Work until completion of cleaning operations, the Departmental Representative may be on site to collect air samples either inside or outside of the Lead Work Area in accordance with standard methods for workplace air sampling and analysis.

.1 This air monitoring does not relieve the Contractor of any responsibility for air monitoring inside the Lead Work Area to verify that the respiratory protection in use provides a suitable protection factor.

.2 Use results of air monitoring inside the Lead Work Area to establish type of respirators to be used. Workers may be required to wear sample pumps for up two full-shift periods.

.1 If airborne lead concentrations are above the protection factor of respirators in use, the Contractor shall:

.1 Stop abatement.

.2 Introduce more stringent engineering controls.

.3 Use a higher protection factor in respiratory protection for persons inside the Lead Work Area.

.2 If air monitoring shows that airborne lead concentrations outside the Lead Work Area exceed 0.025 mg/m³, the Contractor shall maintain and clean these areas, in same manner as applicable to the Lead Work Area, at no additional cost.

.3 Final clearance air monitoring will be performed at the sole discretion of the Departmental Representative.

.1 Final air monitoring results must show airborne lead levels less than 0.005 mg/m³.

.2 If air monitoring results show airborne lead levels in excess of 0.005 mg/m³, the Contractor shall re-clean the Lead Work Area at no additional cost.

.3 Repeat as necessary until airborne lead levels are less than 0.005 mg/m³.

.4 The following criteria shall be used to define an acceptable level of cleanliness after lead abatement activities:

.1 Where removal of paints and other surface coatings has been performed to accommodate the project scope of work:

.1 Visibly free of paint(s), primer(s), and surface coating(s), and/or associated dust.

.2 Residual lead dust concentration less than:

.1 2,150 micrograms/square metre for interior floor surfaces

.2 2,691 micrograms/square metre for interior windowsills

.3 8,611 micrograms/square metre for exterior surfaces

.4 Repeat cleaning as necessary until lead concentrations are below specified levels, at no additional cost.

3.7 FINAL CLEANUP

.1 Remove polyethylene sheet by rolling it towards the centre of the Lead Work Area. Immediately vacuum any visible paint chips, particles, dust and debris observed during cleanup using HEPA vacuum equipment.

.2 Place polyethylene seals, tape, cleaning material, clothing, and other contaminated waste in sealed labelled waste containers for transport.

.3 Include in clean-up Work areas, Equipment and Access Room, Shower Room, and other contaminated enclosures.

.4 Include in clean-up sealed waste containers and equipment used in Work and remove from work areas, at appropriate time in cleaning sequence.

.5 A final check may be carried out to ensure that no lead dust or debris remains on surfaces as a result of dismantling operations.

.6 As work progresses, and to prevent exceeding available storage capacity on site, remove sealed and labelled waste containers.

.1 Dispose of lead-containing waste in accordance with R.R.O. 1990, Regulation 347, as amended. Ensure that waste hauler and receiver are fully aware of hazardous nature of material to be disposed of and that guidelines and regulations for lead-containing waste disposal are followed.

.2 Ensure that materials removed during the Work of this Section are treated, packaged, transported and disposed of as lead-containing waste.

.3 Clean up waste routes and loading area after each load. Use lead abatement procedures if appropriate or requested by Departmental Representative.

.4 Drop garbage bins at designated locations. Keep bins covered and enclosed while at the site. Bin loading area shall be kept clean at all times.

.5 Transport all waste to a landfill licensed by the Authority having jurisdiction.

.6 Provide Departmental Representative with copies of shipping documents and lead-containing waste manifests for each load of waste. The Contractor is responsible to ensure that written documentation is submitted for each load of waste leaving the site.

.7 Cooperate with provincial inspectors and immediately carry out instructions for remedial work at landfill to maintain environment, at no additional cost.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 This section specifies requirements and procedures for silica precautionary measures. This section conforms to the requirements of the Ontario Occupational Health and Safety Act, R.S.O. 1990, Regulation 490/09 “Designated Substances”, as amended.

.2 Comply with the requirements of this Section when performing the following work:

.1 Work at site which may involve contact with silica dust generated through such processes as sawing, cutting, grinding, blasting and/or breaking of the silica containing material.

.3 Refer to the following documents for details on silica-containing materials:

.1 Refer to the Specification Section 01 14 25 – Designated Substances

1.2 RELATED SECTIONS

.1 Section 01 14 25 – Designated Substances

.2 Section 02 82 00.01 – Asbestos Low-Risk Precautions

.3 Section 02 82 00.02 – Asbestos Moderate-Risk Precautions

.4 Section 02 82 00.03 – Asbestos High-Risk Precautions

.5 Section 02 83 00 – Lead Precautionary Measures

1.3 REFERENCES

.1 Comply with current Federal, Provincial, and local requirements pertaining to silica, provided that in case of conflict among these requirements or with these specifications the more stringent requirement applies. Comply with regulations in effect at time work is performed.

.2 Federal Legislation

.1 Canada Labour Code and associated regulations.

.3 Provincial legislation

.1 Ontario Occupational Health and Safety Act, R.S.O. 1990, Regulation 490/09 “Designated Substances”, as amended.

.2 Ontario Ministry of Labour, Immigration, Training and Skills Development – Silica on Construction Projects, as revised.

1.4 DEFINITIONS

.1 **Dangerous Goods:** product, substance, or organism that is specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.

.2 **Hazardous Material:** product, substance, or organism that is used for its original purpose; and that is either dangerous goods or a material that may cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.

.3 **Hazardous Material Workplan**: A brief report identifying the location and quantities of hazardous materials and the methods that will be used to remove, store, transport and dispose of them.

.4 **Workplace Hazardous Materials Information System (WHMIS):** Canada-wide system designed to give employers and workers information about hazardous materials used in workplace. Under WHMIS, information on hazardous materials is provided on container labels, safety data sheets (SDS), and worker education programs. WHMIS is put into effect by combination of federal and provincial laws.

1.5 SUBMITTALS

.1 Silica abatement section within Hazardous Material Work Plan.

1.6 PRECAUTIONARY MEASURES AND PROCEDURES

.1 Execute work by methods to minimize raising silica dust from demolition operations. Where practical, wet methods or a dust collection system should be used to reduce dust.

.2 Adequate ventilation, including local exhaust ventilation, should be maintained to prevent the accumulation and recirculation of harmful concentrations of free crystalline silica in the work area.

.3 As practical, processes that generate silica dust should be completed in enclosed areas wherever possible to prevent the spread of silica dust outside of the work area.

.4 Implement and maintain silica dust control measures during work to ensure that silica levels do not exceed allowable limits.

.5 Departmental Representative may stop work at any time when release of silica dust to adjacent area is suspected. Contractor must discuss procedures that Contractor proposes to resolve problem. Make all necessary changes to operations prior to resuming any demolition activities that may cause release of silica dust at no extra cost to the Departmental Representative.

.6 Silica dust should be cleaned from machinery and work surfaces by wet sweeping, the use of sweeping compounds or vacuum cleaners fitted with a HEPA filter to prevent the recirculation of dusty air. Cleaning methods such as blowing with compressed air or dry sweeping should be avoided. Where exposure to free crystalline silica occurs, protective work clothing should be vacuumed before removal.

.7 Store material containing silica dust in closed containers or use other appropriate means to prevent dust from becoming airborne.

1.7 PERSONAL PROTECTIVE EQUIPMENT

.1 Anticipated minimum levels of personal protection based on work activity involving silica dust are listed below and are in addition to the personal protective equipment required for the completion of the demolition activities. Personal protection is dependent on the work practices and associated silica exposure risks.

- .1 Air purifying respirator equipped with HEPA filter cartridges or supplied-air type, personally issued to the worker and marked as to efficiency and purpose, and acceptable to the Provincial (Ontario) Authority having jurisdiction as suitable for silica and the level of silica exposure in the Work Area. If disposable type filters are used, provide sufficient filters so that workers can install new filters following disposal of used filters and before re-entering contaminated areas.
- .2 Eye Protection: Goggles, Safety glasses with side shields, or Face shield.
- .3 If requested by a worker,
  - .1 Hand Protection: Gloves
  - .2 Clothing: Full body protective clothing

1.8 AIR MONITORING

.1 If air monitoring shows that work areas contain crystalline silica above applicable regulated occupational exposure limits, these areas shall be cleaned by previously outlined methods at no additional cost to the Departmental Representative.

1.9 PERMITS

.1 Contractor is responsible to obtain all necessary permits, licenses and approvals to conduct the abatement.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section.

.2 Related Requirements:

.1 Comply with Conditions of the Contract and Division 01 - General Requirements.

1.2 REFERENCES

.1 Concrete materials and methods of construction are to conform to CSA A23.1/A23.2 except as noted herein. Where specific requirements are noted herein, they are additional to the requirements of A23.1/A23.2, and the most stringent shall govern. The latest edition of all standards applies.

.1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 ACI 117 Specification for Tolerances for Concrete Construction and Materials and Commentary.

.3 CSA S269.1, Falsework for Construction Purposes

.4 CSA S269.3, Concrete Formwork

.5 ACI 347, Recommended Practice for Concrete Formwork

.6 CSA-O86S1, Engineering Design in Wood

.7 CSA O121, Douglas Fir Plywood

.8 CSA O151, Canadian Softwood Plywood

.9 CSA O153, Poplar Plywood

.10 CSA-S157/S157.1 Strength Design in Aluminum/Commentary on CSA S157, Strength Design in Aluminum

.11 CSA-S136, North American Specification for the Design of Cold Formed Steel Structural Members

.12 CGSB 41-GP-35M, Polyvinyl Chloride Waterstop.

.13 ASTM D1751, Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).

.14 ASTM D1752, Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.

.2 The Contractor shall keep a copy of CSA A23.1/A23.2 on the site for reference.

1.3 SUBMITTALS

.1 Assume full responsibility for complete structural design and construction of formwork in accordance with CSA Standards S269.1 and S269.3 for falsework and formwork respectively.

.2 Prepare and submit a schedule of form erection, stripping and reshoring procedures. This schedule shall take into account requirements of curing, weather and other circumstances, as well as the rate of application of loads from on-going construction.

.3 Indicate on shop drawings the materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts to the DCC Representative for his approval.

.4 Formwork and falsework shall be designed by a Professional Engineer, licensed in the Province of Ontario. Submit formwork shop drawings stamped and signed by design engineer for review, however, these will be reviewed for their effect on the finished structure only and the responsibility for the adequacy of the formwork remains with the formwork designer. Where required by the local authority, submit drawings to the authority for approval.

.5 Indicate formwork design data, such as the permissible rate of concrete placement.

.6 Submit drawings showing sleeves required through floors and roof. Do not commence placing sleeves before drawings have been reviewed and DCC Representative's comments incorporated on drawings issued to site.

1.4 **COOPERATION WITH OTHER TRADES**

.1 Set all bolts, inserts, anchors, hangers and other means of fasteners required to be installed for other trades.

.2 Provide holes through concrete work required by other trades for pipes, ducts, conduits and other items of equipment. Obtain DCC Representatives approval for location of holes not shown on the structural drawings.

1.5 **DELIVERY, STORAGE AND HANDLING**

.1 Deliver, handle and store formwork materials to prevent weathering, warping, and damage detrimental to strength of materials or surfaces to be formed.

1.6 **QUALITY ASSURANCE**

.1 Tolerances:

.1 The indicated tolerances govern unless otherwise specified. Concrete construction shall meet the specified tolerances. Tolerances are not cumulative. The most restrictive tolerance controls.

.2 Plus (+) tolerance increases the amount of dimension to which it applies, or raises a level alignment. Minus (-) tolerance decreases the amount of dimensions to which it applies, or lowers a level alignment. A nonsigned tolerance means + or -. Where only one signed tolerance is specified (+ or -), there is no limit in the other direction. Tolerances are in millimetres, except those in brackets are in inches, unless noted otherwise.

.2 Definitions:

.1 Flatness - The degree to which a surface approximates a plane.

.2 Lateral Alignment - The location relative to a specified horizontal plane or line, or to a point in a horizontal plane.

.3 Level Alignment - The location relative to a specified horizontal plane.

.4 Levelness - The degree to which a line or surface parallels horizontal.

.5 Tolerance -

.1 The permitted variation from a given dimension or quantity.

.2 The range of variation permitted in maintaining a specified dimension.

.3 A permitted variation from location or alignment.

.6 Specified Surface, Plane, or Line - A surface, plane, or line specified by the contract documents; specified planes and lines may slope and specified surfaces may have curvature.

.7 Vertical Alignment - The location relative to specified vertical plane or a specified vertical line or from a line or plane reference to a vertical line or plane. When applied to slabs, ramps, or other nominally horizontal surfaces established by elevations, vertical alignment is defined as the vertical location of the surface relative to the specified profile grade and specified cross slope.

.8 Warping - The displacement of the surface, portion, or edge of a planar element from a plane passing through any three corners of the element.

.3 Structural Tolerances:

.1 Fabricate and erect formwork to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA A23.1/A23.2.

PART - 2 PRODUCTS

2.1 MATERIALS

.1 Materials for formwork brought on site shall be new.

.2 Plywood: Douglas Fir, minimum thickness of 17.0 mm, to CSA O121, finished one side, fabricated specially for use as concrete form panels, with sealed edges.

.3 Some formwork plywoods are affected by the high alkalinity of concrete, provide formwork finish to resist these high pH levels to reduce or eliminate the effects of alkalis diffusing into the base wood plies and reacting with the wood resin.

.4 Form release agent: Quick drying, sprayable non-staining, non-toxic coating, compatible with paint and mortar, VOC compliant, containing compounds that react with free lime present in concrete forming water insoluble soaps, preventing concrete from sticking to forms.

.5 Metal Joist Forms: reusable, fabricated of gauge to provide adequate strength and of profile approved by DCC Representative.

.6 Round Columns Fibre Forms:

.1 To produce architectural concrete surface that is aesthetically smooth without spiral marks or seam markings, of uniform texture and appearance:

.1 Newform Poligloss, by The Newark Group.

.2 Sonotube Finish-Free with Duraglas coating, by Sonoco Limited.

.2 Fibre Forms for concrete without special architectural features:

.1 Sonotube Commercial, by Sonoco Limited, or equivalent.

.7 Form Ties:

.1 At non-architectural surfaces: use removable or snap-off metal ties, of fixed or adjustable length free of devices leaving holes in concrete larger than 25 mm in diameter with spreader washer and 25 mm break back.

.8 Chamfers: 19 mm x 19 mm wood, smooth, with no open defects.

.9 Joint tape: non-staining, water impermeable, self-release, as approved by DCC Representative.

.10 Lintel and shelf angle anchors: built-in, adjustable, with askew head bolts, washers and nuts: Acrow Richmond Peerless Wedge Adjustable Anchor Slot.

.11 Dovetail anchor slots: 0.55 mm thick galvanized steel, glass fibre filled.

.12 Waterstops:

.1 PVC waterstop to CGSB 41-GP-35M, types II and III:

.1 Construction joints, external waterstop

.1 240 mm wide by 4.5 mm thick.

.2 Construction joints, internal ribbed waterstop with centre bulb:

.1 150 mm wide; tapered thickness varying from 9.5 mm near centre to 6.4 mm near edge, with 7.9 mm inside diameter centre bulb.

.3 Expansion joints, internal ribbed waterstop with centre bulb:

.1 229 mm wide; tapered thickness varying from 9.5 mm near centre, to 6.4 mm near edge, with 20 mm inside diameter centre bulb.

.13 Expansion Joint Filler and Isolation Joint Filler:

.1 Non-Bituminous Type:

.1 Premoulded, resilient, non-extruding, to ASTM 1752, and compatible with polysulphide urethane, polyepoxide urethane, or neoprene sealants, as applicable.

.14 Void form:

.1 Honey comb cellular core structure manufactured from recycled corrugated kraft papers.

.1 Waxmat by CaraCor Carton Forms, Winnipeg, Manitoba.

.2 Carton Void Form by Beaver Plastics, Edmonton, Alberta.

.3 VoidForm by Form Tech Product Inc., Toronto, Ontario

.15 Vertical Drainage Pans:

.1 Prefabricated high-impact polymeric drain core with bonded geotexile fabric:

.1 Hydroduct 220 by GCP Applied Technologies, Ajax, Ontario.

.2 CCW MiraDRAIN 6200XL by Carlisle Construction Materials, Wylie, Texas.

.3 Delta-MS Drain by Dörken Systems, Beamsville, Ontario

PART - 3 EXECUTION

3.1 ERECTION

.1 Verify lines, levels and column centres before proceeding with formwork and falsework.

.2 Install forms to lines, levels, sizes, and dimensions indicated on shop drawings.

.3 Obtain DCC Representative’s approval for use of earth forms.

.4 Trim sides and bottoms to remove loose earth from earth forms before placing concrete.

.5 Do not place shores and mud sills on frozen ground.

.6 Fabricate and erect falsework in accordance with CSA S269.1.

.7 Fabricate and erect formwork in accordance with CSA S269.3.

.8 Refer to architectural drawings for concrete members requiring architectural exposed finishes.

.9 Immediately before concrete is placed, all forms shall be carefully inspected, thoroughly cleaned and free from snow, ice, or other foreign materials in accordance with CSA A23.1/A23.2.

.10 Form joints for smooth (sandblasted) slabs which are exposed to view in the finished work to be located symmetrically within each bay. All joints shall be made watertight by means which will not be visible in the finished work. Corridor ceilings to have joints across their widths only. Align joints in ceilings and adjacent walls. Obtain DCC Representative's approval for location of joints. Re-use forms in these areas only with DCC Representative's approval.

.11 Form joints for exposed columns, exterior and interior, to be at the same elevation within a single floor level. Except where noted, column forms to be constructed without the use of ties through the concrete. Adequate external stiffeners shall be employed to prevent deflection of the formwork.

.12 Install chamfers at all external corners exposed to view.

.13 Unless agreed otherwise for specific locations by the DCC Representative, provide shear keys in all construction joints as detailed in the typical details.

.14 In walls, form grooves for control joints on both faces, as detailed. Sealant and sealant backing - under Joint Protection Section 07 92 00.

.15 Form for and around all chases, slots, openings, recesses, expansion joints and control joints shown as indicated.

.16 Where specifically noted on the drawings, lay formwork with an upward camber. The camber noted shall be to the concrete surface before stripping the forms.

.17 Where concrete floors and a structural steel frame are designed to act as a 'composite' section, provide shoring to the steel frame as indicated on the drawings. Shore shall be properly braced and designed to carry the loads shown. The shores shall remain in place a sufficient time to permit the floor to develop the capability of carrying the construction and working load, but in no case less than seven days.

3.2 BUILT-IN WORK

.1 Form openings and build in anchors, inserts, embedded plates, sub-frames, sleeves, miscellaneous metal items, flashing reglets and similar items furnished under work of other sections, which are indicated on Drawings and on shop drawings of other trades, and as required for proper completion of project.

.2 Install dowels which protrude through formwork or install form savers as indicated on drawings.

.3 Shelf angle anchors: Install anchors as indicated on drawings and shop drawings. Tighten nuts and bolts in each anchor.

.4 Anchor bolts: Tie anchor bolts securely in position to prevent movement during concrete placing. Use template to locate bolts. Ensure bolts have specified projection above concrete.

.5 No openings other than those shown on the Drawings shall be made through slabs, beams or bearing walls, unless prior approval is obtained from the DCC Representative.

.6 Confirm that built-in items that penetrate surface waterproofing are installed to meet requirements of waterproofing trade.

.7 Dovetail Anchor Slots:

.1 Build in dovetail anchor slots for masonry anchors in locations directed by mason.

.2 Install dovetail anchor slots for full height of vertical concrete surfaces faced with masonry that exceed a height of 400 mm and that are not waterproofed. Install slots continuous and vertical at 600 mm o.c. maximum, with at least one slot at each surface 600 mm or less in width.

.3 At junctions of masonry wall partitions with concrete walls and columns, install one continuous vertical slot at centre line of partition for full height.

.4 Supply of dovetail anchor slots is specified in Section 04 20 00, Masonry.

.8 No continuous slotted inserts are to be used in beams.

.9 No continuous slotted inserts are to be used in slabs except within the following limitations:

.1 Parallel to main reinforcing - any length.

.2 Perpendicular to main reinforcing - only in the middle half of the span and in lengths not exceeding 1 m and spaced so that not more than 35% of the main reinforcing is affected.

3.3 CONSTRUCTION AND EXPANSION JOINTS

.1 Form construction and expansion joints with bulkheads to ensure straight lines. Immediately before subsequent pour at a construction joint, remove bulkhead and tighten forms so that concrete surfaces will be on same plane with no overlapping of concrete.

.2 Review with DCC Representative and Structural Engineer proposed location and details of construction joints in walls, columns, beams and slabs.

.3 Construction Joints:

.1 Construction joints shall present appearance of normal form panel joint.

.2 Locate construction joints in framed floors at point in span where shear will be equal to zero (normally at midspan under uniformly distributed load).

.3 Provide vertical construction joints in walls at not more than 9 m centre to centre, and in exposed-to-the-exterior retaining walls at not more than 6 m centre to centre.

.4 Provide and install external PVC waterstops at below grade construction joints, on earth face of walls which retain earth.

.5 Provide and install internal PVC waterstops at construction joints in walls which retain earth, and in construction joints in tunnel slabs. Tie edges to adjacent reinforcing bars to prevent displacement during concrete placement.

.6 Heat seal joints in PVC waterstops to make watertight.

.7 Vibrate concrete adjacent to waterstops.

.4 Expansion Joints:

.1 Install expansion joints in locations and as detailed and noted on drawings.

3.4 **REMOVAL OF FORMS**

.1 Forms and falsework to remain undisturbed until the concrete has attained sufficient strength to sustain its own weight in addition to any temporary or permanent load which may be placed on it during construction of the building.

.2 Elevation Survey:

.1 Before removing shores prior to stripping soffit forms, survey pour area and record elevation of finished concrete top surface at each column or other permanent support, at mid-point between columns, and at centre of each bay area.

.2 Provide DCC Representative with copy of survey.

.3 Be responsible for safety of structure, both before and after removal of forms, until concrete has reached it specified 28 day strength.

.4 In addition to satisfying the above requirements leave formwork in place for the following minimum periods of time after placing concrete.

.1 4 days for walls and sides of beams.

.2 4 days for footings and abutments.

.3 7 days for slabs, decks, columns, and other structural members.

.5 Reshoring shall conform to CSA Standard S269.1, except that the reshoring procedure shall be reviewed by the DCC Representative.

.6 While reshoring is underway, beams and slabs shall be kept free of construction loading. Shores shall be placed bay-by-bay as the formwork is removed. Under no circumstances shall the concrete remain unsupported over areas of several column bays.

.7 Leave reshoring in place until the concrete has attained a minimum 75% of its 28-day compressive strength, unless otherwise agreed by the DCC Representative. Any lower compressive strength than that specified will cause additional creep deflection to the affected members which may be a design criterion; hence the Contractor shall obtain approval if he wishes to use lower strength at the time of reshoring.

.8 Where form ties and cones are specified to be used, remove and replace by plastic plugs after stripping the forms. When the surface is exposed to the weather, embed the plugs in `polysulphide' sealant.

.9 Re-use of formwork and falsework subject to requirements of CSA A23.1/A23.2.

3.5 **REPLACEMENT OF DEFECTIVE WORK**

.1 Movement and displacement of formwork during construction, variations in excess of specified tolerances and marked and disfigured surfaces that cannot be repaired by approved methods will be considered defective work performed by this Section.

.2 Reconstruct defective formwork and replace concrete and reinforcement placed in defective formwork at no additional cost to DCC Representative.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section.

.2 Related Requirements:

.1 Comply with Conditions of the Contract and Division 01 - General Requirements.

1.2 REFERENCES

.1 Reference Standards:

.2 The latest edition of the following reference standards shall govern work of this Section, except where they are in conflict with requirements imposed by this specification, in which case the latter shall govern. Standards referenced in CAN/CSA-A23.1 apply but are not repeated in following list:

.1 CSA Standard CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction.

.2 CSA Standard CAN3-A23.3, Design of Concrete Structures for Buildings.

.3 CSA Standard G30.5, Welded Steel Wire Fabric for Concrete Reinforcement.

.4 CSA Standard CAN/CSA G30.18, Billet-Steel Bars for Concrete Reinforcement.

.5 CSA Standard W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.

.6 CSA Standard CAN/CSA-S413, Parking Structures.

.7 ASTM D3963/D3963M, Standard Specification for Epoxy-Coated Reinforcing Steel.

.3 Qualifications:

.1 Welding: Undertake welding of reinforcement only by a fabricator or subcontractor approved by Canadian Welding Bureau to Requirements of CSA W186.

1.3 SUBMITTALS

.1 Refer to Submittals Section 01 33 00.

.2 Shop Drawings:

.1 Prepare shop drawings showing the size, spacing, location, quantities and details of reinforcing steel in accordance with the drawings and specifications. Use the "Manual of Standard Practice" by the Reinforcing Steel Institute of Ontario as a guide only. Drawings shall be prepared by a detailing firm approved by the authority having jurisdiction required by applicable Codes. All drawings and bar lists prepared under this section shall be checked and initialled by the Checker of the firm producing the drawings before submission to the DCC Representative.

.2 Include all necessary plans and elevations of walls and beams on the diagrams, drawn to a scale of not less than 1:50. Sections shall be drawn to a scale of not less than 1:20. Placing drawings shall include sufficient details, dimensions and field instructions to permit complete setting of all reinforcement without reference to

the design drawings and shall show location and lengths of lap splices. Detailer is to ensure that reinforcement will not be displaced or fouled by other reinforcement.

.3 In concrete beams, where no stirrups are indicated on the drawings, indicate stirrups to adequately support the top reinforcement. For flat slabs indicate support bars for reinforcement.

.4 Submit drawings showing the location and size of all sleeves, pipes and openings required for all trades which are not already shown on the structural drawings. Submit these drawings for DCC Representative's review well in accordance with Section 01 32 16.19 Construction Progress Schedule. Drawings shall show the total openings required by all trades involved in the area covered by the drawing.

.5 DCC Representative will review and return shop drawings in accordance with an agreed schedule. DCC Representative's review will be for conformity to design concept and for general arrangement only, and shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting all requirements of Contract Documents.

.6 Contractor shall make any changes in shop drawings which DCC Representative may require consistent with Contract Documents and resubmit unless otherwise directed by DCC Representative. When resubmitting, Contractor shall notify DCC Representative in writing of any revisions other than those requested by DCC Representative.

.7 Do not commence fabrication of reinforcement before drawings have been reviewed and DCC Representative's comments incorporated on drawings issued to fabricating shop.

.3 Samples:

.1 Submit samples of accessories such as chairs bolsters and support blocks.

1.4 **DELIVERY, STORAGE AND HANDLING**

.1 Store materials in accordance with CSA A23.1.

PART - 2 PRODUCTS

2.1 **MATERIALS**

.1 Bar Reinforcing Steel

.1 CSA G30.18, with 400 MPa minimum yield strength.

.2 Welded Wire Fabric: to CSA G30.5, and in flat sheets, not rolls.

.3 Epoxy-Coated Reinforcement: to ASTM D3963/D3963M.

.4 Mechanical Splice Couplers shall be as shown on drawings and shall either be Type 1 or Type 2 mechanical splices per CSA A23.3-04. They shall be one of the following products or an approved equivalent product.

.1 Bar-Lock or Taper-Lock™ by Dayton Superior.

.2 Lenton® Lock Mechanical Rebar Splicing System or Lenton® Taper Threaded Splice by ERICO.

.3 Stricon ultimate stress splicer by Stricon Products Ltd.

.2 The contract price shall be based on the specified couplers. Alternative mechanical splice couplers may be considered to the above provided that adequate test data and satisfactory evidence of use on other projects is submitted for approval.

2.2 **FABRICATION**

.1 Fabrication of Reinforcing Steel

.1 Fabricate reinforcing bars in accordance with CSA A23.1.

.2 Fabricate welded wire fabric in accordance with CSA G30.5 or CSA G30.15.

PART - 3 EXECUTION

3.1 **PLACING OF REINFORCING STEEL**

.1 Place reinforcing bars and mesh as shown on Drawings and in accordance with CSA A23.1.

.2 Clean steel before placing concrete in accordance with CSA A23.1.

.3 Support reinforcing steel in such a manner as to ensure that the spacing and cover of the reinforcement is accurately maintained, taking into account the proposed methods of placing and consolidating the concrete, and the weight of the reinforcement supported.

.4 For concrete toppings, use mesh in flat sheets.

.5 In concrete toppings, terminate floor mesh at edge of electrical in-floor duct. Add 51 x 51 MW9.1 x MW9.1 mesh over duct and lap 300 mm with floor mesh.

.6 Tie, do not weld, reinforcement in place. Tie the intersections of all reinforcing bars. Maintain supports in position by wiring to the reinforcement or by other positive means.

.7 At control joints in walls, unless otherwise noted, cut or stop alternate horizontal reinforcing bars at the joints.

.8 Unless otherwise detailed on the structural drawings, reinforcement shall be continuous through construction joints.

.9 Unless otherwise shown, reinforce platforms and sidewalks with 152 x 152 MW 13.3 x MW 13.3 welded wire mesh.

.10 Reinforce concrete fill in treads and landings with 102 x 102 MW 9.1 x MW 9.1 welded wire mesh, tied to 6 mm studs welded to steel pans.

.11 Provide reinforcement as specified under Masonry Division, Section 04 20 00 Unit Masonry.

3.2 **MECHANICAL SPLICE COUPLERS**

.1 Install mechanical splice couplers in strict accordance with the manufacturer's directions. Consult with the manufacturer's representative before starting installation and have him on site to supervise the installation of splices in the early stages of the work. He is to revisit the site to inspect the work in progress when requested by the Contractor or DCC Representative.

.2 Unless otherwise noted on the drawings at splice locations, a maximum of 50% of the bars to be spliced at any one location. The minimum distance between splices, to be the diameter or greatest dimension of the column. The first splice location to be a minimum of 600 mm above the floor.

3.3 **ADJUSTING AND CLEANING**

.1 Adjust and secure reinforcement in correct position immediately before concrete is placed.

.2 Remove contaminants which lessen bond between concrete and reinforcement.

3.4 **FIELD QUALITY CONTROL**

.1 Mechanical Splice Couplers

.1 Cut out up to 1% of all tension splices with adequate length of bar to permit testing. The cost of all replacements of steel and splices taken for testing shall be paid under this section. If test results are unacceptable, cut out further splices in the same area for testing. Testing will be carried out by an independent testing company approved by the DCC Representative. Where additional tests are required due to unsatisfactory results, the costs of such additional tests shall be paid under this section.

.2 The location of test samples will be determined by the DCC Representative, but will include samples from the initial splices used on the project. Do not place concrete around these splices until test results have been received by the DCC Representative and permission given to proceed. The Contractor shall schedule the work accordingly.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section.

.2 Related Requirements:

.1 Comply with Conditions of the Contract and Division 01 - General Requirements.

.3 Co-operation with DCC Representative:

.1 Before commencing work, review with DCC Representative, work performed under this Section.

.2 Schedule work to allow sufficient time and access for DCC Representative to carry out periodic field review.

1.2 REFERENCE

.1 The following reference standards govern work of this Section, except where they are in conflict with requirements imposed by this Specification in which case the latter governs. Standards referenced in CAN/CSA-A23.1 are not repeated in following list.

.1 CSA Standard CAN/CSA-A23.1/A23.2 Concrete Materials and Methods of Concrete Construction/Methods of Tests for Concrete.

.2 CSA A283-06 Qualification Code for Concrete Testing Laboratories.

.3 CAN/CSA-A3000 Cementitious Materials Compendium

.4 ACI 117 Standard Specifications for Tolerances for Concrete Construction and Materials, American Concrete Institute.

.5 Ontario Provincial Standard Specification OPSS 1010 Material Specification for Aggregates - Granular A, B, M and Select Subgrade Materials.

.6 ASTM C260/C260M Standard Specification for Chemical Admixtures for Concrete.

.7 ASTM C309 Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete.

.8 ASTM C494/C494M Standarad Specification for Chemical Admixtures for Concrete.

.9 The Contractor shall keep a copy of CSA A23.1 on the site for reference.

1.3 SUBMITTALS

.1 Refer to Submittal Procedures Section 01 33 00.

.2 Provide testing, inspection results and reports for review by DCC Representative and do not proceed without written approval when deviations from mix design or parameters are found.

.3 Concrete hauling time: Provide for review by DCC Representative including deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of work and discharged after batching.

.4 Minimum four (4) weeks prior to starting concrete work, provide proposed quality control procedures for review by DCC Representative on the following items:

.1 Hot weather concrete protection.

.2 Cold weather concrete protection.

.3 Concrete curing.

.4 Uniform and consistent concrete finishing

.5 Concrete placing schedule

.5 Samples:

.1 Submit for inspection material samples of specified mix designs.

.6 Concrete Mix Designs:

.1 Minimum four (4) weeks prior to starting concrete work submit concrete mix design for review including:

.1 CSA class of concrete exposure

.2 Maximum water/cementing materials ratio (W/CM)

.3 Minimum concrete strength

.4 Maximum aggregate size

.5 Specific replacement limits on any materials (ie. fly ash, additives or ggbs)

.6 Air content and range

.7 Architectural requirements

.8 Durability requirements (ie. AVS or RCP)

.9 Slump at time of discharge

.10 Contractor placement requirements

.2 When optimum bulk density of aggregates is specified, provide supporting evidence of compliance with requirements.

.3 Review of mix design does not relieve Contractor from responsibility for compliance with Contract Documents.

1.4 **QUALITY ASSURANCE**

.1 Manufacturer’s qualifications:

.1 The ready mix concrete supplier shall be a member in good standing of Ready Mix Concrete Association of Ontario (RMCAO).

.2 Ready mix concrete must hold Concrete Ontario Production Facilities Certification.

.3 Material and production must conform to CSA Standards for Concrete Materials, Construction and Testing (CSA A23.1 / CSA A23.2).

.4 Testing must be performed by Canadian Council of Independent Laboratories (CCIL) Certified laboratories.

1.5 **PROJECT RECORDS**

.1 Concrete Pour Records: Maintain accurate records of concrete pours including the following information:

.1 Date and time of concrete pour

.2 Location in building of each concrete pour

.3 Specified strength of concrete

.4 Air temperature when concrete was placed

.5 Test samples taken and results of tests as described in PART 3

.6 Keep these records on site until the project is completed.

.2 Delivery Records: Before unloading concrete at site, file duplicate copies of the delivery ticket with each batch of concrete on which the following information shall be recorded:

.1 Name of concrete supplier

.2 Location of batch plant

.3 Date and serial number of slip

.4 Truck number, cumulative total, and/or load number

.5 Name of contractor

.6 Project name and location

.7 Approved mix code, specified strength, air content, and exposure class

.8 Volume of concrete in load

.9 Time loaded or time of first mixing of aggregate, cementing materials and water.

.3 Record the following information after discharge of concrete has been completed:

.1 Time that load arrived at site

.2 Time that discharge of load was started

.3 Time that discharge of load was completed

.4 Type and amount of admixtures, if added at site

.5 Amount of water, if added at site

.4 Record Drawings:

.1 Record on a set of Drawings:

.1 Time and date of each pour

.2 High and low ambient air temperature during each pour

.3 Date of removal of forms in each area

.4 Founding elevations of all footings

.5 Variations of foundation work from that shown on drawings

.2 Make record drawings available for DCC Representative's inspection at all times.

1.6 **DELIVERY, STORAGE, AND HANDLING**

.1 Deliver and store materials on site in accordance with CAN/CSA A23.1/A23.2

.2 No water shall be added after the initial introduction of the mixing water for the batch. This requirement may be waived at the start of discharge, when the measured slump of the concrete is less than that specified and when not more than 60 minutes have elapsed from the time of batching to the start of discharge. In this case, water may be added once and only with the authority of the DCC Representative and in an amount not exceeding 12 L/m^3. The drum or blades shall then be turned an additional 30 revolutions or more if necessary at mixing speed, until the uniformity of concrete is consistent with A23.1. Water shall not be added to the batch at any later time.

.3 In no case shall time between batching and complete discharge exceed 120 minutes.

.4 At no time shall water be added to the concrete after it has left the mixer.

PART - 2 PRODUCTS

2.1 MATERIALS

.1 Cement and Supplementary Cementing Materials shall conform to CAN/CSA A3000

.2 Water shall conform to CSA A23.1/A23.2

.3 Aggregates shall conform to CSA A23.1/A23.2

.4 Fine Aggregate:

.1 For slabs on grade, fineness modulus of fine aggregate to be between 2.7 and 3.1.

.5 Coarse Aggregate:

.1 20 mm to 5 mm (No.4 sieve) except as specified below.

.2 For slabs on grade 125 mm and thicker, 40 mm to 5 mm (No.4 sieve); combine at least two of the single sizes specified in table 11 (eleven) Group II of A23.1, one of which is to be 40 mm; to obtain maximum bulk density (unit weight) and optimum grading, in accordance with an approved procedure.

.3 For slabs on grade:

.1 Abrasion loss not to exceed 35%.

.2 Petrographic number of aggregate not to exceed 125 when tested in accordance with CSA test method A23.2-15A, as conducted by Ministry of Transport of Ontario.

.4 For columns less 300 mm in least dimension, or less than 95,000 mm^2 in cross-sectional area: 10 mm to 5 mm (No.4 sieve).

.5 For all other concrete: 20 mm to 5 mm (No.4 sieve).

.6 Aggregates for exposed architectural concrete to be of a uniform colour range and to match the aggregates used in the approved sample for colour and size.

.6 Admixtures:

.1 Air entraining admixture shall conform to CSA A23.1/A23.2 and ASTM C260/C260M

.2 Chemical admixture shall conform to ASTM C494/C494M

.3 Provide only admixtures that are free of chlorides.

.4 DCC Representative to approve accelerant or set retarding admixtures during cold and hot weather placing.

.5 When requested, provide evidence acceptable to DCC Representative that superplasticizer does not increase shrinkage of concrete.

.6 Superplasticizers to be compatible with finishes and other admixtures.

.7 Steel Fibres:

.1 Dramix (3D 65/60) by BOSFA Pty Ltd.

.2 Viberx 60 by Sika Canada

.3 MasterFiber Steel 65 by BASF Canada

.8 Synthetic Fibres:

.1 Sika Fibre HP, Sika Group, Canada.

.2 Sika Fibre MS, Sika Group, Canada.

.3 FORTA-FERRO synthetic fiber reinforcement by FORTA Corporation.

.4 MasterFiber M 200 from BASF's Master Builders Solutions.

.9 Granular Underbed:

.1 For slabs on grade: 20mm clear limestone, proof rolled for compaction, compacted thickness 150 mm under slabs 125 mm or less, 200 mm under thicker slabs.

.10 Curing-Sealing Compound:

.1 Membrane curing-sealing compound formulated from chlorinated rubber resins or acrylic emulsion or solvent free for use in occupied buildings, to ASTM C309, type 1.

.11 Floor Hardener:

.1 Metallic Hardener: Ferrous aggregate premixed with Portland cement and plasticizers.

.2 Non-metallic Hardener: Natural and synthetic materials with Mohs hardness 7 minimum, premixed with Portland cement.

.12 Premixed Grout:

.1 Non-shrink Metallic:

.1 Embeco 636 Grout by Master Builders Ltd.

.2 SikaQuick 2500 by Sika Canada Inc.

.3 Planitop Fast 330 by MAPEI Canada.

.2 Non-shrink Non-metallic:

.1 V-3 grout by W.R. Meadows of Canada Limited.

.2 Masterflow 713 grout by Master Builders Ltd.

.3 Planitop 110 by MAPEI Canada.

.3 Flowable grout, Non-metallic shrinkage compensating:

.1 Masterflow 713 by Master Builders Ltd.

.2 SikaGrout-212 by Sika Canada Inc.

.3 Planigrout 712 by MAPEI Canada

.13 Ladder Rungs for Manholes - 19mm deformed bars meeting high-strength, galvanized steel reinforcement bars (rebar) with superior bond strength for concrete applications.

.14 Concrete Fireproofing - Type S concrete to conform to the requirements of the National Building Code. Except where heavier reinforcement is shown on the drawings, reinforce fire proofing to conform to the requirements of Supplement NBC.

2.2 **CONCRETE MIXES**

.1 Concrete:

.1 Ready mix, with 28 day compressive strength as indicated on Drawings, and in specifications.

.2 Air dry unit weight: minimum 2320 kg/m^3 adjusted proportionally for maximum air content listed in CAN/CSA-A23.1.

.3 Design concrete mix in conformance with CAN/CSA-A23.1, Alternative 1 and as follows:

.1 Exposure Classification C-1 with 25% Portland cement replaced with cementitious hydraulic slag, for parking garage floors, and walls, balustrades and columns adjacent thereto. Conform to the additional requirements of CAN/CSA-S413, Parking Structures.

.2 Exposure Classification C-2 with 25% Portland cement replaced with cementitious hydraulic slag, for pavements, sidewalks, curbs and gutters.

.3 Exposure Classification F-1 with 25% Portland cement replaced with cementitious hydraulic slag, for exposed exterior beams, columns, walls and slabs not exposed to chorides.

.4 Slabs-on-grade: Use Portland cement. When mean daily temperature exceeds 18°C at time of placement, replace 25% of cement with cementitious hydraulic slag.

.1 Water/cement ratio 0.45 maximum.

.2 Cement content 285 kg/m^3 minimum.

.3 Modulus of rupture 3.5 MPa average, 3.0 MPa minimum.

.4 Slump at delivery, before addition of superplasticizer, 80 mm; add superplasticizer, not water, to bring slump to level acceptable to floor finisher for placement.

.5 Interior Concrete, other than specified above, and not exposed to freezing and thawing or the application of deicing chemicals:

.1 Select water/cement ratio or cement content on basis of strength, workability and finishing requirements.

.6 Columns:

.1 Incorporate superplasticizer to provide 200 mm slump concrete for columns.

.7 Steel fibre reinforced concrete:

.1 Provide cement content of 285 kg/m^3, a water cement ratio less than 0.50, and 25 kg/m^3 of steel fibres. Supply concrete with slump of 50 mm and incorporate a superplasticizer at dosage sufficient to provide 100 mm slump.

.4 Admixtures:

.1 Chemical Admixture

.1 Incorporate water-reducing admixture, type WN, in all concrete.

.2 Air Entraining Agent

.1 Incorporate air-entraining agent in addition to chemical admixture in concrete of exposure classification F-1, F-2, C-1, C-2, C-3 and C-4 in accordance with CAN/CSA-A23.1.

.3 Calcium Chloride

.1 Do not use calcium chloride or admixtures containing chloride in concrete.

.2 Concrete Toppings:

.1 Provide topping with minimum 28 day compressive strength of 30 MPa.

.2 For floors left exposed: noted as traprock finish, provide topping with traprock aggregate and with minimum 28 day compressive strength of 35 MPa and maximum slump of 50 mm.

.3 Grout:

.1 Dry pack grout under steel plates and where grout thickness does not exceed 75 mm:

.2 Premixed grout mixed in accordance with manufacturer's instruction.

.3 Dry pack grout for underpinning and where grout thickness equals or exceeds 75 mm:

.4 Mix one part Portland Cement, one and one-half parts concrete sand and two parts of 10 mm pea gravel, with only sufficient water that mix will retain its shape when made into ball by hand.

PART - 3 EXECUTION

3.1 PREPARATION FOR PLACING CONCRETE

.1 Notify DCC Representative at least 24 hours before commencing to place concrete, and 48 hours before wall forms are closed in accordance with Section 01 32 16.19 Construction Project Schedule.

.2 Ensure that footing excavations and skim slabs are free of frost or water before placing concrete. If a sump is required for pumping water from the excavation, excavate it outside the area of the footing. Remove any wet or disturbed soil just prior to placing concrete.

.3 Before placing concrete, check that all forms are rigid and structurally safe, and that all reinforcing steel, formwork, sleeves, anchor bolts and other items are installed in accordance with the drawings and specifications. Ensure that all trades have checked the security and location of all components required in the concrete by those trades.

.4 Ensure that the electrical conduits have been properly set in the mid-height of the slab, beam, or other concrete. Avoid concentrations and crossing of conduit. Any such concentrations which are required shall be approved by the DCC Representative before concrete is placed. The Contractor shall co-ordinate the placing of reinforcement with the Electrical Subcontractor to ensure that both conduit and reinforcement are properly placed.

.5 Obtain DCC Representative's written approval that prepared subgrade is acceptable for placement of granular underbed.

.6 Place granular underbed over area of scheduled pour and proof roll.

.7 Obtain geotechnical DCC Representative's written approval that thickness, elevation and proof rolling of granular underbed are acceptable.

.8 Prior to placing interior concrete slabs on grade, cover granular base with one layer of polyethylene in areas shown on drawings. Lap joints 150 mm and ensure that sheet is not perforated.

.9 Immediately prior to placing concrete slabs on granular base, where a vapour barrier is not required, moisten the base material to reduce absorption of moisture from the concrete.

3.2 **COOPERATION WITH OTHER TRADES**

.1 Set all bolts, inserts, anchors, hangers and other means of fasteners required to be installed for other trades. Consult "Work by Other Sections" Article of other sections to determine scope of this work.

.2 Provide holes through concrete work required by other trades for pipes, ducts, conduits and other items of equipment. Obtain DCC Representative's approval for location of holes not shown on the structural drawings.

.3 Ensure that all sleeves, inserts, anchors and other fasteners required to be installed by other trades are installed before placing concrete.

.4 Set all frames in concrete.

3.3 **CONTROL JOINTS**

.1 In walls, form grooves for control joints on both faces, as detailed. Unless otherwise noted, cut or stop alternate horizontal reinforcing bars at the joints. Sealant and sealant backing - under Joint Sealant Section 07 92 00.

.2 In slab on grade floors, form or sawcut control joints as detailed. Where 'diamonds' or other isolation joints are shown to be constructed around columns or piers, place after the floor has been concreted and sawcuts have been made as specified under Section 03 35 00.

3.4 **CONSTRUCTION JOINTS**

.1 Where construction joints other than those indicated on drawings are required, locate in consultation with the DCC Representative.

.2 Unless agreed otherwise for specific locations by the DCC Representative, provide shear keys in all construction joints. Normally, form keys from 50 x 100 mm (2" x 4") material. Depth of keys shall total approximately 1/4 of the depth of the member. In deep members, use two or more keys.

.3 Construction joints shall be straight and plumb unless otherwise agreed for specific conditions.

.4 Install PVC waterstops in horizontal and vertical construction joints in walls at or below grade, and at other locations where shown. Waterstops shall be continuous throughout length of joint.

.5 Unless otherwise detailed on the structural drawings, reinforcement shall be continuous through construction joints.

.6 Maximum length of pour not to exceed 20 m, unless advance authorization is obtained from DCC Representative.

3.5 **EXPANSION JOINTS**

.1 Provide expansion joints where shown and as detailed.

.2 In exterior walls, or interior walls against soil, install PVC waterstop for full length of joint. Fill joint with pre-moulded plastic foam filler to within 25 mm (1") of the wall faces. Sealant and Sealant Backing -under Joint Sealant Section 07 92 00.

.3 Take special care to keep the exposed portion of expansion joints free of concrete.

.4 Expansion joints in floors and walls shall be continuous from one to the other.

3.6 **COLD WEATHER CONCRETE**

.1 When the air temperature is below, or is expected to fall below 5°C (as forecast by the local meteorological office) carry out all concrete work in accordance with the recommendations of CSA A23.1. Have all equipment prepared and operational before commencing to place concrete.

.2 When heated concrete is exposed to the drying effects of wind, provide adequate windbreaks to protect the surface.

.3 Methods of heating shall be such as to prevent discharge of combustion products over, or drying of, the surface of the fresh concrete.

.4 Keep a permanent temperature record conforming to the following requirements:

.1 Records to show date, time, outside temperature and the maximum and minimum temperature at several points within any enclosure, before the placing of concrete in or above the enclosure.

.2 Use maximum and minimum type thermometers for measuring temperature. If concrete is placed on forms heated from an enclosure below, place thermometers close to the underside of the forms. Temperature record to be kept available for DCC Representative's inspection at any time.

.5 Temperature of air within enclosures shall not exceed 32°C. Maintain concrete temperatures at 21°C for five days. Removal of concrete protection shall conform to CSA A23.1.

.6 If required by the DCC Representative, place tubes in the concrete to permit insertion of thermometers for direct reading of concrete temperature. Provide thermometers of suitable length and diameter.

.7 Do not place concrete on frozen ground, on ground which contains frozen materials, nor on or against any surface which is at a temperature of less than 10°C.

3.7 **HOT WEATHER CONCRETE**

.1 Carry out hot weather concreting, unless otherwise specified, in accordance with CSA A23.1.

.2 Protect concrete from effect of hot or drying weather conditions. Protect forms and reinforcing from the direct rays of the sun, or cool by fogging and evaporation.

.3 Refer to curing article for special curing precautions in hot weather.

.4 At air temperature over 27°C, use a set retarding admixture meeting requirements of CSA A23.1 and this specification, in accordance with manufacturer's directions. Set retarding admixture shall be used in all slabs exceeding 200 mm thickness and in all walls, unless otherwise agreed by the DCC Representative.

3.8 **TEMPERATURE OF CONCRETE**

.1 In cold weather, concrete shall be delivered to the work having a temperature of not less than 18°C and not more than 32°C.

.2 In hot weather, concrete shall be delivered to the work having a temperature of not less than 10°C and not more than 27°C

3.9 **SYNTHETIC FIBER-REINFORCED CONCRETE**

.1 Provide synthetic fibre entrained concrete where called for on the drawings.

.1 Sika FibreMesh 150

.2 Febercon Novomesh 450

.3 MasterFiber Mac 220

.2 Use 12 mm long rapid dispersing micro-element synthetic fibers at the rate of .91 kg/m^3 of concrete, Fibrin 23 as supplied by Fibrin Inc. SikaFiber PPM-12 AG or PSI Fiberstrand 100 by Euclid Chemical Company.

.3 Fibers may be introduced with the aggregates or after all ingredients have been blended or mixed.

.4 Add fibers to the mix slowly to aid in dispersion and allow a few minutes additional mixing for proper distribution.

.5 All work shall be as per manufacturer's instructions or recommendations.

3.10 **STEEL FIBER-REINFORCED CONCRETE**

.1 Provide steel fiber-reinforced concrete for all interior slabs on grade.

.2 Use 60 mm lg x 1.00 mm diameter fibers at the rate shown on drawings.

.3 Apply as per manufacturer's instructions and recommendations.

.4 Add sufficient superplasticizer to compensate for loss of shear slump after the addition of steel fibers.

.5 Test slab:

.1 After the mix design has been reviewed and approved by the DCC Representative, place and finish a test slab. Surface hardeners may be omitted.

.2 Test slab size shall be cast 1000mm x 1000mm.

.3 Wet curing may be omitted and spray membrane substituted for the test slab only.

.4 If results are not satisfactory, another test slab shall be made.

.5 The unsatisfactory slab shall be removed from the site.

3.11 **DEPOSITING**

.1 Notify the DCC Representative at least 48 hours before each day's operation of placing concrete.

.2 Convey concrete from the mixer to the place of final deposit by methods which will prevent:

.1 The separation or loss of ingredients. Chutes, if used, shall be rounded in cross-section and have a minimum diameter of 8 times the maximum aggregate size.

.2 Displacement of rebar and/or mesh from their specified location.

.3 Do not deposit any concrete in the work which has partly hardened or which has been contaminated with foreign matter.

.4 Cast footings, beams and slabs their full design depth in one operation. In upset beams, stepped footings and similar details cast the upper portion as soon as stiffening of the lower portion will permit. The consistency of the lower portion shall be of lower slump than generally specified for the class of work. Remove any free water or laitance from the lower portion before the subsequent layer of concrete is placed.

.5 Immediately before placing concrete in walls, cover the bottom of the form with a layer of stiff grout. Proportions of cement and sand in the grout shall be similar to that in the concrete being used in the wall.

.6 Place and consolidate concrete in floors (suspended and on grade) and screed to level ready for finishing under the concrete floor finish section.

.7 Where pumps are to be used for placing concrete design the concrete mix accordingly. Maintain design slump at point of entry into pumps and add superplasticizer to take into account the slump lost during the pumping process.

.8 Unless otherwise agreed by the DCC Representative, consolidate concrete including slabs on grade in place by means of internal vibrators. Use the largest vibrator consistent with the type and location of concrete being placed. Vibrators shall be in accordance with CSA-A23.1.

.9 When concrete is being placed in deep members (such as walls and footings) vibrators shall be inserted and withdrawn vertically, and shall not be used to flow concrete into final position. They shall be lowered through the full lift of concrete into the lift below, so as to ensure blending of the concrete in the two lifts.

.10 Apply vibrators systematically and at such spacing that the zones of influence over-lap. Do not over-vibrate.

.11 Keep one spare vibrator for every three vibrators in use, in case of breakdown.

.12 After completing concrete in walls or columns, allow at least two hours before placing slabs and beams supported thereon.

3.12 **TOLERANCES**

.1 In accordance with ACI 117; definitions for tolerance terminology and tolerances for formed concrete surfaces are recapitulated in Section 03 11 00.

.2 Difference between elevation of high point and low point in specified area not to exceed:

.1 In any bay up to 100 m^2: 12 mm

.2 In any bay up to 400 m^2: 25 mm

EITHER

.3 F-Number System:

.1 Finish floor slabs to meet following tolerance classification in accordance with CAN/CSA-A23.1.

.1	Class A	$F_F = 20$	$F_L = 15$
.2	Class B	$F_F = 25$	$F_L = 20$
.3	Class C	$F_F = 35$	$F_L = 25$
.4	Class D	$F_F = 45$	$F_L = 35$

.4 Measure F levelness tolerance within 72 hours of concrete placement, on slabs on grade, and on formed slabs before removal of shores.

OR

.5 Straight-edge Method:

.1 Finish floor slabs to meet following tolerances when measured within 72 hours after placement and before shores are removed from formed slabs, by placing a freestanding unlevelled straightedge anywhere on slab and allowing it to rest on two high spots. Gap between straightedge placed on two highspots and floor surface not to exceed: 3 m straightedge

.1 Class A 8 mm

.2 Class B 6 mm

3.13 **CURING**

.1 Protect and cure concrete in such a manner as to prevent evaporation of moisture from the concrete and injury to the surface.

.2 When the air temperature may exceed 27°C curing shall be by methods which keep the surface continually moist for at least 7 days after placing, commencing immediately the concrete has set sufficiently. Moisture shall be applied by fogging or by the application of wetted burlap, or by other acceptable methods which will not damage the surface. A curing membrane is not acceptable under these conditions.

.3 When the temperature will not exceed 27°C a curing membrane meeting requirements of CGSB 90-GP-1 type 1 may be used. Membrane must be compatible with finish to be applied. For sidewalks, curbs and similar exterior concrete, use a membrane conforming to CGSB 90-GP-1 type 2.

.4 For vertical surfaces, forms shall be left in place for a minimum of seven curing days or alternatively forms may be stripped earlier, and the surfaces kept covered with wet burlap, subject to the DCC Representative's approval. Wood forms remaining in place shall be wetted down during periods of hot weather.

3.14 **TREATMENT OF FORMED SURFACES**

.1 Sandblasted concrete:

.1 For concrete surfaces shown to be sandblasted finish, treat with a light (medium, heavy) sandblasting to match the approved sample for colour and texture.

.2 For sandblasted concrete seal forms at joints to minimize dark lines due to leakage of laitence. Forms shall be free of "boats" and other surface imperfections.

.3 Contractor proposed to carry out sandblasting shall submit evidence of approval by the authority having jurisdiction required by applicable Codes in this class of work, including examples of such work carried out by them.

.4 Protect other surfaces and equipment which are not to be sandblasted during the course of the work and be responsible for the cost of correction due to the failure of such protection.

.5 Schedule, provide sufficient equipment and carry out the work in such a manner as to obtain a uniform texture throughout the work. Complete sandblasting before caulking joints in the concrete.

.2 Flat Finish

.1 Where the concrete is to be painted, finish the concrete with a "sack rubbed finish" (Type 6) in accordance with CSA A23.1.

.2 Where the concrete is not to be painted, finish the concrete with a "smooth rubbed finish" (type 5) in accordance with CSA A23.1. Do not fill small air or water pockets in the surface of the concrete.

.3 "As-formed" concrete - not exposed in the finished work. Repair honeycomb, no additional treatment required.

.3 Tie-Hole Filling

.1 Unless tie holes are shown or specified to be plugged with plastic plugs, cut back and patch tie holes in accordance with CSA A23.1.

3.15 **NON-SHRINK GROUT**

.1 Grout between column and base plates and bearing surface of concrete piers and foundations and/or masonry walls. Use a premix non-shrink grout in accordance with the manufacturer's directions, and with a minimum 28 day strength of 35 Mpa.

.2 Base plates up to 380 mm square shall be dry-packed. Place a rigid form on two adjacent sides and pack grout against the form from the other sides.

.3 Where accessibility is difficult and for bases in excess of 380 mm square use a flowable grout. Install the grout with a positive hydraulic head and ensure that provision is made for escape of air from below the baseplate.

.4 When grout is being placed at air temperatures below 4°C, ensure that concrete, grout and steel is preheated to 21°C before grouting. Enclose grouted area (including nearest 1.5 m length of all steel connecting to the base) and maintain at 10°C for a minimum of 3 days. If required by the DCC Representative, submit a written proposal describing the heating methods to be adopted.

3.16 **FLOOR INSTALLATION**

.1 Structural slabs to receive a separate topping at a later date to be stiff-broomed after screeding to provide a suitable bonding surface; except that where a membrane or slip sheet is to be installed, the surface shall be machine-trowelled.

.2 Bonded Toppings

.1 Clean and roughen all existing surfaces as required to accept new concrete work.

.2 Drill holes and/or set all bolts, inserts, anchors, hangers and other means of fastening required to be installed for other trades and as noted.

.3 Prime the cleaned and roughened surface with a latex, Sika Antisol. Master Builder Solutions Masterkure, Mapei - Planicure series or approved equivalent.

.4 Where topping is less than 25 mm in thickness, use 10 mm coarse aggregate.

.5 Where topping is less than 13 mm in thickness, use sand aggregate only and terminate topping at a straight chase 3 mm deep.

.3 Slabs on Grade

.1 Locate control joints and construction joints in consultation with DCC Representative. See concrete finishing section for spacing of joints.

.4 Provide concrete chairs with plain concrete of the same strength under reinforcing bars and mesh at maximum 600 mm centres in both directions.

.5 Saw cuts shall be made in the concrete at the appropriate time but within 24 hours after placing.

3.17 **EXTERIOR CONCRETE STEPS, PLATFORMS, WALKS**

.1 Exterior concrete ramp and landing, where indicated on the drawings, shall be of reinforced concrete.

.2 Construct concrete walks and platforms with sides straight and plumb, and edges slightly rounded.

.1 Lay concrete platforms with positive slope away from the building. This slope shall not be less than 20 mm in one metre unless indicated otherwise on drawings.

.2 Unless otherwise noted, lay walks with crown, except where they abut a wall, in which case slope walk away from wall.

.3 Unless otherwise shown, platforms and sidewalks shall be 125 mm thick and be reinforced with 6 x 6 x w2.1/w2.1 welded wire mesh.

.4 Provide control and expansion joints in sidewalks and platforms. Install premoulded expansion joint filler to expansion joints. Unless otherwise shown, provide expansion joints at maximum spacing of 4.5 m and control joints at maximum spacing of 1.5 m. Control joints shall be tooled with a 'V' section. Expansion joints shall be tooled with rounded section, approximately 6 mm radius.

.5 Finish top surface of steps, platform and walks by trowelling all tool marks from top surface of concrete and then brushing with a corn broom. Broom strokes shall be continuous across the surface. Direction of finish shall be across the narrow width of the concrete unless otherwise directed by DCC Representative.

3.18 **SKIM COATS AND CONCRETE BACKFILL**

.1 Immediately after completing excavation for footings, and before placing any reinforcement, cover the bottom of the excavation with a 75 mm skim coat of plain concrete.

.2 During the excavations, if soft areas are located and the depth of such excavation has to be increased, backfill the areas with plain concrete. The cost of the extra concrete will be paid for as stated in the unit prices section. Obtain DCC Representative's instructions before undertaking this work.

3.19 **TRENCHES AND PITS**

.1 Construct trenches and pits. Angle frames and covers to be supplied under the Metal Fabrication Section 05 50 00 but installed under this section.

3.20 **CONCRETE BASES AND CURBS**

.1 Construct concrete bases housekeeping pads, including oil tank storage bases, as shown on the drawings and as required by other sections.

.2 Construct concrete curbs as per typical details shown on the drawings.

3.21 **LINTELS, BOND BEAMS AND BEARING BLOCKS**

.1 Provide and install concrete and reinforcing steel to all reinforced concrete, concrete block lintels, bond beams and bearing blocks. Concrete block lintel and bond beam units and bearing blocks will be supplied and installed under the Unit Masonry Section 04 20 00.

3.22 **INSPECTION AND TESTING**

.1 Refer to Quality Control Section 01 45 00.

.2 Tests will be carried out under the appropriate CSA Standard. Tests will be carried out as directed by the DCC Representative.

.3 Tests may be required on any material being supplied under this section including the following:

.1 Aggregates.

.2 Concrete.

.3 Non-shrink grout.

.4 Supply necessary samples to the inspection company for test. Supply additional labour required to assist the inspection company in making such tests. Costs of this material and labour to be borne by this trade.

.5 Pay costs of delivery of samples and concrete cylinders to the testing company's laboratory.

.6 Submit samples of aggregate for analysis and if such samples fulfil the requirements of CSA A23.1, similar material shall be considered to be acceptable. Acceptance of samples not to be considered as a guarantee of acceptance of all material for same source.

.7 Inspection company will make slump tests and test cylinders in accordance with the requirements of CSA A23.2. Not less than three cylinders from each 76 m^3 of concrete of the same class, and in any case not less than one set of test cylinders from each class of concrete placed on the same day will be tested. No tests are required for concrete for skim slabs or concrete backfill.

.8 If the inspector for the testing company reports to the Contractor's representative that the slump is excessive, the Contractor shall remove the balance of that concrete from the site without further instructions.

.9 Testing company will label cylinders with the sample number and record and report the following information:

.1 Project.

.2 Location in structure where concrete placed.

.3 Concrete Supplier.

.4 Name - cylinders cast by. slumps.

.5 Time mixer charged. Time of sampling.

.6 Concrete temperature. Air temperature.

.7 Specified air (from ticket), measured air %.

.8 Admixtures.

.10 In addition to the above information, the inspection company shall also comment on the type of failure of the cylinder.

.11 When air entrainment is specified, it shall be measured in accordance with CSA A23.2.

.12 Provide a box or boxes of sufficient size for storage of concrete cylinders in a location adjacent to the area where tests are made. Box to be such as to maintain the temperature of the cylinders between 15°C and 32°C and to prevent loss of moisture from the concrete.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM C309-19, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

.2 CSA Group (CSA)

.1 CSA A23.1-19/A23.2-19, Concrete Materials and Methods of Concrete Construction/ Test Methods and Standard Practices for Concrete.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide manufacturer's printed product literature and data sheets for concrete finishes and include product characteristics, performance criteria, finish and limitations.

.2 Include application instructions for concrete floor treatments.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

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

1.4 SITE CONDITIONS

.1 Temporary lighting: Minimum 1200 W light source, placed 2.5 m above floor surface, for each 40 m 2 of floor being treated.

.2 Electrical power: Provide sufficient electrical power to operate equipment normally used during construction.

.3 Work area: Make work area watertight protected against rain and detrimental weather conditions.

.4 Temperature: Maintain minimum 10 degrees C ambient temperature for 7 days before installation and minimum 48 hours after completion of work and maintain relative humidity maximum 40 % during same period.

.5 Moisture: Ensure concrete substrate is within moisture limits prescribed by flooring manufacturer.

.6 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.

.7 Ventilation: Provide continuous ventilation during and after coating application.

PART - 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

.1 Product quality and quality of work in accordance with Section 01 61 00 - Common Product Requirements.

.2 Submit written declaration components used compatible and not adversely affect finished flooring products and their installation adhesives.

2.2 SEALING COMPOUNDS

.1 Surface sealers not contain aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium and their compounds.

.2 Penetrating Sealers: as specified in Section 07 19 00 - Water Repellents.

2.3 CURING COMPOUNDS

.1 Waterborne membrane forming curing membrane to ASTM C309, Type 1, Clear Class B.

.1 Verify compatibility with subsequent finishes.

2.4 MIXES

.1 Mixing ratios in accordance with manufacturer's written instructions.

2.5 SAFETY NOSINGS

.1 Safety Nosing – Contrasting Strips (AS-1): non-flammable and non-combustible, extruded aluminum base type 6063-T5, abrasive non-slip filler inserts containing not less than 65% virgin grain Aluminum Oxide (Al2O3) abrasive, complete with concrete screw anchors.

.2 Refer to Section 01 61 10, List of materials for colour and additional information.

PART - 3 EXECUTION

3.1 EXAMINATION

.1 Verify substrate surfaces are ready to receive work.

3.2 PREPARATION OF CONCRETE SLAB

.1 Rub exposed sharp edges of concrete with carborundum to produce 3 mm radiused edges unless otherwise indicated.

.2 Saw cut control joints to CSA A23.1, 24 hours maximum after placing of concrete.

.3 Use mechanical stripping to remove chlorinated rubber or existing surface coatings.

3.3 APPLICATION

.1 Apply concrete finishing in accordance with manufacturer's written instructions.

.2 After floor treatment dry, seal control joints and joints at junction with vertical surfaces with sealant.

.1 Sealants: to Section 07 92 00 - Joint Sealants

.3 Apply floor treatment in accordance with Sealer manufacturer's written instructions.

.4 Clean over spray. Clean sealant from adjacent surfaces.

.5 Schedule concrete pour so as to install the metal safety nosings quickly before the initial set of concrete occurs. Install nosings flush with the top of the traffic surface.

3.4 **CLEANING**

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

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

3.5 **PROTECTION**

.1 Protect finished installation in accordance with manufacturer's instructions.

3.6 **FLOOR FINISHES SCHEDULE**

.1 Resilient Flooring

.1 Finish: Smooth steel trowel.

.2 Hardener: None required.

.3 Curing: Water or poly curing.

.2 Hardened Concrete

.1 Finish: Steel trowel.

.2 Penetrating Sealer CSLR-1 specified in Section 07 19 00 Water Repellents.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section.

1.2 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation meeting:

.1 Minimum two weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive work of this Section.

.2 Establish a procedure to maintain optimum working conditions and to coordinate this work with related and adjacent work.

.3 Advise the DCC Representative of the date and time of the meeting.

1.3 SUBMITTALS

.1 Product Data:

.1 For each type of product, confirming compliance with the specified or named product or material.

.2 Prior to ordering products or materials, submit manufacturer's printed product datasheets for each type of product. Include product characteristics, performance criteria, physical size, finish and limitations for products listed in selected designs.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials in their original, unopened packages, and protected from exposure to the elements. Remove damaged or deteriorated materials shall be removed from the premises.

1.5 SITE CONDITIONS

.1 Before, during and after installation of work, building interior shall be enclosed and maintained at a temperature above 10 degrees C.

PART - 2 PRODUCTS

2.1 MATERIALS

.1 Floor underlayment: High-strength, self-levelling, calcium-aluminate-based underlayment, lightweight, with compressive strength to ASTM C109 after 28 days 24 MPa (minimum).

.1 VOCs (Rule #1168 of California’s SCAQMD): 0 g per L

.2 Flexural strength to ASTM C348 (CAN/CSA-A23.2-8C) at 28 days: > 500 psi (3.45 MPa).

.3 Compressive strength to ASTM C109 at 28 days: > 3,000 psi (20.7 MPa)

.4 Single lift application thickness: up to 25 mm. Comply with manufacturer’s recommendations for additional thickness above 25 mm.

.5 Product: Utraplan Lite by Mapei, LevelLite by Customs Building Products, or K-34 by Ardex.

.2 Aggregate: clean, washed, dry, stable, non-reactive aggregate or pea gravel measuring 3 to 10 mm in diameter, meeting requirements of the manufacturer for intended end use.

.3 Mix water: Potable, free from impurities.

.4 Sealer: per product manufacturer's recommendations.

.5 Primer: per product manufacturer's recommendations.

.6 Crack filler: Quick setting patching compound, compatible with floor underlayment.

2.2 **MIX**

.1 Mix proportions and methods shall be in strict accordance with product manufacturer recommendations.

PART - 3 EXECUTION

3.1 **PREPARATION**

.1 Subfloor shall be structurally sound. Shot blast or scarify steel trowel concrete, concrete with sealer or curing compound, slick or smooth concrete. Clean subfloor to remove mud, oil, grease, and other contaminating factors before application of work.

.2 Fill cracks and voids with crack filler where leakage of underlayment could occur.

.3 Prime subfloor in accordance with manufacturer's recommendations.

.4 Expansion Joints: Allow joints to continue through the underlayment at the same width.

3.2 **APPLICATION**

.1 Do not commence work until the building is enclosed, including roof, windows, doors, and other fenestration.

.2 Spread and screed underlayment to a smooth surface. Except at authorized joints, place underlayment as continuously as possible until application is complete so that no underlayment slurry is placed against underlayment product that has obtained its initial set.

.3 Provide continuous ventilation and adequate heat to rapidly remove moisture from the area until the underlayment has set and cured.

.4 For pours greater than 25 mm, pre-place aggregate over primed surface at no more than half of the total pour depth. Pour self-levelling underlayment over aggregate and rake to ensure full contact and bond with the substrate. Refer to manufacturer's written instructions for other methods and when applying a second coat of self-levelling underlayment.

.5 Apply sealer to underlayment that receive glue down floor coverings.

.6 Clean floor areas where the underlayment has been damaged and seal regardless of floor covering to be used. Where floor covering manufacturers require special adhesive or installation systems, their requirements supersede these requirements.

3.3 **FIELD QUALITY CONTROL**

.1 Slump Test: Test underlayment as it is being pumped using a 50 mm x 100 mm cylinder resulting in a patty size of 225 mm plus or minus 25 mm diameter.

.2 At least one set of 3 molded cube samples shall be taken from each day's application. Cubes shall be tested as recommended by the manufacturer in accordance with modified ASTM C109. Make test results available to the DCC Representative.

.3 Manufacturer's site inspection: Have the manufacturer's technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this

Section, to ensure the Work is correctly installed. When requested, submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

.4 Submit manufacturer's inspection reports and verification that work of this Section is correctly installed.

3.4 **PROTECTION**

.1 During construction, place temporary wood planking over underlayment wherever it will be subject to heavy wheeled or concentrated loads.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section in accordance with the Contract Documents. The work of this Section includes but is not limited to:

.1 Concrete unit masonry

.2 Mortar and grout.

.3 Reinforcing, ties and anchors.

.4 Miscellaneous masonry accessories.

1.2 SUBMITTALS

.1 Product Data:

.1 For each type of product, confirming compliance with the specified or named product or material.

.2 Prior to ordering products or materials, submit manufacturer's printed product datasheets for each type of product. Include product characteristics, performance criteria, physical size, finish and limitations for products listed in selected designs.

.2 Provide engineered shop drawings for reinforcement and connectors, load diagrams, and design calculations signed and stamped by a professional engineer licensed in the Province of Ontario. Ensure that the proposed systems comply with the requirements of the Building Code for the project location.

.1 Submit engineered shop drawings for the following:

.1 Masonry reinforcement.

.2 Masonry ties and connectors.

.2 Upon completion of the parts of the Work covered by the engineered submittal, the professional engineer responsible for the preparation of the engineered submittal and for undertaking the periodic field reviews described above, shall prepare and submit to the DCC Representative and authorities having jurisdiction, as required, a letter of conformance for those parts of the Work, certifying that they have been Provided in accordance with the requirements both of the Contract.

.3 Samples: If requested submit samples of, block, masonry accessories and mortar, for review by DCC Representative before commencing work.

.4 Certificates: Submit manufacturer's certificate verifying that masonry reinforcement supplied to Project conform to ASTM A153, Class B-2 hot dipped galvanized requirements.

1.3 QUALITY ASSURANCE

.1 Employ a professional structural engineer registered in the Province of Ontario to review components and supporting systems for the Work of this Section requiring structural performance, to be responsible for determining sizes, joint spacing to allow thermal movement, and loading of components in accordance with applicable codes and regulations.

.2 Conform to requirements of CSA A370, CAN/CSA A371 and design requirements of CSA S304.1 except where more stringent requirements are noted and/or indicated on Drawings and specified herein.

.3 Submit copy of test reports from independent CSA certified testing laboratories certifying compliance of concrete masonry units with specification requirements including compressive strengths, water absorption rates, solid to void ratios and densities.

.4 Engineered Masonry: Engineered masonry shall conform to CSA A371 and CAN3-S304 and to details as indicated on structural Drawings.

1.4 **SOURCE QUALITY CONTROL**

.1 Submit three copies of test reports from independent CSA certified testing laboratories certifying compliance of concrete masonry units with specification requirements including compressive strengths, water absorption rates, solid to void ratios and densities.

.2 Perform tests on concrete masonry units produced within 3 months of delivery dates for the Work. Test methods and equipment shall be in accordance with requirements referenced in the CSA-A165 Series Standards.

1.5 **DELIVERY, STORAGE AND HANDLING**

.1 Deliver and store masonry units on pallets and locate well away from roads.

.2 If masonry units are not used immediately after delivery, cover with tarpaulins or 6 mil polyethylene adequately secured. Keep units protected from roofing bitumen, concrete, mortar and other materials which could stain them.

.3 Store bagged products, such as lime, cement and metal accessories in dry, waterproof sheds.

.4 Keep masonry materials completely free from ice and frost.

1.6 **COLD WEATHER PROTECTION**

.1 When laying masonry in ambient temperature below 4 deg C, use heat and maintain temperature of masonry materials. Protect completed work from freezing to satisfaction of DCC Representative. Heat and maintain temperature of masonry materials to at least 4 deg C, but not more than 48 deg C, and maintain air temperature above 4 deg C on both sides of masonry for period of at least 72 hours.

.2 Do not use scorched sand. Do not use salts, admixtures or anti-freezes. Use approved smokeless heaters.

.3 Use warm water and use less mix water in winter; cover sand to keep dry; heat sand and ensure no frozen lumps; use small batches; provide temporary heat and weather protection enclosure at area of masonry work; cover top of all unfinished work to prevent water or ice getting into masonry work.

1.7 **HOT WEATHER REQUIREMENTS**

.1 Plan in advance for hot weather construction. Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.

.2 Avoid using dry masonry in hot weather conditions.

.3 Spread only enough mortar to permit soft setting of masonry units; do not over mix mortar materials.

.4 Protect laid masonry from damage by weather. At end of each day or shutdown period, cover exposed tops of masonry with canvas or strong waterproof membrane securely clamped down and overhanging on each side of wall at least 600 mm. Use wire spring clamps which extend 200 mm down each side of wall, spaced 2400 mm maximum or other approved method.

PART - 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

.1 Concrete Block: Modular, CSA A165 Series and as follows:

.1 Normal weight concrete block:

.1 SF or SS/15/A/M: Solid block walls for load bearing walls.

.2 H/15/A/M: Filled solid for top 2 courses of load bearing walls, for all locations where structural members bear on concrete block, and where indicated on Drawings.

.2 Provide special shapes and sizes as indicated or specified such as halves, jambs, lintels, solids, corners, bullnoses and double bullnoses, semi-solids, and other shapes. Use only bullnosed units with full and complete radius with no vertical ridge.

.3 Use normal weight concrete where finished face exposed to exterior or to earth below grade.

.4 Where concrete block walls are required to act as fire separations or barriers, provide blocks conforming to the building code with respect to classification, thickness, fire resistant ratings and type of concrete.

.5 Exposed block shall be uniform in colour, shade and texture, and made by one manufacturer.

2.2 REINFORCEMENT AND CONNECTORS

.1 Manufacturers: Subject to compliance with requirements of the specified product, in function, design, performance, material properties, construction, and installation methods, equivalent products by one of the following manufacturers are acceptable:

.1 Dur-O-Wall Limited.

.2 Hohmann and Barnard Inc.

.3 Peikko DELTABEAM & HHB Solutions

.2 Horizontal reinforcement for single wythe masonry: 3.66 mm steel longitudinal and cross wires, ASTM A82 / CSA G30.3 compliant. Width of reinforcing unit shall be 40 mm less than the nominal thickness of the wall. Provide prefabricated corners and tees.

.3 Vertical Reinforcing: As indicated.

.4 Flexible anchors and adjustable ties: Fabricated from 3.66 mm steel rods.

.5 Steel anchors, masonry reinforcement and other accessories, mill galvanized Class 3 complying with ASTM A116 for interior walls.

2.3 **MORTAR AND GROUT**

.1 Aggregate: CAN/CSA A179, except that the maximum allowable percentage passing 600 µm (No. 30) sieve shall be 80% and maximum passing 300 µm (No. 50) sieve shall be 50%.

.2 Cement: Normal Portland, CAN/CSA-A5.

.3 Hydrated lime: ASTM C207; Type S.

.4 Mortar mix: to CAN/CSA A179, proportion specifications using Type S hydrated lime.

.1 Type N: Masonry walls above grade and non-load bearing masonry walls.

.2 Type S: Masonry walls above grade and load bearing masonry walls

.3 Type M: Masonry walls for security walls as indicated on drawings.

.5 At Contractor's option, one of the following may be used:

.1 Pre-mixed mortar: CAN/CSA A179, portland cement/lime/aggregate, by St. Lawrence Cement Company, Canada Cement, St. Mary Cement or Lake Ontario Cement Ltd. Mix mortar, use and store in accordance with manufacturer's instructions to produce small batches for immediate use only. Discard mixed mortar after 2 hours.

.2 Site silo mix: CAN/CSA A179, portland cement/lime/aggregate, by Mega-Mix Ltd. or Max-Mix Ltd. or Jiffy Concrete Products. Mix required amount from site silo as required. Take representative samples for testing consistency of strength in accordance with CAN/CSA A179. Use mortar within 2 hours after mixing at temperature of 26 deg C (79 deg F), or 2-1/2 hours at temperatures under 10 deg C (50 deg F).

.6 Grout:

.1 Grout for masonry: Grout to CAN/CSA A179.

.1 Compressive strength:

.1 20 MPa minimum unless otherwise indicated.

.2 Beneath bearing plates: 35 MPa.

.2 Slump: 200 mm unless otherwise indicated.

.2 Grout for hollow metal frames: Fine grout to CAN/CSA A179.

.1 Compressive strength: 15 MPa minimum.

PART - 3 EXECUTION

3.1 **EXAMINATION**

.1 Examine conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work. Prepare written report listing conditions detrimental to performance of work.

.2 Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

.3 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 **INSTALLATION**

.1 Do masonry work in accordance with CSA S304.1 and CAN/CSA A371 except where specified otherwise.

.2 Do masonry mortar and grout work in accordance with CAN/CSA A179 and CAN/CSA A371 except where specified otherwise.

.3 Keep exposed faces free from stains, chips and cracks. Keep tolerance in plane 3 mm in 2400 mm.

.4 Buttering corners of units, throwing mortar droppings into joints, deep or excessive furrowing of bed joints will not be permitted. Do not shift or tap units after mortar has taken initial set. Where adjustment must be made after mortar has started to set, remove mortar and replace with fresh supply.

.5 When mortar is thumb-print hard, tool joints slightly concave for exposed work; elsewhere, strike joints flush. Use sufficient force to press mortar tight against masonry units on both sides of joints. Remove excess material or burrs left after jointing. Use trowel or rub with burlap bag.

.6 Lay all joints approximately 10 mm thick unless otherwise specified or otherwise indicated on Drawings. Fill joints full of mortar except where specifically designated to be left open.

.7 Use bullnose and double bullnose block at all external corners where block is left exposed.

3.3 **BLOCKWORK**

.1 Lay block to align plumb over each other with thick ends of webs up. Leave no cells open in exposed work.

.2 Minimize cutting block. Cut exposed block with power driven abrasive cutting disc or diamond cutting wheel where cutting is required and for flush mounted electrical outlets, grilles, pipes, conduit, leaving 3 mm maximum clearance.

.3 Do not wet concrete masonry before or during laying in wall.

.4 Locate corners accurately.

.5 Use full bed of mortar for first course. For remaining courses bed face shells and cross and end webs and vertical end joints fully in mortar. Compress end joint mortar.

.6 Stagger end joints in every course. Align joints plumb over each other in every other course.

.7 Bond intersecting block walls in alternate courses with metal anchors. Where blockwork abuts concrete, bond each block course with dovetail anchors.

.8 Do not break bond of corridor walls or other walls of exposed units where partitions intersect and if bonding would show through on exposed face of walls. Bond these partitions, to walls they intersect, with prefabricated intersection masonry anchor reinforcement in each course.

3.4 **PARTITIONS**

.1 Load bearing partitions, and partitions at stair wells and elevator, mechanical and electrical shafts: Extend partitions to structure above, wedge and grout. (i.e. to underside of floor and roof slabs and to structural framing). Rake out full mortar joint between partition and structure for a depth of 12 mm on one side for caulking specified under Section 07 92 00. Rake joint shall be on side of suspended ceiling (if any). If no ceiling then on side as directed.

.2 Non-load bearing Corridor partitions, demising partitions, partitions in areas without suspended ceilings and other partitions: Extend partitions up through ceiling to structure above. Terminate partitions 19 mm below structure and fill space between top of masonry and structure with compressed packing insulation.

.3 Load bearing walls: Wedge and grout load bearing walls to underside of structure.

.4 Co-ordinate bracing to provide lateral support for tops of partitions required to extend to within 19 mm of underside of structure where they occur under steel joists and beams, slabs and other structural elements with other Sections.

.5 Where walls and partitions are pierced by structural members, ducts, pipes, fill voids with mortar to within 19 mm of such items flush with wall finish.

.6 Fill spaces between partition and structure, ducts and pipes with compressed packing insulation full depth of partitions.

.7 Reinforce and grout cores in block walls for installation of adult change tables.

3.5 **CONTROL JOINTS AND EXPANSION JOINTS**

.1 Control Joints: Provide control joints in masonry walls where wall height changes; where wall direction changes; where wall thickness changes; at pipe and column chases; at bond beam breaks; at abutments of columns and walls; at abutment of cold garages to warm basements or walls; at openings in walls such as doors and windows; and at intervals in continuous walls as follows:

.1 Up to 2400 mm high: 9000 mm to 10500 mm oc

.2 2400 mm to 3600 mm high: 10500 mm to 12000 mm oc

.3 Over 3600 mm high: 12000 mm to 13500 mm oc

.2 Expansion Joints: Provide expansion joints within wall construction in locations indicated on Drawings.

3.6 **REINFORCEMENT AND REINFORCING TIES**

.1 Reinforce masonry walls and partitions with continuous reinforcement in every second block. Provide continuous reinforcing.

.2 Adjustable masonry reinforcement not permitted to correct poorly laid masonry. Bending of masonry reinforcement or ties not permitted.

.3 At corners of openings provide extra reinforcement, so that first and second courses above and below openings are reinforced. Extend extra reinforcement 600 mm beyond opening in each direction.

.4 Where columns occur in masonry walls so that masonry passed by in front of or behind column, or both, use reinforcement at every horizontal block joint and extend outer strand or strands of reinforcement through past column. Where possible, extend reinforcement at least 760 mm each side of column.

.5 Where steel and concrete columns occur in masonry walls embed steel bar anchors including bent ends fully with mortar.

3.7 **SETTING AND BUILDING-IN**

.1 Build in items occurring in masonry provided by other Sections including; steel door frames; anchor bolts; sleeves; inserts; loose steel lintels; shelf angles; access panels; masonry flashings not in direct connection with roofing and other such items. Build in items to present neat, rigid, true and plumb installation. Leave wall openings required for ducts, grilles, pipes and other items.

.2 Fill voids between masonry and metal frames with masonry mortar or insulation, as required.

3.8 **REPOINTING**

.1 Repoint defective joints.

.2 Cut back joints 13 mm taking care not to damage units. Remove dust and loose materials by brushing.

.3 Repoint with same mix and colour as original.

.4 Pack mortar tightly in thin layers, and tool joint to match non defective joints.

3.9 **FIELD QUALITY CONTROL**

.1 Manufacturer’s site inspection: Have the manufacturer’s technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. Submit manufacturer’s inspection reports and verification that the work of this Section is correctly installed.

.2 Submit manufacturer’s inspection reports and verification that work of this Section is correctly installed.

3.10 **CLEANING**

.1 Obtain cleaning materials manufacturer's instructions and masonry manufacturer's written instructions for cleaning and verify cleaning procedures outlined in CAN/CSA-A371 with manufacturers. Follow masonry manufacturer's written instructions for cleaning masonry. Test 10 sq.m. sample area to judge effectiveness of cleaning procedures and obtain DCC Representative's approval.

.2 Keep wall clean and free of mortar stains during laying. Allow mortar droppings which adhere to wall to dry out but not set. Then rub with small piece of masonry followed by brushing to remove all traces. On completion of masonry construction, after mortar is thoroughly set and cured, clean masonry thoroughly.

.3 Protect windows, trim and metal from cleaning agents.

.4 Remove mortar with wood paddles and scrapers before wetting. Saturate masonry with clean water and flush off loose mortar and dirt. Clean blockwork using water, scrubbing brushes and wood paddles only.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section.

1.2 REFERENCE

.1 Comply with the National Building Code and the By-laws of the local municipality.

.2 Reference Standards: Perform work of this Section in conformance with requirements of the latest edition of the following standards:

.1 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality/Steel/Structural Quality Steel.

.2 CSA-S16-14, Limit States Design of Steel Structures.

.3 CSA-S136, Cold Formed Steel Structural Members.

.4 CSA W47.1, Certification of Companies for Fusion Welding of Steel.

.5 CSA Standard W59, Welded Steel Construction (Metal Arc Welding).

.6 CSA Standard G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

.7 CSA Standard W178.1, Qualification Code for Welding Inspection Organizations.

.8 CSA Standard W178.2, Certification of Welding Inspectors.

.9 CISC Handbook of Steel Construction.

.10 CISC/CPMA Standard 1-73a, A Quick-drying One-coat Paint for Use on Structural Steel.

.11 CISC/CPMA Standard 2-75, Quick-drying Primer for Use on Structural Steel.

.12 CISC Code of Standard Practice, Appendix I, Architecturally Exposed Structural Steel (AESS).

.13 ASTM E1444/E1444M and ASTM E709 and ASTM E164-19 for ultrasonic testing

.14 SSPC.SP 1, Solvent Cleaning

.15 SSPC.SP 2, Hand Tool Cleaning

.16 SSPC.SP 3, Power Tool Cleaning

.17 SSPC.SP 6, Commercial Blast Cleaning

.18 SSPC.SP 7, Brush-off Blast Cleaning

.19 SSPC.SP 10, Near-white Blast Cleaning

.20 ASTM A123/A123M, Standard Specification for Zinc (Hot Dip Galvanized) coating on Iron and Steel Products.

.21 ASTM A36/A36M, Standard Specification for Carbon Structural Steel.

.22 ASTM F3125/F3125M, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPA) Minimum Tensile Strength, Inch and Metric dimensions

.3 Materials, design, fabrication and erection shall conform to CSA S16 except as noted herein. Where specific requirements are noted herein, they are in addition to the requirements of CSA S16 and do not supersede them unless specifically stated.

1.3 **QUALITY ASSURANCE**

.1 The work of this section shall be fabricated and installed by a company which is a member in good standing of the Canadian Institute of Steel Construction.

.2 Structural steel fabricator and erector to be certified by the Canadian Welding Bureau under the requirements of CSA W47.1.

.3 Licensed Professionals: Engage a Professional Engineer licensed in the Province of Ontario and experienced in design and installation of the work of this Section to:

.1 Prepare or directly supervise the design, execution, operations, procedures, and preparation of shop drawings.

.2 Check all drawings and calculations before submission.

.3 Certify that checks have been made by sealing and signing shop drawings and calculations.

.4 Undertake welding only by fabricators certified by Canadian Welding Bureau.

1.4 **QUALITY CONTROL**

.1 Inspection and testing of materials and shop fabrication of work of this Section, and field quality control specified elsewhere in this Section, will be performed by an Inspection and Testing Company.

.2 Inspection and Testing Company shall be qualified under CSA W178.

.3 Welding inspectors shall be certified by Canadian Welding Bureau in Category (a), Buildings, to CSA W178.2.

.4 Do not commence fabrication until details of inspection have been worked out with the Agency

.5 Inspection and Testing Company shall check:

.1 Mill Inspection:

.1 Check that materials conform to specified standards. Mill test reports, properly correlated to materials, will be accepted in lieu of physical tests.

.2 Check welders' CWB certification and review welding procedures.

.3 Perform shop and field inspection and testing as outlined in 3.7.

1.5 **SUBSTITUTIONS**

.1 Substitution of alternative sections will be allowed provided the new members have equal or greater capacity and stiffness and are of dimensions acceptable at that location. Clearly identify all substitutions on shop drawings.

.2 Submit all proposals for alternative sections substitutions to the DCC Representative in writing in advance of shop drawings. Each item shall be clearly identified. Do not proceed with a proposal unless it is accepted in writing

1.6 **SUBMITTALS**

.1 Refer to Section 01 33 00 Submittals.

.2 Shop Drawings:

.1 Submit erection diagrams and shop details, fully detailed and dimensioned, with complete information necessary for fabrication and erection without reference to structural drawings.

.2 Submit typical details of connections and any special connections for review before preparation of shop drawings.

.3 Submit sample connection calculations for review, including the following:

.1 Typical shear connections.

.2 Typical shear connections with axial load.

.3 Typical connections for lateral system.

.4 Typical tension connections.

.5 Any other calculations requested by the DCC Representative. Confirm requirements with the DCC Representative prior to submitting shop drawings.

.4 Submit loads used in connection design without reference to structural drawings. Clearly indicated if loads are factored or otherwise amplified for connection design. At minimum, submit all loads used in design of all lateral connections and tension connections, as well as a representative sample of all other connection types. Confirm requirements with the DCC Representative prior to submitting shop drawings."

.5 Prior to submission to DCC Representative, Contractor shall review all shop drawings. By this review, Contractor represents to have determined and verified all field measurements, site conditions, materials, catalogue number and similar data and to have checked and coordinated each shop drawing with the requirements of Contract Documents. Contractor's review of each shop drawing shall be indicated by stamp, date and signature of a responsible person.

.6 At time of submission, Contractor shall notify DCC Representative in writing of any deviations in shop drawings from requirements of Contract Documents.

.7 DCC Representative will review and return shop drawings in accordance with an agreed schedule. DCC Representative's review will be for conformity to design concept and for general arrangement only, and shall not relieve Contractor of responsibility for errors and omissions in shop drawings or of responsibility for meeting all requirements of Contract Documents.

.8 Contractor shall make any changes in shop drawings which DCC Representative may require consistent with Contract Documents, and resubmit unless otherwise directed by DCC Representative.

1.7 **PRODUCT HANDLING**

.1 Handle and store steel materials at the job site in such a manner as to cause no damage to other materials, to existing buildings, to property or to the new structure.

.2 Handle structural steel so as to avoid distortion.

PART - 2 PRODUCTS

2.1 DESIGN AND DETAILING REQUIREMENTS

.1 Design and fabricate shop and field connections as indicated on the structural drawings, or herein, or in the absence of any such indications in accordance with CSA S16 and the CISC Handbook of Steel Construction.

.2 Beam connections shall be adequate to resist the reactions indicated on drawings. When shears are not indicated, select or design non composite beam end connections to resist reaction due to maximum uniformly distributed load capacity of the beam in bending.

.3 For composite construction, the minimum end connection shall be such as to resist the greater of either Article 2.2.2 or the reaction resulting from a uniformly distributed load causing the equivalent of the factored moment resistance as tabulated in the CISC Handbook, assuming a 100% shear connection and with the depth of steel deck and/or slab shown on the drawings.

.4 Provide simple beam connections for unrestrained members in accordance with CSA S16, unless shown otherwise on Drawings. Submit for review, in advance of preparation of shop drawings, sketches and, when requested, design calculations sealed by a Professional Engineer licensed in the Province of Ontario, of connections which do not meet these requirements.

.5 Provide double angle header connections where practical. Where not practical, provide seat connection and top or side clip angles for lateral support.

.6 One sided connections or fish plates are not acceptable for members subjected to bending.

.7 Where steel is exposed in the finish work, provide neat details and connections. Avoid excessive gaps and protrusions in forming connections.

.8 Provide adjustable connections for all lintel angles and head supports attached to the structural frame to allow for frame deflections and tolerances.

.9 Provide all eccentrically loaded spandrel beams with top and bottom flange lateral bracing for torsional restraint.

.10 Provide at least one stiffener plate each side of web of beams continuous over columns unless another arrangement of stiffeners is shown on the drawings.

.11 Do not permit connections to encroach on the clearance lines required for the installation work of other sections.

.12 Bolted connections shall be bearing-type unless otherwise shown on the structural design drawings. Use of oversize holes shall be subject to approval and such connections shall be detailed as slip-critical.

.13 Minimum thickness of material for exterior exposures – 5 mm.

.14 Where galvanized steel members are exposed to weather, connections are to be bolted to ensure minimum damage to galvanizing. Contact faces of bolted connections are also to be galvanized and connection capacities designed accordingly.

2.2 MATERIALS

.1 Provide new materials in accordance with reference standards, of strength and quality noted on the structural drawings:- Structural Steel - CAN/CSA G40.20/21 grade 350W.

.2 Square and rectangular hollow structural sections - CSA G40.20/21 grade 350W (Fy = 350 MPa) class C or H, ASTM A500 grade C (Fy = 345 MPa) or ASTM A1085 (Fy = 345 MPa)

.3 Circular hollow structural sections - CSA G40.20/21 grade 350W (Fy = 350 MPa) class C or H, ASTM A500 grade C (Fy = 317 MPa) or ASTM A1085 (Fy = 345 MPa)

.4 Bolts, nuts and washers - ASTM F3125, grade A325. Where in contact with galvanized structural steel, use galvanized bolts, nuts and washers.

.5 Anchor rods: CSA G40.21 grade 300W, or ASTM 1554 grade 36 or 55

.6 Headed studs: to CSA W59, Type B, min. Fy=350 MPa.

.7 Drilled-in concrete anchor rods adhesive: Hilti – HIT-HY 200, Simpson Strong-Tie – SET-3G, Sika – AnchorFix-3001, or equivalent.

.8 Quick-drying one-coat paint CISC/CPMA standard 1-73a.

.9 Quick-drying primer CISC/CPMA standard 2-75.

.10 Zinc - rich paint: CGSB 1-GP-181, minimum dry thickness of each coat - three mils.

.11 Galvanizing - CSA G164 M92 - Minimum 5 mil thickness.

.12 Coal tar protective coating - Koppers Bitumastic No. 50 by Carboline Canada, Tnemec Series 20 Chem-Elastomer and Macropoxy 646.

.13 PPG Amercoat 385HS Coal Tar Epoxy by PPG Canada, Tremclad 7500 by Rust-Oleum Canada, Sherwin-Williams Corothane I (Coal Tar Epoxy).

2.3 FABRICATION

.1 In addition to the tolerance requirements of S16, connections on columns shall not have a variation from the detailed location of more than 10 mm.

.2 Cutting of steel beams in the field shall be done only when directed.

.3 Note that roof areas have slopes in two directions. This involves sloping some members, special shoes and special camber on some joists. No deviation from indicated requirements can be considered.

.4 Provide effective drainage holes to prevent accumulation of water in tubular members.

.5 Provide 6mm cap plates on all HSS members exposed to the exterior unless another arrangement is shown on the drawings.

2.4 CLEANING, SURFACE PREPARATION AND PRIMING

.1 Surface cleaning and preparation shall be in conformance with the following:

.1 Clean all members to SSPC-SP 1 – Solvent Cleaning, Remove loose mill scale, rust, oil, dirt and foreign matter using any suitable method.

.2 For members receiving shop primer paint clean steel to SSPC-SP 7 Brush-Off Blast Cleaning.

.3 For members receiving coal tar protective coating clean steel to SSPC-SP 7 Brush-Off Blast Cleaning.

.4 For members receiving intumescent coating clean steel to SSPC-SP 6 Commercial Blast Cleaning.

.5 For members to be hot dip galvanize clean steel to SSPC-SP 6 Commercial Blast Cleaning.

.6 For members receiving zinc-rich coating clean steel to SSPC- SP 6 Commercial Blast Cleaning.

.2 Apply one coat of primer in the shop with the exception of:

.1 Surfaces encased in or in contact with cast-in-place concrete including top flanges of beams supporting slabs.

.2 Surfaces and edges to be field welded for a distance of 50 mm from the joint.

.3 Contact surfaces of friction type shear connections assembled with high-strength bolts.

.4 Top flanges of composite beams with field welded shear connectors.

.5 Members for which zinc-rich paint or galvanizing is specified.

.6 Surfaces fireproofed by spraying.

.3 Hot dip galvanize all structural steel located beyond the vapour barrier including but not limited to shelf angles, hangers and their connections which support exterior wythes of exterior masonry walls, lintels in exterior walls and any steel members exposed to weather. Use recommended practice for safeguarding against embrittlement and recommended principles of design and preparation of materials.

.4 If galvanized steel is to be painted, use only non-passivated galvanizing process (without chromate coating).

.5 Apply one shop coat of zinc-rich paint to steel members embedded in the interior wythes of exterior masonry walls.

.6 Apply zinc-rich primer paint not more than 24 hours after blast cleaning but prior to any visible rust occurring on the surfaces. Do not apply when relative humidity exceeds 80%.

.7 Apply one shop coat and one field coat of coal tar protective coating to columns, base plates and anchor bolts in contact with soil where indicated on drawings. Apply minimum 15 mil dry thickness each coat.

.8 Apply Primer 2-75 to all steel which is exposed in finished work unless other coating is specified. Cleaning as specified in CISC/CPMA 2-75.

.9 Apply Primer 1-73a to all steel not otherwise primed except as listed in 2.5.2. Clean as specified in CISC/CPMA 1-73a.

.10 Apply touch-up paint after erection to all areas which have been missed, scraped or chipped using the same paint as the shop coat or primer.

PART - 3 EXECUTION

3.1 EXAMINATION

.1 Verify, before delivery of structural steel, that work of other sections on which work of this section is dependent is correctly installed and located.

3.2 PREPARATION

.1 Supply anchor rods, base and bearing plates and other members to be built in under work of other sections as work progresses. Co-operate with installers of this work and provide instructions for its setting.

.2 Where new work connects to existing construction, determine site conditions and dimensions accurately in field before making any necessary adjustments. Report adjustment to DCC Representative.

.3 Where the Work includes modification or removal of existing steel prepare a method statement to be reviewed by the DCC Representative. Retain a Professional Engineer to prepare demolition drawings, design the temporary shoring and to review this work on site. Demolish existing structural steel as required. Provide temporary shoring and bracing required for these operations. Prepare existing steel to receive new steel work. Remove from site dismantled steel which is not to be incorporated in the Work.

3.3 **ERECTION**

.1 Repair all small bends and kinks received during transportation before the members are erected. Replace, as directed, members seriously damaged.

.2 Make adequate provision for all loads acting on the structure during erection. Provide temporary bracing to keep the structure stable, plumb and in true alignment during construction. Any bracing members or connections shown on the plans are those required for the finished structure, and may not be sufficient for erection purposes. Such additional temporary bracing as may be required is the responsibility of the contractor. Temporary bracing shall remain in place until concrete slabs, masonry etc., required for final stability are completed.

.3 Set column base plates on levelling screws or on steel shims to the required elevation ready for grouting. Locate steel shims at the corners of the base plate to permit full grouting.

.4 The use of levelling plates for beams or columns is not permitted.

.5 Install bolts which are not pre-tensioned to be snug tight. Use turn-of-nut method for bolts in pre-tensioned connections. Finger tighten bolts to a snug fit and burr threads for slotted connections.

.6 Report failure of material to fit together properly and report to obtain approval for corrective measures.

.7 Fix all lintel angles and head supports to the steel frame only after nearly all the dead loads have been put on the steel frame, and immediately prior to the installation of the windows, door or screens below or walls that they support.

.8 Structural drawings do not generally show loose lintels required. Refer to general notes on the drawings.

.9 Bolt together multiple angle lintels. Provide spacers where separated. Provide steel spacers where angle seats are at different elevations.

.10 Connect ends of suspended lintels to the structure and/or extend into masonry to provide adequate bearing and restraint.

.11 Provide diagonal or cantilevered support angles at sides of columns where required for bearing support of interrupted deck.

.12 Provide dissimilar metal separators between aluminium members and structural steel.

.13 Structural Thermal Break Assembly:

.1 Install level, plumb, and square within specified allowable tolerances. Provide temporary structural supports, and bracing as required to maintain position, stability, and alignment of units until permanent connection or support.

.2 Field cutting of components is not permitted without review of the DCC Representative.

.3 Field welding of components is not permitted.

3.4 **WELDING**

.1 Do not weld in the field in rain, snow, sleet, or direct wind.

.2 Dry all surfaces by heat before commencing any welding.

.3 Weld members only when the air temperature is above -18°C (0°F). If the air temperature is above -18°C (0°F) but is cold enough to prevent the welder from producing sound work, then welding will not be permitted.

3.5 **SPECIAL BEARINGS**

.1 Install special bearings in locations, sizes and for loadings as shown on the drawings. Install in accordance with manufacturer's recommendations.

3.6 **COATING TOUCH-UP**

.1 Clean welds to remove all residue from electrodes.

.2 After erection is complete, apply one coat of touch-up paint to field bolts, field connections, burnt areas, and abrasions or damage to prime coats.

.1 Use a compatible primer to touch-up 1-73a or 2-75 shop applied primer.

.2 Use a compatible zinc-rich paint to touch-up shop or field applied zinc-rich paint.

.3 Apply two coats of zinc-rich paint to areas of bare metal on galvanized members.

3.7 **INSPECTION AND TESTING**

.1 Inspection and Testing Company shall:

.1 Verify that structural steel is fabricated in accordance with shop drawings.

.2 Verify that specified fabrication, welding, cleaning and painting procedures are followed.

.3 Inspect erection and fit-up, including placing, plumbing, levelling and temporary bracing and conformance with specified tolerances.

.4 Inspect bolted connections.

.5 Inspect welded joints, including slag removal.

.6 Provide general inspection of field cutting and alterations.

.7 Provide general inspection of shop coating touch-up.

.8 Inspect zinc primer and zinc-rich paint, including surface preparation and coating thickness.

.9 For surfaces inaccessible for cleaning and painting after assembly verify that these are treated before assembly.

.10 For surfaces painted with zinc-rich paint or zinc primer, verify that specified surface preparation is followed, and specified paint thickness is applied.

.11 Visually check of all welds at plate girders, all butt welds, all welds in moment connections, all welds at crane girders, all welds of roof anchors to structure, 50% of welds in hanger connections and 20% of all other welds for: size, length and profile, joint preparation, fit up and alignment, penetration and fusion, slag removal, distortion, porosity and cracks.

.12 Be present during the performance of welding of 10% of moment connections and 10% of butt welds in direct tension.

.13 Check 10% of columns and 10% of beams for plumbness using instrumentation.

.14 Perform pull test on 5% of post installed anchors for 200% of allowable tensile load as listed in manufacturer's data sheet.

.15 Carryout non-destructive testing of welded connections chosen at random as follows:

.1 10% of moment connections involving use of fillet welds, by Magnetic Particle Inspection.

.2 All moment connections and all connections in direct tension involving use of Full Penetration Groove welds, by ultrasonic testing.

.3 Where moments are transferred by either fillet welds or groove welds into end plates in "T" joint configurations, examine base metal for lamellar tearing or cracking, by ultrasonic testing.

.4 All welded splices, by ultrasonic testing.

.2 Submit reports to DCC Representative, Contractor and Authorities of Jurisdiction including extents of inspection and deficiencies observed. Work will be inspected in shop and when erected.

3.8 **DEFECTIVE WORK**

.1 Variations in excess of specified tolerances, and failure of materials or workmanship to meet requirements of this specification, and which cannot be repaired by approved methods, will be considered defective work performed by this section.

.2 Replace defective work, as directed by DCC Representative.

.3 Contractor shall pay for additional inspection and testing and related expenses if work has proven to be deficient.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section.

.2 Comply with requirements of Division 01.

1.2 RELATED REQUIREMENTS

.1 Section 03 20 00: Concrete Reinforcing.

.2 Section 03 30 00: Cast in Place Concrete.

.3 Section 05 12 23: Structural Steel for Buildings.

.4 Section 05 50 00: Metal Fabrications.

.5 Section 09 91 23: Interior Painting.

1.3 REFERENCE STANDARDS

.1 Comply with the National Building Code and the By-laws of the local municipality.

.2 Except where specified otherwise, design, fabricate and erect steel decking in accordance with the requirements of the latest edition of the following Standards:

.1 CSA S136, North American Specification for the Design of Cold Formed Steel Structural Members.

.2 CSA W47.1, Certification of Companies for Fusion Welding of Steel Structures.

.3 CSA W55.3, Certification of Companies for Resistance Welding of Steel and Aluminium.

.4 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.

.5 CSA W59, Welded Steel Construction, (Metal Arc Welding).

.6 CSA-S16, Limit States Design of Steel Structures.

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

.8 ASTM A792/A792M, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.

.9 ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.

.10 For Steel Roof Deck - CSSBI Standard 10M.

.11 For Composite Steel Deck - CSSBI Standard 12M.

.12 CGSB Standard for Coating, Zinc-rich, Organic, Ready Mixed, 1-GP-181M.

1.4 **SUBMITTALS**

.1 Submit shop drawings sealed and signed by a Professional Engineer licensed in the place where the project is located and is in responsible charge of its preparation.

.2 Indicate design loading, including concentrated loads required by NBC, concrete strength, material grade and thickness, deck profile, zinc coating designation, ULC fire rating and test design specification number if applicable, whether deck is inverted, required minimum bearing, layout of units, framing and supports, anchorages, openings and reinforcement, accessories, details of flashings or closures at openings and columns, dimensions and deck edge distances, and details of construction, including size and spacing of fastenings to meet uplift and diaphragm action.

.3 Submit installation instructions for electrical raceways in accordance with CSA Standards.

.4 Prior to submission to DCC Representative, Contractor shall review all shop drawings. By this review, Contractor represents to have determined and verified all field measurements, site conditions, materials, catalogue number and similar data and to have checked and coordinated each shop drawing with requirements of the work and of the Contract Documents. Contractor's review of each shop drawing shall be indicated by stamp, date and signature of a responsible person.

.5 At time of submission, Contractor shall notify DCC Representative in writing of any deviations in shop drawings from requirements of Contract Documents.

.6 DCC Representative will review and return shop drawings in accordance with an agreed schedule. DCC Representative's review will be for conformity to design concept and for general arrangement only, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting all requirements of the Contract Documents. Contractor shall make changes in shop drawings which DCC Representative may require consistent with the Contract Documents, and resubmit unless otherwise directed by DCC Representative. When resubmitting, Contractor shall notify DCC Representative in writing of revisions other than those requested by DCC Representative.

1.5 **QUALITY ASSURANCE**

.1 Deck supplier and erector to be certified under Division 1 or 2.1 of CSA W47.1 for fusion welding of steel and/or CSA W55.3 for resistance welding.

.2 Welders to be CWB approved for deck welding.

.3 Engage a Professional Engineer licensed in the place where the project is located to be responsible for design, detailing and installation of all decking.

PART - 2 PRODUCTS

2.1 **DESIGN AND DETAILING REQUIREMENTS**

.1 Floor Deck:

.1 Design of steel floor deck shall be by a Professional Engineer licensed in the Province of Ontario, who shall sign and seal shop drawings prior to submission for review.

.2 Design floor deck (either composite or non-composite as specified) in conformance with CSA S136 and CSSBI 12M, Articles 7.6 and 7.7, including Appendix thereto, for loading indicated on drawings and concentrated loads stipulated in NBC.

.3 Design composite deck sections for concrete strength indicated on drawings. In design of composite deck allow for loss of composite action at trench header duct locations.

.4 Deflection of floor deck shall not exceed:

.1 1/360 of span under superimposed dead and live loads.

.2 1/180 of the span or 20mm, whichever is smaller, under the weight of wet concrete and steel deck.

.5 Steel deck units shall be capable of sustaining the loads of wet concrete and placing and finishing operation, including unbalanced conditions, without overstressing the deck units or causing undue deflection or vibration, and, unless otherwise specified, without temporary shoring.

.6 Requirements of Regulatory Agencies:

.1 Satisfy requirements of any Fire Rated Assembly Design specified for the Project.

.2 Fabricate and install floor deck which forms part of a required fire rated system exactly as specified in Underwriters' Laboratories test design specification that validates required rating.

2.2 MATERIALS

.1 Steel Deck: Zinc-iron Alloy (ZF) coated steel sheet to ASTM A653/A653M, structural quality Grade 230, with ZF75 coating, or aluminum-zinc alloy (AZ) coated steel sheet to ASTM A792/A792M, structural quality grade 230 with AZ 150 coating.

.2 Galvanized deck: Zinc (Z) coated steel sheet to ASTM A653/A653M, structural quality Grade 230, with Z275, coating or aluminum-zinc alloy (AZ) coated steel sheet to ASTM A792/A792M, structural quality grade 230 with AZ 150 coating.

.3 For prefinished deck: Colour to be selected by the DCC Representative from manufacturer’s standard list.

.4 For decks to be painted on site: zinc-iron alloy coated decks suitable for finish painting.

.5 Fasteners for galvanized deck and prefinished deck: coated or stainless steel, hex head, self-tapping screws with EPDM bonded washers.

.6 Powder-actuated fasteners:

.1 Hilti Decking Fastening System.

.2 Simpson Strong-Tie (PNA/Powers) and

.3 DeWalt (Powers).

.7 Cover plates, closures, pour stops, edge strips, flashings and deck reinforcing: steel sheet with minimum base steel thickness of 0.91 mm. Metallic coating same as deck material.

.8 Headed studs: to CSA W59, Type B, min. Fy=350 MPa. Studs shall be of uniform diameter, heads shall be concentric and normal to the shaft, and the weld end shall be chamfered and solid fluxed.

2.3 **TYPES OF DECK**

.1 Roof deck with interlocking or overlapping side joints.

.1 38 mm

.2 76 mm

.2 In addition, for composite floor deck over composite steel beams with shear studs, minimum average width of concrete ribs to be:

.1 50 mm for 38 mm deep deck

.2 150 mm for 76 mm deep deck

2.4 **FABRICATION**

.1 Fabricate roof deck in accordance with CSSBI 10M.

.2 Fabricate composite steel deck in accordance with CSSBI 12M.

.3 Fabricate sections from steel sheets by rolling. Form integral ribs which will bear on supports and form interlocking male and female side laps.

PART - 3 EXECUTION

3.1 **EXAMINATION**

.1 Verify alignment and levels of supporting members before laying floor or roof deck. Do not proceed with erection until conditions are made satisfactory.

3.2 **ERECTION**

.1 Erect steel decking in accordance with CSA S136, CSSBI 10M, CSSBI 12M.

.2 Place steel decking on structure and adjust to final position before permanently securing thereto. Bring each unit to proper bearing on supporting members. Pack if required between supporting steel and steel deck.

.3 Align deck end to end to accurately fit with the corresponding sections, with sections parallel, even and straight.

.4 Lap over supports. Minimum lap 50 mm, maximum lap 100 mm.

.5 Use coated or stainless steel fasteners to connect deck to all supporting beams and perimeter beams. Interconnect sheets at side laps.

.6 Place deck so that bottom flutes are centred over composite beams running parallel to deck. Otherwise split deck and trim with closures as required to allow min. 25 mm clear between studs and deck webs / closure(s).

.7 Immediately after deck is permanently secured in place, touch up metallic coated top surface with compatible primer where burned by welding.

.8 Prior to concrete placement, steel deck to be free of soil, debris, standing water, lose mil scale and other foreign matter.

.9 Install necessary angle and channel closure pieces at ends of deck abutting other steel.

.10 Install sheet metal flashing of similar material to the deck to close gap between floor units and columns. Close open ends of cell runs which occur at columns, openings, walls and where cells change direction, with cell closures of minimum core thickness of 1.2 mm.

.11 Where metal decking rests on exterior masonry walls, fill web spaces with neoprene closures.

.12 Where flutes are at right angles to exterior walls, and decking exposed on underside extends beyond these walls, the interlocking side laps of the decking shall be caulked for 0.4 m immediately over the walls. Install interior and exterior closures, the exterior closures being suitably caulked to prevent air infiltration. In addition, provide roofer with sufficient quantity of glass fibre pads to close off top-side flutes directly over the face of the wall.

.13 Where flutes run at right angles to interior partitions, fill web spaces with double run of acoustical closures.

.14 Closures are not required between interior partitions and underside of decking in areas having a suspended ceiling.

.15 Where flutes are parallel to interior partitions, install steel flashings to provide a neat juncture between the two materials.

.16 Attach metal cell closures at locations required to contain poured concrete.

.17 Install edge forming for concrete slabs over deck.

.18 Reinforcement is not required for openings cut in deck which are smaller than 150 mm diameter or sq. and where not more than two vertical webs are removed.

.19 For deck openings from 150 to 300 mm diameter or sq. in size, install 50 x 50 x 6 mm steel angle, perpendicular to flutes, welded to 2 flutes each side of opening.

.20 Immediately after decking is permanently secured in place, touch up galvanized surface with primer where burned by welding.

3.3 **WELDING OF SHEAR STUDS:**

.1 Weld shear studs, with a full 360 degrees weld capable of developing 120% of the shear values listed in CSA S16, through steel deck where required, on the top flange of supporting steel.

.2 Test the first two studs installed each day in accordance with CSA W59. Maintain record of the studs tested. Replace studs rejected by Inspection and Testing Agency

.3 Studs shall not be welded to painted surfaces or to surfaces with heavy rust, mill scale, dirt, sand, or other materials which will interfere with the welding operations.

.4 Install studs in conformance to stud manufacturer's printed directions.

.5 Inspection and testing company will test the studs.

3.4 **INSPECTION AND TESTING**

.1 Inspection and Testing Company shall check:

.1 Mill test reports, welders' CWB certification, deck types, gauge and coating thicknesses.

.2 All fastening, side laps and button punching.

.3 Deck reinforcement at holes cut in deck.

.4 Installation of sheet metal strips and edge reinforcing.

.5 Deck bearing lengths at supporting members.

.2 Inspection and Testing Company shall visually check all stud shear connectors and test as stipulated in 05 12 23.

.3 Submit reports to DCC Representative, Contractor, and Authorities of Jurisdiction including extents of inspection and deficiencies observed.

3.5 **DEFECTIVE WORK**

.1 Variations in excess of specified tolerances, and failure of materials or workmanship to meet requirements of this specification, and which cannot be repaired by approved methods, will be considered defective work performed by this section.

.2 Replace defective work, as directed by DCC Representative.

.3 Contractor shall pay for additional inspection and testing and related expenses if work has proven to be deficient.

END OF SECTION

PART - 1 GENERAL

1.1 REFERENCE STANDARDS

.1 ASTM International

.1 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM B209, Standard Specification for Aluminium and Aluminium-Alloy Sheet and Plate.

.4 ASTM B210/B210M Standard Specification for Aluminium and Aluminium-Alloy Drawn Seamless Tubes.

.5 ASTM B221M, Standard Specification for Aluminium and Aluminium-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

.6 ASTM B241/B241M, Standard Specification for Aluminium and Aluminium-Alloy Seamless Pipe and Seamless Extruded Tube

.7 ASTM B308/B308M, Standard Specification for Aluminium-Alloy 6061-T6 Standard Structural Profiles.

.8 ASTM D149, Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials.

.1 ASTM F436/F436M, Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.

.2 ASTM F738M, Standard Specification for Stainless Steel Metric Bolts, Screws, and Studs.

.3 ASTM F836M, Standard Specification for Style 1 Stainless Steel Metric Nuts (Metric).

.4 ASTM F844, Standard Specification for Washers, Steel, Plain (Flat), Unhardened for General Use.

.9 ASTM F3125/F3125M, Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength.

.2 CSA International

.1 CSA G40.20/G40.21, General requirements for rolled or welded structural quality steel/structural quality steel.

.2 CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CSA S16, Design and construction of steel structures.

.4 CSA W48, Filler metals and allied materials for metal arc welding.

.5 CSA W59, Welded Steel Construction.

.6 CAN/CSA-W117.2, Safety in welding, cutting, and allied processes.

.2 Canadian Institute of Steel Construction (CISC)

.1 CISC/CPMA 2.75, A Quick-drying Primer for Use on Structural Steel.

.3 Green Seal Environmental Standards (GS)

.1 GS-11-2008, Paints, Coatings, Stains, and Sealers.

1.2 **ACTION AND INFORMATIONAL SUBMITTALS**

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit Engineered Shop drawings stamped and signed by professional engineer licensed in Province of Ontario, Canada, responsible for design.

.2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

.3 Submit shop drawings for each item showing:

.1 Product and material identification, thicknesses, gauges, finishes.

.2 Dimensions and jointing details.

.3 Cuts and drilled holes.

.4 Anchorage and securement systems.

.5 Interfaces with the work of other Sections.

.4 Where structural or miscellaneous metal shapes and sizes, including shapes and sizes of hangers, bracing and anchors, are indicated on Architectural and Structural drawings it is the responsibility of the Metal Fabrications Subcontractor's structural engineer to review these shapes and sizes and confirm that they are adequate to support the loads anticipated. Obtain information from DCC Representative regarding loading allowed by building structure. Subcontractor's structural engineer shall stamp and sign each shop drawing ensuring that the assemblies are provided in accordance with the engineer's design.

.4 Test Reports: Provide certified test reports showing compliance with specified performance characteristics and physical properties.

1.3 **QUALITY ASSURANCE**

.1 Employ a professional structural engineer registered in the province of Ontario to review components and supporting systems for the Work of this Section requiring structural performance, to be responsible for determining sizes, joint spacing to allow thermal movement, and loading of components in accordance with applicable codes and regulations.

.1 It is imperative that the Metal Fabrications Subcontractor's structural engineer review and coordinate shop drawings with respective Subcontractors specified to ensure proper interface of Work between both Subcontracts.

.2 Retain a firm certified in accordance with CSA W47.1 Division 1 or 2.1 to perform welding.

.3 Employ welding operators licensed per CSA W47.1 for types of welding required by the Work.

1.4 **DELIVERY, STORAGE AND HANDLING**

.1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions and 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 accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

.4 Use strippable coatings or wrappings to protect exposed surfaces of prefinished metal work which does not receive site finishing. Use materials recommended by finishers or manufacturers of metals, to ensure that method is sufficiently protective, easily removed, and does not damage the finish.

1.5 **COORDINATION**

.1 Supply to concrete, masonry, and other Sections, materials requiring setting and/or building-in in concrete, masonry or other trades. This includes inserts, anchors, frames, sleeves, etc. Verify locations of said materials.

1.6 **PROJECT CONDITIONS**

.1 Field Measurements: Take measurements at the building to assure proper fitting, fabrication, and erection of the work. Check dimensions in the field, whether or not shown, upon which the accurate fitting together and building-in of the metal fabrication work may depend or which affects the proper installation of the work of others.

PART - 2 PRODUCTS

2.1 **MATERIALS**

.1 Performance/Design Criteria:

.1 Structural Design: Employ a registered structural engineer to:

.1 design components for work of this Section requiring structural performance.

.2 be responsible for determining sizes, yield strengths, gauge thicknesses and joint spacing to allow thermal movement and loading of components in accordance with applicable codes and regulations.

.2 Retain a qualified Professional Engineer registered or licensed to practice in the Province of Ontario to design; prepare, seal and sign engineered shop drawings; and to perform field review of the installation.

.2 Metals - General: free from defects which impair strength or durability, or which are visible; new, of best quality and free from rust, waves or buckles, and clean, straight throughout entire length, of sharply defined profiles and true in web and flange.

.3 Steel - General:

.1 Structural Shapes, Plates: New material conforming to CSA-G40.20/G40.21-M, Grade 350W for W and H shapes, and Grade 300W for other shapes, and plates.

.2 Hollow Structural Sections: New material conforming to CSA-G40.20/G40.21-M Grade 350W, Class C.

.3 Steel Pipe: Conforming to ASTM A53, Type "S", bare, Schedule 40, Grade A steel pipe.

.4 Welding materials: to CSA W59.

.5 Welding electrodes: to CSA W48 Series.

.6 Aluminum - General

.1 Aluminum: Aluminum Association alloy AA-6063T5 for mill finish extruded sections and AA-1100 for mill finish sheet.

.2 Aluminum Rolled or Extruded Shapes: Structural quality to ASTM B308/B308M, Alloy 6061-T6.

.3 Aluminum Bar, Rod, Wire: to ASTM B221M.

.4 Aluminum Sheet or Plate: to ASTM B209M.

.5 Aluminum Checkered Plate: to ASTM B209M, Alloy 5086.

.6 Aluminum Drawn Tubes: to ASTM B210M.

.7 Aluminum Pipe: to ASTM B241/B241M, Schedule 40, 6061 alloy.

.7 Stainless Steel - General

.1 Provide highest architectural quality in various forms, straight and true. Ensure there are no scratches, scars, creases, buckles, ripples or chatter marks. Provide finish surfaces suitable for polishing where required. Ensure finished surfaces exposed to view are free of pitting, seam marks, roller marks, oil-canning, stains, discolouration or other imperfections.

.2 Sizes as required to meet design requirements.

.3 Stainless Steel Shapes: to ASTM A276, Type 304 for interior use; Type 316 for exterior use.

.4 Stainless Steel Plate: to ASTM A167, Type 304 for interior use; Type 316 for exterior use.

.5 Stainless Steel Sheet: to ASTM A167, Type 304 for interior use; Type 316 for exterior us.

.6 Stainless Steel Pipe: to ASTM 312, Type 316, 180 grit finish.

.7 Stainless Steel Fasteners: Type 304 or Type 316 to suit application.

.8 High Strength Bolts with Bolts, Nuts and Washers (for structural connections): Conforming to ASTM A325M with each type and size of bolt and nut sourced from same manufacture and of same lot. Use hot dipped galvanized where used in exterior connections or in unheated areas inside the building.

.1 Bolts: Heavy, hexagon head high strength structural bolts, of standard size, of lengths required for thickness of members joined and for type of connection.

.2 Nuts: Heavy hexagon semi-finished nuts.

.3 Washers: Flat and smooth hardened washers, quenched and tempered per ASTM F436M. Provide AISI Type 316 stainless steel washers at exterior locations

.4 Stainless Steel Bolts: To suit applications and conforming to ASTM F738M.

.5 Stainless Steel Nuts: To suit applications and conforming to ASTM F836M.

.6 Lock Washers: Helical spring type steel “lock” washers to suit applications and conforms to Federal specification FF-W-84. Provide AISI Type 316 stainless steel lock washers at exterior locations.

.7 Exterior Vandal Resistant Fasteners: AISI Type 316 stainless steel, dual pin type vandal resistant fasteners to suit applications.

.8 Security Fasteners: Button head screw tamper resistant #10, 25 mm long, corrosion resistant machine screws.

.1 Spax #19 x 1" Security Torx Button Head Screws.

.2 McMaster-Carr #10-24 x 1" Pin-In-Torx Button Head Screws.

.3 Fastenal #10-24 x 1" Security Button Head Cap Screw.

.9 Common or Ordinary Bolts and Anchor Bolts (for general applications): Unfinished bolts conforming with ASTM A307, Grade A, with hexagon heads and nuts where exposed in the finish work. Use hot dipped galvanized where used in exterior connections or in unheated areas inside the building.

.1 Common bolts: of lengths required to suit thickness of material being joined, but not projecting more than 6 mm beyond nut, without the use of washers.

.2 Anchor bolts: of lengths noted, but projecting not less than 13 mm beyond nut unless otherwise noted.

.3 Washers: plain, unhardened, to ASTM F844.

.10 Drilled Inserts: Ramset "Mega" or Hilti "HSL" heavy-duty anchors or Strong-Bolt installed in accordance with manufacturer's directions, to sizes shown. Load capacity when embedded in 25 MPa concrete shall not be less than:

Diameter	Pullout kN	Shear kN
8 mm	30.0	36.0
10 mm	43.6	57.2
12 mm	53.6	82.8
16 mm	83.6	149.6
20 mm	119.6	205.6

.11 Dielectric Separator: conforming to ASTM D149, non-conductive, resistant to moisture, epoxy resin solution or membrane type material, with dielectric strength > 15 kV/mm.

.12 Primer Paint: Solvent reducible alkyd, red oxide, in fast drying, lead and zinc-chromate free formulation conforming to CISC/CPMA 2.75. Use one brand of primer throughout the work.

.13 Galvanized Primer: Zinc rich conforming to CAN/CGSB-1.181 for new galvanized metal in compliance with CGSB 85-GP-16M. For galvanized fabrications touch-up to remain unpainted in finished work, use W.R. Meadows of Canada Ltd. "Galvafroid", or Kerry Industries "Z.R.C." or Niagara Paint Inc. "PL052898" zinc rich coating.

.14 Slotted Channel Framing: Cold-formed metal box channels (struts), complying with MFMA-4.

.1 Material: Galvanized steel, ASTM A 653/A653M, commercial steel, Type B, with Z275 (G90) coating; minimum 2 mm (0.08”) nominal thickness.

.2 Size of Channels: As required.

.15 Anchor bolts: CAN/CSA-G40.21, Grade 260W, expansion type with expandable collar not requiring oversize holes, non-corrosive type for exterior use, stainless steel for use with aluminum.

.16 Drilled concrete anchors: Kwik-Bolt by Hilti or Wedge Anchor by Ucan Fastening Products or Strong-Bolt Wedge Anchor by Simpson Strong-Tie.

.17 Drilled masonry anchors: HIT-HY 70 Hybrid adhesive anchor with HIT-SC mesh sleeve by Hilti or SLE Sleeve Anchor by Ucan Fastening Products or SET-XP High-Strength Epoxy Adhesive with sleeve by Simpson Strong-Tie.

.18 Grout: non-shrink, non-metallic, high quality, flowable, minimum 15 MPa at 24 hours.

.19 Grout for posts: epoxy grout, Anchorite by C.C. Chemicals or Epojet by Mapei or SET-XP Epoxy by Simpson Strong-Tie.

2.2 **FABRICATION**

.1 Fabricate the work true to dimensions, square, plumb and level. Joints and intersecting members shall be accurately fitted with adequate fastenings.

.2 Finished work shall be free from distortion and defects detrimental to appearance and performance.

.3 Unless otherwise specified, noted or approved, all connections shall be welded.

.4 Where not possible connections shall be bolted or secured in an approved manner. Exposed fastenings shall be countersunk, bolts cut off flush with nuts and made as inconspicuous as possible. Exposed fastenings where approved shall be of the same material, colour and finishes as the base metal on which they occur.

.5 Shop and field connections shall comply with CSA S16.

.6 Connections to structural steel members shall be welded. No bolting or drilling of holes shall be done unless approved in writing by the DCC Representative.

.7 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

.8 Fabricate items that are to be built into masonry or concrete and deliver to project site for setting; furnish items complete with bolts, anchors, clips, etc., ready to set. Furnish, completely install and connect other items. Erect items to proper lines and levels, plumb and true, and in correct relation to adjoining work. Secure parts in a rigid and substantial manner using concealed connections where practicable.

.9 Where necessary to secure work to the structure by means of expansion bolts, cinch anchors, and similar connections, lay out the work and install such connections, install the work and bolt up, unless otherwise noted.

.10 Provide bolts, shims, blocks, nuts, washers, wedging pieces, etc., required for complete installation, unless otherwise noted.

.11 Drill field holes for bolts or rivets. Do not burn holes.

.12 Furnish fitting-up bolts, drift pins, other tools and equipment and do necessary reaming of unfair holes found in field connections. New holes or enlargement of unfair holes by use of cutting torch is cause for rejection of the entire member. Replacement shall be made at Contractor's expense.

.13 Mill joints to a tight, hairline fit; cope or miter corners. Form joints exposed to weather to exclude water.

.14 Remove burrs from all exposed cut edges.

.15 Accurately cut, machine and fit joints so that finished work presents a neat appearance.

.16 Assemble members without twists or open joints.

.17 Drill properly sized holes for connecting the work of other trades where such can be determined prior to fabrication. Where possible, show such holes on shop drawings. Place holes so not to cause an appreciable reduction in strength of member.

2.3 **FINISHES**

.1 Stainless Steel Sheet: ANSI No. 4 satin finish, unless noted otherwise in other specification sections or on drawings.

.2 Galvanizing: hot dipped galvanizing with zinc coating 600g/m2 to CAN/CSA-G164 after fabrication.

.3 Chromium plating: chrome on steel with plating sequence of 0.009mm thickness of copper 0.010mm thickness of nickel and 0.0025mm thickness of chromium.

.4 Shop coat primer: in accordance with chemical component limits and restrictions requirements and VOC limits of GS-11.

.5 Zinc primer: zinc rich, ready mix in accordance with chemical component limits and restrictions requirements and VOC limits of GS-11.

.6 Powder Coating: to AAMA2605, pigmented, polyester based, thermosetting, powder coating. Provide coating system that complies with coating manufacturer's written instructions for pre-treatment, application, baking, and minimum dry film thickness.

2.4 **ISOLATION COATING**

.1 Metal members shall be isolated where necessary in an approved manner to prevent corrosion due to metal to metal contact, or contact between masonry and concrete and metal.

.2 Backpaint aluminum surfaces in contact with cement, concrete, masonry, plaster or dissimilar metals with heavy coat of zinc chromate or non-staining alkali resistant bitumious paint.

2.5 **SHOP PAINTING**

.1 Primer: VOC limit 250 g/L maximum to GS-11.

.2 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.

.3 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.

.4 Clean surfaces to be field welded; do not paint.

2.6 **ANGLE LINTELS**

.1 Steel angles: prime painted galvanized, sizes indicated for openings. Provide 150mm minimum bearing at ends.

.2 Finish: shop painted.

.1 Primer: VOC limit 250g/L maximum to GS-11when applied onsite.

2.7 **CHANNEL FRAMES**

.1 Fabricate frames from steel, sizes of channel and opening as indicated.

.2 Weld channels together to form continuous frame for jambs and head of openings, sizes as indicated.

.3 Finish: prime coat painted.

PART - 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal fabrications 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.

3.2 ERECTION

.1 Execute welding work in accordance with the following standards:

.1 CSA W48: for Electrodes. If rods are used, only coated rods are allowed.

.2 CSA W59: for design of connections and workmanship.

.3 CAN/CSA-W117.2: for safety.

.2 Fit joints and intersecting members accurately. Make work in true planes with adequate fastenings. Build and erect work plumb, true, square, straight, level and accurate to sizes detailed, free from distortion or defects detrimental to appearance or performance.

.3 Provide suitable means of anchorage such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.4 Exposed fastening devices to match finish and be compatible with material through which they pass.

.5 Supply components for work by other trades in accordance with shop drawings and schedule.

.6 Weld field connection.

.7 Include all cutting and patching of masonry walls where necessary. Obtain Contractor's approval of cut-outs in advance.

.8 Insulate where necessary to prevent electrolysis due to dissimilar metal to metal contact, or metal to masonry and concrete. Use bituminous paint, butyl tape, building paper or other approved means.

.9 Install materials in a good and workmanlike manner, cleaning and grinding all welding laitance and touching up primer where necessary.

.10 Touch-up rivets, field welds, bolts and burnt or scratched surfaces with primer after completion of:

.1 Primer: maximum VOC limit 250 g/L to GS-11.

3.3 **CONNECTIONS**

.1 Weld or high strength bolt main member connections. Use CISC double angle header connections wherever possible. High strength bolted connections shall be bearing type using 19mm dia. bolts conforming to ASTM A325M. Secondary members may be bolted with machine bolts.

.2 Perform high tensile bolted connections in accordance with CSA-S16. Accurately space holes of size 1.6 mm larger than the nominal diameter of the bolt. Install bearing type high tensile bolted connections unless shown otherwise on Drawings. Provide compressor or electrical equipment capable of supplying and maintaining required pressure at the wrench. Make connections without the use of erection bolts, some high tensile bolts will serve that purpose. Prevent nuts on bolts, except high tensile bolts, from becoming loose by burring bolt thread, by welding or by lock washers or lock nuts.

3.4 **CHANNEL FRAMES**

.1 Install steel channel frames to openings as indicated.

3.5 **SCHEDULE OF METAL FABRICATION ITEMS**

.1 General

.1 Provide metal fabrication items specified herein and items not indicated to be supplied under other Sections.

.2 Refer to drawings for details of metal fabrication work and related items not specifically listed in this Section.

.3 Where work is required to be built into work of other Sections, supply such members to respective Sections where specified or called out on drawings.

.4 Provide anchor bolts and expansion bolts or other means of anchorage required for building into floors, walls and ceilings, where it is necessary to secure metal and wood to concrete, masonry or steel work. Supply anchor bolts, nuts and similar hardware to the respective Sections for fastening.

.2 Stainless Steel Items

.1 Supply and install stainless steel items indicated on drawings, complete with fastenings and other incidentals required and as detailed.

.2 Stainless steel used in the Work shall be type as specified in each perspective Section, and shall be high quality and manufactured of non-rusting, virgin, and non-recycled materials.

.3 Use tools that are free of contaminants that will cause corrosion and rusting of stainless steel in the fabrication and finishing of stainless-steel work.

.4 When requested by the DCC Representative, identify the names of the stainless-steel manufacturers, fabricators and the finishing subcontractors.

.3 Steel Sections covered under this specification section 05 50 00, Metal Fabrications, are as follows:

.1 Metal Fabrications Subcontractor's to supply and install steel sections which are:

.1 Not shown on structural drawings.

.2 Shown in outline but not identified on structural drawings.

.3 Not noted on drawings to be supplied by another specification section.

.4 Not specified to be supplied under another specification section.

.2 Refer to drawings for details of metal fabrication work and related items not specifically listed in this Section.

.3 Cutting of these steel sections in the field shall be done under this section and as directed. The cost of field cutting shall be borne by the trades requiring such cutting.

.4 Where sections are required to be built into masonry or concrete, supply such members to respective trades.

.4 Concealed support elements and framing

.1 Construct concealed support elements and framing from rolled steel sections assembled by welding, unless noted otherwise.

.2 Design and engineer systems for lateral restraint.

.3 Design work to withstand, within acceptable deflection limitations, their own weight, the weight of the items to be supported, loads imposed by the motion of supported items, where applicable, and all live loads, static and dynamic which might be applied to the supported items in the course of their normal function. Design supports with a safety factor of 3. Design supports further as required to accommodate structural deflection.

.4 Provide accessories, inserts and fixings necessary for attachment of supports to building structure. Drill supports to receive attachment of supported items. Arrange supports to avoid conflicts with pipes, ducts, thermal and air/vapour barrier construction, framing provided under other Sections, and such that supports and their fixings are fully concealed from view within the finished work.

.5 Paint all supports unless galvanizing is specified.

.5 Steel Frames for Miscellaneous Openings

.1 Connections: Connect built-up members of frames by means of plug welding. Miter or cope and join members with continuous welding beads.

.6 Benches

.1 Supply and install steel brackets and supports for benches.

.2 Anchor solidly to walls, floors and structure as required and detailed.

.3 Provide fixing holes, countersunk where required, for fastening.

.7 Miscellaneous Steel Frames, Brackets and Supports: coordinate dimensions and profiles with interfacing sections

.8 Anchors, Bolts and Other Anchorages

.1 Provide all anchors, bolts and expansion bolts or other means of anchorage required for building into floors, walls and ceilings, where it is necessary to secure metal and wood to concrete, masonry or steel work, other than anchorages specified under other sections. Supply anchor bolts, nuts and similar hardware to the respective sections for fastenings.

.9 Brackets, Miscellaneous Steel

.1 Supply and install steel brackets and angles shown, detailed or required for completion of the project. Brackets shall be of sizes, shapes and at spacing shown. Drill for countersunk wood screws and anchor bolts.

.10 Boxes, Protective

.1 Fabricate 0.6 mm galvanized steel sheet boxes for soffit lights. Supply for installation under Gypsum Board Assemblies Section 09 21 16.

.11 Floor Hatch (HTCH-2): Floodtight against 9 m head of water from the topside and 1 m head of water from the underside without leakage.

.1 Material: 6mm aluminum cover and extruded aluminum frame.

.2 Cover: Diamond-pattern tread plate reinforced for AASHTO H-20 wheel loading, non-skid cover finish.

.3 Frame: Extruded aluminum with bend down anchor tabs around the perimeter. Extrusion is designed with a water retention lip to keep water from falling into the opening.

.4 Gasket: EPDM gasket adhesive bonded around the entire perimeter of the cover.

.5 Hinges: Aluminum hinges welded to the cover and frame with 6 mm type 316 stainless steel hinge pins.

.6 Locking mechanism: minimum of 2 lever type lock assemblies to compress the gasket to provide a flood tight seal. Each lock is engaged by turning a hex head bolt from the topside of the door.

.7 Lift Assistance: Type 316 stainless steel gas spring operators with built-in hold open device.

.8 Finish: Mill Finish aluminum with a bituminous coating applied to the exterior of the frame

.9 Hardware: Type 316 stainless steel throughout.

.12 Stainless steel ladders for sump pits:

.1 Provide ladders complete with necessary attachment brackets in accordance with with OHSA Reg. 851.

.2 Material: Stainless steel Grade 316L.

.3 Anchorage: Use stainless steel Grade 316 mechanical anchors of size required. Connect to sump pit wall only.

.4 Assemble using gas metal arc welding (GMAW) method.

.5 Manufacturer-supplied with the following, minimum sizes indicated, unless otherwise required by the design.

.1 6 mm x 50 mm flat bar side rails.

.2 28 mm x 43 mm, 3-hole perforated slip-resistant rungs.

.3 Brackets 6 mm x 50 mm, bent flat bar welded to ladder side rail, and offset from wall face as required.

.13 Access ladder for elevator pits:

.1 Refer to Section 14 20 00, Traction Elevators.

3.6 RECONSTRUCTION, ALTERATIONS AND MAKING GOOD

.1 Do all re-construction, alterations, fitting, patching and making good of the existing building and to join new work to existing.

3.7 **PROTECTION**

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

3.8 **FIELD TOUCH-UP**

.1 Paint bolt heads, washers, nuts, field welds and previously un-primed items. Touch up shop primer damaged during transit and installation with material to match shop primer or galvanize coating.

.2 Clean off dirt on installed miscellaneous metal surfaces.

3.9 **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 00 Cleaning and Waste Management.

END OF SECTION

PART - 1 GENERAL

1.1 REFERENCE STANDARDS

.1 ASTM International (ASTM)

.1 ASTM A653/A653M-23, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 ASTM F1667-21a Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.

.2 American Wood-Preservers' Association (AWPA)

.3 AWPA M2-19, Standard for Inspection of Treated Wood Products.

.4 AWPA M4-23, Standard for the Handling, Storage, Field Fabrication and Field Treatment of Preservative-Treated Wood Products.

.5 CSA Group (CSA)

.1 CAN/CSA O80 Series-2021, Wood preservation.

.2 CSA O112.9-21, Evaluation of Adhesives for Structural Wood Products (Exterior Exposure).

.3 CSA O121-17, Douglas Fir Plywood.

.4 CSA O141-23, Canadian Standard Lumber.

.5 CSA O151-17, Canadian Softwood Plywood.

.6 CSA O153-19 (R2024), Poplar plywood.

.6 National Lumber Grades Authority (NLGA)

.1 Standard Grading Rules for Canadian Lumber 2017.

.2 Underwriters Laboratory of Canada (ULC)

.3 CAN/ULC S102-2019(R2024), Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.2 For products treated with preservative and fire-retardant by pressure impregnation submit following information certified by authorized signing officer of treatment plant:

.1 Information listed in AWPA M2 and revisions specified in CSA O80 Series, Supplementary Requirement to AWPA M2 applicable to specified treatment.

.2 Moisture content after drying following treatment with water-borne preservative or fire-retardant.

.3 Acceptable types of paint, stain, and clear finishes that may be used over treated materials to be finished after treatment.

.3 Recommended metal connector and fastener materials and corrosion protection.

.4 Product recommendation for field treatment.

1.3 **QUALITY ASSURANCE**

.1 Wood preservation plants: certified by Canadian Wood Preservation Authority (CWPCA) to Environment Canada Technical Recommendation Document for the Design and Operation of Wood Preservation Facilities.

.2 Regulatory Requirements:

.1 Each board or bundle of fire-retardant treated material and panel to bear ULC label indicating Flame Spread classification, and smoke developed.

1.4 **DELIVERY, STORAGE, AND HANDLING**

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:

.1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store materials off ground with moisture barriers at both ground level and as a cover forming a well-ventilated enclosure, with drainage to prevent standing water.

.3 Replace defective or damaged materials with new.

.4 Store separated reusable wood waste convenient to cutting station and work areas.

PART - 2 PRODUCTS

2.1 **MATERIALS**

.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 Furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers:

.1 S2S or better grade.

.2 Board sizes: "Standard" or better grade.

.3 Dimension sizes: "Standard" light framing or better grade.

.4 Post and timbers sizes: "Standard" or better grade.

.3 Pressure treated lumber: pressure treated in accordance with CAN/CSA- O80 Series. Use Chromated Copper Arsenate (CCA) preservative to obtain minimum net retention of 6.73 kg/m3. Wood shall be precut, where practical, prior to preservative treatment.

.1 Following preservative treatment, dry material to maximum moisture content of 19 % for lumber, and 15% for plywood materials.

.2 Provide pressure treated materials for furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers.

.4 Fire Retardant Treated Wood: Pressure impregnated wood to CAN/CSA O80, with high temperature fire retardant chemicals, with flame spread and smoke development rating of 25 or less to CAN/ULC S102.

.1 Kiln dry fire retardant treated products after treatment to the following moisture contents:

.2 Plywood: 15%.

.3 Lumber: 19%.

.4 Identify Fire retardant treated wood by a label from an independent testing laboratory or certification organization which indicates that the necessary tests were performed, and production controls maintained.

.5 Electrical equipment mounting boards:

.1 Fire retardant treated plywood, square edge 19 mm thick, on 38 mm x 89 mm furring around perimeter and at maximum 300 mm intermediate spacing.

2.2 **PANEL MATERIALS**

.1 Veneer Core (Plywood): Provide exterior grade, veneer core (plywood) conforming to NAAWS.

.2 Softwood plywood (concealed locations): Canadian Softwood Plywood (CSP) to CSA O151, standard construction, grade as required, of thickness as indicated, as recommended by NAAWS.

.3 Softwood plywood (rough framing and rough carpentry only): Premium Grade; Douglas Fir plywood to CSA O121; or Western Softwood Plywood to CSA O151; or Poplar plywood to CSA O153-M. Grade S2S where exposed on two sides, and Grade S1S where exposed on one side.

2.3 **ACCESSORIES**

.1 General purpose adhesive: to CSA O112.9.

.2 Nails, spikes and staples: to ASTM F1667.

.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, recommended for purpose by manufacturer.

.5 Nailing discs: flat caps, minimum 25 mm diameter, minimum 0.4 mm thick, sheet metal, formed to prevent dishing. Bell or cup shapes not acceptable.

.6 Fastener Finishes:

.1 Galvanizing: to ASTM A653/ A653M, use galvanized fasteners for exterior work and interior highly humid areas.

.2 Proprietary corrosion resistant fasteners for pressure- preservative and fire-retardant treated lumber: as recommended by manufacturer for material and service conditions.

.3 Plated finish: use cadmium plated fasteners for interior work.

.4 Preservative for Field Treatment:

.5 Treat cut ends of pressure treated lumber cut on site with copper naphthenate based end cut preservative, or other type recommended by manufacturer to suit pressure treated products for protection against fungal decay.

PART - 3 EXECUTION

3.1 EXAMINATION

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

.1 Visually inspect substrate in presence of DCC Representative.

.2 Inform DCC Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

.1 Comply with requirements of NBC, supplemented by the following paragraphs.

.2 Install members true to line, levels and elevations, square and plumb.

.3 Construct continuous members from pieces of longest practical length.

.4 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.

.5 Countersink bolts where necessary to provide clearance for other work.

.6 Install furring and blocking as required to space-out and support casework, cabinets, A/V equipment, wall and ceiling finishes, facings, fascia, soffit, electrical equipment mounting boards, and other work as required.

.7 Align and plumb faces of furring and blocking to tolerance of 1:600.

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

.9 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using corrosion resistant fasteners.

3.3 FIELD TREATMENT

.1 Comply with AWPA M4 and revisions specified in CSA O80 Series, Supplementary Requirements to AWPA M2.

.2 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of recommended preservative before installation.

.3 Remove chemical deposits from surfaces of treated wood to receive applied finish.

3.4 CLEANING

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

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

3.5 **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

PART - 1 GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C39/C39M-12, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

.2 ASTM C267-20, Standard Test Methods for Chemical Resistance of Mortars, Grouts, and Monolithic Surfacings and Polymer Concretes.

.2 U.S. Army Corps of Engineers

.1 CRD C48-92, Standard Test Method for Water Permeability of Concrete

1.2 ACTION SUBMITTALS

.1 Product Data: For each type of product indicated. Include material descriptions, construction details**,** and installation instructions for crystalline waterproofing.

1.3 INFORMATIONAL SUBMITTALS

.1 Product Certificates: For waterproofing, patching, and plugging materials, from manufacturer.

.2 Product Test Reports: Based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for crystalline waterproofing.

1.4 QUALITY ASSURANCE

.1 Pre-Installation Conference: Prior to installation of waterproofing, conduct meeting with waterproofing applicator, installers of work adjacent to or which penetrates waterproofing, DCC Representative, and waterproofing manufacturer's representative to verify and review the following:

.1 Project requirements for waterproofing.

.2 Manufacturer's product data, including application instructions.

.3 Substrate conditions and procedures for substrate preparation and waterproofing installation.

.4 Minimum curing period.

.2 Material compatibility: Provide materials that are compatible with one another under conditions of service and application required, as demonstrated by product manufacturer based on testing and field experience.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Package waterproofing materials and identify on attached labels the manufacturer, contents, and material specification number.

1.6 PROJECT CONDITIONS

.1 Proceed with waterproofing work only after pipe sleeves, vents, curbs, inserts, drains, and other projections through the substrate to be waterproofed have been completed. Proceed only after substrate defects, including honeycombs, voids, and cracks, have been repaired to provide a sound substrate free of forming materials, including reveal inserts.

.2 Ambient Conditions: Proceed with waterproofing work only if temperature is maintained at 5 degree C or above during work and cure period, and space is well ventilated and kept free of water.

.3 Provide forced air circulation during curing period for enclosed applications.

1.7 **PROTECTION**

.1 Ensure that no other materials are applied to waterproofing membranes until the membrane has cured.

.2 Protect waterproofing membranes from damage until they are covered by other materials.

.3 Take particular care to prevent soiling of work of other Sections and adjacent surfaces resulting from the work of this Section.

PART - 2 PRODUCTS

2.1 **PERFORMANCE REQUIREMENTS**

.1 Installed system shall withstand hydrostatic pressures, thermally induced movement, and exposure to environment without failure due to defective manufacture, fabrication, installation, or other defects in construction. System shall remain watertight.

2.2 **MATERIALS**

.1 System description: Chemical treatment for the waterproofing and protection of concrete sump pits and elevator pits by process of diffusion and crystalline formation and migration throughout the pores and capillary tracts of concrete.

.2 Crystalline Waterproof Coating: Prepackaged, gray-colored proprietary blend of portland cement, specially treated sand, and active chemicals that, when mixed with water and surface-applied, penetrates into concrete and concrete unit masonry and reacts chemically with the byproducts of cement hydration in the presence of water to develop crystalline growth within substrate capillaries to produce an impervious, dense, waterproof substrate; that has VOC content complying with limits of authorities having jurisdiction; with properties meeting or exceeding the criteria specified below.

.1 Permeability: no measurable leakage after crystalline growth has occurred, as tested to U.S. Army Corps of Engineers CRD C48:

.2 Chemical Resistance: no detrimental effects after exposure, and have a minimum of 14% increase in compressive strength versus untreated control specimens, as tested to ASTM C267 and ASTM C39:

.3 Patching Compound: Factory-premixed cementitious repair mortar, crack filler, or sealant recommended by waterproofing manufacturer for filling and patching tie holes, honeycombs, reveals, and other imperfections; compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.

.4 Plugging Compound: Factory-premixed cementitious compound with hydrophobic properties and recommended by waterproofing manufacturer; resistant to water and moisture but vapor permeable for all standard applications (vertical, overhead, and horizontal surfaces not exposed to vehicular traffic); compatible with substrate and other materials indicated; and VOC content complying with limits of authorities having jurisdiction.

.5 Water: Clean and potable.

PART - 3 EXECUTION

3.1 EXAMINATION

.1 Examine substrates, areas, and conditions, with Applicator present, for suitable conditions where waterproofing is to be applied.

.2 Proceed with application only after unsatisfactory conditions have been corrected.

.3 Notify DCC Representative in writing of active leaks or defects that would affect system performance.

3.2 PREPARATION

.1 Free substrates from laitance, oil, hardener, curing compounds and other materials detriment to the bond, penetration and performance of the work of this Section. Employ steam cleaning, acid etching or light sand blasting if necessary.

.2 Rout out honeycombed pockets and faulty construction joints to sound concrete.

.3 Fill surface irregularities, holes, honeycombs, cracks, open joints, and porous areas with mortar materials acceptable with the waterproofing manufacturer.

.4 Dampen substrates before applying waterproofing. Remove free water.

3.3 APPLICATION - GENERAL

.1 Mix waterproofing materials to a slurry coat mix in accordance with manufacturer's instructions.

.2 Apply on the interior surfaces of the sump pits and elevator pits.

.3 Apply work by stiff masonry brush, by trowel, or by funnel pistol sprayer. Allow each successive coating to reach an initial set before re-coating.

.4 Protect the freshly treated surfaces from rain for a minimum of 24 hours.

.5 Moisture cure treated surfaces for a minimum period of two days, starting with fine water fog spraying the day following completion of the application.

.6 During extreme hot weather, apply light water fog spray to the freshly applied slurry application in order to prevent dehydration of the coatings.

3.4 APPLICATION - HORIZONTAL SURFACES

.1 Apply waterproofing uniformly in two successive coats, each coat at a rate of 1 kg/sq.m. in slurry consistency. The second slurry coating can be applied while the first coat is still green, but after it has reached an initial set.

3.5 APPLICATION - VERTICAL SURFACES

.1 Apply waterproofing uniformly in two successive coats, each coat at a rate of 1.5 kg/sq.m. in slurry consistency. The second slurry coating can be applied while the first coat is still green, but after it has reached an initial set.

3.6 **CLEANING**

.1 Clean spillage and soiling from adjacent surfaces using appropriate cleaning agents and procedures

END OF SECTION

PART - 1 GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for water repellents and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Manufacturer's Instructions:

.1 Submit manufacturer's installation instructions.

1.2 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

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

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:

.1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

1.4 SITE CONDITIONS

.1 Ambient Conditions:

.1 Maintain substrate temperature at water repellent installation area in accordance with water repellent manufacturer's printed instructions.

.2 Apply coating during dry weather. Allow surfaces to dry minimum of 3 days after rainfall or cleaning before applying further coats.

.3 Protect plants and vegetation which might be damaged by water repellents.

.4 Protect surfaces not intended to have application of water repellents.

PART - 2 PRODUCTS

2.1 MATERIALS

.1 Sealer (CSLR-1): colourless, high-performance, clear, breathable, 100% silane penetrating sealer, with the following minimum performance:

.1 Silane Content by Weight: 100 percent.

.2 Penetration, average depth, depending upon substrate: 9 mm.

.3 Surface Appearance after Application: Unchanged.

.4 Flash Point, SETA: Greater than 62.7 degrees C.

.5 Waterproofing Repellency after Heavy Abrasion: 83.5 percent.

.6 Water Weight Gain, NCHRP 244 Series II Cube Test:

.7 6.1 m2/L: 90 percent reduction.

.8 9.8 m2/L: 85 percent reduction.

.9 Absorbed Chloride, NCHRP 244 Series II Cube Test:

.10 6.1 m2/L: 96 percent reduction.

.11 9.8 m2/L: 87 percent reduction.

.12 Absorbed Chloride, NCHRP 244 Series IV Southern Climate: 98 percent reduction.

.13 VOC Content: 365 g/L, less water and exempt solvents.

PART - 3 EXECUTION

3.1 EXAMINATION

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

.2 Visually inspect substrate in presence of DCC Representative.

.3 Inform DCC Representative of unacceptable conditions immediately upon discovery.

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

3.2 MANUFACTURER'S INSTRUCTIONS

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

3.3 PREPARATION

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

.2 Protect surfaces to remain uncoated during application. Use drop cloths or masking as required.

3.4 APPLICATION

.1 Apply Sealer on te exterior surfaces - new ramp, landings and steps.

.2 Apply coating of water repellent on surfaces to be treated using low-pressure spray to the point of saturation, at rate per manufacturer's recommendations for surface to be coated, minimum of 2 coats. Apply coating in dual passes of uniform, overlapping strokes. Remove excess material; do not allow material to puddle beyond saturation.

.3 Stir material thoroughly before and during application.

.4 Apply sealer with flooding action. Eliminate ponding.

.5 Apply even distribution of sealer.

.6 Apply sealer on walls and columns: extend sealer application up from slabs and ramps minimum 600 mm on walls and columns.

.7 Apply a second saturation coating, repeating first application.

.8 Where sealer is to be applied adjacent to caulked joints, apply sealer carefully to full coverage and in a manner, which ensures it is not deposited on the caulking.

3.5 **CLEANING**

.1 Immediately clean water repellent from adjoining surfaces and surfaces soiled or damaged by water-repellent application as work progresses. Correct damage to work of other trades caused by water-repellent application.

.2 Comply with manufacturer's written cleaning instructions

.3 Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

3.6 **PROTECTION**

.1 Repair damage to adjacent materials caused by water repellent application.

.2 Protect installed products from damage during construction.

3.7 **FIELD QUALITY CONTROL**

.1 Upon completion of the work of this Section:

.2 After water repellent has dried, spray coated surfaces with water to verify coating coverage. Allow DCC Representative to witness tests.

.3 After surfaces have adequately dried, recoat surfaces that show water absorption, minimum of 2 coats.

.4 2 weeks prior application for Substantial Performance:

.5 Spray coated surfaces with water to verify coating to has not been damaged during construction. Allow DCC Representative to witness tests.

.6 After surfaces have adequately dried, recoat surfaces that show water absorption

.7 Apply water repellents using low pressure spraying apparatus, at rate per manufacturer's recommendations, minimum of 2 coats.

END OF SECTION

PART - 1 GENERAL

1.1 QUALITY ASSURANCE

.1 Installation: Maintain continuity of air barrier at interface with adjacent construction and at where work of other Sections project through the air barriers. Allow for expansion and contraction and linear movement of these items.

.2 Pre-installation meeting: Before commencing the work of this Section, arrange a site meeting attended by the Contractor, this Section, the DCC Representative, and the material manufacturers' qualified representative. Discuss surface conditions, application procedures, suitability of materials and alternative recommendations.

1.2 SUBMITTALS

.1 Product data: Provide data on Products, characteristics, performance criteria, and limitations, installation instructions indicating preparation, installation requirements, Product storage and handling criteria.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials in factory wrapped rolls with labels indicating manufacturer and trade name, material type, thickness, roll width and area.

.2 Protect materials from direct exposure to sunlight and physical damage.

1.4 COORDINATION

.1 Coordinate installation of sheet air-vapour barrier with work of other Sections to achieve an air and vapour tight building envelope.

1.5 PROJECT CONDITIONS

.1 Do not install solvent curing sealants or vapour release adhesive Products in enclosed spaces without ventilation.

.2 Maintain temperature and humidity recommended by the Products manufacturers before, during and after installation.

PART - 2 PRODUCTS

2.1 MATERIALS

.1 Air/vapour barrier membrane: 1 mm thick impermeable to air, moisture vapor, and water, self-adhering, SBS-modified asphalt membrane compound laminated on a polyethylene film, complete with primer, mastic and liquid membrane as required.

.1 Air-Shield by W.R. Meadows

.2 Blueskin SA by Henry

.3 Perm-A-Barrier by GCP Applied Technologies

.4 Sopraseal Stick 1100 by Soprema

PART - 3 EXECUTION

3.1 INSTALLATION - AIR/VAPOUR BARRIER MEMBRANE

.1 Install the membrane in strict accordance with the manufacturer's written instructions and the representative's on site instructions.

.2 Ensure complete coverage of and adhesion to all substrate to receive the air/vapour barrier membrane, including all wall protrusions. Extend membrane 150 mm below top of foundation walls. Co-operate with other Sections to ensure continuity of the barrier.

.3 Use a roller to apply pressure over the entire surface of the membrane to ensure uniform adhesion to substrate.

.4 Apply the membrane to primed substrate in 2400 mm lengths or as recommended by the membrane manufacturer.

.5 Apply membrane so that horizontal joints overlap with the upper sheet over the lower sheet, shingle style. Use mastic sealant were reverse lapping cannot be avoided. Lap all horizontal joints minimum 50 mm all side joints minimum 64 mm and all end joints minimum 150 mm. Stagger vertical joints to avoid four way joints.

.6 At the end of a day's work apply a trowelled head of mastic to all terminations of the membrane.

.7 Apply a trowelled head of mastic to all terminations of the membrane at the end of a day's work and at membrane terminations.

.8 Reinforce all inside and outside corners with a continuous 300 mm wide sheet membrane prior to installing the air/vapour barrier.

.9 Fill gaps and joints with liquid membrane and reinforce with a continuous 300 mm wide sheet membrane prior to installing the air/vapour barrier.

.10 Use liquid membrane at all protrusions and difficult detail areas and provide a minimum 64 mm overlap with the sheet membrane.

.11 Apply air/vapour barrier so that the exterior wall is air tight, with air tight junctures at openings, penetrations and edges.

.12 Supply and install sheet metal membrane support to all locations where no other substrate occurs to support the membrane, including at all locations of through wall membrane flashing at cavities. Form return flanges or provide suitable angles, and fasten to adjacent substrates to prevent deflection movement.

.13 Provide membrane supports for all gaps in the substrate or between components, larger than 12 mm or as otherwise recommended by the membrane manufacturer.

.14 Provide metal backing at junctions between different substrates.

.15 Overlap metal back-up with adjoining substrates and securely attach with fasteners appropriate for the substrate encountered. Where metal back-up is used to span deflection joints or areas where movement is anticipated between dissimilar materials, fasten metal on one side only to allow for movement. Provide continuity of air/vapour barrier with adjacent air/vapour barrier systems.

.16 Inspect air/vapour barrier for continuity immediately prior to installation of insulation. Do not cover the air/vapour barrier until it has been inspected.

.17 Inspect membrane thoroughly before covering and immediately make corrections and modifications required. Misaligned or inadequately lapped seams, punctures, fishmouths or other damage must be repaired with patch of membrane extending minimum 150 mm in all directions from edge of damaged area. Seal all edges of the patch with mastic. Slit fishmouths prior to repair with a membrane patch.

.18 Repair punctures, rips and tears with pieces of membrane completely adhered to the damaged membrane.

.19 Where punctures and tears are extensive, replace entire damaged section.

.20 Install membrane over doors, windows and other openings to exterior walls.

.21 At openings, extend membrane 200 mm beyond jambs, heads and sills.

.22 Use mastic or fixing bars to adhere membrane to windows, doors etc. to maintain continuity of the barrier.

3.2 **INSPECTION**

.1 Do not cover any portion of the air-vapour barrier until it has been inspected by the DCC Representative or by an inspection agency.

END OF SECTION

PART - 1 GENERAL

1.1 DESIGN AND PERFORMANCE REQUIREMENTS

.1 Design of metal panel wall systems in accordance to the latest edition of the following documents:

.1 CSA-S136 for the design of Cold Formed Steel Structural Members

.2 Canadian Sheet Steel Building Institute Standards 20M.

.2 Limit deflection under design loads to L/240. Components of siding system shall not vibrate when subjected to the effects of wind.

.3 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, overstressing of components, failure of connections, and other detrimental effects.

.4 Design expansion joints to accommodate movement in cladding and between cladding and structure to prevent permanent distortion or damage to the cladding.

.5 Design wall system to maintain the following erection tolerances:

.1 Maximum variation from plane or location shown on shop drawings: 20 mm/10 m.

.2 Maximum offset from true alignment between two adjacent members abutting end to end in line: 1 mm.

1.2 QUALITY ASSURANCE

.1 Subcontractor shall assume responsibility for design and installation of the panel mounting components of the exterior panel system including, but not limited to attachment to sub-construction, panel to panel joinery, panel to dissimilar material joinery, and joint seal associated with the panel system.

1.3 DELIVERY, STORAGE, AND HANDLING

.1 Deliver components, sheets, metal wall panels, and other manufactured items so as not to be damaged or deformed. Unload, store, and erect panels in a manner to prevent bending, warping, twisting, and surface damage.

.2 Store products in accordance with manufacturer's recommendations.

.3 Protect prefinished steel during fabrication, transportation, site storage and erection, in accordance with CSSBI Standards.

1.4 PROJECT CONDITIONS

.1 Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

.2 Field Measurements: Verify locations of framing and opening dimensions by field measurements prior metal wall panel and soffits fabrication, and indicate measurements on Shop Drawings.

.3 Coordinate wall construction to ensure that actual building dimensions, locations of structural members, and openings correspond to established dimensions.

1.5 **SUBMITTALS**

.1 Product Data:

.1 Include material and system description, panel installation instructions, engineering performance and finish data.

.2 Manufacturer Erection Instructions: Provide manufacturer's written installation instructions including proper material storage, material handling, installation sequence, panel locations, and attachment methods, details and required trim and accessories

.2 Samples:

.1 Submit 610 x 610 mm size, duplicate samples of each coloured metal cladding profile for review by the DCC Representative, prior to fabrication.

.3 Engineered Shop drawings:

.1 Submit Engineered Shop drawings and associated design calculations bearing the stamp and signature of the registered professional engineer, licensed to practice in the Province of Ontario, responsible for the design of this Section.

.2 Engineered submittals shall include associated design calculations, complete with references to codes and standards used in such calculations, supporting the proposed design represented by the submittal. Prepare calculations in a clear and comprehensive manner so that they can be properly reviewed.

.3 Panel Analysis: Provide calculations to verify panels will withstand the design wind loads without detrimental effects or deflection exceeding L/240. Include effects of thermal differential between the exterior and interior panel facings and resistance to fastener pullout.

.4 Be responsible for determining sizes, yield strengths, gauge thicknesses and joint spacing to allow thermal movement and loading of components in accordance with applicable codes and regulations.

.5 Sub-girt system to be part of the Engineered stamped Shop drawing.

.6 Submit Engineered Shop drawings indicating the following:

.1 Arrangement of cladding system, including dimensions, location of joints, profiles of inner and outer skin, types and locations of supports, fasteners, flashing, closures and all metal components related to the cladding and soffit installation;

.2 Material identification, thicknesses and gauges;

.3 Cladding system details;

.4 Drainage paths and compartment closure locations;

.5 Flashing installation method;

.6 Locations and type of sealants;

.7 Locations and details of horizontal fire stopping;

.8 Size, spacing and location of structural supports;

.9 Indicate provisions for structural and thermal movement between metal cladding and adjacent materials.

.10 Sequence of erection and any special handling or bracing required.

.11 Indicate panel sizes and finishes in elevation, sections, materials and thicknesses arrangements of joints and bonding, metal framing and anchorage and flashing.

.7 Engineered Shop drawings shall be signed and sealed by a Professional Engineer, attesting to the ability of the metal panels' assembly to withstand required loads.

.8 Information on Architectural Drawings referring to specific design of attachment, panel stiffening, and structural systems is intended to show design concept only. Final engineering design, as well as system performance, based on project conditions and compliance with all applicable codes and loading requirements, shall be the responsibility of this trade.

1.6 **MAINTENANCE DATA**

.1 Provide maintenance data for cleaning and maintenance of panel finishes for incorporation into operation and maintenance manual.

1.7 **ADMINISTRATIVE REQUIREMENTS**

.1 Pre-installation Meeting:

.1 Establish a procedure to maintain optimum working conditions and to coordinate this work with related and adjacent work.

.2 Advise the DCC Representative of the date and time of the meeting.

.3 Make sure manufacturer's technical representative, installer, and other parties directly affected by the work of this Section attend the pre-installation meeting.

PART - 2 PRODUCTS

2.1 **MATERIALS**

.1 Sub-girts: Minimum 1.21 mm (0.048") thick formed galvanized steel, ASTM A653M, Grade 230 with Z275 zinc coating, structural steel quality, full depth of wall system, factory formed.

.2 Semi-Rigid Mineral Fibre Board Insulation: Fibrous glass or mineral wool rigid or semi-rigid board insulation, having a thermal resistance value of not less than RSI=0.704 per 25 mm thickness at a mean temperature of 24 deg C and a minimum nominal density of 64 kg/m^3. Ensure deformation of fibrous glass rigid board does not exceed 10% when tested at 1.2 kPa (25 psf) in accordance with CAN/ULC-S702, Type 1 and ASTM C165. Thickness as indicated.

.3 Metal Wall Panels (Pre-finished Metal Cladding): Hidden Fasteners cladding system, factory-formed, coil coated, galvanized by the hot dip process to requirements of ASTM A653/A653M, coating weight Z275, pre-finished sheet with factory applied two-coat Silicone Modified Polyester resin system.

.1 Steel Sheet nominal core thickness: 22 ga. minimum.

.2 Profiles and Colours: as identified in Section 01 61 10, List of Materials.

.4 Girts, Z members, clips and brackets: CSA G40.20-13/G40.21, Grade 300W of required core steel thickness to meet design requirements, hot dipped galvanized after fabrication to CSA G164.

.5 Air/Vapour Barrier: as specified in Section 07 27 00 Air Barrier.

.6 Fasteners: Non-corrosive concealed fasteners of stainless steel, or cadmium plated steel, size as recommended by the manufacturer. Where exposed fasteners are required, provide fasteners in colours matching cladding work.

.7 Backer rod: Non-absorbent, non-gassing, closed cell polyolefin foam, over sized 25%.

.8 Thermal break: Rigid neoprene or EPDM of suitable hardness to suit intended use.

2.2 **ACCESSORIES**

.1 Flashing: In accordance with Section 07 62 00. Material to match cladding in exposed locations, galvanized material in concealed locations. Custom fabricated to suit architectural details, as required. Use preformed corner pieces only. Double back exposed edges.

.2 Closures: Metal closures to suit profiles selected, to manufacturer's recommendations.

.3 Butyl Tape: As recommended by manufacturer.

.4 Sealants - Concealed: Tape or compound, non-skinning, non-drying, butyl rubber.

.5 Sealants - Exposed: high-performance, single-component, low or mid-modulus silicone sealant to accommodate larger thermal expansions, non-sag, non-staining, moisture-curing silicone joint sealant to ASTM C 920, Type S, Grade NS, Class 100/50, Use NT; SWRI validated.

.1 Primer: type as recommended in writing by sealant manufacturer.

2.3 **FABRICATION**

.1 Do not commence fabrication until all Engineered Shop drawings have been reviewed.

.2 Co-ordinate and verify at job site dimensions affecting work of this Section. Ensure suitability of adjacent building components in relation to work of this Section.

.3 Fabricate components to comply with dimensions, profiles, gauges and details as shown on the Engineered Shop drawings, including fascia and soffit panels and all companion flashing.

.4 Accurately fit joints and intersecting members to true planes, adequately and securely fastened and made completely water and weathertight. Component fastening devices shall be of adequate strength and concealed, except as specified otherwise.

.5 Fabricate work to profiles and sizes indicated complete with rabbets, interlocks, flashings, cappings, trim, filler sections as required to interface with work of other Sections. Make provisions for thermal and structural movements.

.6 Fabricate all devices required for erection and adequate anchorage and attachment required to be built into or attached to substrate and framing members for proper support.

.7 Accurately cut and form flashing true and straight without waves or buckles. Make adequate provision for thermal movement and make joints watertight.

.8 Reinforce work to meet project’s requirements and prevent undue deflection. Provide concealed corrosion resistant fastening and continuous formed prefinished cleats.

.9 Provide metal cladding and all accessories in longest practicable length to minimize field lapping of joints.

PART - 3 EXECUTION

3.1 INSTALLATION - GENERAL

.1 Install cold rolled structural girts and other members required to support work of this Section.

.2 Install work in accordance with manufacturer's written instructions, plumb with intersecting parts joined together to provide tight, accurately fitted joints with adjoining surfaces in true planes, as per layout indicated on the Engineered Shop drawings. Attach components in manner not restricting thermal movement.

.3 Ensure continuity of thermal and air/vapour barriers systems is maintained.

3.2 INSTALLATION - METAL WALL SYSTEM

.1 Lay a ribbon of sealant on the face of the support at top and bottom of wall panels and around perimeter of openings.

.2 Fasten Z members and girts to structural supports to suit loading requirements.

.3 Install insulation. Ensure insulation is properly fixed to prevent sagging. Butt each board against adjacent boards, with joints staggered. Fit neatly with tight joints around obstructions, openings and corners. Fill voids behind flashings and trim with neatly cut blocks of insulation.

.4 Fasten cladding to Z members and girts with concealed fasteners where possible and at spacings to suit loading requirements. Ensure complete nesting of exterior siding sheets on Z members and girts and sealed side lap joints.

.5 Align units end-to-end to provide accurate fit with corresponding sections parallel and straight. Keep exposed fasteners to a minimum. Maintain minimum end overlap of 50 mm and locate directly over supports.

3.3 INSTALLATION - FLASHING, CLOSURE, TRIM AND ACCESSORIES

.1 Cut and flash openings for louvres, doors, windows and the like. Provide all necessary closures to stop direct weather penetration. Refer to Section 07 62 00.

3.4 SEALING

.1 Seal junctions with adjoining work with sealant. Apply and cure sealant in accordance with manufacturer's instructions.

.2 Use backer rod to maintain correct sealant width/depth ratio as recommended by the sealant manufacturer.

.3 Apply sealant in continuous beads, using gun with proper size nozzle and sufficient pressure to fill voids and joints solid.

.4 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.

.5 Tool exposed surfaces to give slightly concave shape.

3.5 **FINAL CLEANING AND REPAIRING**

.1 As work progresses, remove excess sealant with recommended solvent and which will not affect metal surfaces.

.2 Wipe down exposed exterior surfaces with soft clean wiping cloths as work proceeds leaving face clean and free of contaminants, finger marks and stains.

.3 Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by manufacturer. Maintain in a clean condition during construction.

.4 Panel surface shall be free of deleterious material including dirt and shall be free of any scratches, dents, discoloration or other damage resulting from the installation process.

.5 Remove damaged, dented, defaced, defectively-finished or tool-marked components and replace with new.

.6 Remove waste materials, rubbish, tools, equipment, machinery, and surplus materials.

.7 Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.

3.6 **PROTECTION**

.1 Protect installed metal wall panel system as per manufacturer’s recommendation to ensure that panels remain without damage at time of Substantial Completion.

END OF SECTION

PART 1 GENERAL

1.1 SYSTEM DESCRIPTION

.1 Work of this section includes installing 2-ply Modified Bitumen membrane, including but not limited to the following:

- .1 Self-adhesive vapour retarder.
- .2 Insulation boards in adhesive.
- .3 Insulation overlay boards in adhesive.
- .4 Torched Base Sheet.
- .5 Self-adhesive Base Sheet Flashing.
- .6 Torched Cap and Cap Sheet Flashing.

1.2 REFERENCE STANDARDS

.1 ASTM International Inc.

- .1 ASTM C1289, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation board.
- .2 ASTM D41/D41M, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
- .3 ASTM D4586/D4586M, Standard Specification for Asphalt Roof Cement, Asbestos-Free.
- .4 ASTM E96/E96M, Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials.

.2 Canadian General Standards Board (CGSB)

- .1 CAN/CGSB 37.56, Membrane, Modified, Bituminous, Prefabricated, and Reinforced for Roofing.

.3 Canadian Roofing Contractors Association (CRCA)

- .1 CRCA Roofing Specifications Manual.

.4 CSA Group (CSA)

- .1 CAN/CSA-A123.23, Product Specification for polymer-modified bitumen sheet, prefabricated and Reinforced.

.5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

- .1 Safety Data Sheets (SDS).

.6 Underwriters Laboratories' of Canada (ULC)

- .1 CAN/ULC-S107, Standard Methods of Fire Tests of Roof Coverings.
- .2 CAN/ULC-S704, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
- .3 CAN/ULC-S770, Standard Test Methods for Determination of Long-Term Thermal Resistance of Closed-Cell Thermal Insulation Foams.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Convene pre-installation meeting one week prior to beginning roofing work, with roofing contractor's representative, roofing manufacturer and DCC Representative to.

.1 Verify project requirements.

.2 Review installation and substrate conditions.

.3 Co-ordination with other subcontractors.

.4 Review flashings, special interface details and scheduling with adjacent material assemblies, penetrations, and conditions of other construction that will affect roofing system.

.5 Review manufacturer's installation instructions and warranty requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Provide technical roofing components data sheets describing materials' physical properties and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit manufacturer’s product data for roof hatch and ladder.

.3 Provide two copies of WHMIS SDS and indicate VOC content for primers and sealers.

.3 Provide shop drawings:

.1 Showing method of installation and layout of each layer, fastening and flashings at edges, flashing of protrusions and penetrations, connection to air/vapour barrier in wall, details of insulation, and securement details of sheathing.

.2 Provide layout for tapered insulation.

.3 Indicate flashing, control joints, tapered insulation details.

.4 Indicated waterproofing details of roofing penetrations.

.5 Indicate location of roof hatch and ladder, sizes, connections, size, and type of fasteners and accessories.

.4 Manufacturer's Certificate: certify that products meet or exceed specified requirements.

.5 Manufacturer's Installation Instructions: indicate special precautions required for seaming the membrane.

.6 Manufacturer's field report:

.1 Indicate procedures that have been followed, ambient temperatures and wind velocity during application.

1.5 QUALITY ASSURANCE

.1 Perform Work in accordance with CRCA Roofing Specifications' Manual and manufacturer's instructions.

.2 Use materials that are compatible with the roofing membrane and acceptable to the membrane manufacturer. Provide all materials by one manufacturer when possible.

.3 Verification of performance:

.1 Arrange for manufacturer's technical representative to inspect the Work at intervals during application, and on completion, and submit written verification of compliance with specifications and drawings.

1.6 REGULATORY REQUIREMENTS

.1 Conform to applicable code for roof assembly fire hazard requirements.

.2 Conform to ULC requirements, applicable to the work, for roofing materials intended for protection of roof decks from external fire exposure in accordance with CAN/ULC-S107, for ULC Class A.

1.7 FIRE PROTECTION

.1 Prior to the start of work, conduct site inspection to establish safe working practices and make sure that procedures are approved by manufacturer to minimize the risk of fires.

.2 Comply with Section 01 35 35 DND Fire Safety Requirements.

.3 Respect safety measures prescribed by the manufacturer and roofing association recommendations. Follow safety measures described in technical data sheets.

.4 Organize job planning to ensure workers are still on location at least 2 hours after torch application.

.5 At the end of each workday, use a heat detector gun to spot smouldering or concealed fire.

.6 Maintain fire watch for 2 hours after each day's roofing operations cease.

.7 Do not place torches near combustible or flammable products. Do not use torches where the flame is not visible or cannot be easily controlled. Do not apply the torch directly to wood surfaces.

.8 Throughout roofing installation, maintain a clean site and have one ULC labelled ABC fire extinguisher per torch applicator, within 6 meters of each roofing torch.

1.8 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions and Section 01 61 00 - Common Product Requirements.

.2 Deliver products in manufacturer's original containers, dry, undamaged, seals and labels intact.

.3 Storage and Handling Requirements:

.1 Safety: comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of sealing compounds, primers and caulking materials.

.2 Provide and maintain dry, off-ground weatherproof storage.

.3 Protect all components used in roofing systems from exposure to moisture before, during and after installation.

.4 Protective, plastic factory packaging that is used to wrap roof boards for shipment is intended to provide temporary protection from moisture exposure during transit only and is not intended to provide protection during storage after delivery.

.5 Roof boards stored outside shall be stored level and off the ground and protected by a waterproof covering. Provide means for air circulation around and under stored bundles of roof boards. Use adequate supports to keep the bundles flat, level and dry.

.6 Do not expose insulation and sheathing to wet weather. Store and handle to prevent broken edges and corners, punctures, indentations or other damage. Remove damaged insulation from Site.

.7 Store rolls of felt and membrane in upright position. Store membrane rolls with salvage edge up.

.8 Store sealants at +5 degrees C minimum.

.9 Store insulation protected from daylight, weather and deleterious materials.

1.9 SITE CONDITIONS

.1 Ambient Conditions

.1 Do not install roofing when temperature remains below -18 degrees C for torch application, for 24 hours before, during, and 24 hours after installation.

.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 Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

1.10 CO-ORDINATION

.1 Coordinate Work with installing associated metal flashings as Work of this section proceeds.

1.11 EXTENDED WARRANTY

.1 For the work of this Section 07 55 52, the 12-month warranty period is extended as specified below.

.2 Submit in duplicate copies, two (2) warranty provisions which shall run concurrently commencing from Date of Substantial Performance:

.1 Standard Workmanship Warranty (by Roofing Subcontractor):

.1 Warrant the roofing and flashing membranes against workmanship defects for a period of two (2) years from date of Substantial Performance and agree to promptly make good any defects which occur or become apparent within the warranty period, such defects to include but not to be restricted to leakage, latent defects, failure to stay in place, lifting and deformations. Use Canadian Roofing Contractors' Association (CRCA) "Standard Form of Warranty".

.2 Repair defects within 24 hours of notification. Temporary repairs done during inclement weather shall be replaced with permanent work as soon as weather permits.

.2 Total Systems Warranty (by Roofing Material Manufacturer):

.1 Submit membrane manufacturer's total system warranty covering

watertightness of the roofing assemblies (material defects and workmanship deficiencies) for a period of twenty (20) years.

.2 Warrant the roofing and flashing membranes from defects caused by workmanship and material deficiencies and agree to promptly make good any defects which occur or become apparent within the warranty period, such defects include but not to be restricted to leakage, failure to stay in place, lifting and deformations, and any other failure.

.3 Warranties shall cover labour and Products and include replacement, to the extent required, of the Work of this Section.

.4 Provide for removal of Products which fail to meet specified criteria, replacement with new Products and restoration of adjacent Work damaged by removal and replacement, including all Products, labour and installation costs.

.5 Promptly correct any defects or deficiencies which become apparent within warranty period. Defects include but are not limited to actual leakage and latent defects.

.6 Repair defects within 24 hours of notification. Temporary repairs done during inclement weather shall be replaced with permanent work as soon as weather permits.

.3 Carry out repair work required under the warranty in accordance with the manufacturer's recommendations.

.4 Inspect the roof 30 days before expiry of warranty and correct defects within 15 days of inspection. Perform this inspection at no additional cost to the DCC Representative.

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 Provide roofing assembly and make component and material connections in consideration of the loads shown on the structural drawings.

.3 Provide roofing assembly to withstand the required loads and wind uplift resistance based on the building location, roof heights, Importance Category, and NBC requirements.

.4 Roofing system and base flashings to withstand uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing system and base flashings shall remain watertight.

2.2 MATERIALS

.1 Patching Material: Latex premixed compound requiring only water to produce cementitious paste suitable for exterior use.

.2 Primer: stabilised primer to promote adhesion of membranes, to ASTM D41.

.3 Vapour Retarder: 0.8 mm thick, self-adhesive vapour barrier membrane to ASTM E96, composed of SBS modified bitumen and a tri-laminated woven polyethylene facer. The underface is covered with a silicone release film.

.1 Water vapour permeance to ASTM E96 (Procedure B): less than 2.5 ng/Pa.s.m² (< 0.04 perm).

.4 Carpentry: Refer to Section 06 10 00 - Rough Carpentry.

.5 Waterproofing Mastics: Mastic made of synthetic rubbers, plasticized with bitumen and solvents, meeting requirements of ASTM D4586.

.6 Liquid Flashing Membrane / Waterproofing of Penetrations:

.1 Two-component (PMMA) methyl methacrylate-based liquid membrane, self-terminating, UV stable, complete with non-woven, needle-punched polyester fabric used as fabric reinforcement, to form a monolithic, self-flashing and self-adhering reinforced field membrane; primer type as recommended by the manufacturer based on the substrate, designed to improve adhesion of the liquid membrane.

.1 Water vapour transmission to ASTM E96: 0.3 perm.

.2 Drying time: 1 hour.

.3 Full curing time: 3 – 6 hours.

.4 Colour: to match the membrane.

.5 Use summer or winter formulation depending on the time of installation.

.7 Adhesive

.1 Low-rise two-part polyurethane adhesive with no solvents. Allows a complete cure in few minutes, with no temperature restrictions.

.8 Insulation: CAN/ULC S704, ASTM C1289. Closed cell, polyisocyanurate foam insulation board laminated with polymer-coated, inorganic fibreglass facers.

.1 Tapered Insulation (Sloped): same type.

.9 Insulation Overlay Board (protection board): Multi-ply, semi-rigid asphaltic roofing substrate board composed of a mineral fortified asphaltic core formed between two asphaltic saturated fibreglass liners. Length 1200 mm x width 1500 x thickness 6.4 mm

.10 Flame stop membrane: localized fire-protection layer used while installing heat-welded (torch-applied) SBS modified bitumen roofing membranes.

.1 Self-adhesive flame screen membrane composed of a glass mat reinforcement and SBS modified bitumen, minimum thickness 1.6 mm.

.2 Flame-stop protection required only in specific zones, such as:

.1 Parapets and vertical transitions.

.2 Roof edges and perimeters.

.3 Curbs, penetrations, and upstands.

.4 Areas adjacent to wall assemblies with combustible components.

.11 Sealants: Caulking - see Section 07 92 00 - Joint Sealants.

.12 Prefabricated Control or Expansion Joint Flashing: sheet butyl reinforced with closed cell urethane foam backing, seamed into metal flashing flanges, including sheet butyl counter flashing each side.

.13 Cant Strips: purpose made, as shown on drawings.

2.3 MEMBRANE

.1 Base sheet, torch applied: High performance

.1 Styrene-Butadiene-Styrene (SBS) modified bitumen prefabricated sheet, with polyester and fibreglass composite reinforcement, having nominal weight of 160 g/m^2, thickness 2.5 mm

.2 Type 2 for covered applications, fully adhered.

.3 Class C - plain surfaced.

.4 Grade 2, heavy duty service.

.5 Top and bottom surfaces:

.1 Both faces covered with thermofusible poly film.

.2 Top face marked with three (3) distinctive blue chalk lines to ensure proper roll alignment

.6 Base sheet membrane properties: to CAN/CGSB 37.56-M, and to CAN/CSA-A123.23, having the following characteristics (nominal value):

.1 Strain energy (longitudinal/transversal): 7.8 /7.2 kN/m.

.2 Breaking strength (longitudinal/transversal): 15/13.5 kN/m.

.3 Ultimate elongation (longitudinal/transversal): 60/65%.

.4 Tear resistance: 125 N.

.5 Static puncture resistance: 560.

.6 Dimensional Stability: 0.2 / 0 %.

.7 Cold bending at -30 degrees C: no cracking.

.2 Base Sheet Flashing: High performance

.1 CGSB 37-GP-56M, Type 2, Class C, Grade 2 (CSA A123.23, Type C, Grade 3).

.2 Roofing membrane with glass and polyester reinforcement and SBS modified bitumen, thickness 3.0 mm. Top face covered with thermofusible poly film, under side self-adhesive. Top face marked with three (3) distinctive blue chalk lines to ensure proper roll alignment.

.3 Cap sheet and Cap Sheet Flashing membrane, torch applied: High performance.

.1 Styrene-Butadiene-Styrene (SBS) modified bitumen prefabricated sheet, with polyester and fibreglass reinforcement, having nominal weight of 160 g/m^2, fully adhered, thickness 4 mm.

.1 Class A - granule surfaced. Colour for granular surface: light grey.

.2 Heavy duty service.

.3 Bottom surface: thermofusible poly film.

.4 Cap sheet membrane properties: to CAN/CGSB 37.56-M and to CAN/CSA-A123.23

.1 Strain energy (longitudinal/transversal): 7.8 / 7.2 kN/m.

.2 Breaking strength (longitudinal/transversal): 15 / 13.5 kN/m.

.3 Ultimate elongation (longitudinal/transversal): 60 / 65%.

.4 Tear resistance: 125 N.

.5 Static puncture resistance: 560 N.

.6 Dimensional Stability max MD/XD: + or -0.6 / + or - 0.1 %.

.7 Cold bending at -30 degrees C: No cracking.

2.4 ROOF ACCESS HATCH AND LADDER

.1 Roof access hatch (HTCH-1): single leaf, pre-assembled from the manufacturer, and as described below. Additional information and requirements, including finish: as per Section 01 61 10, List of Materials.

.2 Performance characteristics:

.1 Cover shall be reinforced to support a minimum live load of 40 psf (195kg/m2) with a maximum deflection of 1/150th of the span or 20 psf (97 kg/m2) wind uplift.

.2 Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.

.3 Operation of the cover shall not be affected by temperature.

.4 Entire hatch shall be weather tight with fully welded corner joints on cover and curb.

.3 Cover and frame material: 14 gauge (2 mm) galvannealed steel.

.4 Cover: Brakeformed, hollow-metal design with 1" (25 mm) fully concealed fiberglass insulation, 3" (76 mm) beaded, overlapping flange, fully welded at corners, and internally reinforced.

.5 Curb: 12" (305 mm) high with integral capflashing, 1" (25 mm) fiberboard insulation, fully welded at corners, and 3-1/2" (89 mm) mounting flange with 7/16" holes (11 mm) provided for securing frame to the roof deck.

.6 Gasket: Extruded EPDM rubber gasket permanently adhered to cover.

.7 Lift Assistance: Compression spring operators enclosed in telescopic tubes. Automatic hold-open arm with grip handle release.

.8 Hardware: zinc plated and chromate sealed, unless noted otherwise

.1 Hinges: Heavy-duty pintle hinges with 3/8" (9 mm) Type 316 stainless steel hinge pins.

.2 Cover shall be equipped with a spring latch with interior and exterior turn handles.

.3 Roof hatch shall be equipped with interior and exterior padlock hasps.

.4 The latch strike shall be a stamped component bolted to the curb assembly.

.5 Cover shall automatically lock in the open position with a rigid hold open arm equipped with a 1" (25mm) diameter red vinyl grip handle to permit easy release for closing.

.6 Cover hardware shall be bolted into heavy gauge channel reinforcing welded to the underside of the cover and concealed within the insulation space.

.9 Ladder (LDR-1): Manufactured from high grade structural aluminum, complete with required brackets and anchors, for installation to existing structure.

.1 Overall ladder width: 605mm.

.2 Distance between vertical side rails: 525mm.

.3 Rung diameter: 50 x 35mm (profiled).

.4 Rung spacing: 300mm

.5 Retractable vertical side rail extension above landing surface: 900 to 1100mm

.6 Minimum clearance behind ladder: 200mm

.7 Maximum distance between rest platforms: 6.0M

.8 Finish: powder coating, in colour selected by DCC Representative.

.9 Assembly: Upright tops shall be plugged with weather and light resistant material.

.10 Design Requirements:

.1 Industrial rated, suited to high frequency usage, designed to National Building Code of Canada (NBC) load requirements.

.2 Detail and fabricate metal ladder in accordance with ANSI-ASC A14.3.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Perform examination, preparation and roofing Work in accordance with Roofing Manufacturer's Specification Manual and CRCA Roofing Specification Manual, particularly for fire safety precautions.

.2 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 Verify roof openings, curbs, pipes, conduit, sleeves, ducts, and vents through roof are solidly set, and cant strips are in place.

.3 Prior to 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 Exterior grade plywood and treated lumber nailer plates have been installed to deck, walls and parapets as indicated.

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

3.2 PROTECTION OF IN-PLACE CONDITIONS

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

.2 Use warning signs and barriers. Maintain in good order 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.

3.3 CANT STRIPS

.1 Install cant strips at intersections of roofing and vertical surfaces.

.2 Embed firmly in a continuous bed of approved adhesive.

.3 Angle cut cants to fit tightly on back and bottom where roof to wall angle varies from 90 degrees.

.4 Lay true to line, level and with flush, butt joints and accurately mitred corners.

3.4 INSTALLATION

.1 General:

.1 Perform priming in accordance with manufacturers written recommendations.

.2 Install the interface of the walls and roof assemblies with durable rigid material providing connection point for continuity of air barrier.

.3 Use liquid flashing vertically to the height of the insulation on all structural supports, such as fall arrest anchors and equipment supports, as well as pipe penetrations.

.2 Vapour retarder installation:

.1 Beginning at the bottom of the slope, without adhering the membrane, unroll onto the substrate for alignment. Do not immediately remove the silicone release sheet.

.2 Peel back one end of the silicone release sheet and adhere this part of the membrane to the substrate. Peel back the remaining release sheet at a 45 degree angle to avoid wrinkles in the membrane.

.3 If the membrane is not properly aligned, do not try to adjust it. Instead, cut the roll and start again, making sure that it is properly aligned and that it overlaps the end of the misaligned piece by 150 mm.

.4 Overlap adjacent membranes by 75 mm. Overlap end laps by 150 mm. Stagger end laps by at least 300 mm.

.3 Insulation application:

.1 Install insulation with adhesive in conformance with manufacturer's written recommendations.

.2 Install insulation boards to maintain continuity of thermal envelope. Minimize joints. Fit insulation tight to roof penetrations, butt insulation boards firmly. Do not jam or deform boards. Stagger joints minimum 300 mm.

.3 Install only as much insulation as can be covered in the same day.

.4 Install insulation in two layers and stagger seams between layers.

.5 Around the drains lower insulation by 1” to create a sump 4’ X 4’ in area. Bevel the edge of the 3” insulation on a 45° angle.

.6 Where insulation is in contact with cants, cut bevel edges on insulation to fit snug to cant slope.

.7 Install tapered insulation in adhesive where indicated on drawings, in accordance with reviewed shop drawings.

.8 Provide preformed saddles, crickets, square tapered sumps, tapered edge strips, and other tapered shapes for sloping to drains as required.

.9 Provide minimum 2 percent slope to drains. Increase slope at crickets to prevent trapping of water behind parapets or curbs

.4 Insulation overlay Board:

.1 Install insulation overlay with adhesive in conformance with manufacturer's written recommendations. Follow required uplift pattern.

.2 Firmly set the insulation boards, long joints continuous and short joints staggered. Ensure all boards are evenly and tightly butted together.

.3 Stager vertical joints between boards and insulation.

.4 Install only as many boards as can be covered with base sheet in the same day.

.5 At parapets and curbs mechanically fasten overlay board to substrate before installation of self-adhesive base flashings

.5 Base sheet application – torch applied:

.1 Starting at low point of roof, perpendicular to slope, unroll base sheet, align and reroll from both ends.

.2 Unroll and torch base sheet entirely onto prepared substrate, taking care not to burn membrane or its reinforcement.

.3 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps.

.4 Stagger end joints by a minimum of 300 mm.

.5 Torch sufficiently and continuously to avoid wrinkles, air pockets or fishmouths. In cold weather, adjust welding time to obtain homogenous seam (it may be necessary to slow down in certain cases or in colder weather.

.6 Base-Sheet Flashing

.1 Apply primer to the substrate at a rate of .25 L/m2. Allow primer to dry before installation of Base Sheet

.2 Install reinforcing gussets at all inside and outside corners.

.3 Install base sheet flashing in one- (1) metre widths to cover roofing substrate over 100 mm. Overlap side laps by 75 mm. Stagger side laps by at least 100 mm from base sheet overlaps on roof to avoid excessive layering.

.4 Install base sheet flashing directly onto substrate by removing siliconed paper cover sheet. Proceed from top to bottom. Once in place, apply pressure manually in a uniform fashion to obtain homogenous adherence over entire surface. Preferably seal seams with rubber roller. Nail outside edge at 300 mm o/c.

.5 Avoid forming wrinkles, air pockets or fishmouths.

.6 Always seal overlaps at the end of the workday

.7 Cap sheet application – torch applied:

.1 Starting at low point on roof, perpendicular to slope, unroll cap sheet, align and reroll from both ends.

.2 Unroll cap sheet at drain. Carefully align first side lap (parallel to roof edge). 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.

.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 Avoid formation of blisters, fishmouths and wrinkles.

.6 Leave no zone unwelded. In cold weather, adjust welding time to obtain homogenous seam (it may be necessary to slow down).

.7 Once cap sheet is installed, carefully check all overlapped joints.

.8 Perform membrane application in accordance with manufacturer's recommendations.

.8 Cap Sheet Flashings:

.1 Install cap sheet in one (1) -metre width. Overlap sied laps by 75 mm. Stagger base and cap sheet overlaps on roof by at least 100 mm to avoid excessive layering. Roof overlaps will be 200 mm wide.

.2 Draw parallel chalk line 150 mm from upstand or parapet bases.

.3 Sink surface granules into bed of hot bitumen with torch and round-nosed trowel from chalk line on roof to upstand or parapet base as well as over granulated vertical parts to be overlapped.

.4 Torch weld cap sheet directly onto base sheet from top to bottom to soften both membranes and obtain homogenous seal.

.5 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.

.6 During installation, avoid overheating membrane and excessive bitumen bleed-out at joints

.7 Do Work in accordance with manufacturer's recommendations, and Section 07 62 00 - Sheet Metal Flashing and Trim.

.9 Waterproofing of penetrations:

.1 Ensure substrate is clear of loose granules and all foreign substances that can impair adhesion.

.2 Apply a base coat of liquid waterproofing.

.3 Trim reinforcing material to conform to shape of penetrations and embed in base coat.

.4 Apply a second coat fully saturating the reinforcement.

.5 To add colour or match existing granules, apply a thin coat of liquid waterproofing and embed granules before it dries.

.10 Roof penetration: Install roof drain pans, vent stack covers, structural projections and other roof penetrations as shown on drawings, and seal to membrane using liquid flashing membrane, in accordance with manufacturer’s instructions. Coordinate scope with structural, mechanical and electrical drawings for locations and type of penetrations.

.11 Roof Hatch and ladder:

.1 Locate units level, plumb, and in proper alignment with adjacent work, in locations as indicated. Isolate where necessary to prevent electrolysis due to metal to metal contact or metal to masonry or concrete. Use bituminous paint, butyl tape, building paper or other approved means.

.2 Secure ladder to wall as shown on reviewed shop drawings.

.3 Install roof access hatches in position indicated, in accordance with manufacturer's directions for secure, watertight installation.

.4 Flash and detail installation to maintain integrity of the building envelope.

.5 Test units for proper function and adjust until proper operation is achieved.

.6 Repair finishes damaged during installation.

.7 Restore finishes so no evidence remains of corrective work.

3.5 FIELD QUALITY CONTROL

.1 Require site attendance of roofing materials manufacturer's representative during installation of Work.

.2 Arrange for manufacturer's technical representative to inspect the Work at intervals during application, and on completion of work of this Section,

.3 Provide written reports prepared by manufacturer's on-site personnel to include:

.1 Detailed review of installation of work.

.2 Indicate procedures that have been followed, ambient temperatures and wind velocity during application.

.3 Submit written verification that the completed work is installed correctly.

3.6 PROTECTION

.1 Adequately protect Products and work from damage by weather, traffic and other causes.

.2 At the end of each Working Day, seal exposed edges of roofing membrane to be watertight.

.3 Protect adjacent Work from damage. Repair damage.

.4 Install signage ‘Smoking Prohibited – No Exceptions’ at all access points onto the roof.

3.7 CLEANING

.1 Remove bituminous markings from finished surfaces.

.2 In areas where finished surfaces are soiled caused by work of this section, consult manufacturer of surfaces for cleaning advice and complying with their documented instructions.

.3 Repair or replace defaced or disfigured finishes caused by work of this section.

.4 Clean drains, gutters and downspouts of debris, ensuring free drainage.

.5 Upon completion remove surplus materials, rubbish, tools and equipment.

.6 Clean adjacent roof surfaces, levels and ground level areas of debris and excess Products.

END OF SECTION

PART - 1 GENERAL

1.1 QUALITY ASSURANCE

.1 Pre-installation meeting: Prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review procedures to be adopted, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise DCC Representative of the date and time of the meeting.

1.2 SUBMITTALS

.1 Submit detailed shop drawings showing proposed method of shaping, forming, jointing, fastening, and application of sheet metal work. Submit lists of materials to be used.

.2 Samples: Submit representative sample section of prefinished metal flashing illustrating "S" lock jointing, minimum 600 mm long. Submit sample well in advance of material fabrication.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Protect the work of this Section from damage. Replace damaged work which cannot be satisfactorily repaired, restored or cleaned, at no cost to the Contract.

1.4 WARRANTY

.1 Submit CRCA written warranty for the Work of this Section stating that the metal flashing Work is warranted against leakage or latent defects for 2 years from the date of Substantial Completion.

.2 Warranty shall provide for removal of Products which fail to meet specified criteria, replacement with new Products conforming to specifications, and restoration of Work damaged by removal and replacement including labour and installation costs.

PART - 2 PRODUCTS

2.1 MATERIALS

.1 Prepainted Sheet Steel: 22 ga. core nominal thickness, commercial quality to ASTM A653/A653M, with Z275 zinc coating designation, pre-finished sheet with factory applied 2-coat Silicone Modified Polyester resin system, Weather XL, in custom colour identified in Section 01 61 10.

.2 Sheet Steel: 22 ga. core nominal thickness, commercial quality to ASTM A653/A653M, with Z275 zinc coating designation.

.3 Starter Strips: Furnish a continuous run of starter strips of Z275 galvanized sheet metal, 0.912 mm (20 ga.) core nominal thickness, of height shown on Drawings, with metal flashing interlocked to the starter strip.

.4 Banding strip: Hot dipped galvanized sheet steel, 3 mm core nominal thickness, Z275 coating designation to ASTM A525M, 25 mm wide.

.5 Isolation coating: Alkali resistant bituminous paint.

.6 Sealant: single-component, medium modulus, non-sag polyurethane sealant, or equivalent conforming to ASTM C920, Type S, Grade NS, Class 50, use NT, T, M, A, O, I.

.7 Fasteners: Conforming to CSA B111 of same material as sheet metal secured, of type, length and size suitable for the particular conditions. Where exposed fasteners are permitted, use colour matched nylon heads with cupped neoprene washers.

.8 Touch-up paint: as recommended by the prefinished sheet metal manufacturer.

.9 Membrane underlayment: 1.0mm thick, SBS modified bitumen self-adhesive membrane, Perm-A-Barrier High Temperature by GCP, Blueskin PE 200 HT (high temperature) by Henry, Lastobond Shield HT by Soprema, or approved equivalents, complete with compatible primer and sealant.

.1 Membrane underlayment primer: as supplied or recommended by the membrane underlayment manufacturer.

.2 Membrane underlayment sealant: as supplied or recommended by the membrane underlayment manufacturer.

2.2 SHEET METAL FABRICATION

.1 Fabricate cap flashings, counter flashings, gutters, closures, starter strips, and other miscellaneous sheet metal work with prefinished sheet metal in general accordance with applicable CRCA FL series specifications and as indicated.

.2 Use competent mechanics and work accurately to details indicated.

.3 Fabricate cap flashings, starter strips, and base counter flashings less than 300 mm in height in 2400 mm maximum lengths. Form counter flashings between 300 mm and 600 mm in height in 1200 mm maximum lengths.

.4 Provide a counter flashing and an intermediate vertical flashing where the cap flashing is greater than 600 mm above the top of the roofing membrane. Form vertical flashings in 1200 mm maximum lengths.

.5 Provide an S-Lock joint at all end joints and at all horizontal joints between the cap flashing and the vertical flashing and between the vertical flashing and base counter flashing.

.6 Mitre and form standing seams at all corners. Make allowance for movement at joints.

.7 Hem all exposed edges at least 13 mm for appearance and stiffness.

.8 Form sections square, true, and accurate to size, free from distortion, oil canning and other defects detrimental to appearance or performance.

.9 Apply isolation coating to metal surfaces to be embedded in concrete or mortar joints.

2.3 SCUPPER FABRICATION

.1 Fabricate scuppers from galvanized sheet metal. Thickness to be a minimum thickness of 24 ga core nominal thickness.

.2 Fabricate scuppers to suit diameter down spout and in general accordance with CRCA detail. Solder all joints in the scupper. Ensure flange is continuous by filling in outside corners.

.3 Fabricate deck flange to provide a 150 mm wide apron. Ensure flange is continuous by filling in outside corners. Apply isolation coating on deck flange. Provide a gravel stop soldered in place across scupper opening.

.4 Provide galvanized metal basket strainers for outlet.

.5 Fabricate a prefinished sheet metal cover for all exposed areas of the scupper in accordance with “Sheet Metal Fabrication” Article above.

PART - 3 EXECUTION

3.1 INSTALLATION

.1 Install cap flashings, counter flashings, starter strips, and other miscellaneous sheet metal work in general accordance with applicable CRCA FL series and as detailed.

.2 Ensure parapet cap flashings are installed with a minimum positive slope of 5% toward the roof area.

.3 Do not use exposed fasteners unless approved before installation or where shown on Drawings.

.4 Provide membrane underlayment beneath sheet metal flashings at all locations, except where membrane flashings are present.

.5 Provide continuous starter strips where indicated or required to present a true, non-waving, leading edge. Fasten starter strips to substrate at a minimum of 300 mm on centre.

.6 Provide continuous banding strips along top of membrane flashings where indicated on Drawings and at locations and where membrane flashings terminate at the base of a wall and no other means of mechanical securement is specified or indicated. Fasten banding strips to substrate at a minimum of 150 mm on centre.

.7 End joints where adjacent lengths of metal flashing meet shall be made using an “S-lock” joint. Execute by inserting the end of 1 coping length in a 25 mm deep “S” lock formed in the end of adjacent length. Extend concealed portion of the “S” lock 25 mm outwards and nail to substrate prior to installation of subsequent sheets. Face nailing of joints will not be permitted.

.8 Insert top edge of sheet metal flashing under cap flashings to form weather tight junctions. Turn top edge of flashings into recessed reglets or mortar joints a minimum of 25 mm. Fasten sheet metal flashing into reglet joint at a minimum spacing of 460 mm.

.9 Ensure fasteners are located a minimum of 300 mm above the surface of the roofing membrane, unless other wise indicated on Drawings.

.10 Tie-in sheet metal flashings to sheet metal flashings associated with metal roofing and ensure weathertight connections.

.11 Exposed fastenings will not be permitted on horizontal work exposed to view from the building exterior.

.12 Install starter strips where indicated or required to present a true, non-waving, leading edge. Anchor to back-up to provide rigid, secure installation.

.13 Prepare and touch up scratches on prepainted material with air drying formulation of the coil coating paint. Replace material at no additional cost to Contract, if touching up is unacceptable to the DCC Representative.

.14 Install scuppers at locations indicated on drawings.

3.2 **MEMBRANE UNDERLAYMENT**

.1 Install membrane underlayment under sheet metal flashings as per manufacturer's printed instructions.

.2 Ensure all surface areas are free from frost, dust, grease, oil, loose or spalled material.

.3 Apply primer as per manufacturer's printed instructions. Allow the primer to dry and install air barrier membrane on the same day as priming.

.4 Proceed only when weather is favourable. Should installation be undertaken at temperature below 4°C, consult manufacturer regarding special procedures.

.5 Maintain the recommended minimum sidelap and endlap in accordance with the manufacturer's printed instructions.

.6 Roll the membrane underlayment immediately after placement to ensure continuous adhesion. The roller to be of the type and size recommended by the manufacturer.

.7 Ensure the continuity of the membrane underlayment is maintained at all penetrations and terminations. Apply membrane sealant as required to fill inaccessible gaps following the manufacturer's instructions.

.8 Do not cover the membrane underlayment until it is reviewed and approved by the DCC Representative.

3.3 **SEALANT**

.1 Apply sealant where required to form weathertight seal between flashing and adjoining surface and between flashing and other work of this Section. Sealant work consists of bedding between members where possible and with neatly formed sealant bead where exposed.

END OF SECTION

PART - 1 GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials (ASTM):

.1 ASTM E605, Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material (SFRM) Applied to Structural Members.

.2 ASTM E736, Standard Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members.

.2 Association of the Wall and Ceiling Industry (AWCI):

.1 AWCI 12-A: Technical Manual 12-A, Standard Practice for the Testing and Inspection of Field Applied Sprayed Fire-Resistive Materials; an Annotated Guide

.3 National Fireproofing Contractors Association (NFCA)

.1 NFCA 100, Standard Practice for the Application of Spray-Applied Fire Resistive Materials (SFRMs).

.2 NFCA 200, Quality Assurance Procedures for Application of Spray-Applied Fire Resistive Materials.

.4 Underwriters Laboratories Inc. (ULI):

.1 UL 263, Standard for Fire Tests of Building Construction and Materials

.2 UL Online Certifications Directory: Fire Resistance Rating - ANSI/UL 263

.3 UL Online Certifications Directory: Fire Resistance Ratings – CAN/ULC-S101 Certified for Canada

.5 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC-S101, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

.2 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.3 ULC Online Certification Directory Guide No. 40 U18, Fire Resistance Ratings.

1.2 DEFINITIONS

.1 Applied fireproofing: spray-applied fire resistive material assemblies (SFRMs), including auxiliary materials, applied according to requirements of fire-resistance designs that comply with the fire ratings of building elements as required by code.

.1 Wet-mix SFRMs: consist of a factory-mixed, dry formulation of gypsum or Portland cement binders and lightweight mineral or synthetic aggregates mixed with water to form a slurry for conveyance and application.

.2 Dry-mix SFRMs: consist of a factory mixed, dry formulation of Portland cement, inorganic binders combined with mineral wool. It is conveyed in a dry state by pneumatic equipment and mixed with water at the nozzle, forming a slurry which is then applied to the substrate.

1.3 **ACTION SUBMITTALS**

.1 Product Data: Prior to ordering materials, submit manufacturer's printed product datasheets for each type of product. Include product characteristics, performance criteria, physical size, finish and limitations for products listed in selected designs.

.2 Fire Test Design Selection:

.1 Submit tested designs which apply to the project construction assemblies or details. Make sure the selected designs has been tested and certified in accordance with CAN/ULC-S101.

.2 Respect the design selection priority, as follows:

.1 Direct reference: Use only tested designs which come from the ULC/ULI or ITS/WH Online Fire Resistance Directories, bearing the testing agencies mark certifying the design for use in Canada.

.2 If the project assembly or detail cannot be supported by tested design source listed by the Standards Council of Canada, submit a technical proposal - Alternative Solution (Engineering Judgment) that best matches the project situations. Submit Alternative Solution (Engineering Judgment) sealed, signed and dated by a Professional Engineer licensed to practice in the province of the Place of Work.

.3 Ensure Alternative Solutions are reviewed and approved for use by the fireproofing material manufacturer and are acceptable to authorities having jurisdiction. Include the cost of Alternative Solutions in the work of this Section.

.3 Shop Drawings: Submit framing plans, sections, elevations and perspective drawings as necessary to depict system configuration, design considerations and application procedures. Indicate the following:

.1 Extent of fireproofing for each construction assembly and fire-resistance rating.

.2 Applicable fire-resistance design designations of a qualified testing and inspecting agency acceptable to authorities having jurisdiction.

.3 Minimum fireproofing thicknesses needed to achieve required fire-resistance rating of each structural component and assembly.

.4 Protection of applied fireproofing during the curing stage.

.4 Samples: Submit duplicate 300 x 300 mm size sample of each exposed fireproofing product for approval of texture and colour.

.5 Application Schedule:

.1 Provide Application Schedule indicating material to be used, structural elements to be protected with spray applied fireproofing, hourly rating and material thickness.

1.4 **INFORMATIONAL SUBMITTALS**

.1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

.2 Test and Evaluation Reports: Submit in duplicate the following:

.1 Submit applicator's certification signed by the fireproofing material manufacturer certifying that spray fireproofing has been applied in accordance with manufacturer's design and acceptable to the authorities having jurisdiction.

.2 Submit test results in accordance with CAN/ULC-S101 for fire endurance and CAN/ULC-S102-M for surface burning characteristics.

.3 Submit certified copies of test reports verifying fireproofing materials applied to substrate as constructed on project will meet or exceed requirements of this specification.

1.5 **ADMINISTRATIVE REQUIREMENTS**

.1 Pre-installation meeting:

.1 Two (2) weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review with installer preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section.

.2 Establish a procedure to maintain optimum working conditions and to coordinate this work with related and adjacent work.

.3 Review products, design ratings, restrained and unrestrained conditions, densities, thicknesses, bond strengths, and other performance requirements.

.4 Advise the DCC Representative of the date and time of the meeting.

1.6 **QUALITY ASSURANCE**

.1 Fire Resistance Rating: Provide applied fireproofing to structural members where indicated on drawings and in thicknesses as required to provide ratings noted on drawings.

.2 Source Limitations: Obtain fireproofing for each fire-resistance design from single source.

.3 Regulatory Requirements:

.1 Provide products that have proper test certification from a recognized, third party-approved fire test laboratory based on CAN/ULC-S101 standard for fire endurance and CAN/ULC-S102-M for surface burning characteristics.

.2 Be responsible for securing approval of materials and installation of proposed fireproofing from authorities having jurisdiction.

.4 Installer Qualifications:

.1 Provide written certificate that the installer is licensed, or otherwise qualified by manufacturer to purchase and install manufacturer's products for spayed fireproofing.

.5 Manufacturer’s site inspection:

.1 Have the manufacturer’s technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is installed in accordance with the manufacturer’s application procedures and tested designs.

.2 Within 3 days of review submit to DCC Representative written manufacturer’s inspection report and verification that the work of this Section is correctly installed.

.6 Preconstruction Testing: Test for compliance with requirements for specified performance and test methods.

.1 Bond Strength: Test for cohesive and adhesive strength according to ASTM E736. Provide bond strength indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.

.2 Density: Test for density according to ASTM E605. Provide density indicated in referenced fire-resistance design, but not less than minimum specified in Part 2.

.3 Verify that manufacturer, through its own laboratory testing or field experience, attests that primers or coatings are compatible with fireproofing.

.4 Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

.5 For materials failing tests, obtain applied-fireproofing manufacturer's written instructions for corrective measures including the use of specially formulated bonding agents or primers

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver applied fireproofing materials in original, sealed, undamaged containers bearing manufacturer's name, brand of product, and ULC/cUL or WH-ETL certification labels for fire hazard and fire resistance classifications.

.2 Use materials with a shelf life within that period. Remove materials that have gone beyond their shelf life from the job site and replace with new materials, unless manufacturer provides a written documentation that the material is still usable for its intended purpose.

.3 Store materials in dry, protected area, off ground in original undamaged, sealed containers. Discard bags or containers that has been exposed to water before use.

1.8 PROJECT / SITE CONDITIONS

.1 Do not apply fireproofing when ambient or substrate temperature is 4ºC or lower unless temporary protection and heat are provided to maintain temperature at or above this level for 24 hours before, during, and a minimum of 24 hours after product application. Provide heated enclosures to maintain temperatures.

.2 Provide adequate air circulation and exhaust to outdoors to achieve 4 air exchange per hour continuously during and for 3 days after application of fireproofing and until material is substantially dry.

1.9 SEQUENCING AND SCHEDULING

.1 Sequence and coordinate application of fireproofing with Work in other sections which would interfere with efficient fireproofing application.

.2 Make sure clips, hangers, supports, sleeves and other attachments to the substrates to receive fire protection are in place prior to the application of SFRMs.

.3 Do not commence Work related to the installation of piping, ducts, conduit or other suspended equipment until the application of the fireproofing material is complete in that area.

.4 Do not apply SFRMs to steel floor decks prior to the completion of concrete work on that deck.

.5 To help prevent SFRMs delamination and the resulting consequences, do not commence the application of fireproofing to the underside of roof deck until the roofing is completely installed and watertight, penthouses are complete, mechanical equipment has have been placed, and after construction roof traffic has ceased.

.1 Construction roof traffic: refers to the activity of walking, installing or working with equipment on the roof of a building.

PART - 2 PRODUCTS

2.1 MANUFACTURERS

.1 Subject to compliance with the requirements outlined in this Section, products of the following manufacturers may be incorporated into the Work:

.1 A/D Fire Protection Systems, part of the Carboline Group of Companies.

.2 CAFCO Industries Limited / Isolatek International Inc.

.3 GCP Applied Technologies.

2.2 MATERIALS – STANDARD DENSITY

.1 Materials listed below are intended for interior environment, either concealed applications or exposed but out of reach to occupants.

.1 Applied fireproofing - wet-mix SFRMs: ULC, cUL or WH-ETL certified, standard density, 15 to 18 pcf, gypsum-based, cementitious fireproofing, meeting applicable Fire Test Designs, containing factory added mold inhibitors to prevent growth of organisms and fungi, acceptable to authorities having jurisdiction, providing required fire rating noted on drawings.

.1 A/D-Southwest Type 5GP by A/D Fire Protection Systems

.2 CAFCO 300 Series by Isolatek International

.3 Monokote MK-6 by GCP Applied Technologies

.2 Applied fireproofing - dry-mix SFRMs: ULC, cUL or WH-ETL certified, standard density, 13-18 pcf, Portland cement-based, cementitious fireproofing, asbestos free, containing factory added mold inhibitors to prevent growth of organisms and fungi; acceptable to authorities having jurisdiction, providing fire rating specified.

.1 A/D Type FP by A/D Fire Protection Systems Inc.

.2 CAFCO Blaze-Shield II by Isolatek International.

.3 Standard Density, GCP Applied Technologies.

2.3 AUXILIARY MATERIALS

.1 General: Provide auxiliary materials that are compatible with fireproofing and substrates and are approved by the testing and inspecting agency acceptable to authorities having jurisdiction for use in applicable fire-resistance designs.

.2 Provide auxiliary materials as recommended by the manufacturer for each condition and substrate.

.3 Primers: recommended steel primers as being listed on ULC’s Directory, within the fire tested design or primer for which adhesion/cohesion capabilities of the sprayed fire resistive material has been verified by the fireproofing manufacturer in writing.

.4 Adhesives and Bonding Agents: Provide as necessary to comply with fireproofing manufacturer's and fire test design requirements. Apply to manufacturer's recommended coverage and application rate.

.5 Lath: Expanded metal lath fabricated from material of weight, configuration, and finish required to comply with ULC/UL requirements, for application to primer or painted steel, according to fire-resistance designs and fireproofing manufacturer's written recommendations.

.6 Provide clips, metal lath accessories, corner beads and other anchorage devices required to attach metal lath to substrates and to receive spray applied fire resistive materials.

.7 Reinforcing Fabric: Glass or carbon fiber fabric of type, weight, and form required to comply with ULC/UL requirements, according to fire-resistance designs; approved and provided by fireproofing manufacturer.

.8 Reinforcing Mesh: Metallic mesh reinforcement of type, weight, and form required to comply with ULC/UL requirements, according to fire-resistance design; approved and provided by fireproofing manufacturer. Include pins and attachment.

.9 Water: Clean, potable and free of deleterious substances harmful to fireproofing material.

.10 Sealers and Topcoats: Type recommended in writing by fireproofing manufacturer for each fire-resistance design, as required. Apply to manufacturer's recommended coverage and application rate.

2.4 **MIXES**

.1 Mix applied fireproofing materials as recommended by manufacturer.

.2 Use mixers with the ability to vary the water ratios for the type of fireproofing being sprayed. Make sure to use correct mixer type as recommended by the fireproofing manufacturer to prevent potentially lower than expected densities.

.3 Do not use partially set, frozen, caked or lumpy materials. Mix each batch separately in mechanical mixer and clean mixer free of particles before mixing new batch.

PART - 3 EXECUTION

3.1 **EXAMINATION**

.1 Examine surfaces to receive applied fireproofing and report to DCC Representative the defects. Commencement of work implies acceptance of surfaces and conditions.

.2 Ensure that ducts, piping, conduit, metal stud framing, concrete masonry walls and other items which would interfere with application of applied fireproofing, have not been installed until sprayed fireproofing work is completed.

.3 Do not apply fireproofing until all clips, hangers, inserts, sleeves and similar items have been installed in areas to receive work of this Section.

.4 Where surfaces to receive applied fireproofing are primed or painted, ensure compatibility with fireproofing materials and bond requirements. Contact the fireproofing material manufacturer for recommendations on how to treat primed or painted steel prior to application of fireproofing.

.5 Do not commence application of fireproofing prior to completion of concrete work on steel decking.

.6 Do not commence application of fireproofing prior to completion of roofing application. Do not allow traffic on the roof until the fireproofing has fully cured.

3.2 **PREPARATION**

.1 Provide temporary enclosure (partitions or tarps) for interior applications to prevent deterioration of applied materials exposed to unfavourable environmental conditions.

.2 Erect appropriate barriers to prevent entry by non-fireproofing workers into the fireproofing spray and mixing areas.

.3 Provide temporary enclosures and masking to prevent spray from contaminating adjacent areas and surfaces.

.4 Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of sprayed fireproofing materials.

.5 Prepare surfaces to ensure proper bonding of applied fireproofing. Ensure surfaces to be sprayed are dry.

.6 Clean surfaces of steel members to SSPC-SP3, and ensure steel members are free of dust, dirt, oil, grease, loose paint, mill scale, rust and other foreign matter which would interfere with bond of fireproofing.

.7 Conduct tests according to fireproofing manufacturer's written recommendations to verify that substrates are free of substances capable of interfering with bond.

.8 To comply with ULC/UL requirements for application to primer or painted steel, when bond strengths is not sufficient, adhesion to substrate is questionable or the primer is unknown and cannot be field tested, obtain mechanical bond by completely wrapping the structural member with metal lath following the contour of the steel member, or as required by the fire test design.

.9 Prepare written report, listing conditions detrimental to performance of the Work.

.10 Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 **APPLICATION**

.1 Construct fireproofing assemblies in accordance with NFCA 100 and manufacturer's printed instructions, using spray equipment approved by manufacturer of fireproofing.

.2 Comply with fireproofing manufacturer's written instructions for mixing materials, application procedures, and types of equipment used to mix, convey, and apply fireproofing; as applicable to particular conditions of installation, including high humidity conditions, and as required to achieve fire-resistance ratings indicated.

.3 Apply fireproofing materials to required thickness per approved fire test design information as required to provide ratings noted on drawings. Thicker applications may require multiple passes, allowing each coat to set prior to application of subsequent coats.

.4 Provide a uniform surface matching design requirements. Apply product at the minimum density required by the fire test design, in conformance with AWCI Technical Manual 12 – A.

.5 Where dry mix fireproofing is used:

.1 Water tamp fibrous fireproofing after application to provide dense, medium smooth surfaces.

.2 Apply sealer or curing compound to surface of fibrous sprayed fireproofing, as required by manufacturer.

.6 Cure fireproofing to prevent premature drying if such site conditions apply.

.7 Protect from freezing until cured.

.8 Where installed material is found not to meet performance criteria, remove material and replace with new material to meet specified criteria at no additional cost to the Contract.

3.4 PATCHING

.1 Cut, patch and repair damage to fireproofing caused by testing or by other Sections before final inspection.

.2 Patching of damaged fireproofing can only be carried out by an installer licensed, or otherwise qualified, by fireproofing material manufacturer.

.3 Costs for repair work to be borne by the party responsible for the damage.

.4 Method of Patching or Repair

.1 For areas less than 2 sq.ft, mix material with a paddle mixer and applied by hand.

.2 For areas greater than 2 sq.ft, spray-apply materials to the same method as the original application.

.5 Do all repairs before fireproofing concealed, or if exposed, before final inspection.

3.5 FIELD QUALITY CONTROL

.1 Follow quality control procedures and the frequency of the procedures as per NFCA 200.

.2 Engage and pay for the services of a qualified independent testing agency. Payment costs for their services shall be included in the Contract Price, and not taken from the Cash Allowance.

.1 Test the spray-applied fire resistive material for thickness and density in accordance with one of the following procedures:

.1 ASTM E605 – Standard Test Method of Sprayed Fire-Resistive Materials Applied to Structural Members;

.2 AWCI Publication: Technical Manual 12-A Standard Practice for the Testing and Inspection of Field Applied Sprayed Fire-Resistive Materials; an Annotated Guide.

.2 Provide test results to all parties at the completion of each area

3.6 CLEANING AND PROTECTION

.1 Cleaning:

.1 Immediately after completing spraying operations in each containable area of Project, remove material overspray and fallout from surfaces of other construction and clean exposed surfaces to remove evidence of soiling.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment

.2 Protection:

.1 Protect fireproofing, according to advice of manufacturer and installer, from damage resulting from construction operations or other causes, so fireproofing will be without damage or deterioration at time of Substantial Performance.

.2 If damage or deterioration occurs despite such protection, cut out and remove damaged or deteriorated systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section for fire stop systems 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, and to maintain the integrity of a fire separation.

.2 This Section includes firestopping work for entire Project including selection, installation and inspection of all required firestops and smoke seals.

.2 Related Requirements

.1 Comply with Conditions of the Contract and Division 01 - General Requirements.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM):

.1 ASTM E119-20, Standard Test Methods for Fire Tests of Building Construction and Materials.

.2 ASTM E595-21, Standard Test Method for Total Mass Loss and Collected Volatile Condensable Materials from Outgassing in a Vacuum Environment.

.3 ASTM E2032-21, Standard Guide for Extension of Data From Fire Resistance Tests Conducted in Accordance with ASTM E119.

.4 ASTM E2174-20a, Standard Practice for On-Site Inspection of Installed Fire Stops.

.5 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 Industry Manual of Practice (MOP), 8th Edition.

.3 Factory Mutual Approvals (FM)

.1 FM 4991, Approval Standard for Firestop Contractors.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Safety Data Sheets (SDS).

.5 International Accreditation Service (IAS)

.1 IAS AC291, Accreditation Criteria for Special Inspection Agencies.

.6 International Firestop Council (IFC)

.1 IFC Guidelines for Evaluating Engineering Judgments, Rev 2018-10.

.2 IFC Guidelines for Evaluating Engineering Judgments - Perimeter Fire Barrier Systems, Rev 2007-02, Reaffirmed 2018-04.

.3 IFC Handbook, Firestopping Inspection Manual.

.4 IFC Inspection Guidelines for Penetration Firestop Systems and Fire Resistive Joint Systems in Fire Resistance Rated Construction, 5th Edition.

.7 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC-S102-2018, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.2 CAN/ULC-S115-2018, Standard Method of Fire Test of Firestop Systems.

.3 ULC Qualified Firestop Contractor Program.

1.3 **DEFINITIONS**

.1 Fire Blocking: materials, components or system installed in a concealed space in the building to restrict the spread of fire and smoke in that concealed space or from that concealed space to an adjacent space.

.2 Fire Stop: a material, component or system, and its means of support, used to protect gaps between fire separations, between fire separations and other construction assemblies, or used in openings where penetrating items wholly or partially penetrate fire separations, to restrict the spread of fire and smoke thus maintaining the fire-resistance continuity of a fire separation.

.3 Fire Stop System: the combination of specific materials and/or devices required with the penetrating item(s), the assembly and the opening to assemble the fire stop.

.4 Intumescent: materials that expand with heat to prevent fire spread through fire separations.

.5 Listed Fire Stop System: a specific field erected construction consisting of the assembly, fire stop materials, any penetrating items and their means of support which have met the requirements for an F, FT, FH, FTH and/or L rating when tested in a fire-resistance rated assembly in accordance with CAN/ULC-S115, Standard Method of Fire Tests of Firestop Systems.

.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 resists the transmission of heat through the fire stop during the same period and limit the rise in temperature on the unexposed face and/or penetrating item of the fire stop.

.3 FH-Rating: a fire stop system with an F-Rating for the required time period which can also resists the force of a hose stream without developing openings for a prescribed period.

.4 FTH-Rating: a fire stop system with an FT-Rating for the required time period which also passed the hose stream test for a prescribed period.

.5 L-Rating: largest test sample leakage rate, determined in accordance with the optional air leakage test of CAN/ULC-S115.

.6 Multi-penetration: two or more service penetrations through an opening in the fire separation.

.7 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.

.8 Single-penetration: single service penetration through an opening in the fire separation.

.9 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 **SYSTEM DESCRIPTION**

.1 Work of this Section is inclusive of all firestopping specified herein and indicated on Drawings except for firestopping and smoke seal within mechanical assemblies (i.e. inside ducts, dampers, intumescent pipe sleeves) and electrical assemblies (i.e. inside bus ducts) shall be provided as part of work of the Mechanical and Electrical Divisions respectively. Firestopping and smoke seals around outside of such mechanical and electrical assemblies, where they penetrate fire rated separations, shall be part of work of this Section.

.2 Fire stopping materials and/or systems intended to act as firestop and smoke seal for any through-penetrating items, termination devices, receptacles or any cut-out openings or joints, including openings and spaces at perimeter edge conditions, with wall and floor assemblies having fire-resistance rating.

.3 Fire stop and seal (draft-tight) gaps, expansion joints and penetrations in fire separations and fire walls against passage of fire, smoke, gasses, fire fighter's hose stream and, where designated, passage of liquids. Smoke seal at angle support at fire dampers.

.4 Materials and systems capable of providing effective barrier against passage of fire, smoke, gasses, and where specifically indicated passage of liquids.

.5 Ensure firestopping system provides fire-resistance rating (flame and temperature) not less than fire resistance rating of surrounding floor, wall or assembly, in accordance with requirements of the Building Code.

.6 Firestop system rating: Comply with F, FH, FT, FTH or L ratings as required by authorities having jurisdiction.

.7 Firestopping seals except for wall joints in visible areas must be of easily identifiable colour, such as red or yellow to be clearly distinguished from other building materials.

.8 Supply asbestos-free and PCB-free materials and systems tested in accordance with CAN/ULC S115, be ULC listed, or be acceptable by authorities having jurisdiction.

.9 Ensure suitability of products for application and compatibility of materials with surfaces to which it will be applied.

.10 Site system assemblies shall be in accordance with ULC listed system design. If there are no listed systems available, submit an Engineering Judgment in accordance with the requirements described in Article “Action and Informational Submittals”.

1.5 **PRE-INSTALLATION MEETINGS**

.1 Convene pre-installation meeting minimum two weeks prior to beginning work of this Section with DCC Representative and the trade performing the work to:

.1 Verify Project requirements.

.2 Review installation and substrate conditions.

.3 Coordinate with other building trades.

.4 Review system design listings, manufacturer's installation instructions and warranty requirements.

.2 Convene pre-installation meetings with other trades to review:

.1 Installation procedures and precautions.

.2 Location, scheduling and sequencing of other work around fire stops that can affect the outcome of the installation.

.3 Requirements for annular opening sizes.

.4 Requirements and preparations for wall/floor single and multi-penetrations.

.5 Requirements for construction and perimeter joints.

.3 Submit copies of applicable listed fire stop system details to each trade for opening preparation. Include installation details required for the listed system.

.4 Meeting minutes: Contractor to take minutes of pre-installation meetings and distribute to DCC Representative and each affected trades.

1.6 **ACTION AND INFORMATIONAL SUBMITTALS**

.1 Submit certificates demonstrating compliance with the requirements of this Section, as described in Article “Quality Assurance”, before starting Work.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet prior to ordering materials. Submit complete product data for each individual component and include:

.1 Product name and product number.

.2 Product characteristics and performance criteria.

.3 Physical size, finish and limitations.

.4 Technical data on out-gassing, off-gassing and age testing.

.5 Curing time.

.6 Chemical compatibility to other construction materials.

.7 Shelf life.

.8 Life expectancy.

.9 Temperature range for installation.

.10 Humidity range for installation.

.11 Sound attenuation STC-Rating.

.2 Manufacture Product Certification:

.1 Submit certification by the manufacturer that products supplied comply with local regulations controlling use of Volatile Organic Compounds (VOC’s) and are non-toxic to building occupants.

.2 Submit test reports showing compliance to ASTM E595.

.3 For each individual component, Submit copies of WHMIS Safety Data Sheets (SDS).

.4 Submit a comprehensive list of all products and components included in submittal.

.3 Shop Drawings: Submit complete and detailed Shop Drawings for each condition encountered on Site. Indicate following:

.1 Submit shop drawings showing system design listings for Project including proposed materials, primers, reinforcement, anchorage, fastenings and method of installation.

.2 Construction details to accurately reflect actual job conditions for each product and assembly.

.3 Submit details for materials and prefabricated devices.

.4 Submit electronic copy of shop drawings and include:

.1 Title page, labelled “Fire and Smoke Stop System Listings”. Include project name, date and the names of the installation company and the manufacturer of proposed products.

.2 Table of Contents.

.3 List of each proposed listed fire stop system and corresponding service penetration type or joint type in a matrix spreadsheet schedule, indicating floor and wall system, including rating for each, size of opening, and adjacent materials.

.4 Location of penetrations.

.5 System Design Listings.

.4 Samples: At the time of shop drawing submission, provide to DCC Representative duplicate 300 x 300 mm samples of each type of label proposed for the identification of fire and smoke stop systems.

.5 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, substrate preparation, installation sequence, and cleaning procedures.

.6 Engineering Judgments:

.1 Where there is no specific tested listed fire stop system available from the manufacturer for a particular fire stop configuration, review systems from other manufacturers to obtain a listed fire stop system.

.2 Submit Engineering Judgment from the system manufacturer if there are no listed systems available from other manufacturers.

.3 Prepare and submit an Engineering Judgment 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 Engineering Judgment submitted, include:

.1 Project name, number and location.

.2 A description of the proposed system with detailed drawing.

.3 Installation instructions.

.4 Complete descriptions of critical elements for the fire stop configuration.

.5 Copies of all referenced system design listings on which the Engineering Judgment is based on.

.6 Engineering Judgment issuer's name and contact information.

.7 Date of issue of Engineering Judgment with seal and signature of a registered Professional Engineer, licensed to practice in the Province of Ontario.

.8 Manufacturer letter stating their opinion, with supporting justification, that the Engineering Judgment will perform as a fire stop system were it to be subjected to the appropriate standard fire test method for the required fire rating duration.

.5 Once the Engineering Judgment has been reviewed by DCC Representative, submit the Engineering Judgment to the authority having jurisdiction for final approval.

.6 Include the cost of Engineering Judgment in the work of this Section.

.7 Engineering Judgment shall be prepared only by fire stop manufacturer's qualified technical personnel or jointly 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 Engineering Judgment being contemplated.

.1 Engineering Judgment must be stamped, signed and dated by a registered Professional Engineer, licensed to practice in the Province of Ontario.

.8 Engineering Judgment shall be based upon interpolations of previously tested fire stop systems that are either sufficiently similar in nature or clearly bracket the conditions upon which the Engineering Judgment is to be given. Additional knowledge and technical interpretations based upon accepted engineering principles, fire science and fire testing guidelines (e.g.: ASTM E2032) may also be used as further support data.

.9 Engineering Judgment shall be based upon knowledge of the elements of the construction to be protected and understanding of the probable behaviour of that construction and the recommended fire stop system protecting it were they to be subjected to the adequate standard fire test method for the required fire rating duration.

.10 Engineering Judgment shall be limited to the specific conditions and configurations upon which Engineering Judgment was rendered and should be based upon reasonable performance expectations for the recommended fire stop system under those conditions.

.11 Engineering Judgment 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.

.7 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in Part 3 - Field Quality Control.

1.7 **CLOSEOUT SUBMITTALS**

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

.1 WHMIS Safety Data Sheets (SDS).

.2 Product data and manufacturer's installation and maintenance instructions for each product/system used on this project.

.3 Approved system design listings and Engineering Judgments.

.4 Matrix schedule listing all system design listings and Engineering Judgments with a description of their penetration or joint type.

.5 Certifications:

.1 Proof of training for each worker that performed installation on the Project.

.2 Proof of company as a FCIA - Member in Good Standing.

.3 Certification of company as a ULC Qualified or FM 4991 Approved Firestop Contractor, including the Designated Responsible Individual (DRI) certificate.

.4 Accreditation of third-party inspection firm.

.6 Manufacturer's field reports.

.7 Third-Party Inspection reports.

.8 Warranty information on fire stop installations.

.9 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).

.2 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 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, blank opening, construction joint, building perimeter).

.3 Fire Stop Schedules:

.1 Submit complete fire stop schedules for floors, walls and ceilings, and slab edge conditions.

.2 Indicate all penetration fire stops and joint fire stops through each reference wall, floor and ceiling in the schedules.

.3 Cross-reference fire stop schedules with as-built drawings and indicate design listing numbers associated to each penetration fire stop and joint fire stop.

1.8 **QUALITY ASSURANCE**

.1 Provide systems selection and analysis, installation and inspection of fire stop systems in accordance with the recommended practices detailed in the following guides:

.1 FCIA Firestop Manual of Practice (MOP).

.2 Company recognized as a Member in Good Standing with the Firestop Contractors International Association (FCIA).

.3 Firestop Contractor: company completed one of the following programs:

.1 ULC Firestop Contractor Program. Submit signed copy of ULC Firestop Contractor Program certificate.

.2 FM 4991 Firestop Contractor. Submit signed copy of FM 4991 Approval certificate.

.4 Third-Party Inspection Firm: IAS AC291 Accredited inspection agency with inspectors who have passed the ULC Firestop Exam or FM Firestop Exam.

.5 Manufacturer Site Visits: as part of Manufacturer's Services described in PART 3 - Field Quality Control, schedule site visits, to review Work, at stages listed. Confirm exact dates to with Contractor.

.1 After delivery of products, and when preparatory work is complete, but before installation begins.

.2 At least one time during progress of Work.

.3 Upon completion of Work, after cleaning is carried out.

1.9 **COORDINATION**

.1 Coordinate with trade work involved and advise dates where work will take place throughout various areas of Work.

1.10 **DELIVERY, STORAGE AND HANDLING**

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Deliver materials to the site in undamaged condition and in original unopened containers, marked to indicate brand name, manufacturer, ULC/cUL or WH-ETL markings, manufacturing date, shelf life expiry date.

.3 Coordinate delivery of materials with scheduled installation dates to allow minimum storage time on site.

.4 Storage and Protection:

.1 Store materials indoors for 24 hours minimum prior to use.

.2 Store indoors in clean, dry, well-ventilated area.

.3 Comply with recommended procedures, precautions and measures described in WHMIS Safety Data Sheets (SDS).

.5 Protect materials from damage and detrimental environmental conditions.

.6 Replace defective, expired or damaged materials with new as no extra cost to the Owner.

1.11 **ENVIRONMENTAL CONDITIONS**

.1 Install fire stops when ambient and substrate temperatures are within the limits prescribed by the manufacturer and when the substrate is dry and without risk of condensation.

.2 Maintain manufacturer’s recommended ambient and substrate temperatures, and relative humidity for 48 hours before installation, during application and until application is fully cured.

.3 Ventilate fire stops in accordance with manufacturers’ instructions by natural means or where this is inadequate using forced air circulation.

.4 Protect water-soluble material from wetting until fully cured.

PART - 2 PRODUCTS

2.1 MANUFACTURERS

.1 To maintain control and integrity of the firestop applications supply and install products from a single manufacturer, to the greatest extent possible, to perform all fire stopping work. Materials of different manufacturers will not be permitted without written authorization of DCC Representative.

.2 Where there is no specific tested listed fire stop system available from the manufacturer for a particular fire stopping application, obtain authorization from DCC Representative to supply and install a listed system from an alternative manufacturer to avoid providing an Engineering Judgment.

2.2 DESIGN / PERFORMANCE CRITERIA

.1 Fire stop and smoke stop systems and systems providing a barrier to smoke spread consisting of a material or combination of materials installed to maintain the integrity of the fire resistance rating of a fire separation in accordance with the requirements of NBC 2015.

.2 Non-rated fire separations: provide L-Rated smoke protection firestop system for application on both sides of separation.

.3 Dynamic joints: where required, fire and smoke stop systems to be designed to accommodate a defined amount of movement to account for expansion or contraction in construction joints and mechanical piping, for movement in structural elements and to accommodate for movement and sound and vibration control in mechanical installations.

.4 Insulated pipes and ducts: listed fire stop system designed and tested with actual insulation materials penetrating the fire separation, as indicated on the system design listing.

.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 Architectural considerations: when exposed to view, fire stop system to consider architectural finish, potential traffic, and exposure to moisture and heat.

.7 Environment considerations: materials selected to consider the environment in which they will be used during and after curing as well as the intended use of space.

.1 Fire stop manufacturer to confirm compatibility of the proposed materials/products for the following cases:

.1 Spaces containing sensitive electronic equipment.

.2 Building perimeter firestop systems to be water-resistant.

2.3 MATERIALS

.1 Primer: As recommended by firestopping material manufacturer for specific substrate and use.

.2 Fire stop and smoke stop systems: in accordance with CAN/ULC-S115.

.1 Asbestos-free materials and systems capable of maintaining effective barrier against the passage of flame, smoke and water, and the transmission of heat in compliance with requirements of CAN/ULC-S115 and not to exceed opening sizes for which they are intended, as indicated on System Design Listing.

.2 Fire stop system rating: to match fire resistance rating of fire separation, in accordance with requirements of NBC.

.3 Service penetration assemblies and fire stop components: certified by test laboratory to CAN/ULC-S115.

.3 Damming and backup materials, support and anchoring devices: Non-combustible, in accordance with tested assembly and as recommended by manufacturer. Combustible material for damming purpose may be permitted only if they are removed after permanent firestop materials are cured. Sheet steel covers over temporarily unused sleeves shall be minimum 0.8 mm thick galvanized steel sheet.

.4 Pipe and duct insulation and wrappings: Compatible with firestopping material; as recommended by manufacturer.

.5 Fire stopping and smoke seals at opening intended for ease of re-entry such as cable: Elastomeric seal. Do not use cementitious or rigid seal at such locations.

.6 Fire stopping and smoke seals at opening around penetrations for ductwork and other mechanical items requiring sound and vibration control: Elastomeric seal. Do not use cementitious or rigid seal at such locations.

.7 Firestop insulation: pre-formed, semi rigid, non-combustible mineral wool.

.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 For vertical joints: non-sagging.

.2 For horizontal joints: single component, self-levelling.

.3 For building perimeter joints: to act as fire, smoke, gas, and water seal.

2.4 **FIRE STOP IDENTIFICATION**

.1 Identification labels and markings to be indelible for the expected service life of the installation.

.2 Fire Stopped Penetrations:

.1 Provide identification labels at each penetration.

.2 Identification labels: pressure-sensitive, self-adhesive, printed vinyl labels.

.3 Attach labels permanently to surfaces of penetrated construction on both sides of each firestopping system installation where labels will be visible to anyone seeking to remove penetrating items or firestopping and smoke seal systems.

.4 Label shall state, in both official languages, that the fill material around the penetration is a fire stop system and it shall not be disturbed except by authorized personnel.

.5 In addition, include the following information on labels:

.1 Penetration number.

.2 Floor number.

.3 Room number.

.4 Product name and number.

.5 Manufacturer’s name.

.6 System Design number or Engineering Judgment number.

.7 Fire Rating Required: in hours.

.8 Fire Stop Contractor's Name and phone number.

.9 Installer's Name.

.10 Date of Installation.

.11 Re-penetrated by: Company, Installer and Date.

.6 Label shall state that the fill material around the penetration is a fire stop system and it shall not be disturbed except by authorized personnel.

.3 Fire Separation (Barrier) Markings:

.1 Provide identification for all vertical fire separations.

.2 Identification markings: adhesive stickers with lettering at least 75 mm in height with a minimum 10 mm stroke in contrasting colour.

.3 Marking to incorporate the assembly's fire-resistance rating and the following suggested wording in both official languages, "FIRE AND/OR SMOKE BARRIER – PROTECT ALL OPENINGS", or other accepted wording.

PART - 3 EXECUTION

3.1 PREPARATION

.1 Verify substrate conditions are acceptable for product installation in accordance with manufacturer's instructions and approved system design listings for each condition.

.2 Remove combustible material and loose material detrimental to bond from edges of penetration. Clean, prime or otherwise prepare substrate material to manufacturer's recommendation.

.3 Verify that the proposed fire stop system is composed of components that are compatible with each other, the substrates forming the openings, and the items, if any, penetrating the fire stop under conditions of application and service, as demonstrated by the fire stop manufacturer based on testing and field experience.

.4 Do not apply firestop material to surfaces previously painted or treated with sealer, curing compound, water repellent or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.5 Verify openings, dimensions and surfaces conform to fire and smoke seal assembly.

.6 Comply with manufacturer's recommended requirements for temperature, relative humidity, moisture content and presence of any sealer or release agents on substrate during application and curing of materials. Surfaces shall be dry, dust and frost free.

.7 Fully protect walls, windows, floors and other surfaces around areas to be firestopped from marring or damage.

.8 Prime surfaces in accordance with manufacturer's directions. Mask where necessary to avoid spillage on to adjoining surfaces. Remove stains on adjacent surfaces as required.

.9 Remove insulation from area of insulated pipe and duct where such pipes or ducts penetrate fire separation unless ULC certified assembly permits such insulation to remain within assembly.

.10 Provide temporary forming, packing and bracing materials necessary to contain firestopping. Upon completion, remove forming and damming materials not required to remain as part of system.

.11 Mix materials at correct temperature and in strict accordance with manufacturer's directions.

3.2 **INSTALLATION**

.1 Install damming and firestopping materials as per manufacturer's instructions.

.2 Seal penetrations through and gaps in fire rated separations. Fill gap in accordance with ULC details for tested system selected.

.3 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.

.4 Schedule work to ensure that fire separations and all other construction that conceals penetrations are not erected before installation of fire and smoke stop systems

.5 Protect holes or gaps made by through penetrations, poke through termination devices, and un-penetrated openings or joints to ensure that both continuity and integrity of fire separation are maintained.

.6 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing per manufacturer’s instructions.

.7 Apply firestopping materials in strict accordance with manufacturer's written instructions and tested designs to provide required temperature and flame rated seal. Apply with sufficient pressure to properly fill and seal openings to ensure continuity and integrity of fire separation. Tool or trowel exposed surfaces as required.

.8 Remove excess compound promptly as work progresses and upon completion.

.9 Examine sizes, anticipated movement and conditions of opening and penetration to establish correct system and depth of backup materials and of firestopping material required. Use firestopping and smoke seals best suited for specific application as required, indicated or specified. Use only components specified in fire test of system. Do not eliminate any component for firestop system that was present in fire tests.

.10 Do not cover materials until full cure has taken place.

.11 Do not use damaged or expired material.

.12 Joint Fire Stops:

.1 For sealant applications, install joint fillers to support fire stop materials during application. Position joint fillers to ensure fire stop material cross-sectional shape and thickness relative to the joint width allows for optimum sealant movement, while developing the required fire-resistance rating.

.2 Install fire stops using techniques recommended by the manufacturer:

.1 Fully wetting joint substrates to optimize adhesion.

.2 Completely filling recesses provided for each joint configuration.

.3 Providing uniform, cross-sectional shapes and thickness relative to joint width that optimize movement capability.

.4 Tooling non-sag fire stop materials immediately after their application and prior to the time skinning begins. Form smooth, uniform beads of configuration indicated or required to:

.3 Joint Systems and Perimeter Fire Containment Systems:

.1 For systems with dynamic joints, ensure movement capabilities of the installation meet or exceed the movement expectations of the system design listing and manufacturer's installation instructions.

.13 Provide firestop systems at following locations, without being limited to:

.1 At openings, voids and penetrations through floor slabs except openings within shafts constructed with a fire resistance rating and slabs on granular fill.

.2 At openings, voids and penetrations through fire rated masonry, concrete and gypsum board walls, partitions and shaft walls.

.3 At openings, voids and penetrations installed for future use through fire rated masonry, concrete and gypsum board walls, partitions and shaft walls.

.4 Joints at top and bottom of fire-resistance rated walls where they meet non-rated fire separation assemblies.

.5 Intersection of fire-resistance rated masonry, concrete and gypsum board partitions.

.6 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.

.7 Openings and sleeves installed for future use through fire separations.

.8 Around mechanical and electrical assemblies/devices penetrating fire separations.

.9 Mechanical and electrical recessed boxes in walls and partitions.

.10 Between tops of fire rated walls and partitions and underside of floor or roof slabs.

.11 At all expansion joints in fire-rated walls, floors, ceilings and roof assemblies.

.12 At building perimeter for the space between a fire-resistance rated floor assembly and the curtain wall or other exterior wall assembly (e.g.: safing slot gaps).

.14 Refer to all other sections of Specifications and the Drawings to ascertain where firestops are to be used and, if noted, type of firestop required.

.15 Cure materials in accordance with manufacturer's directions.

3.3 **IDENTIFICATION**

.1 General:

.1 Clean substrate prior to applying identification.

.2 Final location of identification to be determined on site.

.3 Refer to drawings for locations of fire separations and rating required.

.2 Fire Stopped Penetrations:

.1 Install identification label adjacent to each wall/floor service penetrations fire stopped. Provide one identification label per single opening or per grouping cluster.

.2 Securely apply identification to substrate by providing adequate adhesive.

.3 Identification shall be completely filled out and installed prior to requesting Substantial Performance.

.3 Fire Separations (Barriers):

.1 Provide identification at least 4500 mm of the end of each wall and at intervals not exceeding 9000 mm along wall/floor joint fire stops.

.2 Markings to be installed within ceiling spaces, 600 mm below horizontal fire separation or roof structure unless otherwise indicated.

.3 For occupied areas with exposed ceilings: review location of identification with DCC Representative before proceeding.

3.4 **REPAIRS AND MODIFICATIONS**

.1 Identify damaged or re-entered seals requiring repair or modification.

.2 Remove loose or damaged materials. If penetrating items are to be added, remove sufficient material to insert new elements and to avoid damaging the balance of the seal.

.3 Ensure that surfaces to be sealed are clean and dry.

.4 Use only materials that are suitable for repair of original seal, as approved by manufacturer. Do not mix products from different manufacturers.

.5 Repair all damage resulting from fire stop destructive testing.

3.5 **FIELD QUALITY CONTROL**

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

.2 Manufacturer's Field Services:

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

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

.3 Schedule site visits to review Work as directed in PART 1 - QUALITY ASSURANCE.

3.6 **INSPECTIONS**

.1 Third-Party Inspection Firm carried by the Contractor: Contractor shall hire and pay for the services of a third-party inspection firm to conduct random inspections and direct exploratory review (i.e.: destructive testing) during the course of construction and prior to closing off any concealed areas. Inspections and destructive testing shall be performed in compliance with ASTM E2174 and ASTM E2393.

.1 Include for a minimum of 2% for each area of 900 square meters for exploratory reviews for each approved system design listing and each trade involved. Perform cut tests at perimeter joints every 15 meters. Perform cut test at bottom and top of wall joints and wall to wall joints and building expansion joints every 15 meters.

.2 Perform exploratory review as directed by Third-Party Inspection Firm. Cut out fire stop and remove to ensure fire stop system installation meets or exceeds the system design listing as identified.

.3 After review is completed and acceptance is obtained, replace fire stop system with new materials.

.2 Progressively, provide the DCC Representative with the Inspection Reports.

.3 Upon completion of construction and before requesting Substantial Performance review, Contractor and manufacturer's representative shall inspect all fire stopping work and prepare a deficiency list. Submit deficiency list to DCC Representative for review. Repair any deficiencies and re-inspect work to ensure that all deficiencies have been completed.

.4 Submit formal request for Substantial Performance review of work once all work is completed, deficiencies repaired, quality control has been performed and all fire stop installations have been inspected and identified with the approved fire stop identification labels.

.5 Third-Party Inspection Firm shall conduct the Substantial Completion review in the presence of the Contractor, and provide final report.

.6 At the end of the work, include all reports in the Close-out Documents.

3.7 **CLEANING**

.1 Remove excess materials and debris and clean adjacent surfaces immediately after application to satisfaction of DCC Representative. Remove and/or correct staining and discolouring of adjacent surfaces as directed.

.2 Remove temporary combustible damming materials after initial set of firestopping materials. Such dams may be required to remain in place if flame spread rating is below 25, in accordance with CAN/ULC-S102.

.3 Protect fire stops during and after curing period from contact with contaminating substances. Repair all damage.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section for joint sealants.

.2 This Section specifies sealing work not specified in other Sections. Refer to other Sections for other sealants.

1.2 REFERNCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C719, Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle).

.2 ASTM C834, Standard Specification for Latex Sealants.

.3 ASTM C920, Standard Specification for Elastomeric Joint Sealants.

.4 ASTM C1248, Standard Test Method for Staining of Porous Substrate by Joint Sealants.

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

1.3 ACTION SUBMITTALS

.1 Product Data: Submit to DCC Representative Product information from sealant manufacturer prior to commencement of work of this Section verifying:

.1 Selected sealant materials are from those specified.

.2 Composition and physical characteristics.

.3 Surface preparation requirements.

.4 Priming and application procedures.

.5 Suitability of sealants for purposes intended and joint design.

.6 Test report on adhesion, compatibility and staining effect on samples of adjacent materials used on Project.

.7 Sealants compatibility and adhesion with other materials and Products with which they come in contact including but not limited to sealants provided under other Sections, insulation adhesives, bitumens, membranes, stone, concrete, masonry, metals and metal finishes, ceramic tile, plastic laminates and paints.

.8 Suitability of sealants for temperature and humidity conditions at time of application

.2 Samples: Submit duplicate samples of each type of material and colour. Submit samples of primer, bond breaker tape and joint backing material, if requested.

1.4 **INFORMATION SUBMITTALS**

.1 Product Certificates: For each kind of joint sealant and accessory, from manufacturer.

.2 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.5 **ADMINISTRATIVE REQUIREMENTS**

.1 Pre-installation meeting:

.1 Two (2) weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review with installer preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section.

.2 Establish a procedure to maintain optimum working conditions and to coordinate this work with related and adjacent work.

.3 Advise the DCC Representative of the date and time of the meeting.

1.6 **QUALITY ASSURANCE**

.1 Single source responsibility: Use sealants from single manufacturer for each different product required to ensure compatibility.

.2 Pre-installation compatibility and adhesion testing: Provide sealant manufacturer samples of actual materials that will contact or affect their sealants in the Work for compatibility and adhesion testing. This testing will not be required where sealant manufacturer is able to furnish data acceptable to DCC Representative based on previous testing for adhesion and compatibility to materials matching those of the Work.

.3 Pre-installation field adhesion testing:

.1 Conduct site field-tests for adhesion of sealants to actual joint substrates using proposed preparation methods and materials recommended by manufacturer.

.2 Conduct tests for each type of sealant and substrate.

.3 Locate field-test joints where inconspicuous or as directed by DCC Representative. Include areas typical of those requiring removal of existing sealants and utilize methods proposed for sealant removal.

.4 Test method: Use manufacturer's standard field adhesion test methods and methods proposed for joint preparation to verify proper priming and joint preparation techniques required to obtain optimum adhesion of joint sealants to joint substrate.

.5 Evaluate and report results of field adhesion testing.

.6 Do not use joint preparation methods or sealants that produce less than satisfactory adhesion to joint substrates during testing.

.4 Standard of acceptance: Retain at least one 1500 mm long acceptable joint for each type of sealant and substrate installed during pre-installation field adhesion testing as standard of acceptability for the Work. Acceptable joints may form part of the Work.

1.7 **DELIVERY, STORAGE, AND HANDLING**

.1 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact.

.2 Protect from freezing, moisture and water.

1.8 **PROJECT CONDITIONS**

.1 Do not proceed with installation of joint sealants under the following conditions:

.1 When joint substrates are wet.

.2 Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.

.3 Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART - 2 PRODUCTS

2.1 **MATERIALS - GENERAL**

.1 Provide joint sealants establishing and maintaining watertight, water resistant and air tight continuous joint seals without staining or deteriorating joint substrates.

.2 Ensure joint sealants comply with specified type, grade, class and uses.

.3 Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

.4 Provide Products with capability, when tested, for adhesion and cohesion under maximum cyclic movement in accordance with ASTM C719, to withstand required percentage change in joint width existing at time of installation and remain in compliance with other requirements of ASTM C920 for uses indicated.

.5 VOC Content of Interior Sealants: Sealants and sealant primers used inside shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

.1 Architectural Sealants: 250 g/L.

.2 Sealant Primers for Nonporous Substrates: 250 g/L.

.3 Sealant Primers for Porous Substrates: 775 g/L.

.6 Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

.7 Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

.8 Stain-Test-Response Characteristics: Where sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C1248 and have not stained porous joint substrates indicated for Project.

.9 Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

.10 Sealants, cleaning solvents and primers: Compatible with each other.

.11 Colours of Exposed Joint Sealants: As selected by DCC Representative from manufacturer's full range. Allow for special colours as selected by the DCC Representative.

2.2 **JOINT SEALANTS**

.1 Sealant Type 1:

.1 Single-component, non-sag, polyurethane joint sealant meeting specified requirements of ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

.1 Dymonic by Tremco (Canada),

.2 SikaFlex 1a by Sika Canada Inc.

.3 MasterSeal NP1 by BASF Construction Chemicals, LLC-Building Systems.

.2 Sealant Type 2: Acrylic latex or siliconized acrylic latex joint sealant meeting specified requirements of ASTM C 834, Type OP, Grade NF.

.3 Sealant Type 4: Self-levelling, multi-component, chemically curing polyurethane joint sealant, meeting specified requirements of ASTM C920, Type M, Grade P, Class 25, Use T, M, and O.

.1 THC-900 (for slopes less than 5%) or THC-901 (for slopes up to 10%) by Tremco (Canada).

.2 SikaFlex 2c SL by Sika Canada Inc.

.3 MasterSeal SL2 by BASF Construction Chemicals, LLC-Building Systems.

.4 Sealant Type 5: Provide 1 of following:

.1 Multicomponent, non-sag, polyurethane joint sealant, meeting specified requirements of ASTM C 920, Type M, Grade NS, Class 50, for Use NT.

OR

.2 Multicomponent, non-sag, polyurethane joint sealant, meeting specified requirements of ASTM C 920, Type M, Grade NS, Class 25, for Use T.

.1 Dymeric 240 by Tremco (Canada)

.2 Vulkem 227 by Tremco (Canada),

.3 SikaFlex 2c NS by Sika Canada Inc.

.4 MasterSeal NP2 by BASF Construction Chemicals, LLC-Building Systems.

.5 Compressible sealer: Silicone pre-coated, preformed, pre-compressed, self-expanding, binary sealant system of expanding polyurethane foam impregnated with water-based, stabilized, polymer-modified acrylic with factory applied silicone coated bellows, complete with field applied liquid silicone corner bead in matching colour, depth of seal as recommended by manufacturer, Willseal Color Coreseal by DRE Industries, Colorseal by Emseal Corporation, or Watson Bowman, standard colours.

.1 Provide traffic rated compressible sealers for horizontal applications.

2.3 **MISCELLANEOUS MATERIALS**

.1 Joint primer: As recommended by sealant manufacturer for substrates, conditions and exposures indicated.

.2 Bond breaker: Polyethylene tape or other adhesive faced tape as recommended by sealant manufacturer to prevent sealant contact where it would be detrimental to sealant performance.

.3 Joint backer: Polyethylene foam rod or other compatible non-waxing, non-extruding, non-staining resilient material in dimension 25 percent to 50 percent wider than joint width as recommended by sealant manufacturer for conditions and exposures indicated. Ensure backing is compatible with sealant, primer and substrate.

.4 Masking tape: Non-staining, non-absorbent tape product compatible with sealants and adjacent joint surfaces that is suitable for masking.

.5 Cleaning Material: Non-corrosive, non-staining, solvent type, xylol, MEK, toluol, IPA or as recommended by sealant manufacturer and acceptable to material or finish manufacturers for surfaces adjacent to sealed areas free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way and formulated to promote optimum adhesion of sealants with joint substrates.

PART - 3 EXECUTION

3.1 **EXAMINATION**

.1 Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

.2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 **PREPARATION**

.1 Prepare surfaces to receive work in accordance with sealant manufacturer's instructions and recommendations except where more stringent requirements are indicated.

.2 Thoroughly clean joint surfaces using cleaners approved by sealant manufacturer whether primers are required or not.

.3 Remove all traces of previous sealant and joint backer by mechanical methods, such as by cutting, grinding and wire brushing, in manner not damaging to surrounding surfaces.

.4 Remove paints from joint surfaces except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer.

.5 Remove wax, oil, grease, dirt film residues, temporary protective coatings and other residues by wiping with cleaner recommended for that purpose. Use clean, white, lint-free cloths and change cloths frequently.

.6 Remove dust by blowing clean with oil-free, compressed air.

.7 Joint backer: Provide joint backer uniformly to depth required for proper joint design using a blunt instrument. Fit securely by compressing backer material 25 percent to 50 percent so no displacement occurs during tooling. Avoid stretching or twisting joint backer.

.8 Bond breaker: Provide bond-breaker recommended by sealant manufacturer, adhering strictly to the manufacturer's installation requirements.

.9 Priming: Prime joint substrates where required. Use and apply primer to sealant manufacturers recommendations. Confine primers to sealant bond surfaces; do not allow spillage or migration onto adjoining surfaces.

.10 Taping: Use masking tape, where required, to prevent sealant or primer contact with adjoining surfaces that would be permanently stained or otherwise damaged by such contact or the cleaning methods required for removal. Apply tape so as not to shift readily, and remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

.1 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.

.2 Install sealants immediately after joint preparation.

.3 Mix, apply and cure sealants in accordance with manufacturer's printed instructions.

.4 Install sealants to fill joints completely, without voids or entrapped air, using proven techniques, proper nozzles and sufficient force that result in sealants directly contacting and fully wetting joint surfaces.

.5 Install sealants to uniform cross-sectional shapes with depths relative to joint widths that allow optimum sealant movement capability as recommended by sealant manufacturer.

.6 Dry tool sealants in manner that forces sealant against back of joint, ensures firm, continuous full contact at joint interfaces and leaves a finish that is smooth, uniform and free of ridges, wrinkles, sags, air pockets and embedded impurities.

.1 Tooling liquids that are non-staining, non-damaging to adjacent surfaces and approved by sealant manufacturer may be used if necessary when care is taken to ensure that the liquid does not contact joint surfaces before the sealant.

.2 Provide concave tooled joints unless otherwise indicated to provide flush tooling or recessed tooling.

.3 Provide recessed tooled joints where the outer face of substrate is irregular.

.7 Remove sealant from adjacent surfaces in accordance with sealant and substrate manufacturer recommendations as work progresses.

.8 Do not cover up sealants until proper curing has taken place.

.9 Protect joint sealants from contact with contaminating substances and from damages. Cut out, remove and replace contaminated or damaged sealants immediately, so that they are without contamination or damage at time of Substantial Performance.

3.4 INSTALLATION – COMPRESSIBLE SEALER

.1 Prepare joint faces by grind or wire brush.

.2 Heat and apply compressible sealer in accordance with manufacturer's instructions. Join consecutive lengths with 45 degree power saw miters. Provide corner bead of liquid silicone tooled between the preformed silicone bellows and substrate.

3.5 LOCATION SCHEDULE

.1 Refer to Drawings for sealing work not specifically listed in this Section.

.2 Use one of the sealants specified for each type in following locations. Ensure sealant chosen from several specified types listed under Part 2 Materials, and recommended by manufacturer for use for conditions encountered:

.3 Seal following joints with Sealant Type 1 one component modified polyurethane sealant:

.1 Interior masonry and gypsum board control joints.

.4 Seal following joints with Sealant Type 2 acrylic sealant:

.1 Joints between interior metal and/or wood frames and adjacent construction in interior partitions.

.2 Interior joints to receive paint finish.

.5 Seal following joints with Sealant Type 4 self-levelling sealants:

.1 Static joints in horizontal surfaces where self-levelling sealants are required.

.2 Interior horizontal tile control joints.

.6 Seal following joints with Sealant Type 5 multicomponent, non-sag, polyurethane sealant:

.1 Typically used in joints between metal frames and adjacent masonry and/or concrete construction in exterior walls, exterior and interior sides; control and expansion joints in exterior and interior surfaces of poured-in-place concrete walls, and unit masonry walls; sealing of joints between underside of precast concrete floor slabs and masonry; and other locations where sealant is required or noted on Drawings except where sealant is specified in other Sections.

.7 Seal the following joints with compressible sealers:

.1 Masonry and steel expansion joints.

.2 Expansion, control and isolation joints

.8 Refer to Drawings for sealing work not specifically listed in this Section.

END OF SECTION

PART - 1 GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials (ASTM):

.1 ASTM D4060, Standard Test Method for Abrasion Resistance of Organic Coatings by the Taber Abraser.

.2 ASTM E1966, Standard Test Method for Fire-Resistive Joint Systems.

.2 Underwriters' Laboratories:

.1 UL 2079 Tests for Fire Resistance of Building Joint Systems.

.3 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC-S101, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

1.2 DESIGN REQUIREMENTS

.1 Supply and install expansion joint systems to withstand structural movements, as well as the environmental conditions in accordance with details shown on plans and requirements of specifications.

.2 Provide fire barrier assemblies utilizing pre-engineered components and materials tested to meet required fire rating.

.3 Expansion joint cover assemblies to provide a smooth and bump free transition between building elements or components.

.4 Joint movement: design to permit unrestricted omnidirectional movement of up to +/-50% of joint width without disengagement of cover.

.5 Rated assemblies shall be fire-rated as per UL, ULC, or Warnock Hersey listed designs. Extend fire barrier beyond expansion joint cover, in concealed locations to maintain fire rating, for full length of expansion joint.

.6 Cyclic-Movement-Test-Response Characteristics: No evidence of visual fatigue, inability to cycle between designated joint widths, or other types of failure as determined by testing products identical to those indicated per ASTM E1399 including Appendix X3.

1.3 SUBMITTALS

.1 Product data in the form of manufacturer's product specifications, specific, detailed installation instructions and general recommendations for each type of expansion joint assembly indicated.

.2 Provide detailed shop drawings showing joints cross-sections, indicating pertinent dimensioning, general construction, component connections, and anchorage methods. Indicate joint locations, dimensions, and adjacent construction. Shop drawings shall show full extent of expansion joint assemblies; include details indicating finishes and profiles of each type of expansion joint assembly, joinery with other types, special end conditions, and relationship to adjoining work and finishes.

.3 Samples: Duplicate 300 mm long samples showing assembly and finish for each expansion joint assembly.

.4 Test Reports: Submit material test reports from qualified independent testing laboratory indicating and interpreting test results relative to compliance of fire-rated expansion joint fire barrier assemblies with requirements indicated.

.5 Closeout Submittals: Submit maintenance instructions for all items for incorporation into the operation and maintenance manuals.

1.4 **DELIVERY, STORAGE, AND HANDLING**

.1 Deliver packaged materials to the project site in the manufacturer's original, unopened containers which bear intact, legible and visible labels that identify the manufacturer's name and brand name, the contents, grade and type.

.2 Upon delivery, immediately inspect shipments to assure their compliance with the requirements of the Contract Documents and approved submittals, and that products are complete, undamaged and adequately protected. Immediately report damaged, missing, or defective items. Remove broken, damaged, or unlabelled items from the site immediately.

.3 Store products in accordance with manufacturer's instructions with seals and labels intact, legible, and visible.

1.5 **SITE CONDITIONS**

.1 Check actual locations to which work must fit, by accurate field measurements before fabrication. Show recorded measurements on final shop drawings and coordinate fabrication schedule with construction progress.

PART - 2 PRODUCTS

2.1 **EXPANSION JOINT SYSTEMS**

.1 Materials: Traffic grade upper and lower silicone sealing surface adhered to fire-retardant impregnated foam backing installed into field-applied epoxy adhesive.

.2 Form: Precompressed to less than nominal material size for installation into designed joint size equal to material nominal size.

.3 Adhesive: Epoxy type, furnished by joint seal manufacturer.

.4 Silicone: Field applied sealant band at face of seal to substrate interface, furnished by joint seal manufacturer; same material and colour as factory coating.

.1 Abrasion resistance: Maximum 1 percent weight loss, tested to ASTM D4060.

.5 Intumescent Sealant: Field applied to face of joints, furnished by joint seal manufacturer.

.6 Fire protection rating: as indicated, tested to UL 2079.

.7 Refer to Section 01 61 10, List of Materials for additional information and requirements. Final colour as selected by DCC Representative.

2.2 **FABRICATION**

.1 Fabricate expansion joint square, true, straight and accurate to required sizes and profiles.

.2 Fabricate in maximum practical lengths to minimize joints. Provide factory-fabricated transitions for all expansion joint systems where joint changes direction.

.3 Shop assemble covers ready for installation where practicable.

PART - 3 EXECUTION

3.1 EXAMINATION

.1 Prior to commencement of the work of this section:

.1 Examine structure and substrates for tolerances in dimension and any condition affecting the work under this Section; and

.2 Inform DCC Representative in writing of unacceptable existing work and conditions.

.2 Commencement of installation of work of this specification section shall be construed as acceptance of existing work and conditions and no other claims based on same will be entertained.

3.2 PREPARATION

.1 Prepare substrates according to expansion joint system manufacturer's written instructions.

.2 Prepare joint faces by grind or wire brush.

.3 Clean joints thoroughly; remove loose and foreign matter that could impair adhesion or performance.

.4 Joint surfaces to receive seal shall be sound, smooth, straight, parallel, clean, dry and free of all visible contaminants.

3.3 INSTALLATION

.1 Comply with manufacturer's written instructions for handling and installing expansion joint assemblies and materials, unless more stringent requirements are indicated or specified.

.2 Set work plumb, square, level, free from distortion.

.3 Accurately set joints to be flush with finished materials.

.4 Secure work accurately to structure in manner not restricting joint movement.

.5 Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required to install joint systems.

.1 Install joint cover assemblies in true alignment and proper relationship to joints and adjoining finished surfaces measured from established lines and levels.

.2 Locate all expansion joint covers in continuous contact with adjacent surfaces.

.3 Securely attach in place with required accessories.

.6 Continuity: Maintain continuity of joint systems with a minimum number of end joints.

.7 Install fire-rated assemblies, where required, to meet requirements of Authorities having Jurisdiction.

.8 Compression Seals: Apply adhesive or lubricant adhesive as recommended by manufacturer to both interfaces before installing compression seals.

.9 Terminate exposed ends of expansion control systems with field- or factory-fabricated termination devices.

.10 Fire Barrier Systems

.1 Site verify width of openings to receive fire barrier systems conforming with the requirements of the Contract Documents and the tested and listed fire barrier system.

.2 Protect fire barrier components from damage during installation and post installation activities including placement of expansion control system.

.3 Install fire barrier system assemblies in accordance with manufacturer's written specifications. Join consecutive lengths with 45-degree power saw mitres.

.4 Fire barrier assemblies shall be cut in the field for exact length and changes in direction.

.5 Upon completing installation of fire barrier system, verify sealants have been applied in accordance with fire barrier system manufacturer’s requirements.

.6 Clean and remove any debris from fire barrier system prior to installation of expansion joint cover.

3.4 CLEANING AND PROTECTION

.1 Protect system and its components during construction.

.2 Do not permit heavy construction vehicles to cross expansion joints.

.3 Repair subsequent damage to expansion joint systems at no cost to DCC Representative.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

.1 ASTM International (ASTM)

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

.2 CSA Group (CSA)

.1 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CSA W59, Welded Steel Construction.

.3 Canadian Steel Door Manufacturers' Association (CSDMA)

.1 CSDMA, Recommended Specifications for Commercial Steel Doors and Frames.

.2 CSDMA, Selection and Usage Guide for Commercial Steel Doors and Frame Products.

.4 National Fire Protection Association (NFPA)

.1 NFPA 80, Standard for Fire Doors and Other Opening Protectives.

.2 NFPA 252, Standard Methods of Fire Tests of Door Assemblies.

.5 South Coast Air Quality Management District (SCAQMD), California State

.1 SCAQMD Rule 1168, Adhesives and Sealants Applications.

.6 Underwriters' Laboratories of Canada (ULC):

.1 CAN/ULC-S104, Standard Method for Fire Tests of Door Assemblies

.2 CAN/ULC-S105, Standard Specification for Fire Door Frames Meeting the Performance Required by CAN/ULC-S104.

.3 CAN/ULC-S702.1, Standard for Mineral Fiber Thermal Insulation for Buildings.

.4 CAN/ULC-S704.1, Standard for Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.2 SYSTEM DESCRIPTION

.1 Design Requirements:

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

.2 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.

.3 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN/ULC-S104 and CAN/ULC-S105 for ratings specified or indicated.

.4 Provide fire labelled frames for openings requiring fire protection ratings.

.1 Test products in conformance with CAN/ULC-S104 and listed by nationally

recognized agency having factory inspection services.

.2 Install labelled steel fire rated doors and frames to NFPA 80.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide product data: in accordance with Section 01 33 00 - Submittal Procedures.

.2 Provide shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.

.1 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, louvres, arrangement of hardware and fire rating and finishes.

.2 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings, fire rating and finishes.

.3 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.

.4 Submit test and engineering data, and installation instructions.

.3 Provide samples in accordance with Section 01 33 00 - Submittal Procedures.

.4 Submit one 305 x 305 mm corner sample of each type of frame.

.1 Show butt cutout, glazing stops, 305 mm long removable mullion connection and snap-on trim with clips.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer’s written instructions.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Hot dipped galvanized steel sheet: to ASTM A653M, ZF75 with a minimum zinc coating of 76 g/sq.m, and a minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.

.2 Reinforcement channel: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653M, ZF75.

.3 Composites: balance of core materials in accordance with manufacturers' proprietary design.

.4 Mineral fibre insulation: to CAN/ULC-S702.1, minimum density 24 kg/m3.

.5 Polyurethane: to CAN/ULC-S704.1 rigid, modified polyisocyanurate, closed cell board. Density 32 kg/m3.

2.2 DOOR CORE MATERIALS

.1 Honeycomb construction:

.1 Structural small cell, 24.5 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m^3 minimum sanded to required thickness.

.2 Stiffened: face sheets welded, insulated core.

.1 Vertically stiffen with steel ribs all insulated doors.

.2 Fill all voids with mineral fibre insulation

2.3 ADHESIVES

.1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.

.1 Adhesive: maximum VOC content 50 g/L to SCAQMD Rule 1168.

.2 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.

.3 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.

2.4 PRIMER

.1 Touch-up prime: Maximum VOC limit 50 g/L.

2.5 PAINT

.1 Field paint steel doors and frames in accordance with Sections 09 91 23 - Interior Painting. Protect weatherstrips from paint. Provide final finish free of scratches or other blemishes.

2.6 ACCESSORIES

.1 Door silencers: single stud rubber/neoprene type.

.2 Exterior top and bottom caps: steel.

.3 Metallic paste filler: to manufacturer's standard.

.4 Fire labels: metal rivited.

.5 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.

.6 Make provisions for glazing as indicated and provide necessary glazing stops.

.1 Provide removable stainless steel glazing beads for use with glazing tapes and compounds and secured with countersunk stainless steel screws.

.2 Design exterior glazing stops to be tamperproof.

.7 Glazing: in accordance with Section 08 80 00 - Glazing

.8 Electrical Hardware Accessories: Where electrified hardware is specified on the approved hardware schedule, provide plug-in connectors and wiring system consisting of CSA approved conduit, junction boxes and wire harness complete with modular plugs for coordinated connection directly to the electrified hardware. Refer to Section 08 71 10 – Hardware Schedule for openings that require electrified hardware.

2.7 FRAMES FABRICATION GENERAL

.1 Fabricate frames in accordance with CSDMA specifications.

.2 Fabricate frames to profiles and maximum face sizes as indicated.

.3 Exterior frames: 1.2 mm welded, thermally broken type construction.

.4 Interior frames: 1.6 mm welded type construction.

.5 Blank, reinforce, drill and tap frames for mortised, templated hardware, and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.

.6 Pre-wire door frames complete with CSA approved EMT metallic conduit and fittings for electrified hardware components where indicated on Door and Frame Hardware Schedule.

.7 Protect mortised cutouts with steel guard boxes.

.8 Prepare frame for door silencers, 3 for single door, 2 at head for double door.

.9 Manufacturer's nameplates on frames and screens are not permitted.

.10 Conceal fastenings except where exposed fastenings are indicated.

.11 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.

.12 Insulate exterior frame components with polyurethane insulation.

2.8 FRAME ANCHORAGE

.1 Provide appropriate anchorage to floor and wall construction.

.2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.

.3 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.

.4 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm on centre maximum.

2.9 FRAMES: WELDED TYPE

.1 Welding in accordance with CSA W59.

.2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.

.3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.

.4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.

.5 Securely attach floor anchors to inside of each jamb profile.

.6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.10 DOOR FABRICATION GENERAL

.1 Doors: swing type, flush, with provision for glass and/or louvre openings as indicated.

.2 Exterior doors: insulated, hollow steel construction. Interior doors: honeycomb construction.

.3 Fabricate doors with longitudinal edges welded. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.

.4 Doors: manufacturers' proprietary construction, tested and/or engineered as part of a fully operable assembly, including door, frame, gasketting and hardware.

.5 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.

.6 Pre-wire doors complete with CSA approved EMT metallic conduit and fittings for electrified hardware components where indicated on Door and Frame Hardware Schedule.

.7 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.

.8 Reinforce doors where required, for surface mounted hardware. Provide flush steel top caps to exterior doors. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.

.9 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.

.10 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in conformance with CAN/CSA-S104 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

.11 Manufacturer's nameplates on doors are not permitted.

2.11 DOORS: HONEYCOMB CORE CONSTRUCTION

.1 Form face sheets for interior doors from 1.6 mm sheet steel with honeycomb core laminated under pressure to face sheets.

2.12 HOLLOW STEEL CONSTRUCTION

.1 Form face sheets for exterior doors from 1.6 mm sheet steel.

.2 Form face sheets for interior doors from 1.6 mm sheet steel.

.3 Reinforce doors with vertical stiffeners, securely welded to face sheets at 150 mm on centre maximum.

.4 Fill voids between stiffeners of exterior doors with mineral fibre core.

.5 Fill voids between stiffeners of interior doors with honeycomb core.

2.13 THERMALLY BROKEN DOORS AND FRAMES

.1 Fabricate thermally broken doors by using insulated core and separating exterior parts from interior parts with continuous interlocking thermal break.

.2 Thermal break: rigid polyvinylchloride extrusion.

.3 Fabricate thermally broken frames separating exterior parts form interior parts with continuous interlocking thermal break.

.4 Apply insulation.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION GENERAL

.1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.

.2 Install doors and frames to CSDMA Installation Guide.

3.3 FRAME INSTALLATION

.1 Set frames plumb, square, level and at correct elevation.

.2 Secure anchorages and connections to adjacent construction.

.3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.

.4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.

.5 Caulk perimeter of frames between frame and adjacent material.

.6 Maintain continuity of air barrier and vapour retarder.

3.4 DOOR INSTALLATION

.1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions, Section 08 71 00 - Doors Hardware, and Hardware Schedule.

.2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.

.1 Hinge side: 1.0 mm.

.2 Latchside and head: 1.5 mm.

.3 Finished floor, non-combustible sill and thresholds: 13 mm.

.3 Adjust operable parts for correct function.

.4 Install louvres.

3.5 FINISH REPAIRS

.1 Touch up with primer finishes damaged during installation.

.2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.6 GLAZING

.1 Install glazing for doors and frames in accordance with Section 08 80 00 - Glazing.

3.7 CLEANING AND PROTECTION

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

.2 Upon completion of the work, remove all debris, equipment and excess material resulting from the work of this Section from the site.

.3 Waste Management: in accordance with Section 01 74 00 – Cleaning and Waste Management.

END OF SECTION

PART - 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 08 71 00: Door Hardware.

1.2 REFERENCES

.1 National Fire Protection Association (NFPA):

.1 NFPA 80-22, Standard for Fire Doors and Other Opening Protectives.

.2 NFPA 257-22, Standard on Fire Test for Window and Glass Block Assemblies.

.2 Underwriters' Laboratories of Canada (CAN/ULC):

.1 CAN/ULC-S104-20 (R2020), Standard Method for Fire Tests of Door Assemblies.

.3 American National Standards Institute (ANSI):

.1 ANSI Z97.1-2015 (R2020), Safety Glazing Materials Used in Buildings – Safety Performance Specifications and Methods of Test.

.4 Consumer Product Safety Commission (CPSC):

.1 CPSC 16 CFR 1201 Categories I and II: Safety Standard for Glazing Materials.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Shop Drawings: Submit shop drawings showing layouts, profiles and product components.

.3 Samples: Submit samples for finishes, colors and textures.

.4 Technical Information: Submit latest edition of manufacturer’s product data providing product description, technical data and installation instructions.

1.4 QUALITY ASSURANCE

.1 Pre-installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

.2 Listings and Labels: Fire rated framing and glazing shall be listed by an approved independent testing agency and maintain a current listing or certification. Assemblies shall be labelled in accordance with limits of listings.

.3 Testing Laboratory: Testing shall be conducted by an approved independent testing laboratory, accredited by the Standards Council of Canada.

.4 Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are classified and labelled to CAN/ULC-S104, for fire ratings indicated. Assemblies must be factory-welded or come complete with factory-installed mechanical joints and must not require job site fabrication.

.5 Fire rated glass: Each lite shall bear permanent, non-removable label certifying it for use in tested and rated fire protective assemblies, labeled and listed by ULC or other testing and inspecting agency acceptable to authorities having jurisdiction.

.6 Glazing material shall be certified to meet the requirements for fire rated and impact resistant assemblies referenced in ANSI Z97.1 and CPSC 16 CFR 1201 for Category II.

.7 Logo: Each piece of fire-rated glazing shall be labelled with a permanent listing mark including name of product, manufacturer, ULC testing laboratory, fire rating period, safety glazing standards, and date of manufacture.

1.5 **SYSTEM PERFORMANCE**

.1 Performance Requirements of the Assemblies: Fire Rating as indicated on the drawings.

.2 Listing/Certification: Fire-rated assemblies shall be tested in accordance with NFPA 80, 257, CAN/ULC-S104.

1.6 **DELIVERY, STORAGE AND HANDLING**

.1 Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

.2 Delivery: Deliver materials to specified destination in manufacturer's packaging undamaged, complete with installation instructions.

.3 Storage and Protection: Store off ground, under cover, protected from weather, direct sunlight, construction activities and at temperature conditions recommended by manufacturer, 0 degree C to 40 degree C.

.4 Handling: Protect materials and finish during handling and installation to prevent damage.

1.7 **PROJECT CONDITIONS**

.1 Field Measurements: Verify actual measurements for openings by field measurements before fabrication. Show recorded measurements on shop drawings. Coordinate field measurements and fabrication schedule with construction progress to avoid construction delays.

PART - 2 PRODUCTS

2.1 **SYSTEM DESCRIPTION**

.1 Fire-rated aluminum Full Vision, glazed doors and frames: extruded to be an integral system, including pre-finished doors, frames, glazing, and hardware.

2.2 **ALUMINUM FRAMING**

.1 Frame construction: Integral structure and glazing stops from extruded aluminum profiles, filled internally with cement composite material, pre-finished from factory.

.2 Dimensions: as indicated on the drawings

.1 Door framing face dimension: 63 mm.

.3 Assembly: Frame corners assembled by means of crimped and bonded miter joints.

.4 Sealing: Framing system shall insulate against effects of fire, smoke, and heat transfer from either side. Perimeter of the framing system to the rough opening shall be firmly packed with mineral wool insulation.

2.3 **MATERIALS – FIRE RESISTANT GLAZING**

.1 Assemblies shall be glazed with fire-rated, impact resistant, clear, wireless glazing material, listed for use in doors, sidelites, transoms, and borrowed lites.

.1 Listings/Approvals: to CAN/ULC-S104, NFPA 80, NFPA 257

.2 Impact Safety Resistance: ANSI Z97.1 and CPSC 16 CFR 1201 (Cat. II).

.2 Glazing material shall be optically clear, colorless and free from distortion.

2.4 **MATERIALS – GLAZING AND ASSEMBLY ACCESSORIES**

.1 Fasteners: All fasteners, setting pads, and glazing clips, shall be fabricated from Type 304 stainless steel.

.2 Glazing Accessories: The glazing material perimeter shall be separated from the perimeter framing system with approved flame retardant intumescent glazing tape. Ceramic setting blocks shall be placed between the metal setting pads and the glazing material. Setting pads and blocks provided by manufacturer.

2.5 **FABRICATION**

.1 Obtain reviewed shop drawings prior to fabrication.

.2 Fabrication Dimensions: Fabricate fire-rated assembly to field dimensions, in accordance with reviewed shop drawings, and within tolerance of +/- 3 mm.

.3 Factory prepared, fire-rated steel door assemblies to be pre-hung, prefinished with hardware preinstalled for field mounting.

.4 Field glaze door and frame assemblies.

.5 When necessary, splice frames too large for shop fabrication or shipping or to fit in available building openings.

2.6 **FINISHES**

.1 Framing shall be chemically cleaned and pretreated, then finished on all exposed areas:

.1 Anodized – Clear.

.2 Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

.3 Slight variations in appearance of abutting or adjacent pieces are acceptable. Noticeable variations in the same piece are not acceptable.

2.7 **DOOR HARDWARE**

.1 Hardware: supplied by fire-rated door and frame manufacturer.

.2 Refer to Finishing Hardware Schedule for additional requirements.

PART - 3 EXECUTION

3.1 **EXAMINATION**

.1 Examine area to receive doors. Openings shall be plumb, square and within allowable tolerances.

.2 Notify DCC Representative of conditions that would adversely affect installation or subsequent use. Do not proceed with installation until unsatisfactory conditions are corrected.

3.2 **INSTALLATION**

.1 Door installation shall be in strict accordance with the reviewed shop drawings and door manufacturer’s written instructions.

.2 Install hardware to comply with applicable fire and building codes and requirements of local authorities having jurisdiction over doors and hardware.

3.3 **ADJUSTING**

.1 Adjust door function and hardware for smooth operation. Coordinate with other hardware suppliers for function and use of any other attached hardware.

3.4 **PROTECTION AND CLEANING**

.1 Remove temporary coverings and protection of adjacent work areas.

.2 Protect glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove non-permanent labels, and clean surfaces.

.1 Do not clean with astringent cleaners. Use a clean “grit free” soft cloth and a small amount of mild soap and water or mild detergent.

.2 Do not use any of the following:

.1 Steam jets

.2 Abrasives

.3 Strong acidic, alkaline or fluoride detergents, or surface-reactive agents

.4 Detergents not recommended in writing by the manufacturer

.5 Organic solvents including but not limited to those containing ester, ketones, alcohols, aromatic compounds, glycol ether, or halogenated hydrocarbons.

.6 Metal or hard parts of cleaning equipment must not touch the glass surface

.3 Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

.4 Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

.5 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 – Cleaning and Waste Management.

END OF SECTION

PART - 1 GENERAL

1.1 REFERENCES

.1 American Society for Testing and Materials (ASTM):

.1 ASTM B36/B36M, Standard Specification for Brass Plate, Sheet, Strip, and Rolled Bar.

.2 ASTM B455, Standard Specification for Copper-Zinc-Lead Alloy (Leaded-Brass) Extruded Shapes.

.3 ASTM C1048, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass

.2 Canadian Standards Association (CSA):

.1 CSA-G40.20/G40.21, General requirements for rolled or welded structural quality steel / Structural quality steel.

.2 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

.3 CSA W47.1, Certification of Companies for Fusion Welding of Steel.

.4 CSA W59, Welded Steel Construction (Metal Arc Welding).

.3 Canadian General Standards Board (CGSB):

.1 CAN/CGSB-19.13, Sealing Compound, One-component, Elastomeric, Chemical Curing.

1.2 SUBMITTALS

.1 Product Data: Manufacturer's data sheets on each product to be used, including:

.1 Preparation instructions and recommendations.

.2 Storage and handling requirements and recommendations.

.3 Installation methods.

.2 Shop Drawings: Show construction, materials and finishes. Include elevations, sections, and installation details for each wall-opening condition, including anchor sealant installation. Indicate handing of the sliding windows.

.3 Include the following:

.1 Storefront systems Plans, elevations, and detail sections.

.2 Indicate materials, methods, finishes, and types of joinery, fasteners, anchorages, and accessory items. Specify finishes.

.3 Provide setting diagrams and templates for hardware, anchorages, sleeves, and bolts installed by others.

.4 Where materials or fabrications are indicated to comply with certain design loadings, include structural computations, material properties, and other information needed for structural analysis.

.4 Samples: Duplicate samples of materials, components and finishes to be used in the work, including samples of proposed jointing methods in aluminum framing.

.5 Maintenance instructions: Submit three (3) copies of a maintenance manual for inclusion in the Operations and Maintenance Manual. Give specific warning of any maintenance practice or materials which may damage or disfigure the finished work.

1.3 **QUALITY ASSURANCE**

.1 Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction.

.2 Source Limitations for Glass: Obtain each glass type through one source from a single manufacturer.

1.4 **DELIVERY, STORAGE, AND HANDLING**

.1 Store products in manufacturer's unopened packaging until ready for installation.

1.5 **PROJECT CONDITIONS**

.1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

.2 Field Measurements: Check openings by field measurement before fabrication to ensure proper fitting of work; indicate measurements on shop drawings.

1.6 **PROTECTION**

.1 Provide suitable means of protection to finished aluminum surfaces to prevent damage by mortar, plaster, jointing compound or similar deleterious substances and to prevent physical damage to finished surfaces.

1.7 **WARRANTY**

.1 Submit a 10 year warranty, commencing from date of Substantial Completion, against defects in the insulating glass units. Defects shall include but not necessarily limited to:

.1 Obstruction of vision as a result of dust or film formation on the internal glass surfaces and seal failure.

.2 Glass breakage, under design conditions, other than extrinsic glass breakage, but including breakage due to thermal shock and temperature differential due to inherent glass faults.

.2 Submit five (5) year warranty, commencing from date of Substantial Completion, against defects in the materials, products and workmanship of work of this Section and that it is structurally sound and free from distortion; that finishes will not develop excessive fading or non-uniformity of colour, and will not crack, peel or otherwise corrode; that glazing splines and sealant will be free from deterioration from oxidation, and will be free from permanent deformation under load.

PART - 2 PRODUCTS

2.1 **MATERIALS**

.1 All aluminum work: Comply with CSA HA Series.

.2 Aluminum: Extruded shapes of 6063-T5 alloy, sheet and plate of 1100-H14 alloy, anodizing quality.

.3 Aluminum framing members: Extruded 6063-T5 alloy, minimum wall thickness 1.6 mm.

.4 Aluminum Extrusions: Aluminum Association alloy AA 6063-T5, free from scratches and surface blemishes.

.5 Aluminum Sheet: Aluminum Association alloy AA 1100, free from all scratches and surface blemishes.

.6 Doors: Fabricated from extrusions having a minimum wall thickness of 3.2 mm, except that glazing mouldings shall not be less than 1.27 mm thick, welded construction, with the following dimensions:

.1 Door thickness: as shown on the Door Schedule.

.7 Frames and Screens: Extruded aluminum sections having a minimum wall thickness of 2.4mm suitably reinforced to ensure proper rigidity. Cross-section dimensions of frames for doors and screens shall be as detailed on Drawings, Bottom rail and centre rail of side lights shall match width of bottom rail and centre rail of door.

.8 Glazing Frames: Extruded aluminum, for indicated glass thickness.

.9 Steel Reinforcements: CAN/CSA-G40.20/G40.21-M, Grade 300 W.

.10 Screws, Bolts, Nuts, Washers and Other Fastening Devices: Stainless steel with not less than 12% chromium content to prevent galvanic action, and of sufficient strength for the purpose. Exposed screws or pop rivets are not acceptable.

.11 Zinc Chromate Primer: CAN/CGSB-1.40-M.

.12 Bituminous Paint: CAN/CGSB-1.108-M, Type 2.

.13 Hardware: Supply of finish hardware as listed in Hardware Schedule is provided under Finish Hardware Section 08 71 00 and the receiving, fitting, installation and leaving in good working condition under this Section.

.14 Sealants: Refer to Section 07 92 00, Joint Sealants.

.15 Sealant Bond Breaker: Open cell foam backer rod sized to suit project requirements.

.16 Insulation - packing in voids and cavities: Mineral fibre batt insulation conforming to CAN/ULC-S702, Type 1.

2.2 **GLASS AND GLAZING**

.1 Refer to Section 08 80 00.

2.3 **FABRICATION**

.1 Execute fitting and assemblies in the shop with the various parts or assemblies ready for erection at the building site.

.2 Take field measurements and levels required to verify or supplement those shown on the Drawings for the proper layout and installation of the work. Co-ordinate dimensional tolerances in adjacent building elements and confirm prior to commencement of work.

.3 Fabricate members with wall thicknesses to provide for design loads and allowable deflections, to meet engineering design requirements.

.4 Shop fabricate frames of extruded aluminum sections, to profiles and sizes shown. Design sections to accommodate expansion and contraction. Form accurate extrusions with clean, straight, sharply defined profiles free from any defects.

.5 Match components carefully to produce perfect continuity of line and design. Metal in contact shall have hairline joints unless otherwise shown on the approved shop drawings. Location of exposed joints shall be subject to the approval of the DCC Representative. No exposed fixings are permitted.

.6 Make allowances for the deflection of the structure.

.7 Weld aluminum by welders qualified under CSA W47.2. Do welding with inert metal arch equipment and methods recommended by the Aluminum Co. of Canada. Make exposed welds continuous and flush with adjacent surface.

.8 Weld steel in accordance with CSA W59 by welders qualified under CSA W47.1. Welded joints shall be of adequate strength and durability with jointing tight and flush.

.9 Reinforce work by concealed means as necessary.

.10 Provide devices for anchoring assemblies to the building structure with sufficient adjustment to permit correct and accurate alignment.

.11 Include anchors, dowels and fastenings shown or necessary to anchor the work together or to the work of the other Sections. Supply items and inserts required to be built into the work of respective Sections. Provide instructions for proper location.

.12 Nuts, bolts, screws, clips and other means of fastening shall be concealed in the finished work.

.13 Sizes of glass doors and screens are as indicated.

.1 Fabricate holes and cutouts to receive hardware before tempering glass. Do not permit cutting, drilling or other alterations to glass after tempering.

.2 Fabricate work to accommodate required fittings, hardware, anchors, reinforcement, and accessory items.

.14 Continuity: Maintain accurate relation of planes and angles, with hairline fit of contacting members.

.15 No manufacturer's names, plates, labels or any other means of identification will be permitted on any of the finished units or hardware.

2.4 **FABRICATION - GLAZING**

.1 Glass: Each unit bearing manufacturer's label indicating quality and thickness.

.2 Insulating glass units, Tempered Safety Glass and Laminated Glass: as specified in Section 08 80 00, Glazing.

.3 Accurately size glass to fit openings allowing clearances following trade practices. Cut glass clean and carefully; nicks, damaged edge conditions will not be accepted. Replace all glass with nicked or damaged edges.

2.5 **FABRICATION - ALUMINUM FRAMES**

.1 Construct frames of aluminum extrusions with minimum wall thickness to suit performance requirements.

.2 Provide supplemental steel reinforcement in the frame to suit design loads.

2.6 **FABRICATION - ENTRANCE DOORS**

.1 Accurately join and fit to flush hairline joints, corners of doors and weld along the concealed lines of contact.

.2 Thoroughly penetrate material with weld to produce complete fusion of metal between stiles and rails. Mechanically joined corners or those developed by tie rods or superficial welding will not be permitted.

.3 Use interlocking type glazing beads with no exposed screws.

.4 Fit each door leaf with an adjusting mechanism located in top rail near lock stile, permitting minor clearance adjustments after installation.

.5 Preparation for Hardware: Accurately prepare and reinforce with backing plates to ensure adequate strength, cutouts, recesses and mortising required for hardware. Take delivery of hardware from Section 08 71 00, Finish Hardware, in addition to finish hardware required to be supplied with the work of this Section to complete installation.

2.7 **FINISHES**

.1 Architectural Anodic Finish: Clear Anodic Finish, Architectural Class I, clear coating 0.70 mils minimum.

.1 Applicator must be fully compliant with all applicable environmental regulations and permits, including wastewater and heavy metal discharge.

.2 Galvanizing:

.1 Ensure steel is blast cleaned and hot dip galvanized in accordance with ASTM A123/A123M, minimum coating designation of 610 g/m². Thread dimensions to be such that nuts will thread over bolts without rethreading or chasing galvanized threads.

.2 Galvanize after fabrication where possible. Follow standard precautions to avoid brittlement of the base metal by overpickling or overheating during galvanizing.

.3 Touch-Up Primer for Galvanized Steel Surfaces: SPCC Paint 20 zinc rich.

PART - 3 EXECUTION

3.1 **EXAMINATION**

.1 Verification of Conditions: Examine areas and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.

.2 Do not begin installation until substrates have been properly prepared.

.3 If substrate preparation is the responsibility of another installer, notify DCC Representative of unsatisfactory preparation before proceeding.

3.2 **PREPARATION**

.1 Do not commence work until shop drawings and samples are reviewed.

.2 Remove existing work, dust, debris and other loose materials from openings.

.3 Provide steel supports for work of this Section.

.1 Comply with Landlord Regulations, if drilling of concrete, masonry and steel is necessary to install the work of this Section.

.4 Apply a heavy brush-coat of back paint to aluminum or galvanized steel placed in or in contact with concrete, masonry, mortar or dissimilar metals.

.5 Erection tolerances for operable elements: Consistent with smooth operation.

3.3 **INSTALLATION**

.1 Install work of this Section in accordance with manufacturer's instructions.

.2 Apply specific torques to bolts to ensure satisfactory performance.

.3 Provide structural steel framing and supports required to support work of this Section unless indicated to be supplied under other Sections.

.4 Set work of this Section plumb, square, level at correct elevation and in alignment with adjacent work. Anchor securely. Brace work rigidly for building-in.

.5 Accurately fit frames to provide weathertight installation and provide clearances required due to expansion, contraction and deflection of building structure and frames.

.6 Install sills, drips, flashings, cover plates, weatherstripping and all other items, shown, specified or necessary for a complete installation.

.7 Provide packing insulation in voids between framing members and adjacent constructions and where detailed.

.8 After adjustment the anchorage devices shall be rivetted, welded or positively locked to prevent movement once alignment is achieved.

.9 Assume all responsibility for the design of the assembly, reinforcing and anchoring to suit each specific condition complying with the requirements specified herein and as shown on the reviewed shop drawings.

.10 Fabricate and install glass in accordance with manufacturer's instructions.

.11 Use spacers, setting blocks and shims of proper size to support and hold glass in position.

.12 Free rabbets, stops and glass edges of dust, dirt, moisture, oil and other foreign matter detrimental to glazing material adhesion. Ensure drainage holes are not blocked.

.13 Place two setting blocks under each unit at quarter points. Place spacers on all edges of glass, located directly opposite each other when on both sides of the glass, located at maximum 600 mm centres and maximum 300 mm from corners and uniformly spaced.

.14 Install performed tape to ensure complete contact on surface of glass and stops. Make joints only at corners of sash or frame. Cut tape to fit close around spacers. Fit tape accurately with tight joints, free from tension, gaps and cracks.

.15 Set glass properly centred with uniform bite and face and edge clearance, free from twist, warp or other distortion likely to develop stress. Seal glass joints with full bead of sealant.

.16 Ensure water and air tight seal for glass between glazed element and frame is flush with sight line.

.17 Perform glazing only when the temperature is above 5 degree C.

3.4 **INSTALLATION - SEALANT**

.1 Seal all joints between work of this Section and adjacent surfaces, with sealant to provide a completely weathertight enclosure. Apply joint backing to achieve correct joint depth and shape in accordance with manufacturer's instructions.

.2 Mix, apply and cure sealant in strict accordance with manufacturer's instructions. Apply sealant to clean, dry, grease and oil free surfaces.

.3 Apply sealant in continuous full beads, using gun with proper size nozzle and sufficient pressure to fill voids and joints solid.

.4 Form surfaces smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.

.5 Tool exposed surfaces to slightly concave shape.

.6 Remove excess compound promptly as work progresses and upon completion.

3.5 **ADJUSTMENTS**

.1 Upon completion of the project and just prior to handing over of the building to DCC Representative or at a time as directed, inspect, test and adjust installation.

.2 Test all operable elements and ensure easy and smooth operation.

.3 After alignment, positively lock anchorage devices to prevent movement other than that designed to accommodate deflection and thermal expansion and contraction.

3.6 **CLEANING**

.1 At completion of work, remove debris from site.

.2 Clean glass and polish metal surfaces.

END OF SECTION

PART - 1 GENERAL

1.1 SUBMITTALS

.1 Shop Drawings:

.1 The hardware specialist shall prepare and submit shop drawings containing a completely itemized schedule of hardware for review. The schedule of hardware shall list all doors by number (in sequence) and location with complete details of the hardware to be supplied, including installation, location and mounting heights of each type of hardware, and special instructions. Format of schedule to be approved.

.2 The schedule of hardware shall incorporate the catalogue numbers of hardware as specified.

.3 The Contractor shall furnish copies of final reviewed shop drawings to the doors and frames fabricators and to the door and hardware installers.

.2 Product Data:

.1 Manufacturer's specifications and technical data including catalogue cut sheets on each item of hardware. Annotate manufacturer's model numbering systems to explain meaning.

.3 Wiring Diagrams: Include complete wiring diagrams indicating all component parts, disconnect switches, conduit, and voltage requirements provided under other Sections, and required to operate assembly.

.4 Samples: The hardware specialist shall submit complete samples of hardware items for review.

.5 Templates: The hardware specialist promptly furnishes templates and information necessary for proper preparation or doors and frames and for the installation of hardware to the doors and frames fabricator and to the doors and hardware installer, in ample time to facilitate the progress of the work.

.6 Furnish manufacturers' instructions for proper installation of each hardware component.

.7 Closeout Submittals:

.1 Warranty documents executed by manufacturer’s authorized official.

.2 Operation and Maintenance data: Prior to Date of Substantial Completion, hand over to DCC Representative, a manual containing a final "as built" hardware schedule, full instructions for the adjustment, maintenance, spare part list etc. of all hardware items, together with special keys, wrenches etc. required to carry out normal adjustments to hardware. Include methods for maintaining installed products and precautions against cleaning materials and methods detrimental to finishes and performance.

.8 Certification: Prior to date of Ready-for-Takeover, have the hardware specialist provide a letter which certifies that the hardware has been furnished and installed in accordance with hardware manufacturer’s instructions and in accordance with requirements of Contract Documents.

1.2 QUALITY ASSURANCE

.1 Conduct pre-installation meeting to verify project requirements, manufacture’s installation instructions and manufacturer’s warranty requirements.

.2 Have the supervision, administration and servicing of the work of this Section performed by a hardware specialist certified as an Architectural Hardware Consultant (AHC) or person of equivalent experience.

.3 Have the hardware installer fully cooperate with the hardware specialist to ensure doors and hardware are properly and securely installed and that the installed doors and hardware are functioning properly.

1.3 **INSPECTION AND SUPERVISION**

.1 The hardware specialist shall examine the Drawings, Hardware Schedules and shop drawings to determine final dimensions, sizes and quantity of the hardware items required, ensure that the hardware listed shall fit and operate properly and make adjustments to the hardware at no extra cost to DCC Representative.

.2 The hardware specialist shall obtain electrical characteristics of the security and fire alarm systems from the electrical Subcontractor and furnish electrically operated hardware which suits the electrical characteristics and wiring connection requirements at no extra cost to the Contract.

.3 The hardware specialist shall obtain and examine shop drawings for doors and frames to ensure proper provisions and preparations for hardware are made.

.4 The hardware specialist shall make periodic inspections of the hardware and door installations, report improper and unsatisfactory conditions and expedite the replacement or correction of faulty hardware.

.5 The hardware specialist and the door and hardware installer shall attend job site meetings when so requested.

1.4 **LABELLING, PACKAGING, DELIVERY AND STORAGE**

.1 Deliver and store each hardware item in the manufacturers' original containers. The containers shall be clearly labelled as to content and door on which the hardware is to be installed, in accordance with the shop drawing schedule of hardware.

.2 The hardware specialist shall be responsible for ensuring the timely delivery of hardware so that all on site work progresses without delay and interruptions.

.3 Store hardware in a locked storage room in the building. Lay out all hardware in an organized manner on shelves.

.4 Stockpile items sufficiently in advance to ensure their availability and make all necessary deliveries in a timely manner to ensure orderly progress of the total Work.

.5 Store items in such a manner to allow easy access to each hardware item/group as needed without significantly disrupting storage arrangement.

.6 Review shipments at time of arrival on the site to ensure agreement with respect to items shipped and received, quantity, back ordered or short-shipped items, and adherence to hardware schedule.

1.5 **PROJECT CONDITIONS**

.1 Maintain environmental conditions (temperature, humidity and ventilation) within limits recommended by manufacturer for optimum results. Do not install product under environmental conditions outside manufacturer’s absolute limits.

1.6 **EXTENDED WARRANTY**

.1 Fully warrant exit devices, locksets, latchsets and door closers for a period of five (5) years from the date of Substantial Completion of the Project.

.2 The warranty shall state expressly that all hardware will be replaced on the doors and frames at no cost to the Contract in the event of breakage or other defect occurring, willful damage excluded.

PART - 2 PRODUCTS

2.1 HARDWARE SCHEDULE AND ALTERNATIVES

.1 Door Hardware schedule is appended to this Section.

.2 While certain manufacturer's catalogue numbers are used in the schedule of finishing hardware, it is not the intent that these items are specified exclusively. The manufacturer's numbers are used to denote minimum quality, style, design function, finish.

.3 Other manufacturer's products may be used providing the items are equal in all respects to the items specified.

.4 If requested, the Hardware Contractor shall submit a complete physical sample of each hardware type for review prior to the preparation of shop drawings. All hardware delivered to the job sites shall be equal in all respects to the accepted sample.

.5 List all manufacturer's names and complete catalogue number of all alternative hardware types proposed for supply and submit this list for review before preparing shop drawings.

.6 DCC Representative’s decision on the quality of proposed alternative products shall be final.

.7 Any proposed item that in the opinion of DCC Representative is not equal to the item specified will be rejected and the supplier shall be required to supply items equal to the one specified at no extra cost.

2.2 MATERIALS

.1 General:

.1 Hardware shall be as specified in the Door Hardware Schedule prepared under the direction of DCC Representative and as specified in this Section.

.2 Installed hardware shall comply with applicable fire and building codes and requirements of local authorities having jurisdiction over doors and hardware.

.3 All hardware applied to metal doors and frames shall be made to template.

.4 Supply hardware complete with all necessary screws, bolts and other fastening of suitable size and type to anchor the hardware in position neatly and properly in accordance with the best practices and to DCC Representative’s approval.

.5 All fastenings shall harmonize with the hardware as to materials and finishes.

.6 Hardware for fire rated and labelled door and frame assemblies: ULC listed or as accepted by authorities having jurisdiction.

.7 Finish on all stainless steel items (C32D) shall be equal to No. 4 finish.

.2 Hinges:

.1 Hinges for exterior doors shall be non-ferrous metal parts so that rust will not bleed from the bearing or other parts. Screws shall be provided in stainless steel.

.2 Where specified, provide hinges with non-removable pins or with safety stud feature to prevent doors being removed from frames even if pins are removed.

.3 Stamp hinge catalogue numbers on face of leaf of each hinge at factory to enable easy recognition of hinge material and manufacture after doors are hung.

.4 Where doors are required to swing to 180 degrees, furnish hinges of sufficient throw to clear trim.

.5 Furnish non-removable pins at out-swinging exterior doors.

.6 Supply concealed wired electric hinges with ULC label. Hinges to have 8 wires.

.7 Supply continuous hinges as indicated in the Hardware Schedule.

.3 Locks and Latches:

.1 Provide and install all locks and latches exactly as specified, complete with cylinders.

.2 Strikes shall be ANSI standard size with curved lip strikes for latch bolts and no lip strikes for dead locks. Provide complete with wrought boxes finished to match strike.

.3 Electric locks: as indicated in the Hardware Schedule.

.4 Exit Devices:

.1 All exit devices installed on labelled fire doors shall bear the ULC Label.

.2 Through bolts complete with sleeves for mineral core doors.

.3 Coordinate exit devices with astragals, coordinators, carry open bars and thresholds for correct and safe operation.

.5 Keying:

.1 All locks and exit devices with cylinder operation shall be keyed alike for construction. Provide 4 change keys for each lock.

.2 Permanent keying by DCC Representative at project completion.

.6 Closers:

.1 All door closers shall be hydraulically controlled and full rack and pinion in operation.

.2 Each closer shall have adjustable general speed, latch speed and back check control.

.3 The swing power of door closers shall be adjustable.

.4 Supply to the DCC Representative special closer keys and wrenches as usually packed with closers.

.5 Install all necessary attaching brackets, mounting channels, cover plates, etc. where necessary for correct application of door closers.

.6 Closers to have parallel arms at out swinging exterior doors and at interior doors where specified.

.7 Coordinate closers with overhead holders.

.8 Through bolts complete with sleeves for mineral core doors.

.7 Thresholds:

.1 Provide and install thresholds exactly as specified in required widths and lengths to suit door openings.

.2 The ends of the thresholds shall be cut to follow exactly the door frame profile.

.3 All thresholds shall be supplied in aluminum and installed complete with lead shields and stainless steel screws.

.8 Push Plates and Kickplates

.1 Provide and install stainless steel plates in C32D finish and install secure with screw fastening.

.2 Length of kick plates shall be 40 mm less than door width for single doors and 19 mm less than door width for doors in pairs.

.3 All stainless steel plates are to be 1.3 mm thick, free of rough or sharp edges. Corners and edges to be slightly radiuses. Install kick plates and armor plates on both sides of the door with 3M tape.

.4 Engrave pushplates with pictographs as noted in hardware schedule.

.9 Door Push/Pulls:

.1 Where door pulls are scheduled on one side of door and push plates on other side issue installations instructions to ensure that the pull is secured through door from reverse side and countersunk flush with door installation of push plate. Locate push plate to cover fasteners for door pulls.

.10 Door Stops:

.1 Wall stops shall not be installed on drywall partitions.

.2 Floor stops shall be installed so as not to create a tripping hazard and allows maximum opening of doors.

.3 Furnish door stops of height to engage doors.

.11 Door Seals:

.1 Provide and install door seals, top door sweeps and astragals.

.12 Electronic Hardware Items:

.1 Ensure electrical characteristics are compatible with card readers and related security systems provided by other Sections.

.2 Obtain electrical power and wiring characteristics from the Electrical Subcontractor and provide the hardware to suit.

.3 Power Door Operators: Install operators by skilled trade persons who have been specifically trained in the installation and operation of these devices by a manufacturer's factory representative.

.4 All wiring shall be supplied and installed by Division 26 including conduit, boxes and other electrical appurtenances, including connection and termination.

.5 Be responsible for ensuring that all wiring work is performed at appropriate times to coordinate with installation of frames, doors and finish hardware. It is also responsible for ensuring that all electrical work is done in accordance with electronic hardware manufacturer's wiring diagrams and directions and that boxes, cut-outs, connections etc. are installed properly.

.6 Arrange for testing and commissioning of electronic finish hardware by manufacturer or system. Submit a copy of reports to DCC Representative.

.13 Miscellaneous Accessories:

.1 All other items, not specifically described in this Section or in the Hardware Schedule but required for complete and proper installation of finish hardware, shall be as selected by Hardware Supplier subject to approval of DCC Representative.

.14 Hardware Finish Codes:

	BHMA	Canadian Code	US Code	Description
.1	600	CP	USP	Primed for Paint
.2	602	C2C	US2C	Cadmium Plated
.3	603	C2G	US2G	Zinc Plated
.4	605	C3	US3	Brightened Brass, Clear Coated
.5	606	C4	US4	Satin Brass, Clear Coated
.6	612	C10	US10B	Satin Bronze, Clear Coated
.7	613	C10B	US10B	Oxidized Satin Bronze Oil Rub
.8	619	C15	US15	Satin Nickel Plate, Clear Coat
.9	625	C26	US26	Bright Chromium Plated
.10	626	C26D	US26D	Satin Chromium Plated
.11	627	C27	US27	Satin Aluminum Clear Coated
.12	628	C28	US28	Satin Aluminum Clear Anodize
.13	629	C32	US32	Polished Stainless Steel
.14	630	C32D	US32D	Satin Stainless Steel
.15	671	AL		Black Anodized
.16	689	SBL, AL	US28	Aluminum Paint
.17	690	DBL, STAT	US20	Dark Bronze Paint
.18	691	ES, SB		Bronze Lacquer
.19	692	TAN		Tan Lacquer
.20	693	KPD, BLACK		Black Lacquer
.21	696	EAB, SB		Satin Brass Lacquer

.15 Keying symbol/codes:

.1	GMK	Grand Master Keyed
.2	MK	Master Keyed
.3	KA	Keyed Alike
.4	KD	Keyed Different
.5	SK	Separate Key (no masters)

.16 Hardware codes:

.1	LH	Left Hand
,2	RH	Right Hand

.3	LHR	Left Hand Reverse
.4	RHR	Right Hand Reverse
.5	LHA	Left Hand Active
.6	RHA	Right Hand Active
.7	LHRA	Left Hand Reverse Active
.8	RHRA	Right Hand Reverse Active
.9	SGL,SGLE	Single
.10	PR	Pair
.11	D/A	Double Acting
.12	O/S	Opposite Swing
.13	D/E	Double Egress
.14	DR	Door
.15	FR	Frame
.16	HM	Hollow Metal
.17	AL	Aluminum
.18	PS	Pressed Steel
.19	P/LAM	Plastic Laminate
.20	KAL	Kalamein
.21	HMD	Hollow Metal Door
.22	HMF	Hollow Metal Frame
.23	CIF	Channel Iron Frame
.24	PSF	Pressed Steel Frame
.25	WD	Wood
.26	WD/DR	Wood Door
.27	WD/FR	Wood Frame
.28	CYL	Cylinder
.29	H/O	Hold Open
.30	O/H	Overhead
.31	U/C	Undercut
.32	B/S	Back Set
.33	NRP	Not Removable Pin
.34	TB	Thru Bolts
.35	CTB	Countersunk Thru Bolts
.36	TMS	Template Machine Screws
.37	MS	Machine Screws

.38	STS	Self Tapping Screws
.39	WS/LS	Wood Screws & Lead Shields
.40	TRR	Labeled for Temperature Rise Rating.
.41	A Label, 3 Hour Label or 180MFR	Labeled for 180 minutes (3 hour) Fire Protection Rating.
.42	B Label, 1-1/2 Hour Label or 90 MFR	Labeled for 90 minutes (1-1/2hour) Fire Protection Rating.
.43	C Label, 3/4 Hour Label or 45 MFR	Labeled for 45 minutes (3/4 hour) Fire Protection Rating.
.44	20 MIN Label or 20 MFR	Labeled for 20 minutes Fire Protection Rating.

PART - 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: Examine doors, frames, related items and conditions under which work of this section is to be performed and identify conditions detrimental to proper and timely completion.

.1 Do not proceed until unsatisfactory conditions have been corrected.

.2 Confirm kickplate and threshold sizes before ordering.

3.2 INSTALLATION

.1 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide to Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association, except as otherwise indicated in this Section and elsewhere in the Contract Document.

.2 Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

.3 Where door stop contacts door pulls, mount stop to strike bottom of pull.

.4 Barrier Free Access: Mount all hardware in full conformity with authorities having jurisdiction. Confirm mounting heights with DCC Representative prior to commencement of frame and door preparation.

.5 Install all miscellaneous hardware as shown on details and specified.

.6 Do not use wall stops on gypsum board and moveable partitions.

.7 Mineral core doors: Pre-drill 3 mm diameter pilot holes for all hardware items. Manually turn fasteners into pilot holes. If installer does not follow this method, it may void door manufacturer warranty.

.8 Provide even margins between doors and jambs and doors and flooring and/or thresholds as follows:

.1 Hinge side: 1.6 mm.

.2 Latchside and head: 1.6 mm.

.3 Flooring and/or thresholds: 12 mm.

.4 Flooring, fire rated assemblies: 6 mm.

3.3 **HARDWARE MOUNTING HEIGHTS**

.1 Install and mount hardware as follows:

.1 Door knobs and lever: 965 mm centre line from finish floor

.2 Deadlock cylinder: 1370 mm centre line from finish floor

.3 Deadlatch cylinders: 1370 mm centre line from finish floor

.4 Door pulls: 1069 mm centre line from finish floor

.5 Push plates: 1090 mm centre line from finish floor

.6 Push bars: 1069 mm centre line from finish floor

.7 Top hinges: 125 mm down from top of door to top of hinge

.8 Bottom hinges: 250 mm up from finish floor to bottom of hinge

.9 Intermediate hinges: equally spaced between top and bottom hinges

.10 Floor stops: maximum 150 mm from lock edge when door is in fully open position

.11 Exit devices: to manufacturer's instructions

.12 Kickplates: maximum 3 mm from bottom of door to bottom of kickplate

3.4 **ADJUSTING AND CLEANING**

.1 Clean hardware with materials and methods as recommended by hardware manufacturer. Repair or replace defective hardware.

.2 Remove protective material where present.

.3 Adjust operable parts for correct function.

.4 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

DOOR HARDWARE SCHEDULE

08 71 10

PROJECT: Government of Canada

Royal Military College of Canada
R13 Elevator Replacement & Barrier Free Upgrades
Kingston, ON

ARCHITECT: NORR

Prepared By: Cameron Gibson
Date: March 14, 2025
Revised: September 22, 2025
September 25, 2025
March 23, 2026 IFT

SPYDER SC
26 Dale Crescent, Cookstown, Ontario, L0L 1L0
spydersc.com
647-271-6489
cameron.gibson@spydersc.com

Architectural Hardware Finishes



Door Handing's

Abbreviations

RH = Right Hand	RHA = Right Hand Active	SS = Single Slider
LH = Left Hand	LHA = Left Hand Active	BP = Bi-Parting Slider
RHR = Right Hand Reverse	RHA/LHA = Right & Left Hands Active	BF = Bi-Folding Slider
LHR = Left Hand Reverse	RHRA/LHRA = Right & Left Hand Reverse Active	TS = Telescopic Slider
RHRA = Right Hand Reverse Active	DA = Double Acting	PKT = Pocket Slider
LHRA = Left Hand Reverse Active	DE = Double Egress	

NOTE: The handing of a swing door is determined by placing yourself on the secured or keyed side of the door.

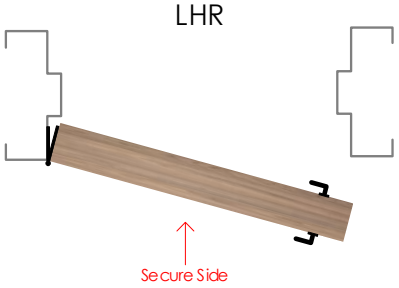


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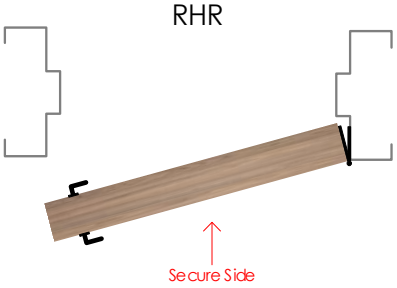


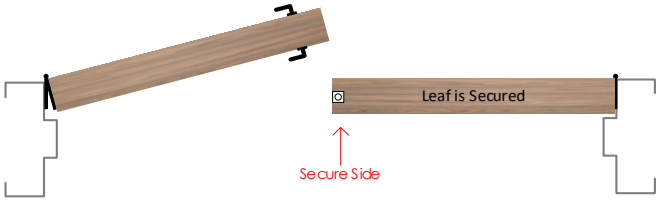
RH

LHR

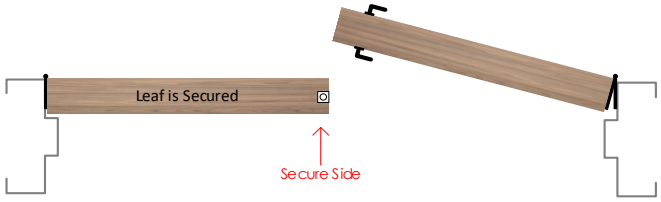


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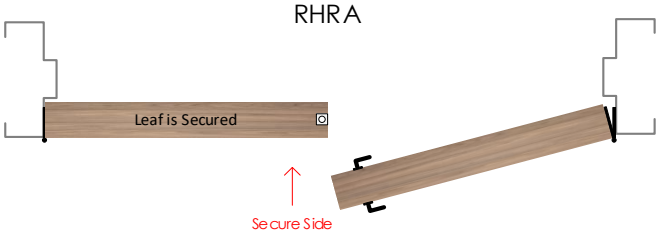


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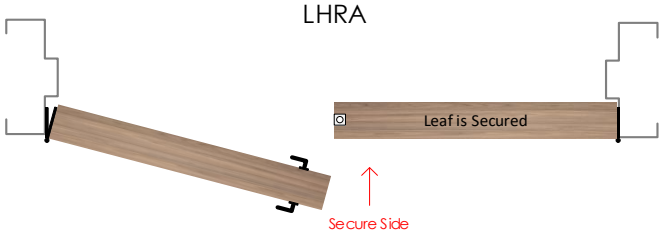


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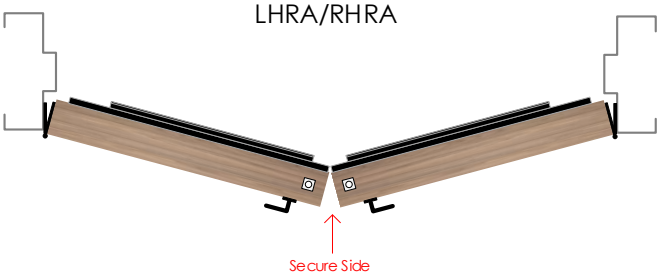
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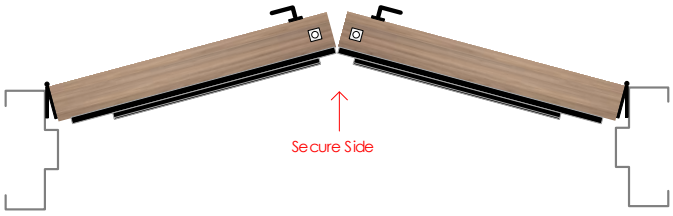


LHRA



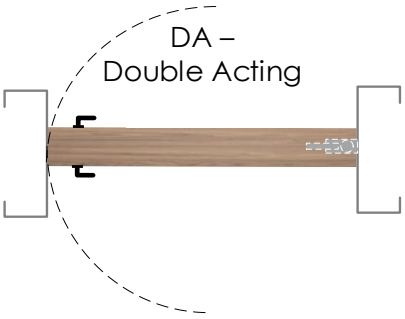
LHRA/RHRA





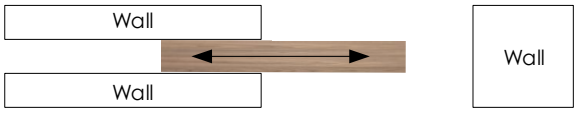
LHA/RHA

DA – Double Acting





DE- Double Egress



PKT- Pocket Door



SS- Single Sliding Door



BP- Bi Parting Sliding Door



BPS- Bi Passing Sliding Door

Products & Alternatives

Product Type	Product#	Manufacturer	Alternate Manufacturer 1	Alternate Manufacturer 2
Butt Hinge	TA314	McKinney	Hager	Stanley
Continuous Hinge	FM-HD1	Pemko	Hager	Select
Continuous Hinge	CFM_SLF-HD1	Pemko	Hager	Select
Mortise Lockset	8200 Series	Sargent	Schlage	Best
Door Closer	1431 Series	Sargent	LCN	Dormakaba
Door Closer	351-P10	Sargent	LCN	Dormakaba
Door Closer Mounting Plate	351-D	Sargent	LCN	Dormakaba
Overhead Stop	6ADJ	Rixson	Glynn Johnson	ABH
Overhead Stop	1ADJ	Rixson	Glynn Johnson	ABH
Kickplate	CBH903	CBH	Gallery	Standard Metal
Door Pull	CBH 6039	CBH	Gallery	Standard Metal
Smoke / Sound Seal	W-66	KN Crowder	Draft Seal	Standard Metal
Door Sweep	W-24S	KN Crowder	Draft Seal	Standard Metal
Astragal Set	W-25	KN Crowder	Draft Seal	Standard Metal
Exit Device	PE80 Series	Sargent	Von Duprin	Precision
Electric Strike	1500C	HES	Dormakaba	Von Duprin
Auto Operator	SW200i	Besam	Dormakaba	Tormax
Push / Wave Column Switch	CM-7436VR/2	Camden	BEA	
Exterior Push / Wave Switch	CM-7436VR/2-WT	Camden	BEA	
Jamb Mounted Key Switch	CM-170/22	Camden	BEA	
Logic Relay	CX-33	Camden	BEA	
Power Transfer	EL-CEPT	Securitron	Von Duprin	ABH
ElectroLynx Cable	QC-C003	McKinney	Von Duprin	
ElectroLynx Cable	QC-C1500	McKinney	Von Duprin	
Door Position Switch	DPS-M-GY	Securitron	Schlage	Dormakaba
Power Supply	LSP-12-24	Sargent	Schlage	Dormakaba
Magnetic Lock	M62BD	Securitron	Schlage	Dormakaba

Symbols



- Door has a fire rating and all associated hardware must have a fire label to suit. Must comply with local requirements.



- Door is automatic and is equipped with an auto operator. Door must meet local barrier free codes



- Door has an electrical requirement and requires power to be brought to the appropriate location above the door or to the latch, for either security or barrier free applications. Refer to security & electrical drawings for further information.



- Door requires security card access. Refer to security / electrical drawings for further information.

Abbreviations

Door:

HMD = Hollow Metal Door
IHMD = Insulated Hollow Metal Door
ALD = Aluminum Door
SSD = Stainless Steel Door
ISSD = Insulated Stainless Steel Frame
STL = Steel Door
IC-ALD = Insulated Clad Aluminum Door
SCWD = Solid Core Wood Door
HCWD = Hollow Core Wood Door
FGD = Frameless Glass Door
FRP = Fiberglass Reinforced Plastic Door
OHD = Overhead Door

Frame:

HMF = Hollow Metal Frame
ALF = Aluminum Frame
Cased Open HMF = Cased Open Hollow Metal Frame
SSF - Stainless Steel Frame
STL = Steel Frame
WDF = Wood Frame
Cased Open WDF = Cased Open Wood Frame
Cased Open Drywall = Cased Open Drywall

Fire Ratings:

0 HR – Zero Hour Fire Rating / Smoke Barrier
20 MIN – 20 Minute Fire Rating
¾ HR – 45 Minute Fire rating
1 ½ HR – 90 Minute Fire Rating
2 HR – 120 Minute Fire Rating
3 HR – 180 Minute Fire Rating

Disclaimer

Weblinks:
Weblinks do change from time to time as manufacturers move around their websites, please inform us if you have a none functioning weblink.

HARDWARE SCHEDULE

Fire Rated

Heading# 1

Opening Information					
Opening Type:	Single	**Opening Size:**	965 x 2134 x 45	**STC Rating**	None
Door Material:	HMD	**Frame Material:**	HMF	**Fire Rating**	1 1/2 HR

1	**Total Openings**							
1	**Door#**	D001	**Location:**	Elev. Vest. 003	From	Elev. Mech. RM. 001	**Handing:**	LHR

By Hardware Supplier					
3	Butt Hinge	TA314 – 127 x 114 x NRP	630 / US32D / Satin Stainless Steel	McKinney	
1	Storeroom Lockset	21-8204-LNL	630 / US32D / Satin Stainless Steel	Sargent	
1	Closer	1431-P9	689 / US28 / Painted Aluminum	Sargent	
1	Overhead Stop	6ADJ-336	630 / US32D / Satin Stainless Steel	Rixson	
1	Smoke / Sound Seal	W-66 x 5235	Black	KN Crowder	
1	Door Sweep	W-24S x 965	628 / US28 / Clear Anodized	KN Crowder	
By Owner					
1	Permanent Medeco Cylinder	By Owner		Medeco	

End of Heading



Heading# 2

Opening Information					
Opening Type:	Pair	**Opening Size:**	2-965 x 2134 x 45	**STC Rating**	None
Door Material:	ALD	**Frame Material:**	ALF	**Fire Rating**	3/4 HR

1	**Total Openings**							
1	**Door#**	D002	**Location:**	Stair No. 1 002	From	Elev. Vest. 003	**Handing:**	LHR/RHR

By Hardware Supplier					
2	Continuous Hinge	CFM_SLF-HD1 x 2108	628 / US28 / Clear Anodized	Pemko	
2	Narrow Stile Concealed Vertical Rod Exit Device	12-NB-AD-PE8415-J-NEL	630 / US32D / Satin Stainless Steel	Sargent	
2	Closer	351-P10	689 / US28 / Painted Aluminum	Sargent	
2	Overhead Stop	1ADJ-336	630 / US32D / Satin Stainless Steel	Rixson	
2	Kickplate	CBH903 x 203 x 927 x 3M TAPE	630 / US32D / Satin Stainless Steel	CBH	
2	Kickplate	CBH903 x 203 x 940 x 3M TAPE	630 / US32D / Satin Stainless Steel	CBH	
1	Smoke / Sound Seal	W-66 x 6200	Black	KN Crowder	
2	Door Sweep	W-24S x 965	628 / US28 / Clear Anodized	KN Crowder	
1	Astragal Set	W-25 x 2134	628 / US28 / Clear Anodized	KN Crowder	

End of Heading







Heading# 3

Opening Information					
Opening Type:	Pair	**Opening Size:**	2-965 x 2134 x 45	**STC Rating**	None
Door Material:	ALD	**Frame Material:**	ALF	**Fire Rating**	3/4 HR

3	**Total Openings**							
1	**Door#**	D104	**Location:**	Stair No. 1 104	From	Entrance Hall 102	**Handing:**	LHR/RHR
1	**Door#**	D202	**Location:**	Stair No. 1 202	From	Elev. Vest. 201	**Handing:**	LHR/RHR
1	**Door#**	D304	**Location:**	Stair No. 1 304	From	Elev. Vest. 301	**Handing:**	LHR/RHR

By Hardware Supplier					
6	Continuous Hinge	CFM_SLF-HD1 x PT x 2108	628 / US28 / Clear Anodized	Pemko	
6	Power Transfer	EL-CEPT	630 / US32D / Satin Stainless Steel	Securitron	
6	ElectroLynx Cable	QC-C003 (power transfer to exit device)	630 / US32D / Satin Stainless Steel	McKinney	
6	ElectroLynx Cable	QC-C1500 (power transfer to junction box)	630 / US32D / Satin Stainless Steel	McKinney	
6	Narrow Stile Concealed Vertical Rod Exit Device w Passage Set	12-NB-AD-56-PE8415-J-NEL	630 / US32D / Satin Stainless Steel	Sargent	
6	Overhead Stop	1ADJ-336	630 / US32D / Satin Stainless Steel	Rixson	
6	Kickplate	CBH903 x 203 x 927 x 3M TAPE	630 / US32D / Satin Stainless Steel	CBH	
6	Kickplate	CBH903 x 203 x 940 x 3M TAPE	630 / US32D / Satin Stainless Steel	CBH	
3	Smoke / Sound Seal	W-66 x 6200	Black	KN Crowder	
6	Door Sweep	W-24S x 965	628 / US28 / Clear Anodized	KN Crowder	
3	Astragal Set	W-25 x 2134	628 / US28 / Clear Anodized	KN Crowder	
By Automatic Operator Supplier					
3	Auto Operator (single unit)	SW200i x PUSH x 82" Header	628 / US28 / Clear Anodized	Besam	
6	Push / Wave Column Switches	CM-7436VR/2	628 / US28 / Clear Anodized	Camden	

Notes:

- 120VAC is required at the head of the door for all barrier free door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit and back boxes for actuators, emergency call kits, and washroom locking kits with pull cords are to be provided by the electrical contractor.
- Electrician to confirm wire locations with auto door operator supplier prior to pulling wires

End of Heading



Heading# 4

Opening Information					
Opening Type:	Single	**Opening Size:**	1000 x 2134 x 45	**STC Rating**	None
Door Material:	ALD	**Frame Material:**	ALF	**Fire Rating**	3/4 HR

1	**Total Openings**							
1	**Door#**	D003	**Location:**	Corridor 004	From	Elev. Vest. 003	**Handing:**	LHR

By Hardware Supplier					
1	Continuous Hinge	CFM_SLF-HD1 x PT x 2108	628 / US28 / Clear Anodized	Pemko	
1	Power Transfer	EL-CEPT	630 / US32D / Satin Stainless Steel	Securitron	
1	ElectroLynx Cable	QC-C003 (power transfer to exit device)	630 / US32D / Satin Stainless Steel	McKinney	
1	ElectroLynx Cable	QC-C1500 (power transfer to junction box)	630 / US32D / Satin Stainless Steel	McKinney	
1	Narrow Stile Exit Device w Passage Set	12-56-PE8515-J-NEL	630 / US32D / Satin Stainless Steel	Sargent	
1	Overhead Stop	1ADJ-336	630 / US32D / Satin Stainless Steel	Rixson	
1	Kickplate	CBH903 x 203 x 927 x 3M TAPE	630 / US32D / Satin Stainless Steel	CBH	
1	Smoke / Sound Seal	W-66 x 5235	Black	KN Crowder	
1	Door Sweep	W-24S x 965	628 / US28 / Clear Anodized	KN Crowder	
By Automatic Operator Supplier					
1	Auto Operator	SW200i x PUSH x 41" Header	628 / US28 / Clear Anodized	Besam	
2	Push / Wave Column Switches	CM-7436VR/2	628 / US28 / Clear Anodized	Camden	

Notes:

- 120VAC is required at the head of the door for all barrier free door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit and back boxes for actuators, emergency call kits, and washroom locking kits with pull cords are to be provided by the electrical contractor.
- Electrician to confirm wire locations with auto door operator supplier prior to pulling wires.

End of Heading

Heading# 5

Opening Information					
Opening Type:	Single	**Opening Size:**	965 x 2134 x 45	**STC Rating**	None
Door Material:	ALD	**Frame Material:**	ALF	**Fire Rating**	None

2	**Total Openings**							
1	**Door#**	D004A	**Location:**	Vestibule 005	From	Corridor 004	**Handing:**	LHR
1	**Door#**	D004B	**Location:**	Vestibule 005	From	Corridor 004	**Handing:**	LHR

By Hardware Supplier					
2	Continuous Hinge	CFM_SLF-HD1 x 2108	628 / US28 / Clear Anodized	Pemko	
2	Narrow Stile Exit Device	PE8510	630 / US32D / Satin Stainless Steel	Sargent	
2	Door Pull	CBH 6039 – 1 ¼" x #3-2 MTG	630 / US32D / Satin Stainless Steel	CBH	
2	Closer	351-P10	689 / US28 / Painted Aluminum	Sargent	
2	Overhead Stop	1ADJ-336	630 / US32D / Satin Stainless Steel	Rixson	
2	Smoke / Sound Seal	By Aluminum Door Supplier			
2	Door Sweep	By Aluminum Door Supplier			

End of Heading





Heading# 6

Opening Information					
Opening Type:	Single	**Opening Size:**	965 x 2134 x 45	**STC Rating**	None
Door Material:	ALD	**Frame Material:**	ALF	**Fire Rating**	None

1	**Total Openings**							
1	**Door#**	D004C	**Location:**	Vestibule 005	From	Corridor 004	**Handing:**	LHR

By Hardware Supplier					
1	Continuous Hinge	CFM_SLF-HD1 x 2108	628 / US28 / Clear Anodized	Pemko	
1	Narrow Stile Exit Device	PE8510	630 / US32D / Satin Stainless Steel	Sargent	
1	Door Pull	CBH 6039 – 1 ¼" x #3-2 MTG	630 / US32D / Satin Stainless Steel	CBH	
1	Overhead Stop	1ADJ-336	630 / US32D / Satin Stainless Steel	Rixson	
1	Smoke / Sound Seal	By Aluminum Door Supplier			
1	Door Sweep	By Aluminum Door Supplier			
By Automatic Operator Supplier					
1	Auto Operator	SW200i x PUSH x 41" Header	628 / US28 / Clear Anodized	Besam	
2	Push / Wave Column Switches	CM-7436VR/2	628 / US28 / Clear Anodized	Camden	

Notes:

- 120VAC is required at the head of the door for all barrier free door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit and back boxes for actuators, emergency call kits, and washroom locking kits with pull cords are to be provided by the electrical contractor.
- Electrician to confirm wire locations with auto door operator supplier prior to pulling wires.

End of Heading



Heading# 7

Opening Information					
Opening Type:	Single	**Opening Size:**	965 x 2134 x 57	**STC Rating**	None
Door Material:	IC-ALD	**Frame Material:**	ALF	**Fire Rating**	None

2	**Total Openings**							
1	**Door#**	D005A	**Location:**	Exterior	From	Vestibule 005	**Handing:**	LHR
1	**Door#**	D005B	**Location:**	Exterior	From	Vestibule 005	**Handing:**	LHR

By Hardware Supplier					
2	Continuous Hinge	CFM_SLF-HD1 x PT x 2108	628 / US28 / Clear Anodized	Pemko	
2	Power Transfer	EL-CEPT	630 / US32D / Satin Stainless Steel	Securitron	
2	ElectroLynx Cable	QC-C003 (power transfer to exit device)	630 / US32D / Satin Stainless Steel	McKinney	
2	ElectroLynx Cable	QC-C1500 (power transfer to junction box)	630 / US32D / Satin Stainless Steel	McKinney	
2	Door Position Switch	DPS-M-GY	630 / US32D / Satin Stainless Steel	Securitron	
2	Exit Device	31-55-56-PE8510	630 / US32D / Satin Stainless Steel	Sargent	
2	Door Pull	CBH 6039 – 1 ¼" x #3 MTG (2 ¼" thick door bolts)	630 / US32D / Satin Stainless Steel	CBH	
2	Closer	351-P10 x 581-2	689 / US28 / Painted Aluminum	Sargent	
2	Mounting Plate	351-D	689 / US28 / Painted Aluminum	Sargent	
2	Overhead Stop	1ADJ-336	630 / US32D / Satin Stainless Steel	Rixson	
2	Smoke / Sound Seal	By Aluminum Door Supplier			
2	Door Sweep	By Aluminum Door Supplier			
2	Threshold	By Aluminum Door Supplier			
By Security Supplier					
X	Door Contact	Provided By Hardware, Security to Wire			
2	Door Controller	By Security Provider			
X	REX Switch	Provided in Exit Device, Security to Wire			
X	Power Supply	See Door D005C for Power Supply			

Notes:

- Hardware Supplier to confirm cable lengths prior to ordering

End of Heading







Heading# 8

Opening Information					
Opening Type:	Single	**Opening Size:**	965 x 2134 x 57	**STC Rating**	None
Door Material:	IC-ALD	**Frame Material:**	ALF	**Fire Rating**	None

1	**Total Openings**							
1	**Door#**	D005C	**Location:**	Exterior	From	Vestibule 005	**Handing:**	LHR

By Hardware Supplier					
1	Continuous Hinge	CFM_SLF-HD1 x PT x 2108	628 / US28 / Clear Anodized	Pemko	
1	Power Supply	LSP-12-24		Sargent	
1	Power Transfer	EL-CEPT	630 / US32D / Satin Stainless Steel	Securitron	
1	ElectroLynx Cable	QC-C003 (power transfer to exit device)	630 / US32D / Satin Stainless Steel	McKinney	
1	ElectroLynx Cable	QC-C1500 (power transfer to junction box)	630 / US32D / Satin Stainless Steel	McKinney	
1	Door Position Switch	DPS-M-GY	630 / US32D / Satin Stainless Steel	Securitron	
1	Exit Device	31-55-56-PE8510	630 / US32D / Satin Stainless Steel	Sargent	
1	Door Pull	CBH 6039 – 1 ¼" x #3 MTG (2 ¼" thick door bolts)	630 / US32D / Satin Stainless Steel	CBH	
1	Overhead Stop	1ADJ-336	630 / US32D / Satin Stainless Steel	Rixson	
1	Smoke / Sound Seal	By Aluminum Door Supplier			
1	Door Sweep	By Aluminum Door Supplier			
1	Threshold	By Aluminum Door Supplier			
By Automatic Operator Supplier					
1	Auto Operator	SW200i x PUSH x 41" Header	628 / US28 / Clear Anodized	Besam	
1	EXTERIOR Push / Wave Column Switches	CM-7436VR/2-WT	628 / US28 / Clear Anodized	Camden	
1	INTERIOR Push / Wave Column Switches	CM-7436VR/2	628 / US28 / Clear Anodized	Camden	
1	Logic Relay	CX-33		Camden	
By Security Supplier					
1	Card Reader	By Security Provider			

X	Door Contact	Provided By Hardware, Security to Wire			
1	Door Controller	By Security Provider			
X	REX Switch	Provided in Exit Device, Security to Wire			
By Owner					
1	Permanent Medeco Cylinder	By Owner		Medeco	

Notes:

- 120VAC is required at the head of the door for all barrier free door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit and back boxes for actuators, emergency call kits, and washroom locking kits with pull cords are to be provided by the electrical contractor.
- Electrician to confirm wire locations with auto door operator supplier prior to pulling wires.
- Hardware Supplier to confirm cable lengths prior to ordering.

End of Heading





Heading# 9

Opening Information					
Opening Type:	Single	**Opening Size:**	965 x 2134 x 45	**STC Rating**	None
Door Material:	HMD	**Frame Material:**	HMF	**Fire Rating**	None

2	**Total Openings**							
1	**Door#**	D006	**Location:**	Corridor 004	From	Lecture Hall 006	**Handing:**	RHR
1	**Door#**	D201	**Location:**	Elevator Vest 201	From	Leadership	**Handing:**	LHR

By Hardware Supplier					
6	Butt Hinge	TA314 – 127 x 114 x NRP	630 / US32D / Satin Stainless Steel	McKinney	
2	Power Transfer	EL-CEPT	630 / US32D / Satin Stainless Steel	Securitron	
2	ElectroLynx Cable	QC-C003 (power transfer to exit device)	630 / US32D / Satin Stainless Steel	McKinney	
2	ElectroLynx Cable	QC-C1500 (power transfer to junction box)	630 / US32D / Satin Stainless Steel	McKinney	
2	Exit Device w Night Latch	21-56-PE8513-J-NEL	630 / US32D / Satin Stainless Steel	Sargent	
2	Overhead Stop	1ADJ-336	630 / US32D / Satin Stainless Steel	Rixson	
2	Smoke / Sound Seal	W-66 x 5235	Black	KN Crowder	
By Automatic Operator Supplier					
2	Auto Operator	SW200i x PUSH x 41" Header	628 / US28 / Clear Anodized	Besam	
2	Jamb Mounted Key Switch	CM-170/22	630 / US32D / Satin Stainless Steel	Camden	
4	Push / Wave Column Switches	CM-7436VR/2	628 / US28 / Clear Anodized	Camden	

Notes:

- 120VAC is required at the head of the door for all barrier free door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit and back boxes for actuators, emergency call kits, and washroom locking kits with pull cords are to be provided by the electrical contractor.
- Electrician to confirm wire locations with auto door operator supplier prior to pulling wires.

End of Heading







Heading# 10

Opening Information					
Opening Type:	Single	**Opening Size:**	1000 x 2134 x 45	**STC Rating**	None
Door Material:	ALD	**Frame Material:**	ALF	**Fire Rating**	3/4 HR

2	**Total Openings**							
1	**Door#**	D101	**Location:**	Elev. Vest. 101	From	Delivery Hall 109	**Handing:**	RHR
1	**Door#**	D208	**Location:**	Existing Space	To	Bridge 208	**Handing:**	RH

By Hardware Supplier					
2	Continuous Hinge	CFM_SLF-HD1 x 2108	628 / US28 / Clear Anodized	Pemko	
2	Continuous Hinge	CFM_SLF-HD1 x PT x 2108	628 / US28 / Clear Anodized	Pemko	
2	Power Transfer	EL-CEPT	630 / US32D / Satin Stainless Steel	Securitron	
2	ElectroLynx Cable	QC-C003 (power transfer to exit device)	630 / US32D / Satin Stainless Steel	McKinney	
2	ElectroLynx Cable	QC-C1500 (power transfer to junction box)	630 / US32D / Satin Stainless Steel	McKinney	
2	Narrow Stile Exit Device w Passage Set	12-56-PE8515-J-NEL	630 / US32D / Satin Stainless Steel	Sargent	
2	Overhead Stop	1ADJ-436	630 / US32D / Satin Stainless Steel	Rixson	
2	Smoke / Sound Seal	By Aluminum Door Supplier			
2	Door Sweep	By Aluminum Door Supplier			
By Automatic Operator Supplier					
2	Auto Operator	SW200i x PUSH x 41" Header	628 / US28 / Clear Anodized	Besam	
4	Push / Wave Column Switches	CM-7436VR/2	628 / US28 / Clear Anodized	Camden	

Notes:

- 120VAC is required at the head of the door for all barrier free door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit and back boxes for actuators, emergency call kits, and washroom locking kits with pull cords are to be provided by the electrical contractor.
- Electrician to confirm wire locations with auto door operator supplier prior to pulling wires.

End of Heading







Heading# 11

Opening Information					
Opening Type:	Pair	**Opening Size:**	2-1000 x 2134 x 45	**STC Rating**	None
Door Material:	ALD	**Frame Material:**	ALF	**Fire Rating**	3/4 HR

1	**Total Openings**							
1	**Door#**	D109	**Location:**	Entrance Hall 102	From	Delivery Hall 109	**Handing:**	LHRA/RHRA

By Hardware Supplier					
1	Continuous Hinge	CFM_SLF-HD1 x 2108	628 / US28 / Clear Anodized	Pemko	
1	Continuous Hinge	CFM_SLF-HD1 x PT x 2108	628 / US28 / Clear Anodized	Pemko	
1	Power Transfer	EL-CEPT	630 / US32D / Satin Stainless Steel	Securitron	
1	ElectroLynx Cable	QC-C003 (power transfer to exit device)	630 / US32D / Satin Stainless Steel	McKinney	
1	ElectroLynx Cable	QC-C1500 (power transfer to junction box)	630 / US32D / Satin Stainless Steel	McKinney	
1	Concealed Vertical Rod Exit Device	12-NB-AD-56-PE8413-J-NEL	630 / US32D / Satin Stainless Steel	Sargent	
1	Concealed Vertical Rod Exit Device	12-NB-AD-PE8410-J-NEL	630 / US32D / Satin Stainless Steel	Sargent	
2	Overhead Stop	1ADJ-436	630 / US32D / Satin Stainless Steel	Rixson	
1	Smoke / Sound Seal	By Aluminum Door Supplier			
2	Door Sweep	By Aluminum Door Supplier			
1	Astragal Set	By Aluminum Door Supplier			
By Automatic Operator Supplier					
1	Auto Operator (PAIRED UNIT)	SW200i x PUSH x 84" Header	628 / US28 / Clear Anodized	Besam	
2	Push / Wave Column Switches	CM-7436VR/2	628 / US28 / Clear Anodized	Camden	

Notes:

- 120VAC is required at the head of the door for all barrier free door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit and back boxes for actuators, emergency call kits, and washroom locking kits with pull cords are to be provided by the electrical contractor.
- Electrician to confirm wire locations with auto door operator supplier prior to pulling wires.

End of Heading







Heading# 12

Opening Information					
Opening Type:	Single	**Opening Size:**	965 x 2134 x 45	**STC Rating**	None
Door Material:	HMD	**Frame Material:**	HMF	**Fire Rating**	3/4 HR

1	**Total Openings**							
1	**Door#**	D301B	**Location:**	Elev. Vest 301	From	Corridor 302	**Handing:**	LHRA/RHRA

By Hardware Supplier					
3	Butt Hinge	TA314 – 127 x 114 x NRP	630 / US32D / Satin Stainless Steel	McKinney	
1	Power Transfer	EL-CEPT	630 / US32D / Satin Stainless Steel	Securitron	
1	ElectroLynx Cable	QC-C003 (power transfer to exit device)	630 / US32D / Satin Stainless Steel	McKinney	
1	ElectroLynx Cable	QC-C1500 (power transfer to junction box)	630 / US32D / Satin Stainless Steel	McKinney	
1	Exit Device W Passage Trim	12-56-PE8515-J-NEL	630 / US32D / Satin Stainless Steel	Sargent	
1	Overhead Stop	1ADJ-336	630 / US32D / Satin Stainless Steel	Rixson	
1	Kickplate	CBH903 x 203 x 927 x 3M TAPE	630 / US32D / Satin Stainless Steel	CBH	
1	Smoke / Sound Seal	W-66 x 6200	Black	KN Crowder	
1	Door Sweep	W-24S x 965	628 / US28 / Clear Anodized	KN Crowder	
By Automatic Operator Supplier					
1	Auto Operator	SW200i x PULL x 41" Header	628 / US28 / Clear Anodized	Besam	
2	Push / Wave Column Switches	CM-7436VR/2	628 / US28 / Clear Anodized	Camden	

Notes:

- 120VAC is required at the head of the door for all barrier free door operators, 15A dedicated circuit. Wall/Frame must be reinforced for automatic operator mounting, all conduit and back boxes for actuators, emergency call kits, and washroom locking kits with pull cords are to be provided by the electrical contractor.
- Electrician to confirm wire locations with auto door operator supplier prior to pulling wires.

End of Heading





Heading# 13

Opening Information					
Opening Type:	Single	**Opening Size:**	965 x 2134 x 45	**STC Rating**	None
Door Material:	HMD	**Frame Material:**	HMF	**Fire Rating**	1 1/2 HR

1	**Total Openings**							
1	**Door#**	D207	**Location:**	Corridor 207	From	Reading Area 319	**Handing:**	RHR

By Hardware Supplier					
3	Butt Hinge	TA314 – 127 x 114 x NRP	630 / US32D / Satin Stainless Steel	McKinney	
1	Exit Device W Passage Trim	12-PE8515-J-NEL	630 / US32D / Satin Stainless Steel	Sargent	
1	Overhead Stop	1ADJ-336	630 / US32D / Satin Stainless Steel	Rixson	
1	Kickplate	CBH903 x 203 x 927 x 3M TAPE	630 / US32D / Satin Stainless Steel	CBH	
1	Smoke / Sound Seal	W-66 x 5235	Black	KN Crowder	
1	Door Sweep	W-24S x 965	628 / US28 / Clear Anodized	KN Crowder	
By Security Supplier					
1	Access Controller	To Suit Building System, By Security Supplier			
1	Power Supply	In Central IT Location			
1	Mag Lock	M62BD	628 / US28 / Clear Anodized	Securitron	
x	Door Contact	In Mag Lock			
1	Fire Pull Station	By Electrical			
1	Fire Alarm Integration	By Electrical			

End of Heading



Heading# 14

Opening Information					
Opening Type:	Pair	**Opening Size:**	2-864 x 2134 x 45	**STC Rating**	None
Door Material:	HMD	**Frame Material:**	HMF	**Fire Rating**	3/4 HR

1	**Total Openings**							
1	**Door#**	D301A	**Location:**	Elev. Vest 301	From	Corridor 305	**Handing:**	LHRA/RHRA

By Hardware Supplier					
6	Butt Hinge	TA314 – 127 x 114 x NRP	630 / US32D / Satin Stainless Steel	McKinney	
2	Concealed Vertical Rod Exit Device	12-NB-PE8415-J-NEL	630 / US32D / Satin Stainless Steel	Sargent	
2	Closer	351-P10	689 / US28 / Painted Aluminum	Sargent	
2	Overhead Stop	1ADJ-236	630 / US32D / Satin Stainless Steel	Rixson	
2	Kickplate	CBH903 x 203 x 826 x 3M TAPE	630 / US32D / Satin Stainless Steel	CBH	
1	Smoke / Sound Seal	W-66 x 6000	Black	KN Crowder	
2	Door Sweep	W-24S x 864	628 / US28 / Clear Anodized	KN Crowder	
1	Astragal Set	W-25 x 2134	628 / US28 / Clear Anodized	KN Crowder	

End of Heading

END OF SCHEDULE

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes: Labour, Products, equipment, and services necessary to complete the work of this Section.

.1 This Section includes glazing work not specified in other Sections. Refer to other Sections for other glazing.

1.2 SUBMITTALS

.1 Shop drawings: Submit shop drawings indicating manufacturing and installation details.

.2 Product Data: Submit manufacturer's product specifications, including the PVB interlayer products. Include documentation of compliance with specified requirements, referenced tests, and compatibility of all products in contact with glazing.

.1 Provide Installer signed letter listing all products to be used, with signed letters from each glass, sealant, glazing tape, and blocking manufacturer certifying their compatibility.

.2 Provide a sample warranty and instructions for handling, storing, installing, cleaning, and protecting each type of glass and glazing material.

.3 Samples:

.1 Submit samples for each type of glass and of glazing materials identifying quality and type of glass if required by the DCC Representative before commencing work.

.2 Submit samples for each type of film.

.3 Ensure samples are clearly labelled with manufacturer's name and type.

.4 Certificates: Submit manufacturer's certification compatibility of glass and glazing materials.

.5 Test Results: Provide test results in accordance with ASTM C1087 and ASTM C794 showing compatibility of applied sealants with accessories used in butt-joint glazing systems and determine strength, and ability of cured sealant to maintain a bond to substrate under severe conditions and characteristics of peel properties of a cured-in-place elastomeric joint sealants for use in butt-joint glazing. Provide a statement and test data confirming sealant used in design indicated to accommodate design load requirements without failure.

.6 Operations and Maintenance Manual: Information on cleaning, maintenance, and replacement of all types of glass or glazing products shall be included in the Operations and Maintenance Manual.

1.3 QUALITY ASSURANCE

.1 Glazing Installation Standard: Comply with recommendations of the GANA (Glass Association of North America), "Glazing Manual" and "Glazing Sealing Systems Manual" except where more stringent requirements are called for by manufacturers or these specifications. Refer to GANA for definitions of glass and glazing terms not otherwise defined.

.2 Safety Glazing Standard: Where safety glass is indicated or required by authorities having jurisdiction, provide type of products indicated which comply with OBC, ANSI Z97.1, and requirements of CPSC 16 CFR Part 1201 for category II materials.

.3 Fire rated glass: Each lite shall bear permanent, non-removable label certifying it for use in tested and rated fire protective assemblies, labeled and listed by UL, ULC or other testing and inspecting agency acceptable to authorities having jurisdiction.

.4 Single Source Responsibility: Provide materials obtained from one source for each type of glass and glazing product indicated, and for visually related areas.

.5 Pre-installation Conference: at least two weeks prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the DCC Representative of the date and time of the meeting.

.6 Manufacturer's site inspection: Have the manufacturer's technical representative inspect the Work at suitable intervals during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. When requested, submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

.7 Mock-Up:

.1 Provide a mock-up of film application for evaluation of surface preparation techniques, application workmanship, and to confirm pattern.

.1 Finish areas designated by the DCC Representative.

.2 Do not proceed with remaining work until workmanship is reviewed by the DCC Representative.

1.4 **DELIVERY, STORAGE AND HANDLING**

.1 Handle and store materials and products in accordance with manufacturer's recommendations. Deliver and store packaged materials and products in original, undamaged containers with manufacturer's labels and seals intact.

1.5 **WARRANTY**

.1 Laminated glass products: Provide written 5-year warranty from date of manufacture for laminated glass. Warranty shall cover deterioration due to normal conditions of use and not to handling, installing, and cleaning practices contrary to the glass manufacturer's published instructions. Warranty shall be manufacturer's standard form in which laminated-glass manufacturer agrees to replace laminated-glass units.

.2 Double glazed units: Provide written 10-year warranty against defects in the insulating glass units and warrant them to be free from material obstruction of vision as a result of dust or film formation on the internal glass surfaces by any cause, under design conditions, other than extrinsic glass breakage, but including breakage due to thermal shock and temperature differential due to inherent glass faults.

PART - 2 PRODUCTS

2.1 **GENERAL**

.1 Glass: Each unit bearing manufacturer's label indicating quality and thickness.

.2 Thickness of glass: Glass thicknesses indicated or scheduled in the Contract Documents are minimums required. Exact thickness of glass to be engineered to account for size of glass and application, to satisfy building code requirements and requirements of authorities having jurisdiction.

.3 Refer to Section 01 61 10, List of Materials, for complete list of glazing products, designations, products, and other requirements.

2.2 **GLASS**

.1 Tempered Safety Glass:

.1 ASTM C1048, Kind FT (fully tempered), Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), and meeting requirements of ANSI Z97.1, tong, and roller marks free, minimum thickness 6 mm.

.2 Ensure surface compression is equal to or greater than 68.9 MPa (10 000 psi)

.3 Tempered glass material to come from one tempering furnace and be tempered to minimize distortion variance.

.1 Roller-wave distortion not to exceed 0.127 mm (0.005") from peak to valley.

.2 Maximum peak to valley roller-wave 0.8 mm (0.003”) in the central area and 0.20 mm (0.008”) within 267 mm (10.5”) of the leading and trailing edge.

.3 Maximum bow and warp 0.79 mm per lineal 305 mm (1/32” per lineal foot).

.2 Laminated safety glass: CAN/CGSB-12.1, Type 1, Class B, fabricated with minimum 1.6 mm clear polyvinylbutyral interlayer between 2 lites of 3 mm thick glass, minimum overall 7.6 mm thick.

.3 Fire Protection rated glass - Laminated ceramic glazing, non-wired:

.1 Fire-rated and impact safety-rated, clear laminated ceramic glazing material, and listed for use in doors, sidelites, transoms, and borrowed lites.

.2 Fire-ratings: as indicated or scheduled, from 20 minutes to 90 minutes, 3 hours in doors where applicable, with hose stream test.

.3 Impact Safety Resistance: ANSI Z97.1 and CPSC 16 CFR 1201 (Cat. I and II).

.4 Surface finish: Premium Grade, clear glass, polished for superior optical clarity.

.5 Acceptable Product: Technical Glass Products ‘FireLite Plus’, Schott ‘Pyran Platinum L’, or Vetrotech’s Keralite Select Laminated.

.4 Translucent film (FLM): flexible polyester material with acrylic, pressure sensitive, permanent adhesive, Class A fire rating (as defined in NFPA 101).

.1 Refer to Section 01 61 10, List of Materials, for list of products, additional information and requirements.

2.3 **GLAZING MATERIALS**

.1 General - Glazing materials (fire-rated and non-fire-rated): Select glazing sealants, tapes, gaskets and additional glazing materials of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.

.2 Shims, spacers and setting blocks: 45, 70 and 90 Durometer A hardness plus/minus 5 respectively, neoprene rubber, resistant to oxidation and permanent deformation under load.

.3 Glazing gaskets: Extruded neoprene or EPDM of approved profile. Tensile strength of 7300 kPa; Durometer A hardness of 50 plus/minus 5; 25% maximum permanent set; 300 % minimum elongation at break; and resistant to ozone, showing no cracks.

.4 Glazing tape: Extruded, ribbon shaped, non-drying, non-skinning, non-oxidizing polyisobutylene tape with continuous synthetic rubber spacer rod, sufficiently wide and thick as to completely cover the bite area of the glazing unit when the unit is pushed into place, polyshim tape.

.5 All glazing materials, products, primers, and cleaning solvents: Mutually compatible, types recommended by manufacturer of glass and gaskets.

.6 Colours for glazing materials: to match colour of entrance and screen frames.

2.4 **FABRICATION**

.1 Accurately size glass to fit openings allowing clearances recommended by the Flat Glass Marketing Association. Cut glass clean and free of nicks and damaged edges. Grind smooth and polish exposed glass edges. Do not cut or abrade tempered, heat treated, or coated glass.

.2 Take field measurements and levels required to verify and supplement those shown on the Drawings for the proper layout and installation of the work. Co-ordinate dimensional tolerances in adjacent building elements and confirm prior to commencement of work.

PART - 3 EXECUTION

3.1 **INSPECTION**

.1 Verify dimensions at the site before proceeding with fabrication or glazing units.

.2 Ensure that openings are free from distortion, and that surfaces are free from protrusions that will obstruct face and edge clearances.

.3 Ensure that wood is sealed; ferrous metals are painted, or zinc coated; and that surfaces are suitable for adhesion of the glazing materials.

.4 Ensure that movable units to be glazed are adjusted for proper operation.

.5 Ensure that surfaces to receive mirrors are sealed.

.6 Ensure that ambient and surface temperatures are above 5°C.

3.2 **PREPARATION**

.1 Inspect hollow metal and other glass framing for compliance with manufacturing and installation tolerances, including those for size, squareness, offsets at corners, existence of minimum required face or edge clearances, and effective sealing of joinery.

.2 Provide written report listing conditions detrimental to performance of glazing work.

.3 Do not perform glazing work prior to correction of unsatisfactory conditions. Commencement of installation indicates Installer's acceptance of substrate.

.4 Ensure rabbets, stops and glass edges are free of dust, dirt, moisture, oil and other foreign matter detrimental to, or obstructing the glazing material.

.5 Clean contact surfaces with solvent and apply primers to surfaces to receive tapes and sealants in accordance with the manufacturer's instructions. Ensure surfaces are free of moisture and frost.

.6 Immediately before glazing clean glazing channels and other framing members to receive glass.

.1 Remove coatings which are not firmly bonded to substrates.

.2 Promptly complete glazing both sides of a lite once started, to prevent re-entry of dust and dirt in glazing channels.

.7 Clean surfaces thoroughly prior to installation of films. Prepare surfaces using the methods recommended by the film's manufacturer for achieving the best result for the substrate under the project conditions

3.3 **INSTALLATION - GENERAL**

.1 Handle and install glass in accordance with manufacturer's directions. Prevent nicks, abrasions, and other damage likely to develop stress on edges.

.2 Remove and replace glazing stops in original locations, using original fasteners, securely set and undamaged.

.3 Use setting blocks and spacers as required to properly support the glass, centred in place in the glazing space independent of the materials and to uniformly distribute its load.

.4 Use a minimum of 2 setting blocks, located at the quarter points. Locate spacers at jamb edges of glass, uniformly spaced at 600 mm o.c. maximum, and 300 mm maximum from top and bottom.

.5 Assess glass units for colour uniformity and arrange to avoid abrupt variation in appearance.

.6 Set glass properly centred with uniform bite and face and edge clearance, free from twist, warp or other distortion likely to develop stress.

.7 Leave labels on glass until it has been set and inspected and approved. Leave glass whole and without cracks, scratches, or other defects and with setting in perfect condition at completion, to the approval of the DCC Representative.

.8 Remove rejected, broken or damaged glass due to defective materials or improper setting and replace with perfect materials. Units producing distorted vision will be rejected and replaced at the reasonable discretion of the DCC Representative.

.9 Apply translucent film to glazing where indicated, free of wrinkles, air bubbles and other defects.

3.4 **INTERIOR GLAZING**

.1 Unless otherwise specified, all interior glazing shall be dry glazing.

.2 Provide glazing gasket around entire perimeter of glass. Make tight butt joint at corners of lights. Place setting blocks at sill and spacers at both jambs as required to centre the unit in the frame. Place the unit into the frames and apply the stops against the gaskets. Tighten the screws or clips to obtain positive uniform pressure avoiding excessive pressure.

.3 Ensure rattle-free cushioning.

.4 Install fire-rated glazing materials in accord with manufacturer's product data complying with specified fire testing standard. Use specified fire-rated glazing sealant for installation of fire tested glass materials.

.5 Remove non-permanent labels promptly after installation and promptly clean adhesive and other residue from both surfaces of all glass.

3.5 **PROTECTION AND CLEANING**

.1 Protect glass from contact with contaminating substances resulting from construction operations or cleaning of adjacent materials. Remove any such substances by method approved by glass manufacturer.

.2 Remove and replace glass, which is broken, chipped, cracked, abraded, scratched, or damaged in other ways during the construction period, including natural causes, accidents and vandalism.

.3 Clean glass on both faces not more than 4 days prior to date scheduled for inspections intended to establish date of Substantial Performance in each area of project. Clean glass by method recommended by glass manufacturer.

.4 Clean and make good to the approval of the DCC Representative, surfaces soiled or otherwise damaged in connection with the work of this Section. Pay the cost of replacing finishes or materials that cannot be satisfactorily cleaned.

.5 Upon completion of the work, remove all debris, equipment and excess material resulting from the work of this Section from the site.

END OF SECTION

PART - 1 GENERAL

1.1 SUBMITTALS

.1 Shop Drawings:

.1 Submit Engineered Shop drawings clearly indicating materials and products being supplied, showing all connections, attachments, reinforcing, anchorage and locations of exposed fastenings.

.2 In addition to minimum requirements indicate following:

.1 Structural supports and framing provided as part of this Section.

.2 Provision for structural and thermal movement between louvres and adjacent materials.

.3 Incorporate key plans, elevations, sections and details showing profiles, angles and spacing of louvre blades and frames; unit dimensions related to wall openings and construction; and anchorage details and locations.

.4 For each type of product specified, submit free area, air performance, water penetration and wind-driven rain ratings determined in accordance with AMCA Standard 500-L 99 and licensed under the AMCA Certified Ratings Program

.3 Employ a registered structural engineer to be responsible for:

.1 Determining sizes, joint spacing to allow thermal movement and loading of components in accordance with applicable codes and regulations.

.2 Production and review of Engineered Shop Drawings.

.3 Stamping and signing each Engineered Shop Drawing and any associated calculations performed.

.2 Samples:

.1 Submit samples to DCC Representative. Submit following samples in sizes indicated:

.1 Louvres minimum 600 mm square.

.2 Louvre flashing minimum 300 mm square.

.3 Submit wind load and free air area calculations for review before commencing louvre fabrication.

.4 Submit samples of each finish for approval, applied on aluminum alloy specified. Samples shall fully represent physical and chemical properties and colour of finish.

1.2 QUALITY ASSURANCE

.1 Perform steel welding to CSA W59 by fabricators certified by the Canadian Welding Bureau to CSA W47.1.

.2 Perform steel resistance welding to CSA W55.2 by fabricators certified by the Canadian Welding Bureau to CSA W55.3.

.3 Perform aluminum welding by fabricators certified by the Canadian Welding Bureau to CSA W47.2.

.4 File or grind exposed welds smooth and flush. Do not leave grinding marks.

PART - 2 PRODUCTS

2.1 DESIGN AND PERFORMANCE REQUIREMENTS

.1 Complete the work of this Section to design, supply and install louvres, structural supports and attachment hardware as required for a complete and proper installation.

.2 Performance/Design Criteria: Material thicknesses stated herein are a minimum. Be responsible for engineering calculations to ensure structural adequacy of louvres.

.3 Minimum Free Area: 50%

.4 Structural Design: Ensure louvre members deflect no more than L/180 of span between supports when subjected to wind load of 958 Pa (20 psf) applied horizontally to louvre face. Employ a registered structural engineer specified herein to:

.1 Design components for work of this Section requiring structural performance.

.2 Be responsible for determining sizes, joint spacing to allow thermal movement and loading of components in accordance with applicable codes and regulations.

.5 Vibration Control: Ensure louvre members do not vibrate when subjected to wind loading. Provide integral bosses as required.

.6 Thermal Movement: Design louvres to accommodate expansion and contraction of components due to temperature changes.

2.2 MATERIALS

.1 Aluminum Extrusions: ASTM B211, Alloy 6005-T5, 6063-T5, 6063-T6 or 6061-T6.

.2 Aluminum Sheet: ASTM B3209, Alloy 1100, 3003 or 5005.

.3 Galvanized Steel Sheet: Supply commercial quality to ASTM A653/A653M with Z275 (G90) zinc coating, exposed surfaces prefinished as specified, in colour later selected by DCC Representative.

.4 Fasteners: Supply screws, bolts, nuts, washers, rivets and other fasteners incorporated into aluminum sections of tamperproof aluminum or ANSI Series 300 stainless steel.

.5 Anchoring Devices: Aluminum, non-magnetic stainless steel or other non-corrosive metal compatible with aluminum. Steel anchors may be used provided they are zinc coated and insulated from aluminum.

.6 Sealant: Non-sag type, 1 component ultra low-modulus, pre-pigmented, neutral cure elastomeric silicone sealant conforming to ASTM C920, Type S, Grade NS, Class 50, Use NT, G, M, A and O. Supply in standard colours as selected.

.7 Structural Steel Supports: Supply new material conforming to CSA G40.20, Grade 300W, cleaned to SSPC-SP 3 requirements and shop primed with primer conforming to CISC/CPMA 2-75.

.8 Nominal Thickness - Blades, Heads, Jambs and Sills: minimum 1.78 mm thick.

.9 Insect Screen: aluminum 18 x 16 mesh retained in a rolled aluminum frame, which is mitered and secured with corner clips. Install screen directly the back of the louver frame in between the louver and Blank- off system.

.10 Insulated blank-off panels: custom fabricated by louvre manufacturer, factory sealed and quality tested blank-off panels to be 50 mm thick and faced on both sides with 0.8 mm thick aluminum sheet. Panels to be fabricated with mineral wool insulation, with #6 density. Panel perimeter frame to be 1.2mm thick-formed aluminum channels. Panel frame to be mitered at the corners. Panels to be finished to match louvers.

.11 Metal Sills: Supply 1 mm (18 B and S ga) aluminum complete with cover plates at sill joints and drip deflectors at sill ends and at abutting vertical surfaces.

2.3 **LOUVRES**

.1 Louvre: 100 mm deep, high-performance, drainable fixed extruded mullion louver, tested and certified by AMCA, complete with insect screens, blank-off panels, structural supports, and attachment brackets.

.2 Material: Heads, sills, jambs, and mullions to be one-piece structural aluminum members with integral caulking slot and retaining beads. Mullions shall be sliding interlock with internal drains. Blades to be one piece aluminum extrusions with gutter(s) designed to catch and direct water to jamb and mullion drains. Closed cell PVC compression gaskets shall be provided between bottom of mullion or jamb and top of sill to insure leak tight connections.

.3 Provide extruded aluminum angles, channels and reinforcement as required to frame and support the louvre elements.

.4 Provide allowance for expansion of louvres at jambs.

.5 Fastenings shall be stainless steel or aluminum.

2.4 **FABRICATION**

.1 Fabricate structural aluminum in accordance with CAN/CSA-S157 and in accordance with reviewed Engineered Shop drawings.

.2 Fabricate louvres to minimize field adjustments, splicing, mechanical joints and field assembly of units.

.3 Provide louvre, structural supports and accessories as specified and/or shown on the engineered Shop drawings. Materials, sizes, depths, arrangements and material thickness to be as indicated or as required for optimal performance with respect to strength; durability; and uniform appearance.

.4 Include supports, anchorage, and accessories required for complete assembly.

.5 Louvre frame must have integral joinery to metal wall panel system where applicable. Flashing of the opening will not be acceptable.

.6 Fabricate work true to dimensions, square, plumb and level. Accurately fit joints and intersecting members with adequate fastenings.

.7 Fabricate finished work free from distortion and defects detrimental to appearance and performance.

.8 Execute fitting and assembly of louvres in shop with various parts or assemblies ready for erection at building site as practicable.

.9 Weld connections where possible; where not possible bolt connections or secure in an approved manner. Countersink exposed fastenings and cut off bolts flush with nuts, and make as inconspicuous as possible.

.10 Provide fabricated metal work complete with components required for anchoring to concrete and masonry.

.11 Provide necessary templates and instructions where fastenings or anchors have to be built in by other trades. Verify dimensions on the site before preparing drawings or proceeding with shop work.

.12 Supply and build in aluminum flashings at head and sill as required.

.13 Blank off panels to be full extent of louvres except where penetrated by mechanical services, unless indicated otherwise.

.14 Provide supports, anchors and accessories required for a complete assembly.

2.5 **FINISHES**

.1 General: Apply finishes in factory. Protect finishes on exposed surfaces prior to shipment. Remove scratches and blemishes from exposed surfaces that will be visible after completing finishing process.

.2 Finish: refer to section 01 61 10, List of Materials.

2.6 **SOURCE QUALITY CONTROL**

.1 Structural Inspection: Ensure a registered structural engineer specified herein inspects work of this Section during fabrication.

PART - 3 EXECUTION

3.1 **INSTALLATION**

.1 Comply with manufacturer's instructions for installation of the work.

.2 Verify dimensions of supporting structure at the site by accurate field measurements so that the work is accurately designed, fabricated, and fitted to the structure.

.3 Do not erect warped, bowed, deformed or otherwise damaged or defaced members. Remove and replace any members damaged in the erection process.

.4 Fasten louvre to supporting structure plumb, level, true, secure and in accordance with louvre manufacturer's instructions.

.5 Make allowances for deflections of building structure and adjacent building components to prevent damage to louvre and building structure and adjacent building components. Perform drilling of concrete and masonry necessary to anchor components.

.6 Securely install flashing indicated and where required to ensure water does not enter into the building construction.

.7 Close off unused portions of louvre area from inside using panels securely fixed to frames and blades to prevent vibration.

.8 Provide close off panels with insulation sandwiched between aluminum sheets. Seal joints in metal sheets and between panel and frame and panel and duct.

.9 Insolate where necessary to prevent electrolysis due to metal to metal contact or contact between metal and masonry or concrete. Use bituminous paint, butyl tape, building paper or other approved means.

.10 Allow for thermal expansion and contraction.

.11 Cut and trim component parts during erection only with the approval of the manufacturer, and in accordance with its recommendations. Restore finish completely. Remove and replace members where cutting and trimming has impaired the strength or appearance of the assembly.

3.2 **SEALING**

.1 Seal joints and spaces between louvres and adjacent building structure and components.

.2 Prepare surfaces in accordance with sealant manufacturer's instructions and recommendations except where more stringent requirements are indicated.

.3 Thoroughly clean joint surfaces using cleaners approved by sealant manufacturer whether primers are required or not. Remove wax, oil, grease, dirt film residues, temporary protective coatings and other residues by wiping with cleaner recommended for that purpose. Use clean, white, lint-free cloths and change cloths frequently.

.4 Joint breaker: Provide joint backer uniformly to depth required for proper joint design using a blunt instrument. Fit securely by compressing backer material 25 percent to 50 percent so no displacement occurs during tooling. Avoid stretching or twisting joint backer.

.5 Bond breaker: Provide bond-breaker recommended by sealant manufacturer, adhering strictly to the manufacturer’s installation requirements.

.6 Priming: Prime joint substrates where required. Use and apply primer to sealant manufacturers recommendations. Confine primers to sealant bond surfaces; do not allow spillage or migration onto adjoining surfaces.

.7 Taping: Use masking tape where required to prevent sealant or primer contact with adjoining surfaces that would be permanently stained or otherwise damaged by such contact or the cleaning methods required for removal. Apply tape so as not to shift readily and remove tape immediately after tooling without disturbing joint seal.

.8 Install sealants immediately after joint preparation.

.9 Mix, apply and cure sealants in accordance with manufacturer's printed instructions.

.10 Install sealants to fill joints completely, without voids or entrapped air, using proven techniques, proper nozzles and sufficient force that result in sealants directly contacting and fully wetting joint surfaces.

.11 Install sealants to uniform cross-sectional shapes with depths relative to joint widths that allow optimum sealant movement capability as recommended by sealant manufacturer.

.12 Dry tool sealants in manner that forces sealant against back of joint, ensures firm, continuous full contact at joint interfaces and leaves a finish that is smooth, uniform and free of ridges, wrinkles, sags, air pockets and embedded impurities.

.13 Provide concave tooled joints unless otherwise indicated to provide flush tooling or recessed tooling.

.14 Remove sealant from adjacent surfaces in accordance with sealant and substrate manufacturer recommendations as work progresses.

.15 Do not cover up sealants until proper curing has taken place.

.16 Protect joint sealants from contact with contaminating substances and from damages. Cut out, remove and replace contaminated or damaged sealants immediately, so that they are without contamination or damage at time of Substantial Performance.

3.3 **INSTALLATION TOLERANCES**

.1 Maximum variation from plane or location shown on the reviewed shop drawings: 3 mm per 3660 mm of length, but not exceeding 13 mm in any total building length or portion thereof (non-cumulative).

.2 Maximum offset from true alignment between two members abutting end to end, edge-to-edge in line or separated by less than 75 mm: 1.5 mm (shop or field joints). This limiting condition shall prevail under both load and no load conditions.

3.4 **PROTECTION**

.1 Protect installed materials to prevent damage by other trades. Use materials that may be easily removed without leaving residue or permanent stains.

3.5 **ADJUSTING AND CLEANING**

.1 Immediately clean exposed surfaces of the louvres to remove fingerprints and dirt accumulation during the installation process. Do not let soiling remain until the final cleaning.

.2 Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to the material finishes. Thoroughly rinse surfaces and dry.

.3 Touch up minor abrasions in finishes with a compatible air-dried coating that matches the colour and gloss of the factory applied coating.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C475/C475M, Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.

.2 ASTM C514, Standard Specification for Nails for the Application of Gypsum Board.

.3 ASTM C557, Standard Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.

.4 ASTM C834, Standard Specification for Latex Sealants

.5 ASTM C840, Standard Specification for Application and Finishing of Gypsum Board.

.6 ASTM C954, 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.

.7 ASTM C1002, Standard Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.

.8 ASTM C1047, Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.

.9 ASTM C1177/C1177M, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.

.10 ASTM C1280, Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing.

.11 ASTM C1396/C1396M, Standard Specification for Gypsum board.

.2 Association of the Wall and Ceilings Industries International (AWCI)

.1 AWCI Levels of Gypsum Board Finish-GA-214.

.3 South Coast Air Quality Management District (SCAQMD), California State, Regulation XI. Source Specific Standards.

.1 SCAQMD Rule 1168, Adhesive and Sealant Applications.

.4 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S101, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

.2 CAN/ULC-S102, Standard Method of Test of Surface Burning Characteristics of Building Materials and Assemblies.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data: Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit gypsum board assembly drawings. Indicate components such as fastener type, dimensions, spacing and locations at gypsum board edges, ends and in field of board as well as installation methods. Components and work to confirm to ASTM C840 standard specification for application and finishing of gypsum board.

.2 Indicate type of joint compound, and number of joint compound layers.

.3 Indicate Level of Finish of gypsum board walls and ceilings.

.4 Include construction details, dimensioned cross-sections at the location where drywall partition terminates at the perimeter curtain wall, indicating dimensions and finish, and the acoustical closure trim caps.

.5 Indicate number and location of electrical boxes for wall and ceiling.

.6 Indicate number, location and sizes of access doors and panels for walls and ceilings.

.4 Engineered Shop drawings:

.1 Submit engineered shop drawings and associated design calculations bearing the stamp and signature of the qualified professional engineer, registered or licensed to practice in the Province of Ontario.

.2 Engineered submittals shall include associated design calculations and load diagrams, complete with references to codes and standards used in such calculations, supporting the proposed design represented by the submittal. Prepare calculations in a clear and comprehensive manner so that they can be properly reviewed.

.3 Submit Engineered Shop drawings including but not limited to the following elements:

.1 Walls acting as guards.

.5 Samples:

.1 Submit for review and acceptance of each component specified or necessary for complete installation. Include technical descriptive data.

.2 Submit duplicate full width samples in 300 mm long length for each trim accessory.

.3 Submit duplicate closure trim cap: for each exposed product and for each colour and texture required: 150 mm sound barrier mullion trim cap sample and 50 mm x 90 mm custom colour paint sample. Certifications:

.4 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address and applicable standard designation.

.3 Exercise care in unloading gypsum board materials shipment to prevent damage.

.4 Storage and Handling Requirements in accordance with ASTM C840:

.1 Store gypsum board assemblies' materials level flat indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect gypsum board assemblies from nicks, scratches, and blemishes.

.3 Protect ready mix joint compounds from freezing, exposure to extreme heat and direct sunlight.

.4 Protect from weather, elements and damage from construction operations.

.5 Handle gypsum boards to prevent damage to edges, ends or surfaces.

.6 Protect prefinished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings which bond when exposed to sunlight or weather.

.7 Replace defective or damaged materials with new.

.5 Develop Construction Waste Management Plan to Work of this Section.

1.4 AMBIENT CONDITIONS

.1 Maintain temperature 10 °C minimum, 21 °C maximum for 48 hours prior to and during application of gypsum boards and joint treatment, and for 48 hours minimum after completion of joint treatment.

.2 Apply board and joint treatment to dry, clean, frost free surfaces.

.3 Ventilation: ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

PART 2 PRODUCTS

2.1 PERFORMANCE/DESIGN CRITERIA

.1 Single source responsibility: Obtain gypsum board products from a single manufacturer, or from manufacturers recommended by the prime manufacturer of gypsum boards.

.2 Fire resistance rating: Where gypsum board systems with fire resistance ratings are indicated or required, provide materials and installations that are identical with those of applicable assemblies tested by fire testing laboratories acceptable to authorities having jurisdiction.

.3 Follow applicable requirements of ASTM C754 for installation of steel framing.

.4 Design system members to withstand own dead load, super-imposed dead loads, to maximum allowable deflection of L/240, without permanent deformation.

.5 Loads on walls acting as guards: Where the floor elevation on one side of a wall is more than 600 mm higher than the elevation of the floor or ground on the other side, the wall shall be designed to resist the lateral design loads prescribed in the building code or 0.5 kPa, whichever produces the greatest effect.

.6 For walls acting as guards provide engineered shop drawings, load diagrams, and design calculations signed and stamped by a professional engineer licensed in the Province of Ontario.

.7 Upon completion of the parts of the Work covered by the engineered submittal, the professional engineer responsible for the preparation of the engineered submittal, shall prepare and submit to the DCC Representative and authorities having jurisdiction, as required, a letter of conformance for those parts of the Work, certifying that they have been provided in accordance with the requirements of the Contract.

.8 Sheet metal thicknesses indicated herein pertains to the “minimum base steel thickness exclusive of coating”.

2.2 MATERIALS

.1 Gypsum board: ASTM C1396/C1396M, paper faced, regular and fire rated Type X core, 1200 mm wide x maximum practical length, ends square cut, edges bevelled, thickness as indicated.

.2 Sheathing: High performance exterior grade gypsum sheathing, meets or exceeds requirements of ASTM C1177/C1177M, water-resistant treated core, non-combustible when tested in accordance with ASTM E136 and CAN/ULC-S114, maximum flame spread 5 and smoke developed 0 when tested in accordance with CAN/ULC S102, meeting definition of Type X product, 16 mm Dens-Glass Gold Sheathing by G-P Gypsum Corporation; 16 mm thick ‘Securock Brand Glass-Mat Sheathing’ by CGC; ‘GlasRoc Sheathing’ by CertainTeed.

.3 Gypsum shaft liner board: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with glass mat faces, Type X core, 25 mm thick gypsum board panel, 600 mm wide, double bevel long edges.

.1 Shaft wall studs and runners: Minimum 25-gauge thick galvanized steel members, J runners, C-H studs and E studs.

.4 Metal furring runners, hangers, tie wires, inserts, and anchors: to manufacturer’s standard.

.5 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.

.6 Resilient clips: 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.

.7 Nails: to ASTM C514.

.8 Steel drill screws: to ASTM C1002 or to ASTM C954.

.9 Stud adhesive: to ASTM C557.

.10 Laminating compound: as recommended by manufacturer, asbestos-free.

.11 Casing beads, corner beads, control joints and edge trim: to ASTM C1047, Zinc metal, zinc-coated by hot-dip process zinc-coated by electrolytic process aluminum coated phosphatized, 0.5 mm base thickness, perforated flanges, one piece length per location.

.12 Sealants: in accordance with Section 07 92 00 - Joint Sealants.

.1 VOC limit 250 g/L maximum to SCAQMD Rule 1168.

.13 Shadow mould: 35 mm high, snap-on trim, of 0.6 mm base steel thickness galvanized sheet pre-finished in satin enamel, white colour.

.14 Acoustical insulation: CAN/ULC-S702, mineral rock wool, flame spread and smoke developed in conformance with NBC requirements and other authorities having jurisdiction in accordance with CAN/ULC-S102. Non-combustible in accordance with requirements of CAN/ULC-S114.

.15 Acoustic sealant: nonsag, paintable, nonstaining latex sealant complying with ASTM C834, tested to reduce airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

.16 Backer rod: Polyethylene foam rod or other compatible non-waxing, non-extruding, non-staining resilient material in dimension 25 percent to 50 percent wider than joint width as recommended by sealant manufacturer for conditions and exposures indicated.

.17 Acoustic putty pads: asbestos free gypsum based synthetic rubber moldable putty pad, 177.8 mm x 177.8 mm x 3 mm, non-conductive, of 1.6 kg/l density, having an STC59 rating in accordance with ASTM E90, with flame spread of 15 and smoke development of 10, tested to UL 263 or equivalent, red colour, for covering electrical boxes in acoustic partitions.

.18 Insulating strip: rubberized, moisture resistant, 3 mm thick cork closed cell neoprene strip, 12 mm wide, with self-sticking permanent adhesive on one face, lengths as required.

.19 Joint compound: to ASTM C475, asbestos-free.

.20 Adjustable partition closure: for vertical junctions between partitions and the curtain wall, aluminum of extruded alloy 6063 T5, wall-to-mullion and wall-to-glass acoustical closures, providing sound-transmission control, pre-finished.

.1 Acoustical closure trim cap where interior metal stud and drywall partitions abut aluminum curtainwall mullions or glass in locations indicated, complete with fasteners and snap-on fastener cover.

.2 Fire-rated where required, with STC Sound Rating where partition is STC rated and where required.

.3 Profile: to allow solid attachment and fastening to the partition wall framing, type as selected by DCC Representative.

.4 Mullion trim cap to be sized to accommodate thermal movement from ambient and surface temperature changes.

.5 Fasteners: self-tapping or other appropriate threaded fasteners, compatible with all materials fasteners will contact with and not causing galvanic corrosion.

.6 Double-sided installation.

.7 Acoustical Sound Sealant: Acrylic latex based.

.8 Custom lengths as required to meet project requirements.

.9 Furnish units in sufficient additional length to allow for field trimming to required length to match variations in construction tolerances of adjacent systems.

.10 Pre-finished to match mullions, acrylic-polyester hybrid powder coat finish, in custom colour. Confirm finish colour with DCC representative.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged. Remove from site and replace them at no additional cost to DCC Representative.

.1 Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.

.2 Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

.2 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for gypsum board assemblies installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of 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 ERECTION

.1 Do application and finishing of gypsum board to ASTM C840 except where specified otherwise.

.2 Do application of gypsum sheathing to ASTM C1280.

.3 Erect hangers and runner channels for suspended gypsum board ceilings to ASTM C840 except where specified otherwise.

.4 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.

.5 Install work level to tolerance of 1:1200.

.6 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles.

.7 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.

.8 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.

.9 Furr above suspended ceilings for gypsum board fire and sound stops and to form plenum areas as indicated.

.10 Install wall furring for gypsum board wall finishes to ASTM C840, except where specified otherwise.

.11 Furr openings and around built-in equipment, cabinets, access panels, on four sides. Extend furring into reveals. Check clearances with equipment suppliers.

.12 Furr duct shafts, beams, columns, pipes and exposed services where indicated.

.13 Erect drywall resilient furring transversely across studs, between layers of gypsum board, spaced maximum 600 mm on centre and not more than 150 mm from ceiling/wall juncture. Secure to each support with 38 mm common nail 25 mm drywall screw.

.14 Install 150 mm continuous strip of 12.7 mm gypsum board along base of partitions where resilient furring installed.

3.3 APPLICATION

.1 Apply gypsum board after bucks, anchors, blocking, sound attenuation, electrical and mechanical work have been reviewed by DCC Representative.

.2 In double layer application, do not apply second layer until base layer has been reviewed by DCC Representative. First side gypsum board and insulation and sealant to be reviewed before second side first layer is applied.

.3 Apply single or double layer gypsum board to metal furring or framing using screw fasteners for first layer, screw fasteners for second layer unless otherwise indicated or required by fire resistance rated assembly. Each layer of gypsum board shall have no gap over 9 mm where abutting a fixed building component. Provide backer rod for any gap larger than 5 mm.

.1 Single-Layer Application:

.1 Apply gypsum board on ceilings prior to application of walls to ASTM C840.

.2 Apply gypsum board on walls vertically or horizontally, providing sheet lengths that will minimize number of board edges or end joints.

.2 Double-Layer Application:

.1 Install gypsum board for base layer and exposed gypsum board for face layer.

.2 Apply base layer to ceilings prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 250 mm.

.3 Apply base layers at right angles to supports unless otherwise indicated.

.4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset at least 250 mm with base layer joints.

.4 Apply single and double layer gypsum board to concrete or concrete block surfaces, where indicated, using laminating adhesive.

.1 Comply with gypsum board manufacturer's recommendations.

.2 Brace or fasten gypsum board until fastening adhesive has set.

.3 Mechanically fasten gypsum board at top and bottom of each sheet.

.5 Exterior Soffits and Ceilings: install exterior gypsum board perpendicular to supports; stagger end joints over supports. Install with 6 mm gap where boards abut other work.

.6 Install water-resistant gypsum board where indicated. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads.

.7 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, in partitions where perimeter sealed with acoustic sealant.

.8 Apply board using stud adhesive on furring or framing laminating adhesive on base layer of gypsum board.

.9 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.

.10 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.

.11 Install gypsum board with face side out.

.12 Do not install damaged or damp boards.

.13 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

.14 Partition framing with gypsum panels in concealed spaces.

.1 Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 0.7 sq.m. in area.

.2 Fit gypsum panels around ducts, pipes, and conduits.

.3 Where partitions intersect open joists and other structural members projecting below underside of slabs and decks, cut gypsum panels to fit profile formed by joists and other structural members; allow 6 mm to 10 mm wide joints to install sealant.

.15 Acoustic putty pads: Apply acoustic putty pads to the exterior of electrical boxes in acoustic partitions, completely sealing pads against the stud within the stud cavity and fitting around conduit and cables, in accordance with manufacturer's recommendations.

1.2 **INSTALLATION - SHAFT WALL**

.1 General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturers' written installation instructions, and ASTM C 754 other than stud-spacing requirements.

.2 Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.

.3 Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.

.1 Elevator Hoistway: At elevator hoistway-entrance door frames, provide jamb struts on each side of door frame.

.2 Reinforcing: Where handrails directly attach to gypsum board shaft wall assemblies, provide galvanized steel reinforcing strip with 0.84-mm (0.033-inch) minimum thickness of base metal (uncoated), accurately positioned and secured behind at least one layer of face panel.

.4 Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.

.5 Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.

.6 Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Consultant while maintaining fire-resistance rating of gypsum board shaft wall assemblies.

.7 Installation Tolerance: Install each framing member so fastening surfaces vary not more than 3 mm (1/8 inch) from the plane formed by faces of adjacent framing.

.8 Securely attach floor and ceiling J-runners with the short leg toward inside side of wall, and fasten to structure at 600 mm o.c.

.9 Erect liner panel vertically between runners. Where walls exceed maximum available panel height, position panels and joints within upper and lower third points of wall. Stagger joints in adjacent panels and reinforce with horizontal C-H studs.

.10 Install C-H studs between liner panels with panels inserted in the stud groove.

.11 Install E-studs or J-runners vertically at intersections, corners and openings.

.12 Frame openings with E-studs or J-runners horizontally, reinforce as necessary.

.13 Apply two layers of shaft wall gypsum board to studs and runners on the opposite side of liner panels.

.14 Fasten base layer vertically to framing with 25 mm screws at 300 mm o.c. Apply face layer vertically over base layer with joints staggered and attached with 41 mm screws staggered from those on base layer, spaced at 300 mm o.c. and driven into studs and runners.

.15 Allow for movement of structures so that the wall will not have load imposed.

3.4 INSTALLATION

.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre using contact adhesive for full length.

.2 Install casing beads around perimeter of suspended ceilings.

.3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.

.4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.

.5 Install shadow mould at gypsum board/ceiling juncture as indicated. Minimize joints; use corner pieces and splicers.

.6 Control Joints

.1 Prior to installation review exact locations of control joints with the DCC Representative.

.2 Construct control joints in gypsum board facing and supported independently on both sides of joint.

.3 Provide continuous polyethylene dust barrier behind and across control joints.

.4 Install control joints full height floor to ceiling or door header to ceiling in partitions and furring runs.

.5 Install control joints from wall to wall in ceiling areas.

.6 Install control joints straight and true.

.7 Install purpose made control joint metal trim at following locations:

.1 Where partition, wall, or ceiling traverses a construction joint (expansion or building control element) in the base building structure.

.2 Furring or partition abuts a structural element or dissimilar wall or ceiling.

.3 Ceiling abuts a structural element, column or dissimilar wall, partition, or other vertical penetration.

.4 Construction changes within a partition or ceiling.

.5 Partition or furring runs exceeding 9100 mm and total area between control joints exceeding 84 m2.

.6 Partition and ceiling runs on column lines or at joints in ceiling runs.

.7 In interior ceilings without perimeter relief exceeding 9100 mm in either direction and total area between control joints exceeding 84 m2.]

.8 In interior ceilings with perimeter relief exceeding 15000 mm and total area between control joints exceeding 230 m2.

.9 In exterior ceilings or soffits exceeding 9100 mm in either direction and total area between control joints exceeding 84 m2.

.7 Ensure that screws or nails are properly applied in process of attaching gypsum board to framing without damaging of gypsum board edges and ends.

.8 Construct expansion joints as detailed, at building expansion and construction joints. Provide continuous polyethylene dust barrier.

.9 Install expansion joint straight and true.

.10 Install cornice cap where gypsum board partitions do not extend to ceiling.

.11 Fit cornice cap over partition, secure to partition track with two rows of sheet metal screws staggered at 300 mm on centre.

.12 Splice corners and intersections together and secure to each member with 3 screws.

.13 Install under the work of this section access doors and panels in walls and ceilings where access is required to electrical and mechanical fixtures specified in respective sections.

.1 Rigidly secure frames to furring or framing systems.

.14 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.

.15 Aluminum adjustable partition closure: install at vertical junctions where interior metal stud and drywall partitions abut curtainwall mullions in locations indicated.

.16 Gypsum Board Finish: finish gypsum board walls and ceilings to following Levels of Finish in accordance with AWCI Levels of Gypsum Board Finish:

.1 Level 1: in plenum areas above ceilings, except provide higher level of finish as required to comply with fire resistance ratings and acoustical ratings.

.2 Level 2: surfaces permanently hidden or concealed in their final arrangement.

.3 Level 3: service areas.

.4 Level 4: all areas – walls and ceilings, except where Level 1, 2 or 3 is identified.

.17 Fill joints, casing beads, corner beads, screwholes and depressions on gypsum board surfaces exposed to view to provide smooth seamless surfaces and square neat corners.

.18 Apply joint compounds and reinforcing tapes in accordance with manufacturer's specifications.

.19 Fill joints and apply joint compounds by three-coat method. Apply cover coat 175 mm wide, level coat 250 mm wide, and skim coat 300 mm wide.

.20 Embed reinforcing tape in a cover coat of joint compound. Apply level coat of joint compound when cover coat has dried. Apply skim coat of compound when level coat has dried.

.21 Feather edges of compounds into surfaces of gypsum boards. After skim coat has dried for at least 24 hours sand to leave smooth for decoration. Do not sand paper face of gypsum board.

.22 At internal corners: First fill gaps between boards with joint compound. Imbed creased reinforcing tape into a thin coat of joint compound applied 50 mm wide at each side of corner.

Apply cover coat. Apply skim coat to one side of joint, and when dry apply skim coat to other side.

.23 At external corners: Fill to nose of corner bead with joint compound and sand smooth.

.24 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board, invisible after surface finish is completed.

.25 Finish gypsum board joints above finished ceiling with tape and first coat of joint compound.

.26 Make sure completed installation is smooth, level or plumb, free from waves, depressions, ridges and other defects, and ready for surface finish.

3.5 INSTALLATION - ACOUSTICAL INSULATION

.1 Install acoustical insulation where indicated.

.2 Provide continuous coverage between studs and run continuously from floor to ceiling, or to structure for full height partitions, over door frames and openings and around corners.

.3 Trim insulation to provide close-fit contact to framing assemblies and fill the partition cavity or acoustic insulation assemblies to thicknesses indicated

.4 Cut insulation and pack to provide close-fit contact around cut openings in gypsum board, behind outlet boxes around plumbing, heating or structural items passing through the system and at abutting walls, and other obstructions and penetrations through and within acoustic assemblies.

.5 Extend acoustic partition assemblies to underside of structure. Incorporate approved provision to prevent transmittance of structural deflection to partition assembly.

.6 Secure acoustical insulation to one interior face of gypsum board with adhesive or mechanical fasteners or by other approved means.

.7 Where studs are not faced with gypsum board on both sides, mechanically fasten wire mesh to non-faced side of stud to retain insulation.

.8 Mechanically attach sound attenuation insulation in wall assemblies where cavity of wall assembly is greater than 150 mm.

.9 Secure insulation in such a manner that it will not sag or settle away from required locations

.10 For partitions receiving acoustical insulation, provide minimum two continuous beads of acoustical sealant at junctions between top and bottom tracks and the structure.

.11 Sound flanking paths:

.1 Where sound rated partition walls intersect non-rated gypsum board partition walls, extend sound rated construction to completely close sound flanking paths through non-rated construction.

.2 Seal joints between face layers at vertical interior angles of intersecting partitions.

3.6 INSTALLATION - FIRE RATED ASSEMBLIES

.1 Construct fire rated assemblies where indicated, to requirements of authorities having jurisdiction.

3.7 INSTALLATION TOLERANCES

.2 Installation tolerances for gypsum and tile backer board panels:

.1 Do not exceed 3 mm in 3 m variation from plumb, level, and plane in exposed surfaces, except at end joint between gypsum board panels.

.2 Do not exceed 10 mm from indicated location.

.3 Do not exceed 1.5 mm variation between planes of abutting edges or ends.

.4 Surface flatness shall not exceed 1.5 mm within 305 mm straight edge. For non-tapered-edge end joints between boards, measure flatness tolerance with end of straight end at centreline of joint.

.3 Installation tolerances accessories:

.1 Alignment with board panels shall not exceed tolerances specified above.

.2 End joints shall be flush aligned to maximum offset of 0.5 mm

3.8 CLEANING

.1 Progress Cleaning: Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

3.9 PROTECTION

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

.2 Repair damage to adjacent materials caused by gypsum board assemblies' installation.

END OF SECTION

PART - 1 GENERAL

1.1 QUALITY ASSURANCE

.1 Products: Provide like products from same production run. Install products in sequence from sequentially numbered dye lots.

.2 Pre-installation meeting: Prior to commencing work of this Section, arrange for manufacturer's technical representative to visit the site and review preparatory and installation procedures to be followed, conditions under which the work will be done, and inspect the surfaces to receive the work of this Section. Advise the DCC Representative of the date and time of the meeting.

.3 Manufacturer's site inspection: Have the manufacturer's technical representative inspect the work at suitable intervals during application and at conclusion of the work of this Section, to ensure the work is correctly installed. When requested, submit manufacturer's inspection reports and verification that the work of this Section is correctly installed.

.4 Moisture vapour emission of concrete floors: Maximum 3 lbs per 1000 sq.ft. per 24 hour. Test floors to ASTM F1869 using anhydrous calcium chloride method. Provide 3 test sites for floor area up to 1000 sq.ft., add one test site for each additional 1000 sq.ft. or fraction thereof. Locate test sites to cover representative areas of the floor. Conduct test simultaneously on floors free of sealer, curing compounds, oil, grease and other agents that are detrimental to the test and the installation of the Products, and in strict conformance with test kit manufacturer's written instructions. Do not proceed with work when the moisture vapour emission is above the specified maximum.

.5 Alkalinity of concrete floors: Acceptable range of 5 to 9 on the pH scale. Test floors using distilled water and pH paper. Provide 2 tests for every moisture vapour emission test. Locate test sites to cover representative areas of the floor. Conduct test simultaneously on floors free of sealer, curing compounds, oil, grease and other agents that are detrimental to the test and the installation of the Products, and in strict conformance with test kit manufacturer's written instructions. Do not proceed with work when the alkalinity is beyond the specified range.

.6 Maintenance seminars: Provide, to the DCC Representative, training seminars and recommendations on Product maintenance procedures.

1.2 SUBMITTALS

.1 Product Data: provide for each type of product, confirming compliance with the specified or named product or material.

.1 Prior to ordering products or materials, submit manufacturer's printed product datasheets for each type of product. Include product characteristics, performance criteria, physical size, finish and limitations for products listed in selected designs.

.2 Samples: Submit three representative samples of each type of flooring and accessories in colours, finishes and textures specified. Samples, when approved will serve as a basis for approving finished work.

.3 Maintenance instructions: Submit three copies of a maintenance manual for incorporation in project record manual. Give specific warning of any maintenance practice or materials which may damage or disfigure the finished flooring.

.4 Maintenance Materials - Extra Stock: Provide 2% of each type and colour of materials installed. Store the extra materials at locations as directed by the DCC Representative. Extra stock shall be of same production run as installed materials. Include cost of extra stock in the Contract Price.

1.3 **EXTENDED WARRANTY**

.1 Provide a two-year extended warranty for work of this section against faulty materials or workmanship. Defects include but are not limited to delamination of flooring from substrates, bubbling of flooring and seam separations.

.2 Promptly repair or replace the defective work upon written notification from the DCC Representative.

1.4 **EXTRA STOCK**

.1 Provide 2% of each type and colour of materials installed. Store the extra materials at locations as directed by the DCC Representative. Extra stock shall be of same production run as installed materials. Include cost of extra stock in the Contract Price.

PART - 2 PRODUCTS

2.1 **MATERIALS - GENERAL**

.1 Colours of flooring and accessories: As selected by the DCC Representative.

2.2 **MATERIALS - LINOLEUM FLOORING**

.1 Marbleized linoleum tiles: ASTM F2034, 2.5 mm thick, sizes as indicated.

2.3 **MATERIALS - ACCESSORIES**

.1 Welding rods: Continuous welding rods, compatible with linoleum flooring and recommended by flooring manufacturer.

.2 Base: top set coved base, coil material complete with premoulded exterior corners.

.1 Refer to Section 01 61 10 List of Materials for size, colour and other information

.3 Primer and adhesives: Waterproof types, approved and recommended by flooring manufacturer, to suit installation conditions.

.4 Subfloor Filler: Trowelable levelling and patching compounds, latex modified, Portland cement based or blended hydraulic cement based formulation provided or approved by floor covering manufacturer for intended applications.

.5 Cleaner and finish solutions: Approved and recommended by flooring manufacturer.

PART - 3 EXECUTION

3.1 **PREPARATION**

.1 Move floor coverings and installation materials into spaces where they will be installed at least 72 hours in advance of installation.

.2 Do not install floor coverings until they are same temperature as space where they are to be installed.

.3 Ensure concrete subfloor has cured for a minimum of 28 days. Examine subfloor conditions to ensure that they are clean, level and free from cracks, ridges, dusting, scaling and carbonation.

.4 Maintain room temperature at least 21 degree C, 3 days before, during and 7 days after the installation. Avoid high humidity and cold drafts.

.5 Make subfloor smooth, flat and level to a tolerance of 3 mm in 3000 mm in any direction, non-cumulative.

.6 Remove ridges by mechanical means. Fill depressions, cracks, joints and other substrate imperfections with filler.

.7 Apply subfloor filler to fill cracks, holes, and depressions in substrates.

.8 Apply primer evenly to substrates free of dust and debris, at a rate recommended by the manufacturer.

.9 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 **INSTALLATION - GENERAL**

.1 Install work of this section in accordance with manufacturer's printed instructions and manufacturer representative's site recommendations.

.2 Distribute variations in shade or pattern of production run. Obtain a uniform effect. Abrupt variations are not permitted. Where flooring has a pattern or grain, lay pattern in one direction unless otherwise required by the DCC Representative.

.3 Apply flooring in full contact with adhesive, free of bubbles and air pockets. Lay flooring with seams parallel to building lines to produce a minimum number of seams and in patterns as indicated on drawings.

.4 Accurately scribe flooring around walls, vertical surfaces, fixed objects and any other projections through the floor.

.5 Set flooring into covers and cleanout recesses. Retain pattern of flooring regardless of location of covers and recesses. Extend flooring under drain clamping rings.

.6 Install edge strips at unprotected or exposed edges where flooring terminates. Centre edge strip under door, where flooring terminates at door opening.

3.3 **INSTALLATION - ADHESIVE**

.1 Mix and spread adhesives evenly, using correct tool type and at a rate to manufacturer's instructions. Do not spread more adhesive than can be covered by flooring within adhesive's working time.

.2 Do not soil walls, bases, fitments, carpentry work and adjacent areas with adhesive. Promptly remove spillage.

3.4 **INSTALLATION – LINOLEUM TILE**

.1 Lay out tiles from center marks established with principal walls, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter. Lay tiles in straight butt joints to moderate contact.

.2 Match tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

.3 Lay tiles with n pattern of colours and sizes indicated to match closely existing terrazzo flooring.

.4 As installation progresses, roll flooring with a polished and clean 45 kg roller in two directions perpendicular to each other to ensure full adhesion. Machine dry buff immediately after rolling.

3.5 **INSTALLATION - RESILIENT BASE**

.1 Install base to walls and fitments. Provide solid backing over the entire area behind the base. Use maximum lengths of coil to keep joints to absolute minimum. Keep base level and straight.

.2 Use preformed exterior corner units. Mitre interior corners. Make joints vertical and butt hairline tight, with no two joints closer than [450 mm][18"] apart.

.3 Scribe and fit to door frames and other obstructions. Use premoulded end pieces at flush door frames and reveals.

.4 Make application firm, free of bubbles and separation of any kind from substrates.

3.6 **CLEANING AND FINISHING**

.1 Protect the newly laid flooring from construction traffic for a period of five days. At the end of this period thoroughly clean all surfaces with a cleaner in accordance with flooring manufacturers instructions.

.2 After the floor has been cleaned and dried, apply a thin coat of polish, let dry and follow by buffing.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section Includes:

.1 Labour, Products, equipment and services necessary to complete the work of this Section for Portland cement terrazzo flooring, including repairs and patching to match existing terrazzo.

.2 Related Requirements

.1 Read and comply with Conditions of the Contract and Division 01 - General Requirements.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data: Submit proposed installation instructions, product literature, and data sheets. Include product characteristics, performance criteria, aggregate sizes, finishes, mixes, and limitations.

.3 Shop drawings: Indicate layout of divider strips and control joints.

.4 Samples

.1 Trial Samples

.1 Prior submitting a trial sample, take samples of existing terrazzo after cleaning.

.2 Submit duplicate trial samples on a suitable backing for each colour of terrazzo flooring.

.3 Approximate size of samples: 600 mm x 600 mm and of appropriate thickness, representative of the proposed finish product, illustrating full range of colour, sheen, pattern, finish and texture expected.

.4 Match aggregate colours and matrix pigments, sheen, overall colour and general appearance of the existing flooring remaining intact. Before producing samples take into account the effects of lighting and UV rays from sunlight on the existing floor.

.5 Make changes in mix and submit new samples of changed mix if required by Consultant until samples are approved.

.6 Submit duplicate trial samples of the divider strips, 300 mm long each.

.1 Divider strips shall be of solid composition, matching existing size, colour and material.

.7 Submit multiple trial samples as required to obtain approval from the Consultant.

.2 Final Samples

.1 Submit final samples, in sets of 3, for each colour of existing cement terrazzo requiring repairs.

.2 Approximate size of samples: 600 mm x 600 mm and of appropriate thickness, representative of the proposed finish product, illustrating full range of colour, sheen, finish and texture expected.

.3 Submit 3 sets of final samples of the divider strips, 300 mm long each.

.3 Consultant will retain one set of final samples. Return the second set to the manufacturer as a guide and keep the third set of final samples on the job site.

.5 TTMAC Inspection Application Form: Provide copy of the completed application form.

.1 The inspection service application form is available on TTMAC website and it includes details of the process and anticipated processing time.

1.3 **CLOSEOUT SUBMITTALS**

.1 Submit maintenance recommendations in accordance with Section 01 78 00 - Closeout Submittals, and incorporate into manual.

.1 Include specific warnings of maintenance practices or materials which may damage terrazzo, provide specific instructions for preservation and cleaning.

1.4 **ADMINISTRATIVE REQUIREMENTS**

.1 Pre-installation meeting: Arrange a meeting attended by Contractor, DCC Representative Consultant, and terrazzo Subcontractor to discuss the following:

.1 Substrate conditions, job site conditions and coordination with other trades.

.2 Verification that TTMAC Inspector has been engaged to perform Site Quality Control.

.3 Installation procedures and techniques, joint details.

.4 Substrate joints and cracks that require adjusting terrazzo divider locations.

.5 Review and finalize construction schedule and verify availability of materials, installer’s personnel, equipment and facilities needed to make progress and avoid delays.

.6 Review terrazzo designs and patterns.

.7 Review plans for concrete curing and site drying to enable timely achievement of suitable slab moisture conditions.

1.5 **QUALITY ASSURANCE**

.1 Installer: Trained and approved by the manufacturer and having a minimum five (5) years’ experience in the installation of the work described in this Section and has completed installations similar to the scope of this Project.

.2 Supplier: Member in good standing with TTMAC.

.3 Manufacturer: Member in good standing with TTMAC.

.4 Manufacturer’s site inspection: Have the manufacturer’s technical representative inspect the Work during application and at conclusion of the work of this Section, to ensure the Work is correctly installed. Submit manufacturer’s inspection reports and verification that the work of this Section is correctly installed.

.5 Site Quality Control:

.1 Engage TTMAC inspector to perform site Quality Control consisting of two site visits:

.1 One site visit during the sample installation.

.2 One site visit to inspect completed terrazzo work and submit TTMAC site inspection report.

.2 TTMAC site inspection service fee is included in the contract price.

1.6 **SAMPLE INSTALLATION**

.1 Prior to commencement of work, install a minimum 1.5m x 1.5m mock-up on site for each epoxy terrazzo system, including change of material and door threshold. Locate mock-up where designated by the Consultant.

.2 Make sure TTMAC inspector is present during the sample installation.

.3 The mock-up will be viewed by all parties, and only when accepted will work of same system be allowed to proceed.

.4 Modify mock-up as necessary to obtain approval.

.5 The mock-up shall be installed using the same Installer's personnel who will perform work. The mock-up will serve as a benchmark for the installation for the rest of the project. Approved mock-ups may remain as part of the completed work.

1.7 **PRODUCT DELIVERY, STORAGE AND HANDLING**

.1 Deliver, store and handle products in a manner to avoid damage to containers and bags. Maintain a minimum temperature of 12 deg. C for storage.

.2 Delivery and Acceptance Requirements: Deliver materials to site in original factory packaging with manufacturer's labels.

.3 Storage and Handling Requirements:

.1 Store materials indoors in a clean dry heated location and in accordance with TTMAC Terrazzo Specification Guide recommendations.

.2 Store and protect materials from excessive humidity and moisture contamination.

1.8 **SITE CONDITIONS**

.1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of materials.

.2 Ventilation:

.1 Provide continuously during and after installation.

.2 Ventilate 24 hours per day during installation.

.3 Provide continuous ventilation for 7 days after installation.

.3 Ambient Conditions:

.1 Maintain ambient and surface temperature at a minimum of 15 degrees C or below 35 degrees C, unless manufacturer's or TTMAC recommendations are more restrictive.

.2 Maintain air temperature and substrate temperature of terrazzo area for 24 hours before, during, and 24 hours after installation.

PART - 2 PRODUCTS

2.1 MATERIALS

.1 Cement: To CSA A3000, Type 10, white, non-staining Portland Cement.

.2 Sand: To CSA A23.1/A23.2, fine aggregates, screened, clean, washed, and dry.

.3 Water: Potable, free from oil, acid, alkali, and organic matter.

.4 Latex Additive: as per flooring manufacturer.

.5 Aggregate: CAN/CSA-A23.1.

.6 Lime: ASTM C206, hydrated.

.7 Chips: Grade chips in accordance with TTMAC standard, free from deleterious and foreign matter, and as follows:

.1 Each aggregate chip colour, grade, type from a single source, from the same production run with consistent appearance.

.8 Colour Pigments: Limeproof, non-fading mineral pigments.

.9 Matrix Colour Pigments: compatible with Portland cement, alkali-resistant, colour-stable, non-fading mineral type.

.10 Divider Strips: to match existing.

.11 Primer: as per flooring manufacturer.

.12 Accessories: Base caps, base divider strips, separator strips, custom made and to match divider strips.

.13 Sealers, finish, cleaners and other maintenance products: as per flooring manufacturer and in accordance with the TTMAC Maintenance Guide.

.1 Cleaner: conforming to CAN/CGSB-2.107.

.2 Sealer: conforming to CAN/CGSB-25.20.

.3 Finish: conforming to CAN/CGSB-25.21.

2.2 MIXES

.1 Underbed mix: 1 part cement, 4 parts sand by volume, water to produce a mortar of a stiff consistency. Thoroughly mix with not more than 4 Imperial Gallons of water per 80 lb bag of cement.

.2 Neat grout mix:

.1 Type 1 (prior to underbed mix): water to saturation, cement broadcast, latex additive to slurry consistency for broom installation.

.2 Type 2 (after terrazzo topping matrix): water to saturation, white cement broadcast, latex additive to slurry consistency for steel trowel installation.

.3 Terrazzo topping matrix: to match existing finishes and colours.

.4 Existing terrazzo identified on original (1958) As-Built drawings: #410.

PART - 3 EXECUTION

3.1 PREPARATION

.1 Examine the areas in which the work of this section is to be installed.

.2 Prepare concrete floors with shot blasting or other method recommended by manufacturer. Remove weak concrete, uneven joints, rough areas, foreign and projection off surfaces. Surface to be hard, and sound. Equip dry blasting machine with vacuum to minimize dust.

.3 Repair cracks, holes or other defects in accordance with manufacturer's recommendations.

.4 Thoroughly clean surfaces before commencing work.

.5 Saturate base slab with water. Remove free water. Apply slurry consisting of a thick paste of cement and water immediately preceding application of underbed.

3.2 INSTALLATION

.1 Where this Specification does not cover a particular aspect of terrazzo application, follow directions of TTMAC standard and applicable manufacturer's instructions.

.2 Underbed

.1 Provide underbed of thickness such that the finished thickness of terrazzo and underbed combined is not less than the existing terrazzo, top of new work shall be level with existing work.

.2 Carefully place underbed to exact level, minimum 5/8" below unfinished floor level.

.3 Build up underbed as required.

.4 Cover underbed with 2 mil thick polyethylene film and allow to cure for a minimum of 24 hours before removing polyethylene film and placing topping.

.3 Divider Strips

.1 Install divider strip in underbed while it is still in a plastic state. Locate divider strips as shown. If locations not shown, locate divider strips to form regular panels to Consultant’s approval.

.2 Where floor finish changes from terrazzo to other type of flooring at door openings and the like, extend terrazzo into opening and terminate against divider strip.

.4 Terrazzo Topping

.1 Use non-staining white cement, coloured as required to match approved sample and chip sizes.

.2 Dry mix topping materials in the proportions 200 lb of chips to 1 bag (80 lb) non-staining cement. Mix thoroughly to a homogeneous mass and apply to underbed while slurry is still wet.

.3 Compact thoroughly until surplus cement has worked out and finish surface shows not less than 80% chips and abrasive aggregate where required. Sprinkle additional chips during rolling to ensure 85% of finished surface will consist of chips to match approved sample. Trowel topping to an even surface disclosing lines of stripping on level with terrazzo finish. Make topping 5/8" thick.

.5 Surfacing of Terrazzo

.1 Surface and grout terrazzo when it has set sufficiently hard. Surface by machine rubbing with #24 grit or finer abrasive blocks. Use plenty of water during grinding.

.2 Immediately following initial grinding, flush terrazzo surfaces thoroughly using water only and apply a grout to fill voids. Mix grout in same proportions of cement and colour as used for topping. Allow grouted surface to cure for at least 48 hours and then resurface by machine rubbing using #120 grit abrasive blocks and plenty of water.

.3 Following removal of grout, scrub thoroughly using machine scrubbers and cleaner. Rinse with clean water and then dry thoroughly. Dry clean with industrial vacuum cleaning machine, removing all traces of dust.

.4 Apply first coat of sealer, as soon after cleaning as possible. Apply sealer in accordance with manufacturer's written directions, and wipe off excess sealer before it dries.

.5 Apply second coat of sealer in same manner as first, but not until all other work is complete and terrazzo has been cleaned again as previously specified above.

.6 Apply 2 coats of surface finish.

.6 Installation – Terrazzo Wall Cove Base: To TTMAC detail 416B.

.1 At wall openings such as door frames, return terrazzo base with eased vertical edge.

.7 Repairs to Existing Portland Cement Terrazzo:

.1 Perform a thorough examination of the existing conditions. Perform any necessary tests on an inconspicuous surface to determine the current conditions and appropriate steps and materials necessary for replacement of affected areas of existing terrazzo surfaces.

.2 Examine existing terrazzo floors scheduled to remain. Remove affected portions for full depth to the nearest divider strip. Reinstated work shall match adjacent existing terrazzo, including divider strips where replacement necessary. Finish patched areas as specified for new work.

.3 Top of repair work shall be level with existing flooring.

3.3 SITE QUALITY CONTROL

.1 Site Tests and Inspections:

.1 TTMAC inspector to inspect completed terrazzo work and submit written report to Consultant.

3.4 **PROTECTION**

.1 Prohibit all traffic on terrazzo floors during installation, for 48 hours after installation, for 48 hours after initial grinding and application of curing compound, and 48 hours after final grinding, polishing and until final sealing.

.2 Protect floor and base from impact, vibration, heavy hammering on adjacent or opposite walls for at least 48 hours after completion.

.3 Properly cover the finished surfaces and protect from damage for the duration of the construction.

END OF SECTION

PART - 1 GENERAL

1.1 REFERENCES

.1 Department of Justice Canada (Jus)

.1 Canadian Environmental Protection Act 1999, c. 33 (CEPA).

.2 Environmental Protection Agency (EPA)

.1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 - 1995, (for Surface Coatings).

.2 EPA SW-846 Revision 8-2014, Hazardous Waste Test Methods.

.3 Health Canada / Workplace Hazardous Materials Information System 2015 (WHMIS)

.1 Safety Data Sheets (SDS).

.4 Master Painters Institute (MPI)

.1 MPI Architectural Painting Specifications Manual, 2004.

.5 Society for Protective Coatings (SSPC)

.1 SSPC Painting Manual, Volume Two, 2009 Edition, Systems and Specifications Manual.

1.2 QUALITY ASSURANCE

.1 Pre-Installation Meeting:

.1 Convene pre-installation meeting one week prior to beginning work of this Section.

.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.

1.3 SCHEDULING

.1 Submit work schedule for various stages of painting to DCC Representative for review. Submit schedule minimum of 72 hours in advance of proposed operations.

.2 Obtain written authorization from DCC Representative for changes in work schedule.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit product data and instructions for each paint and coating product to be used.

.2 Submit product data for the use and application of paint thinner.

.3 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Safety Data Sheets (SDS) in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOCs during application and curing.

.3 Samples:

.1 Submit full range colour sample chips to indicate where colour availability is restricted.

.2 Submit duplicate 200 x 300 mm sample panels of each paint with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards submitted on following substrate materials:

.1 3 mm plate steel for finishes over metal surfaces.

.2 13 mm birch plywood for finishes over wood surfaces.

.3 50 mm concrete block for finishes over concrete or concrete masonry surfaces.

.4 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.

.3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.

.4 Manufacturer's Instructions:

.1 Submit manufacturer's installation and application instructions, including substrate preparation.

.5 Closeout Submittals: submit maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals include following:

.1 Product name, type and use.

.2 Manufacturer's product number.

.3 Colour numbers.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Packing, Shipping, Handling and Unloading:

.1 Pack, ship, handle and unload materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.

.3 Acceptance at Site:

.1 Identify products and materials with labels indicating:

.1 Manufacturer's name and address.

.2 Type of paint or coating.

.3 Compliance with applicable standard.

.4 Colour number in accordance with established colour schedule.

.4 Remove damaged, opened and rejected materials from site.

.5 Storage and Protection:

.1 Provide and maintain dry, temperature controlled, secure storage.

.2 Store materials and supplies away from heat generating devices.

.3 Store materials and equipment in well ventilated area with temperature range 7 degrees C to 30 degrees C.

.6 Store temperature sensitive products above minimum temperature as recommended by manufacturer.

.7 Keep areas used for storage, cleaning and preparation clean and orderly. After completion of operations, return areas to clean condition.

.8 Remove paint materials from storage only in quantities required for same day use.

.9 Fire Safety Requirements:

.1 Provide one 9 kg Type ABC fire extinguisher adjacent to storage area.

.2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.

.3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.

.10 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00 – Cleaning and Waste Management.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for reuse, recycling or all packaging material in appropriate on-site bins in accordance with Waste Management Plan (WMP).

.4 Place materials defined as hazardous or toxic in designated containers.

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

.6 Ensure emptied containers are sealed and stored safely.

.7 Unused materials must be disposed of at official hazardous material collections site as approved by DCC Representative.

.8 Paint and related materials (thinners, and solvents) are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from Provincial Ministries of Environment and Regional levels of Government.

.9 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.

.10 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

.11 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:

.1 Retain cleaning water for water-based materials to allow sediments to be filtered out.

.2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.

.3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.

.4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.

.5 Empty paint cans are to be dry prior to disposal or recycling (where available).

.12 Where paint recycling is available, collect waste paint by type and provide for delivery to recycling or collection facility.

1.6 **SITE CONDITIONS**

.1 Heating, Ventilation and Lighting:

.1 Provide heating facilities to maintain ambient air and substrate temperatures above 10 degrees C for 24 hours before, during and after paint application until paint has cured sufficiently.

.2 Provide continuous ventilation for seven days after completion of application of paint.

.3 Coordinate use of existing ventilation system with DCC Representative and ensure its operation during and after application of paint as required.

.4 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.

.5 Provide minimum lighting level of 323 Lux on surfaces to be painted.

.2 Temperature, Humidity and Substrate Moisture Content Levels:

.1 Unless written approval by product manufacturer is obtained in advance, perform no painting when:

.1 Ambient air and substrate temperatures are below 10 degrees C.

.2 Substrate temperature is above 32 degrees C unless paint is specifically formulated for application at high temperatures.

.3 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.

.4 The relative humidity is under 85 % or when the dew point is more than 3 degrees C variance between the air/surface temperatures. Paint should not be applied if the dew point is less than 3 degrees C below the ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint work.

.5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.

.6 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand 'normal' adverse environmental factors.

.2 Perform painting work when maximum moisture content of the substrate is below:

.1 Allow new concrete and masonry to cure minimum of 28 days.

.2 15% for wood.

.3 12% for plaster and gypsum board.

.3 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using "cover patch test".

.4 Test concrete, masonry and plaster surfaces for alkalinity as required.

.3 Surface and Environmental Conditions:

.1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.

.2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.

.3 Apply paint when previous coat of paint is dry or adequately cured.

.4 Additional interior application requirements:

.1 Apply paint finishes when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.

PART - 2 PRODUCTS

2.1 MATERIALS

.1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.

.2 Provide paint materials for paint systems from single manufacturer.

.3 Conform to latest MPI requirements for interior painting work including preparation and priming.

.4 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing, meeting the MPI Premium Grade finish unless otherwise specified. Provide material from a single manufacturer for each system used.

.5 Linseed oil, shellac, and turpentine: highest quality product from approved manufacturer listed in MPI Architectural Painting Specification Manual, compatible with other coating materials as required.

.6 Provide paint products meeting MPI "Environmentally Friendly" ratings based on VOC (EPA Method 24) content levels.

.7 Ensure manufacture and process of water-borne surface coatings does not release:

.1 Matter in undiluted production plant effluent generating 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to natural watercourse or sewage treatment facility lacking secondary treatment.

.2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to natural watercourse or a sewage treatment facility lacking secondary treatment.

2.2 COLOURS

.1 Provide to DCC Representative for review, the Colour Schedule with product names, based on the colours selected by the DCC Representative.

.2 Selection of colours from manufacturers standard range of colours.

.3 Where specific products are available in restricted range of colours, selection based on limited range.

.4 Second coat in three coat system to be tinted slightly lighter colour than topcoat to show visible difference between coats.

2.3 **MIXING AND TINTING**

.1 Perform colour tinting operations prior to delivery of paint to site. Obtain written approval from DCC Representative for tinting of painting materials.

.2 Mix paste, powder or catalyzed paint mixes in accordance with manufacturer's written instructions.

.3 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.

.4 Thin paint for spraying in accordance with paint manufacturer's instructions.

.5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 **GLOSS/SHEEN RATINGS**

.1 Paint gloss is defined as sheen rating of applied paint, in accordance with following values:

	Gloss @ 60 degrees	Sheen @ 85 degrees
Gloss Level 1 - Matte Finish (flat)	Max. 5	Max. 10
Gloss Level 2 - Velvet-Like Finish	Max.10	10 to 35
Gloss Level 3 - Eggshell Finish	10 to 25	10 to 35
Gloss Level 4 - Satin-Like Finish	20 to 35	min. 35
Gloss Level 5 - Traditional Semi-Gloss Finish	35 to 70	
Gloss Level 6 - Traditional Gloss	70 to 85	
Gloss Level 7 - High Gloss Finish	More than 85	

.2 Gloss level ratings of painted surfaces as indicated.

2.5 **INTERIOR PAINTING SYSTEMS**

.1 Paint systems to meet MPI Premium Grade finish except where otherwise specified.

.2 Concrete vertical surfaces: including horizontal soffits:

.1 INT 3.1C: High performance architectural latex finish.

.3 Concrete horizontal surfaces: floors and stairs:

.1 INT 3.2A - Latex floor enamel low gloss finish, gloss level 3.

.4 Concrete Horizontal Surfaces Directional lines on concrete floor within Mechanical Rooms:

.1 INT 3.2H: Latex zone / traffic marking finish.

.5 Concrete masonry units: smooth and split face block and brick:

.1 INT 4.2A - Latex finish, gloss level 3, painted on both faces

.6 Brick pavers (stair treads, risers, and landings)

.1 One-part Paint System: premium quality, quick-drying, low odor, epoxy-modified acrylic latex, low sheen, floor enamel F122.

.1 Volume Solids: 35 + / - 2%

.2 VOC compliant: 45 g/L, CDPH v1 Emission Certified.

.3 Custom colour selected by DCC Representative, gloss level 3.

.2 Primer: specialty primer for difficult substrates, tinted to the approximate shade of the finish coat, primer type recommended by the paint manufacturer.

.3 Application:

.1 Thoroughly clean surfaces free of dirt, dust, grease, oil, soap, wax, scaling paint, water soluble materials, dull glossy areas, and remove peeling paint.

.2 Fully prime surfaces with tinted primer.

.3 Apply finish system in 2 coats; dry film thickness of each coat 1.0 mils.

.7 Structural steel and metal fabrications: columns, beams, joists:

.1 INT 5.1R: High performance architectural latex finish.

.8 Steel - high heat: (boilers, furnaces, heat exchangers, breeching, pipes, flues, stacks, etc., with temperature range as noted):

.1 INT 5.2A - Heat resistant enamel finish, maximum 205 degrees C, gloss level 5.

.9 Galvanized Metal: (Doors, frames, railings, misc. steel, pipes, overhead decking, ducts, etc).

.1 INT 5.3M: High performance architectural latex; semi-gloss.

.10 Dressed lumber: backboards for equipment:

.1 INT 6.3R - Pigmented fire retardant finish (ULC rated), gloss level 3.

.11 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock type material", and textured finishes:

.1 INT 9.2B: High performance architectural latex,

.2 gloss level 1 for ceiling, gloss level 3 for walls.

.12 Epoxy Paint:

.1 Primer: specific product type, numbers of coats and Dry Film Thickness (DFT) per coat as recommended by the manufacturer for the substrate intended; to provide

.2 Topcoat: Two-component water based catalyzed polyamine epoxy, chemical and abrasion resistant, VOC less than 50 g/l, gloss level 3

.3 Apply two (2) coats, at 3.0 mils DFT per coat.

.13 Canvas and cotton coverings.

.1 INT 10.1A - Latex, gloss level 3.

.2 INT 10.1B - Alkyd, gloss level 3.

.3 INT 10.1C - Aluminum paint finish, gloss level 3.

.14 Bituminous coated surfaces: cast iron pipe, concrete, etc.:

.1 INT 10.2B - Alkyd finish, low sheen, gloss level 3.

.15 Existing Concrete masonry units: smooth and split face block and brick:

.1 RIN 4.2A - Latex, gloss level 3

.16 Existing Structural steel, columns, beams, joists, and metal fabrications:

.1 RIN 5.1N – Latex, gloss level 3.

.17 Existing Galvanized Metal: Low contact low traffic areas such as Misc. steel, pipes, overhead decking, ducts.

.1 RINT 5.3A - Latex, gloss level 5 (over waterborne primer).

.18 Existing Galvanized Metal: High contact high traffic areas such as doors, frames, railings.

.1 RIN 5.3J - High performance architectural latex, gloss level 5.

.19 Existing window frames, and other existing aluminum items:

.1 RIN 5.4F - High performance architectural latex, gloss level 5

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 GENERAL

.1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.

.2 Apply paint materials in accordance with paint manufacturer's written application instructions.

3.3 EXAMINATION

.1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to DCC Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.

.2 Conduct moisture testing of surfaces to be painted using properly calibrated electronic moisture meter, except test concrete floors for moisture using simple "cover patch test". Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.

.3 Maximum moisture content as follows:

.1 Stucco, plaster and gypsum board: 12%.

.2 Concrete: 12%.

.3 Concrete Block: 12%.

.4 Wood: 15%.

3.4 **PREPARATION**

.1 Protection:

.1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore surfaces as directed by DCC Representative.

.2 Protect items that are permanently attached such as Fire Labels on doors and frames.

.3 Protect factory finished products and equipment.

.2 Surface Preparation:

.1 Remove electrical cover plates, light fixtures, surface hardware on doors, bath accessories and other surface mounted equipment, fittings and fastenings prior to undertaking painting operations. Identify and store items in secure location and re-installed after painting is completed.

.2 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.

.3 Place "WET PAINT" signs in occupied areas as painting operations progress. Signs to approval of DCC Representative.

.3 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual regarding specific requirements.

.4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.

.5 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.

.1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.

.2 Apply wood filler to nail holes and cracks.

.3 Tint filler to match stains for stained woodwork.

.6 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.

.7 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes, blowing with clean dry compressed air or vacuum cleaning.

.8 Touch up of shop primers with primer as specified.

.9 Do not apply paint until prepared surfaces have been accepted by DCC Representative.

3.5 **APPLICATION**

.1 Method of application to be as approved by DCC Representative. Apply paint in accordance with manufacturer's application instructions unless specified otherwise.

.2 Brush and Roller Application:

.1 Apply paint in uniform layer using brush and/or roller type suitable for application.

.2 Work paint into cracks, crevices and corners.

.3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.

.4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.

.5 Remove runs, sags and brush marks from finished work and repaint.

.3 Spray application:

.1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.

.2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

.3 Apply paint in uniform layer, with overlapping at edges of spray pattern. Back roll first coat application.

.4 Brush out immediately all runs and sags.

.5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.

.4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access.

.5 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.

.7 Sand and dust between coats to remove visible defects.

.8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as tops of interior cupboards and cabinets and projecting ledges.

.9 Finish inside of cupboards and cabinets as specified for outside surfaces.

.10 Finish closets and alcoves as specified for adjoining rooms.

.11 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

.12 Do not paint gasketing materials in acoustical door assemblies.

3.6 **MECHANICAL/ELECTRICAL EQUIPMENT**

.1 In Finished Areas: Paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as indicated.

.2 Boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.

.3 Paint the inside of all ductwork where visible behind louvers, grilles and diffusers for a minimum of 450 mm or beyond sight line, whichever is greater, with primer and one coat of flat black paint.

.4 Paint the inside of light valances gloss white.

.5 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.

.6 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.

.7 Do not paint over nameplates.

.8 Keep sprinkler heads free of paint.

.9 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.

.10 Paint fire protection piping red.

.11 Paint disconnect switches for fire alarm system and exit light systems in red enamel.

.12 Paint natural gas piping yellow.

.13 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.

.14 Do not paint interior transformers and substation equipment.

3.7 SITE TOLERANCES

.1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.

.2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.

.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.8 FIELD QUALITY CONTROL

.1 Where "special" painting, coating or decorating system applications (i.e. elastomeric coatings) or non-MPI listed products or systems are to be used, paint or coating manufacturer shall provide as part of this work, certification of surfaces and conditions for specific paint or coating system application as well as on site supervision, inspection and approval of their paint or coating system application as required at no additional cost to DCC Representative.

.2 Standard of Acceptance:

.1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.

.2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.

.3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

.3 Field inspection of painting operations to be carried out be independent inspection firm as designated by DCC Representative.

.4 Advise DCC Representative when surfaces and applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.

.5 Cooperate with inspection firm and provide access to areas of work.

.6 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by DCC Representative.

3.9 **EXISTING SURFACES**

.1 Finish or refinish existing surfaces of items or rooms where noted, including new work which has been incorporated into the existing work and existing work which has been damaged, altered or otherwise disturbed during renovation operations.

.2 Refinish surfaces or rooms adjacent to rooms where alterations or renovations have been carried out and which have been damaged or otherwise disturbed by the alterations or renovations. Where such damages occur, refinish completely.

.3 Remove from existing surfaces rust, scale, oil grease, mildew, chemicals and other foreign matters.

.4 If coatings on existing surfaces have failed so as to affect the proper performance or appearance of materials to be applied, or if such coatings can be easily removed, remove them and prepare the substrates properly. Dull hard or glossy surfaces by sanding, sandblasting or by other abrasive methods prior to finishing.

.5 Refinish surfaces entirely between changes of planes which have been incorporated into the existing work and existing work which has been damaged, altered or otherwise disturbed during renovation operations.

3.10 **RESTORATION**

.1 Clean and re-install hardware items removed before undertaken painting operations.

.2 Remove protective coverings and warning signs as soon as practical after operations cease.

.3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.

.4 Protect freshly completed surfaces from paint droppings and dust to approval of DCC Representative. Avoid scuffing newly applied paint.

.5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by DCC Representative.

3.11 **CLEANING**

.1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

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

.2 When installation is complete, remove protective coating and clean surfaces in accordance with the coating manufacturer's instructions. Use only cleaning methods and materials recommended by the coating manufacturer.

.3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Comply with Division 1, General Requirements and documents referred to therein.

.2 Read and conform to all Sections of Division 14.

.3 Where a device or piece of equipment is referred to in singular number, it is intended that such references shall apply to as many devices or pieces of equipment as are required.

1.2 SUMMARY

.1 This Section applies to:

.1 Decommissioning of the existing basement traction elevator. Following this, others will remove all remaining elevator equipment from the site and modify the hoistway to suit the new elevator.

.2 Design, engineering, supply, and installation of one (1) custom machine room less (MRL) passenger-type traction elevator.

.2 Work to be carried out in Massey Library at Royal Military College, Kingston. All elevator work specified herein shall be done by one company.

.3 For the purpose of this work, the elevator will be referred to as Passenger Elevator 1. Obtain final designation for this unit from the DCC Representative, so it can be engraved on car operating station and stencilled on other elevator equipment, as required by Code.

.4 Confirm with Contractor, schedule for milestones associated with elevator installation, including completion dates.

.5 Elevator must be engineered in accordance with Seismic requirements of the Building Code and CSA B44 Elevator Safety Code. The basis of this requirement accounts for the following:

.1 Building is not designated as a post-disaster building.

.2 Earthquake importance factor for the structure (IE) is 1.0.

.3 Acceleration-based site coefficient (Fa) is 1.0.

.4 5% damped spectral response acceleration (Sa (0.2)) is 0.262.

1.3 RELATED WORK (NOT BY ELEVATOR TRADE CONTRACTOR)

.1 It is anticipated that work performed by trade contractors other than the elevator trade contractor includes but is not limited to the following:

.1 Division 1: Power of characteristics, required during erection of elevator, to provide illumination, operation of required tools, hoists and power for starting, testing and adjustment of all equipment.

.2 Divisions 3 and 5: Concrete and steel work required for fire rated and plumb hoistway, control room and pit, including top of hoistway supports.

.3 Divisions 3 and 5: Supports to carry all structural reaction, impact and uplift loads imposed by elevator equipment.

.4 Division 4: Masonry and grouting of entrances and landing sills.

.5 Division 5: Top of shaft equipment hoist beam and means for securing of worker fall arrest equipment.

.6 Division 7: Waterproofing to keep elevator pit dry.

.7 Division 8: Control room access door. Door shall be fire-resistive, self-closing, self-locking and permit door to be opened from inside without a key.

.8 Division 9: Finished flooring in elevator cab enclosure. This Section must ensure that sub-floor is recessed to accept final flooring and that equipment is Engineered to accommodate weight of finished flooring. Co-ordinate and schedule installation of finished flooring with Division 9 Trade Contractor.

.9 Division 9: Painting of control room walls, ceiling and floor.

.10 Division 22: Provide a drain in elevator pit to ensure pit remains dry. Drain shall have a minimum capacity of 11.4 m3/hr.

.11 Division 23: Permanent heating, ventilation, and air conditioning, required to keep elevator control room temperature between 5°C and 32°C with a maximum relative humidity of 95% non-condensing, unless more stringent ranges are required by the Elevator Trade Contractor.

.12 Division 26: Extend electric feeder wires and bonding conductor, suiting requirements of Elevators Trade Contractor, to elevator controller. Include mainline switches, circuit breakers or fuses.

.13 Division 26: Elevator control room, top of hoistway and elevator pit lighting. Minimum light level of 200 lux at control room floor level throughout room and on car top when car top is level with uppermost level served. Minimum light level of 100 lux at pit floor level throughout elevator pit. Locate light switch: inside control room, adjacent to access door; inside hoistway such that it is accessible from top landing, with landing door open; within pit adjacent to access ladder, accessible from lowest landing served. Recommend the use of vapour resistant linear LED fixtures, confirming the final mounting location of all fixtures with the Elevator Trade Contractor and coordinating the installation of same with them.

.14 Division 26: Provide control room, top of hoistway, and elevator pit with Type A GFCI receptacle outlets, coordinating mounting location with Elevator Trade Contractor.

.15 Division 26: Provide main three-phase fused disconnect of elevator with an auxiliary (fourth pole) contact, to prevent automatic movement of elevator on Emergency Battery Assist (provided by Elevator Trade Contractor) in the event that the disconnect is in the "OFF" position. Division 14 will provide an override circuit in the controller and connect it up to the fourth pole contact signals from disconnect. Auxiliary contact must meet prescribed requirements of OESC Rule 38-091(5) including that it must be positively opened mechanically, the opening not being solely dependent on springs.

.16 Division 26: Provide a minimum of three 120 Volt, 15 Amp, separate power circuits with fused and lockable disconnecting means, or breaker, to support power requirements for the elevator. One circuit must be dedicated for auxiliary systems associated with the elevator cab with the Elevator Trade Contractor providing dedicated conductors in the travelling cable to support this requirement.

.17 Division 27: Provide one (1) dedicated telephone line, a single-phase power supply (120 Volt, 15 Amp), and one Local Area Network (LAN) 10BaseT Ethernet port inside the elevator control room to support the elevator emergency communication system. Precise requirements to support this system will be confirmed with the Elevator Trade Contractor.

.18 Division 28: Co-ordinate running of elevator controller(s) signal wiring for fire alarm with Elevator Trade Contractor.

.19 Division 28: Supply of security card reader (where required) for inside elevator.

.20 Division 28: Provide fire alarm signals to elevator control room, including the following:

.1 General Recall Signal, from building fire alarm initiating devices (FAID), except those at main recall level elevator lobby. Main recall level for elevator shall be Level G.

.2 Alternate Level Recall Signal, from designated FAID at main recall level elevator lobby, which will initiate elevator recall to Alternate Recall floor. Alternate Recall level shall be Level 1 (North), unless advised otherwise.

.3 Control Room Fire, from FAID inside the control room, which will initiate recall to the alternate level.

.4 Hoistway Fire, from FAID at the top of the elevator hoistway, which will initiate recall to the main level.

.5 Pit Fire, from FAID in the elevator pit, which will initiate recall to the alternate level.

.6 Fire signals generated from FAID in the control room, hoistway and pit, must be distinct from the remaining signals as recall initiated from one of these FAID's require that the in-car visual signal illuminate intermittently.

.7 Signal requirements for fire recall must be coordinated with the Elevator Trade Contractor.

1.4 QUALITY ASSURANCE

.1 Elevator control system and equipment provided as part of this work must be non-proprietary, permitting equipment maintenance and adjustment to be performed by any qualified elevator company registered with the Technical Standards and Safety Authority (TSSA).

.2 Bidders must provide the following information with their Tender submission:

.1 Description of proposed equipment for elevator, including preliminary layouts,

.2 Description, make and model of control system, and confirmation that it is non-proprietary,

.3 Description, make and model of drive system,

.4 Location of manufacture,

.5 References where Bidder has installed this equipment and provided reliable demonstrated performance in a similar building environment.

.6 Confirmation of fire signals to be brought to elevator controller.

.3 Work shall be performed in strict accordance with current requirements of all local, provincial and federal codes, ordinances and by-laws. Work shall conform to the latest version of the following standards:

.1 CSA B44, Safety Code for Elevators.

.2 Elevating Devices Act, Revised Statutes of Ontario, 1990, Regulation 316

.3 Active Director's Orders and Code Adoption Document as issued by the Technical Standards and Safety Authority (TSSA).

.4 Ontario Building Code

.5 National Building Code

.6 Ontario Electrical Safety Code

.7 Canadian Electrical Safety Code

.8 Underwriters Laboratories of Canada

.9 CSA and Ontario Hydro Certification for electrical components

.10 Occupational Health and Safety Act for Industrial Establishments.

.4 Obtain and pay for governmental design submission registration, inspection and permit, as required, except operation and ownership permits, and make such tests as called for by regulations of such authorities. Tests shall be made in the presence of authorized representatives of AHJ and DCC Representative.

.5 Use only components which can be shown to have performed satisfactorily and proven reliable. Use of prototype or first-time installation equipment, component combinations or equipment mixes are not acceptable.

.6 Elevator work shall be performed by properly trained and skilled mechanics in the direct employ of unit's manufacturer or authorized installation company.

1.5 WARRANTY

.1 Provide one (1) year warranty for new elevator from date of substantial completion of Elevator Trade Contractor Work and acceptance of unit by DCC Representative.

.2 Warranty period shall cover defects in equipment and workmanship provided by Elevator Trade Contractor.

.3 Warranty shall include prompt remedy of all defects upon written notification from DCC Representative that defects exist. Remedy shall include labour, materials, equipment and services required to make good defective areas of Work. Where defects occur in the case of factory-fabricated components, Warranty shall cover the supply and installation of new components.

.4 Warranty work shall be undertaken at times convenient to DCC Representative.

.5 Warranty shall include making good other building parts, finishes and other building property, damaged or disturbed in course of remedying defects, at no additional cost.

.6 In the event that equipment does not meet all requirements of Specification, Elevator Trade Contractor shall:

.1 Promptly remove and replace work failing to comply.

.2 Bear expense of making good all work of separate contractors damaged by such removal or replacement.

1.6 SUBMITTALS, SAMPLES AND SHOP DRAWINGS

.1 Shop drawings shall be of the same uniform size and use Metric System of weights and measures.

.2 Submit, within two (2) weeks after Contract Award, completion schedule showing equipment delivery dates and anticipated completion date. Ensure these dates are reflective of schedule requirements confirmed by General Contractor.

.3 Submit, within three (3) weeks after Contract Award, the following information:

.1 Equipment starting and running currents and recommended fuse ratings.

.2 Electrical power confirmation.

.4 Submit within six (6) weeks of Contract Award, detailed shop drawings showing complete layout of elevator equipment including the following:

.1 Location of machinery and apparatus (and its relationship to adjacent structural building components).

.2 Loads to be carried on structure, including top of hoistway steel or concrete supports. Elevation of top of hoistway steel supports must be confirmed.

.3 Control room cooling requirements, including equipment heat emission rates, recommended room temperature and relative humidity ranges. Where mechanical cooling of elevator shaft is anticipated, Elevator Trade Contractor must identify this requirement at time of bid submission, including equipment heat emission rates.

.4 Design of hoistway entrances, showing location of all signals and fixtures in elevation.

.5 Design of elevator cab enclosure, including all elevations (front, rear, side, ceiling, floor) showing all signage, signals, and operating controls. Indicate accurate location of all finishes.

.6 Design of all hall and car operating controls and signals.

.5 Submit layouts to Municipal or Provincial Authorities having jurisdiction and receive approval before work proceeds.

.6 Before fabrication, submit a minimum of three (3) sets of samples (minimum 250 mm x 250 mm), which fully represent physical and chemical properties of materials to be supplied in final finish. Samples for all operating buttons, signage plaques and handicapped markings shall be full size.

.7 Submit the following samples for review:

.1 Hall and car operating buttons.

.2 Hall lantern assemblies.

.3 Appendix "E" in car and lobby signage (tactile plates and raised Arabic numeral characters).

.4 Elevator cab protective pads.

.8 Submit data indicating sizes, quantities, locations and other relative data for related work to be done under other Sections.

.9 Approval of submittal data or shop drawings for material, equipment, apparatus, devices, arrangements and/or layout shall not relieve Elevator Trade Contractor from the responsibility of furnishing equipment of proper dimensions and weight, capacities, sizes, quantities, quality and installation details and to efficiently perform requirements and intent of these Contract Documents. Review of these documents shall not relieve Elevator Trade Contractor of final responsibility for meeting Contract Document requirements.

1.7 WARRANTY PERIOD MAINTENANCE

.1 Provide 12-month warranty period preventive maintenance for the elevator from date equipment is taken over and accepted by DCC Representative, coinciding with Warranty period in 14 20 00 article1.5.

.2 Maintenance shall be undertaken during regular working hours however, emergency call-backs, available on a 24 hour, 7 days a week basis, shall be included, without additional cost.

.3 DCC Representative shall have the right to postpone commencement of this 12-month warranty maintenance period, provided that unit is taken out of service after work specified in this Contract Document is complete. Put into service such unit on basis of seven (7) days notice from DCC Representative.

1.8 (NOT USED)

1.9 INTERIM MAINTENANCE

.1 Elevator may be turned over for use before being placed into public use, necessitating interim maintenance until Warranty Period Maintenance (see 14 20 00, article1.7) commences.

.2 Interim maintenance is defined as maintenance provided, from time a unit is put initially into "Construction" service to date when elevator is turned over for public use, accepted by DCC Representative and Warranty Period Maintenance commences.

.3 State, in bid form, separate price for Interim Maintenance on a per month basis.

1.10 (NOT USED)

1.11 MANUALS

.1 Provide two (2) sets of Manufacturer's Maintenance and Operating Manuals along with one (1) electronic (.pdf) copy. Resolution of electronic document must be 300 DPI as a minimum.

.2 Manuals shall have sufficient detail regarding all equipment components to allow DCC Representative to undertake equipment maintenance and adjustments.

.3 Manuals shall contain, as a minimum, the following information:

.1 Replacement parts list.

.2 Site specific Maintenance Control Program (MCP).

.3 Description of system's method of operation and control including, but not restricted to, control system and special or non-standard features provided.

.4 Legible laminated schematic wiring diagrams with legend covering all electrical equipment as supplied and installed, including all changes made in final Work, with all symbols listed corresponding to identity or markings on machine room and hoistway apparatus.

.5 Information on each piece of equipment shall include:

.1 Lubrication.

.2 Trouble shooting procedures.

.3 Adjustment techniques.

.4 List of recommended spares to be kept on Site.

.5 List of special tools and appropriate application.

.6 All equipment is to be listed as to types.

.6 A consolidated detailed list of all manufacturer and supplier contact information (i.e. name of firm, address(es), telephone numbers, e-mail address, etc.)

.7 A master cross reference list, identifying each unit by building designation, TSSA number and Manufacturer's sales number, along with which manual information for said unit(s) is located. Master list must appear on inside face of each manual (binder), where applicable.

.4 All documents other than circuit diagrams larger than standard imperial size paper shall be neatly folded and inserted in labelled envelope. All photocopies must be totally legible. Only pertinent details shall be acceptable.

.5 All maintenance and operating manuals/binders shall be approved by DCC Representative before certification of Substantial Performance of work is issued. Full release of all hold back monies will not be processed until manual/binder submissions have been approved.

.6 Manuals and wiring diagrams, supplied by the Contractor, will remain the property of the DCC Representative.

1.12 WIRING DIAGRAMS

.1 Provide two (2) sets of "As Built" wiring diagrams including all field wiring changes, along with one (1) electronic (.pdf) copy. Resolution of electronic document must be 300 DPI as a minimum.

.2 Plasticize wiring diagrams and sheets, and mount one (1) complete set in elevator control room, to a wood frame and plywood backboard.

.3 Remaining set of wiring diagrams and sheets shall be turned over to DCC Representative in properly labelled envelopes, identifying elevator which they are for (i.e. RMC Massey Library - Passenger Elevator 1).

.4 Wiring diagrams shall remain the property of the DCC Representative for the life of the building and shall not be removed from site, at any time, without DCC Representative's prior written consent.

1.13 MAINTAINABILITY

.1 Elevator equipment provided under this specification shall not contain proprietary features, which limit the DCC Representative's ability to engage a qualified elevator maintenance contractor, other than the original manufacturer/installer, for provision of maintenance services.

.2 Where specialized tools are required to perform these services, such tools shall be provided with the equipment as part of the installation and become property of the DCC Representative.

.3 No devices, diagnostic or otherwise, shall lose any function over time or contain self-expiring software.

.4 Provide fault codes, set-up parameters, detailed procedural, operating and troubleshooting instructions, plus all other materials required to permit an alternate contractor to undertake maintenance or service.

.5 At completion of the Project, provide one set of "as built" e-proms, to be retained by the DCC Representative for his sole use and storage.

.6 In the case of coated steel belts, where a special device is required for monitoring the condition of the encapsulated steel belts, this device shall be provided as part of this installation, along with operating instructions, and remain the property of the DCC Representative.

1.14 CONSTRUCTION USE

.1 Where elevator is utilized for construction use, Elevator Trade Contractor shall be responsible for completely cleaning down entire installation, returning to "like new" condition, readjusting and finishing elevator to comply with final acceptance requirements of Contract Documents upon completion of construction use.

1.15 TRAINING OF DESIGNATED BUILDING STAFF

.1 Upon DCC Representative's acceptance of the equipment, arrange with DCC Representative to provide competently trained personnel, thoroughly conversant with all operational and control aspects of elevator equipment installed, to instruct designated DCC Representatives in the operation of this unit. If staff numbers require, provide several training sessions in order to maintain manageable group sizes.

.2 Within three (3) months after final acceptance, at a time convenient to DCC Representative, provide for the period of two (2) days, sufficient personnel, to carry out instructions regarding usage and operation of equipment for designated building employees. Training shall include Firefighters' Emergency Operation, emergency battery assist operation, communication system, Independent Service, etc.

.3 Training shall be carried out only by competent forces, who are completely conversant with all facets of equipment operations, including life safety controls.

PART 2 PRODUCTS

2.1 WORK INCLUDED

.1 Provide all labour, materials, equipment, services, and perform all operations required for:

.1 Decommissioning of the existing basement traction elevator per 14 20 00, article 2.2. Following this, General Contractor will remove all remaining existing elevator equipment from the site and modify the hoistway to suit the new elevator.

.2 Provision of one (1) electric traction passenger elevator, as indicated on Drawings and as specified herein. Elevator work shall be in accordance with all applicable requirements of the Contract Documents.

2.2 DECOMMISSION EXISTING ELEVATOR

.1 Existing basement traction elevator is to be removed and existing hoistway is to be modified to suit new elevator. Elevator Trade Contractor's forces to carry out the following work associated with the removal of the existing elevator:

.1 Disconnect hoist ropes from car and counterweight, such that counterweight can be left resting on the buffer in the elevator pit for removal by others.

.2 Elevator cab, platform, and safety plank shall be dismantled and removed from the elevator hoistway, with all equipment being stored in a location designated by the General Contractor for disposal and removal from site by the General Contractor.

.3 Hoist ropes shall be coiled up on spools and stored in a location designated by the General Contractor for disposal and removal from site by the General Contractor.

.4 Governor rope shall be disconnected from the governor and idler sheave and coiled up on a spool and stored in a location designated by the General Contractor for disposal and removal from site by the General Contractor.

.5 Remove all elevator landing door panels and associated hardware storing same in a location designated by the General Contractor for disposal and removal from site by the General Contractor. Prior to undertaking this work coordinate with General Contractor so they can erect proper hoarding and barriers in front of the resultant opening, so that potential falling hazard is mitigated.

2.3 DESCRIPTION OF NEW ELEVATOR SYSTEM

.1 Passenger Elevator 1

.1 Quantity: One (1) overhead machine room-less traction passenger elevator.

.2 Rated Capacity and Car Loading Classification: 950 kg with Class A loading.

.3 Contract Speed: 0.76 m/s.

.4 Estimated Vertical Travel: 11.228 metres.

.5 Floors served:

.1 Front Openings (South): G, 1, 3

.2 Rear Openings (North): B (Lecture Hall), 1, 2.

.6 Number of Landings: Five (5).

.7 Number of Entrances: Six (6).

.8 Operation: Selective-collective automatic operation, complete with programmable microprocessor and solid-state control devices.

.9 Special Operations and Features:

.1 Independent Service.

.2 Automatic Emergency Battery Assist.

.3 Firefighters' Emergency Operation - Phases I and II - Automatic.

.4 Emergency communications including hands-free telephone, supplemented with video and messaging features.

.5 Security Card reader in cab.

.6 Short floor operation between Levels B and G based on an estimated vertical travel of 1371 mm.

.7 2-Speed Cab Fan.

.8 In-Car Service Cabinet.

.9 Multi-beam door protective device.

.10 Control: Variable Voltage Variable Frequency

.11 Clear Cab Dimensions:

.1 1295 mm wide x 1949 mm deep, minimum (clear inside).

.2 2629 clear cab height to underside of suspended ceiling, 2743 mm cab canopy height.

.3 All clear inside dimensions are approximate.

.12 Dimensions:

.1 Clear shaft is 1905 mm wide x 2800 mm deep (to be field verified by Elevator

Trade Contractor).

.2 Clear pit depth is approximately 1525 mm, as shown on Contract Drawings.

.3 Overhead of approximately 4800 mm, measured from top level served to underside of structure.

.13 Safety: Gradual wedge "B" type for car.

.14 Buffers: Spring.

.15 Landing Doors: Automatic, power operated horizontal sliding, two-speed side-opening. Clear entrance size is 915 mm wide x 2134 mm high, at all levels served.

.16 Door Operation: Heavy-duty door operator.

.17 Signals:

.1 One (1) riser of landing buttons at all levels served. Buttons shall be positioned adjacent to elevator entrances. Buttons to be manufacturer's standard top of the line mechanical action fixture, with light emitting diode (LED) illumination.

.2 One (1) car operating station, incorporated in the centre of the west side wall. Car call buttons to be mechanical action, with LED illumination matching landing buttons.

.3 One (1) car position indicator, over car operating buttons flush mounted in car operating station.

.4 Car riding lanterns, in one entrance jamb on both sides of cab (total of 2).

.5 One (1) hall position indicator, at Level G.

.18 Control Room Location: Adjacent to hoistway, at Level G.

2.4 PERFORMANCE

.1 Elevator shall travel at specified rated speed within maximum variation of 3%, regardless of load or direction of travel.

.2 Maximum flight time shall be 13.0 seconds.

.3 Flight times shall be measured under the following conditions:

.1 Floor-to-floor rise of 3277 mm.

.2 Time starts when car doors begin to close.

.3 Time ends when car is stopped level at next landing and car doors are three-quarters open (flight time assumes door for pre-opening).

.4 Car carrying full rated capacity. Times to be same for both directions of travel.

.5 Time variation within 5% under other loads.

.6 Adjusted such that time can be readily maintained.

.7 Acceleration and deceleration to be smooth transition, without noticeable shifts.

.8 Door operation, including door kinetic force requirements of Code to be met.

.9 Brake-to-brake time of 7.5 seconds.

.10 Door times shall be set to the following:

.1 Door open time of 2.5 seconds.

.2 Door close time of 3.5 seconds.

.3 Car call dwell time of 3.0 seconds.

.4 Hall landing dwell time shall initially be set at 5.0 seconds.

.11 Dwell times should be independently adjustable at all floors.

.12 Door protective device interrupt time set at 20.0 seconds.

.4 All timing devices shall be independently adjustable.

.5 Acceleration component of side-to-side or front-to-back sway, shall not exceed 20 milli(g) peak to peak, measured with a maximum 225 kg non-eccentric car load. Horizontal readings shall be taken in plane of, and perpendicular to, car guide rails.

2.5 MACHINE AND CONTROLLER LOCATION

.1 Place all elevator rotating equipment in hoistway, as required. Elevator control equipment to be placed in control room, as provided. Orient equipment to suit control room configuration and access location, as indicated on Drawings.

.2 Provide all wiring and conduit between hoistway and elevator control room.

2.6 ELECTRICAL REQUIREMENTS

.1 Provide insulated wiring with a flame retarding and moisture resisting outer cover to connect all parts of equipment. Wiring shall be run in metal conduit, metallic tubing or wire ducts.

.2 Signals for fire alarm and communication wiring shall be brought to elevator controller by Electrical Trade Contractor, as co-ordinated on site with Elevator Trade Contractor. Termination of these items within elevator controller shall be the responsibility of Elevator Trade Contractor.

.3 Travelling cables shall have flame retarding and moisture resisting outer cover, running without splices, cuts, breaks or intermediate junction boxes between elevator cab and controller. Travelling cables shall be flexible and suitably suspended to relieve strains in individual conductors. Provide travelling cables with minimum 10% spare conductors.

.4 Insulated conductors and conduit or tubing, as well as fittings, including metal boxes, troughs and ducts, shall comply with governing Electrical Safety Code.

.5 Power supply will be 600 volts, 3-phase, 60 Hz.

.6 Provide car crosshead with a minimum of two (2) fixed work lights, mounted at opposite ends of crosshead, complete with wire mesh protective guards, and a grounded duplex receptacle. Both light fixtures shall be controlled by a single control switch, which must be accessible from landing, prior to boarding car top.

.7 Provide all interconnections at elevator control cabinet for power feeds and control circuits.

.8 Provide flexible conduit interconnections with proper anti-shorts. Properly anchor and support all flexible and rigid conduit sections. Lengths of conduit shall be supported at intervals of not more than 1525 mm.

.9 In addition to the wires for normal operating controls, elevator travelling cables shall be provided with the following wiring and cables:

.1 Four (4) unshielded, stranded conductors (18 AWG).

.2 Four (4) unshielded, stranded conductors (14 AWG).

.3 4x20 C5e AWG shielded pair cable to deliver high-speed Ethernet to the cab. Terminate conductors on a module to facilitate an RJ-45 jack interface at both ends of the conductors.

.4 Eight (8) pairs of shielded wires (20 AWG).

.5 Two (2) RG6/U coaxial cables, with 18 AWG copper centre conductor.

.6 Conductors and cables shall extend from terminal blocks in the elevator controller to the respective device inside the elevator cab. Spare conductors and cables shall be extended to the elevator car top with a minimum excess loop of 2000 mm at both ends.

.7 All wires and cables shall run between control room and elevator cabs without splices, cuts or breaks.

.8 Mount and label each wire on a terminal strip(s) within controller cabinet.

2.7 EMERGENCY BATTERY ASSIST OPERATION

.1 Building has no backup generator and there are no immediate plans to add one.

.2 Provide an emergency battery backup system, with sufficient capacity to move elevator stopped between floors to an adjacent landing where doors will open fully and then close, with the door open button remaining operational. If elevator is stopped at a floor with doors in the closed position when power fails, doors will open fully and then close, with the door open button remaining operational.

.3 Division 26 will provide a fourth pole auxiliary contact in main disconnect.

.4 Provide an over-ride circuit in controller and connect it to fourth pole contact signals from disconnect.

.5 Verify system operation a minimum of once annually and document in the MCP the date when the test was successfully performed. Include complete system maintenance, support, parts replacement, and repairs as part of the preventive maintenance agreement.

2.8 EMERGENCY POWER PROVISIONS

.1 Building has no backup generator but may choose to add one in the future, which will possibly feed this elevator. Elevator Trade Contractor shall provide the following:

.1 Equipment shall be designed so that it can automatically re-start in the event of a power failure and maintain specified performances.

.2 Provide battery backup and surge protection devices for all circuits which contain volatile memory.

.3 Provide a spare fixture for the main recall level (Level G) housing all features required for the initial installation together with an emergency power LED indicator light and required engraving (i.e. "Elevator Emergency Power"). Provide conductors from controller to main recall hall pushbutton fixture for future Emergency Power LED. Label both ends of conductors accordingly. Faceplate of original and future faceplates shall be identical such that back box will accommodate both. Fixture with the emergency power features is to remain inside the elevator controller room.

2.9 FIREFIGHTERS' EMERGENCY OPERATION: PHASE I AND II

.1 Provide elevator with automatic Phase I (recall) and Phase II (in-car) controls. Elevator shall be arranged to operate in accordance with CSA B44 Safety Code for Elevators rule 2.27, as well as local building codes.

.2 Provide one Phase I recall switch, indicators and engraving in Main Recall Level hall station.

.3 Elevator numbering shall be in accordance with Contract Drawings.

.4 Provide 76 mm high raised unit identification number, surface mounted on elevator entrance frame header at designated Main Recall Level.

.1 Number shall be finished in stainless steel.

.2 Number shall be mounted without visible fastening devices, in a location as confirmed by DCC Representative at time of shop drawings review.

.5 Provide three-position Firefighters' Phase II Emergency In-Car Operation key-switch in elevator. Designate key-switch with appropriate signage, as required by Code.

.6 Main Recall level shall be Level G. Alternate recall level shall be Level 1 (North) unless advised otherwise. When operating on Phase II in-car firefighters' emergency operation, unrestricted access to all landings is required.

.7 Fire detection signals, provided by Electrical Trade Contractor, will be wired directly to elevator controller, as co-ordinated on site with Elevator Trade Contractor. Termination of signal wires to controller shall be completed by Elevator Trade Contractor.

.8 Elevator Trade Contractor must confirm quantity and type of fire signals to be provided by the Fire Alarm Trade Contractor.

2.10 EQUIPMENT HARMONIC DISTORTION

.1 Equipment manufacturer shall provide, in writing, a statement that total voltage harmonic distortion (THD) from equipment, as measured from 3rd to 21st harmonic at branch circuit connection, will not exceed 3%, and individual harmonic distortion will not exceed 5%, as defined by I.E.E.E. 519.

.2 This shall apply to all microprocessor based equipment, all equipment containing switch-mode power supplies and all non-linear equipment loads.

.3 Where required, install harmonic filters to meet above requirements.

.4 Measure distortion of each phase, at load terminals of branch breaker, and report results, in writing, to the DCC Representative. Any deficiency in this respect shall be corrected.

2.11 SELECTIVE-COLLECTIVE AUTOMATIC OPERATION

.1 Provide elevator with Selective-Collective Automatic Control, complete with Independent Service operation.

.2 Operation shall be controlled from hall and car call buttons. Momentary pressure of one or more landing or car buttons, other than those at the landing where elevator is located, shall cause car to start, provided safety circuits are closed. Elevator shall travel and stop at first landing for which a car or hall landing call is registered, corresponding to direction of car travel.

.3 Elevator shall stop at all landings for which car or hall landing calls are registered. Stops shall be made in order landings are reached, not in order or sequence in which calls were placed. Elevator shall stop for calls, provided call is registered for direction of intended elevator travel, and call has been registered sufficiently in advance of car arrival to permit a safe stop.

.4 If there are no car calls and elevator starts in UP direction, in response to one or more DOWN calls, elevator shall proceed to highest DOWN call and then reverse direction to respond to remaining DOWN calls.

.5 If there are no car calls and elevator starts in DOWN direction, in response to one or more UP calls, elevator shall proceed to lowest UP call and then reverse direction to respond to remaining UP calls.

.6 If elevator, having no registered car calls, stops at a landing, and a car call is registered in direction of intended car travel within a predetermined interval after door opening, elevator shall continue in that direction of travel and respond to registered car call.

.7 Once elevator stops in response to a hall or car call, hall and car landing doors shall remain open for an adjustable period of time. Upon expiration of this dwell interval, car and hall doors shall close.

.8 If DOWN landing calls are initiated while elevator is travelling UP, elevator shall not stop in response to these DOWN landing calls. These calls shall remain registered. After elevator has answered its highest car or UP direction landing call, elevator shall reverse and respond to DOWN landing call. When travelling DOWN, elevator shall not respond to UP direction landing calls, or car calls registered for levels behind the car. UP direction landing calls shall remain registered until such time as they are answered during next car UP direction trip.

.9 When car is designated to park at a landing, it shall do so with its doors closed.

.10 Provide hall push button failure operation, designed to allow elevator to continue to serve all floor levels when hall push button riser is lost (i.e. wild car or continuous car call operation). When elevator is operating on auxiliary means of dispatching, registered car calls shall not cause elevator to bypass scheduled dispatching stops.

2.12 OPERATION AND CONTROL FEATURES

.1 Provide elevator control system with operation and control features as specified herein:

.1 Provide load weighing to dispatch elevator ahead of prevailing operating intervals once it is filled to approximately 60% of rated capacity. Load weighing shall be provided to by-pass hall calls in event elevator becomes and/or remains filled at 50% rated capacity. Both settings shall be independently adjustable.

.2 Provide anti-nuisance service, which automatically cancels registered car calls when number of registered car calls exceeds proportional load in elevator.

.3 Provide directional reversal so that an elevator arriving at a landing where both UP and DOWN hall calls are registered, will first answer call placed for the direction that elevator was travelling. If no car call is placed in initial direction and elevator is assigned to respond to opposite direction hall call, car doors shall close and immediately re-open to respond to opposite direction hall call. Hall lantern operation shall always correspond to intended direction of elevator travel.

.4 Provide reversal feature, which will allow elevator to automatically stop at next floor, and reverse without opening its doors, upon assignment of opposite direction hall call, when changing traffic conditions have cancelled previous hall call assignment. When elevator stops at floor for reassignment, hall lantern shall not illuminate.

.5 When elevator arrives at terminal floor, automatically cancel all registered car calls. Alternatively, car calls shall not register for levels located below an UP travelling elevator or above a DOWN direction elevator.

.6 Provide dispatch protection to ensure auxiliary means of dispatching in both directions of travel that will automatically be initiated when normal dispatching fails. When elevators are operating on auxiliary means of dispatching, registered car calls shall not cause elevators to bypass scheduled dispatching stops.

.7 Provide high call -- low call reversal so that all elevators shall be capable of making high call -- low call reversals without having to travel to a terminal floor, except to answer landing call or car call at that level.

.8 Once elevator has responded to a hall call, and elevator doors have started to close, registration of further hall call demands at that floor shall not cause closing elevator doors to stop and re-open, provided elevator has further travel demand(s).

.9 In the case where elevator is not in normal group service, hall buttons shall be de-activated.

2.13 INDEPENDENT SERVICE

.1 Provide elevator with Independent Service operation in accordance with the following:

.1 Independent Service to be controlled by two-position key-switch mounted within service cabinet. Key shall be removable with the switch in either position.

.2 Under Independent Service, in-car directional indicators, and car door re-opening device shall be de-activated.

.3 Turning key switch to "ON" position will cancel car calls which were registered while elevator was in normal group operation and allow elevator to be withdrawn from normal group operation, operating in response to car calls only.

.4 When elevator is operating under Independent Service, automatic door closing operation shall not be allowed. Doors shall close by constant pressure on either car call button or Door Close button.

.5 Car calls registered while on Independent Service shall be capable of cancellation by turning key switch to "OFF" position.

2.14 SECURITY SYSTEM PROVISIONS

.1 Elevator Trade Contractor shall be responsible for installing security card reader device, supplied by others, in the car operating panel. Final mounting location of security card reader shall be confirmed by Architect.

.2 Level of security provided shall be dictated by a master security controller, as provided by Security Trade Contractor, and located exterior to elevator equipment.

.3 Once security mode of operation is initiated by master security controller, elevator shall only accept car calls if placed in combination with a proper security card. Car calls to main entry level shall not be controlled by card reader under security mode, or alternatively where car is unable to leave floor, activating in-car door open button shall permit doors to fully open (for a minimum dwell time).

.4 Hall calls shall remain active during security mode, without restrictions.

.5 Under security mode, when not responding to landing or car calls, elevator shall park with its doors closed. Car shall only open its door in response to hall calls or, alternatively, by activation of in-car DOOR OPEN button(s).

.6 Elevator Trade Contractor shall include the following:

.1 Provide security wiring as noted in 14 20 00, paragraph 2.6.9.

.2 Logic and apparatus required to interpret and act on commands given to elevator controller by master security controller.

.3 Install elevator security interface panel supplied by Security Trade Contractor in controller room.

.4 Provide for each car call selection circuit a labelled pair of dry contacts, set in a terminal strip, mounted in the elevator controller, for interconnection to the security system.

.5 Isolate car call signal circuits to prevent unwarranted feedback through interconnections with security system relay controls.

.6 Provide signals at security interface panel to ensure Phase I and II firefighters' emergency operation automatically override security provisions.

.7 Car calls shall be enabled when security system relay controls close in response to a cleared or authorized access card.

.8 Security system will keep car call circuits enabled for a limited time period. Elevator control shall ensure car call circuits, once established, are self-holding until the elevator responds to that call.

.9 Security Trade Contractor will make final interconnections within elevator controller / machine room.

.10 Co-ordinate signals and connections with Security Trade Contractor, to ensure security system operates as required by DCC Representative.

.7 Provide a two-position keyed switch in the service cabinet designated as "SECURITY OVERRIDE". Key-switch positions shall be identified as "ON" and "OFF" with key removable in both positions. With key in "ON" position security card reader restrictions shall be automatically overridden. With key-switch in the "OFF" position, security card reader restrictions shall be initiated by master security card reader controller as detailed above.

.8 Key-switch shall have three indicators one of which illuminates when car-reader restrictions are active, while the remaining indicators will be used to establish the position of the key-switch (i.e. "ON" or "OFF"). Key-switch barrel for this function shall be unique, and as such not used elsewhere, with DCC Representative being provided with a minimum of 10 copies of this key.

2.15 TRACTION MACHINE

.1 Provide gearless traction-type machine of approved design, equipped with slow speed alternating current reversible motor, traction drive sheave, deflector sheave and brake unit, mounted on a continuous steel bedplate. Machine beam bearings shall be amply proportioned, dustproof and be provided with adequate means of lubrication.

.2 Provide machine with cooling and ventilation fans, housed on machine frame and designed to force ventilate machine and motor housing.

.3 Machine bedplate shall be supported by structure at top of hoistway, complete with isolation pads between bedplate and structural support. Between beams provide steel filler pieces and acoustical baffling material designed to minimize equipment noise in the shaft.

.4 Machine bedplate shall be sound isolated from building structure by means of elastomer pads properly loaded for machine developed static and dynamic forces. Provide adjustable mechanical stops to prevent rocking and equip machine with sufficient number of isolation pads so as to eliminate structurally borne machine noise transmissions.

.5 Machine bearings shall be designed to accommodate equipment reactions.

.6 Elevator Trade Contractor must submit details on mounting requirements for their machine.

.7 Where required to install machine Elevator Trade Contractor shall provide scaffolding or other suitable work platform conforming to local safety standards.

2.16 MOTOR

.1 Provide an alternating current reversible motor especially designed for elevator service. Motor shall be provided with high starting torque and low starting current.

.2 Motor shall be capable of meeting performance, condition and reliability requirements of the installation, with sufficient horsepower to drive elevator, under full load conditions, and operate at minimum 180 starts per hour, for a minimum period of twelve (12) consecutive hours, without over-stressing or over-heating hoist motor.

.3 Certify that hoist motor / machine type as selected can meet full load running test consisting of operating elevator at 100% of contract load, running at 100% contract speed, starting and stopping 180 times, during a one hour period with a temperature rise, measured at motor housing, not in excess of manufacturer's specified motor rating, starting at an ambient of approximately 20°C. Test shall be based upon procedure where stop or dwell time between successive starts shall be approximately equal over hour period.

.4 Provide closed loop motor control feedback system which automatically regulates motor drive by comparing actual car acceleration, deceleration and velocity profiles with preset optimised values.

2.17 BRAKE

.1 Brake shall be direct-current operated, electrically released, spring applied, and shall be capable of stopping and holding car securely with load of 125 percent of rated capacity.

.2 Brake shall be equipped with brake switches to ensure that brake is lifted before elevator can run.

2.18 MOTOR CONTROL

.1 Provide variable voltage variable frequency (VVVF) controls for alternating current motor.

.2 Use automatic closed loop system, providing instant and noiseless response to power requirements.

.3 VVVF control systems shall transform incoming alternating current (AC) power to 3-phase direct current (DC) power. AC power of variable frequency and variable voltage shall be generated from DC power.

.4 Include power smoothing filters to provide satisfactory elevator performance and long term reliability.

.5 Switching frequencies shall be at least 12 KHz.

.6 Provide noise suppression devices and harmonic filtering to meet noise levels specified for elevator control room (maximum 65 Db_A within 1000 mm of equipment). Noise levels at harmonic frequencies shall not exceed 70 Db_A within 1000 mm of equipment.

.7 Provide regenerative drive, so that excess power (created by overhauling loads or regenerative braking conditions) is returned back into line supply, filter any emanating rectifier drive frequencies and prevent objectionable interaction with building components and personnel. As part of the regenerative drive, automatically measure and record the amount of power which is being returned to the building grid to allow these details to be displayed on the in-car monitors.

.8 Motor drive unit shall be capable of detecting and reacting, in safe mode, to loss of supply voltage, loss of phase, loss of fuse, and/or excessive heating or short circuits, in either machine or motor drive.

.9 Drive system and motor shall be rated for 180 starts per hour.

.10 Size motor drive to handle full starting current plus a safety factor of 10%. Protect against voltage "spikes". Motor drive shall continue to perform under conditions of fluctuations in line (voltage) supply of +5% and -10% and frequency variations of +2% from normal values, without any degradation to normal elevator service.

.11 Design solid-state devices to handle current in excess of rated amount.

.12 Isolate solid-state drive unit to prevent vibration transmission to building structure.

2.19 EQUIPMENT GUARDING

.1 All equipment installed as part of this work shall be guarded in accordance with the most stringent of current guidelines and regulations as enforced by regulating authorities such as the Ontario Ministry of Labour. This includes equipment installed throughout elevator hoistway, pit and control room areas.

.2 Elevator Trade Contractor shall be responsible for providing all such guarding and as such must be familiar with specific requirements of guidelines such as the Ministry of Labour's "green book" and CSA Z432-04 Safeguarding of Machinery.

2.20 BUFFERS

.1 Provide spring buffers for car and counterweight. All pit equipment shall be designed to accommodate available pit depth.

.2 Arrange car and counterweight run-by to maximize available hoist rope stretch.

2.21 SHEAVES AND SUPPORTING BASES

.1 At top of elevator shaft, provide gearless machine and associated deflector sheave to obtain proper lead of ropes (or belts) to and from car and counterweight. Only support pockets for beams and channels will be provided by other Trade Contractors.

.2 Provide steel beams and channels to support machine and associated equipment at top of hoistway, including bearing plates.

.3 Provide any additional structural members required for installation of equipment, such as steel beam supports for governors and dead end hitch beams (where applicable).

2.22 AUTOMATIC LEVELLING DEVICE

.1 Provide self-levelling device to maintain car levelling accuracy within 6 mm of landing floor, irrespective of load, without "hunting". This device shall automatically and, independent of other devices, correct for over-travel, under-travel and rope stretch.

2.23 SAFETY DEVICES

.1 Provide gradual wedge type car safety devices, mounted to underside of car. Devices shall be equipped with a switch to cut off motor power and apply brake, prior to actual setting of safety grips. Safety grips shall be automatic reset type.

.2 Provide a speed governor and idler devices.

.3 Provide all governor support channels, beams and angles.

.4 Provide elevator with a means to protect against uncontrolled ascending car over-speed and uncontrolled low speed protection within landing zone. Means shall be provided in compliance with requirements established by CSA B44 Safety Code for Elevators Rule 2.19

.5 Car governor shall be located at top of hoistway and be a self-resetting type. Servicing of governor shall be from on top of car, with no openings provided for access to governor by

other Sections. Elevator Trade Contractor must ensure provisions to comply with Elevator Code item 2.7.6.3.4.

2.24 COUNTERWEIGHT

.1 Suitably counterbalance elevator with counterweight consisting of cast iron, reinforced concrete, lead or steel weights, set in structural steel frame. Counterweight shall be equal to weight of complete elevator cab plus approximately 45% to 50% of rated capacity.

.2 Provide blocking between counterweight and buffer strike plate to compensate for hoist rope stretch. Fabricate counterweight sub-weights so they are removable. Secure sub-weights to prevent rattling.

.3 Counterweight shall be located on side hoistway wall.

2.25 CAR FRAME AND PLATFORM

.1 Car frame shall consist of structural steel or formed steel members securely rivetted, bolted or welded together.

.2 Frame shall be reinforced and braced to relieve car enclosure of undue strains. Frame and platform shall be designed to support complete cab enclosure plus cab flooring finish.

.3 Design car platform and frames to accommodate Class A loading, as specified.

.4 Provide cab sub-flooring consisting of two (2) layers of 19 mm Douglas Fir plywood, laminated together and screwed in place. Sub-flooring shall be recessed below car sill sufficiently to permit a flush finish between car sill and finished flooring. Amount of depression on sub-flooring will be confirmed at time of shop drawing reviews.

.5 Provide cab with sound isolated platform, which is suspended on rubberized isolation pads of sufficient density to prevent transfer of noise and vibration from car frame to platform.

.6 Provide car top railing in accordance with requirements of the CSA B44 Elevator Code and TSSA Code Adoption Document. Railings must be engineered and designed so as to not reduce effectiveness of cab isolation.

2.26 LOAD WEIGHING DEVICES

.1 Provide load weighing transducers, or micro switches, mounted underneath the cab platform designed to accurately measure car loading within 25 kg increments.

.2 Load weighing readings must be accurate regardless of the car's position in hoistway. Readings at top of hoistway must equal readings at bottom of hoistway within the maximum permissible variation of 25 kg.

.3 Load weighing measurements shall be integral part of supervisory dispatch algorithm (where applicable) and provide feedback for accurate levelling and pre-torque requirements.

2.27 RAILS AND BRACKETS

.1 Provide car and counterweight with accurately machined standard "T" section guide rails with tongued and grooved joints in ends of rails, to form matching joints between adjacent rails. Locate car guide rails so as to balance car assembly in its guides.

.2 Each rail joint shall be smooth with gaps not exceeding 2 mm. Between each rail joint, provide substantial machined fish plates. Fish plate shall be fitted to each rail joint with not less than four (4) through-bolts with lock-washers. Backs of all rails shall be machined where it is in contact with fish plate.

.3 All rail joints shall be so located that fishplates and brackets will not interfere with relative motion of guide rail, with respect to each rail clip and support bracket. Locate fishplates and brackets so as not to interfere with proper location, alignment and fastening of hoistway levelling switches, reeds and other positioning switches and devices.

.4 Guide rails shall be supported and placed so as not to become distorted by eccentric loading. Additional brackets with sliding rail clips between floor beams shall be provided as required to obtain proper rail rigidity and maintain alignment for both car and counterweight rails. Properly align all rails to provide ride characteristics as specified under 14 20 00, paragraph 2.4.5.

.5 Guide rails shall be thoroughly cleaned and filed smooth throughout their length and at rail joints before car is put into operation.

.6 For all guide rails which must sustain reactions of safeties, they shall be bottomed in pit with adjustable jack bolts, screws or other means to ensure guide rail reactions occur in pit floor.

.7 Provide anti-snag guards to protect against hoisting cables, governor ropes, compensating chains and travelling cables from snagging rails brackets, fishplates, clips or other hoistway, pit fastening devices.

.8 Provide fastenings, seats, brackets, angles and plates to attach guide rail brackets to building structure. Provide inserts to fasten guide rail bracket supports into masonry hoistway wall construction, where additional are required between building support beams.

.9 Provide guide rails with sliding rail clips, designed and maintained to limit maximum vertical forces due to building compression. Arrange guide rails to allow a minimum clearance of 150 mm above each car and counterweight rail, to permit building compression.

.10 Where slotted brackets are used, provide means to prevent lateral movement of bracket, causing expansion of design distance between guide (d.b.g.) allowance.

.11 Provide elevator with ladder type brackets designed to support both counterweight rails, the adjacent car rail and their respective loads. No additional supports (i.e. divider beams) will be provided between the elevator platform and counterweight.

.12 Guide rails shall be sized to accommodate specified capacity and load classification for elevator, and also take into account vertical spacing between guide rail supports, as shown on Contract Drawings. Guide rail supports (such as steel divider beams) shall be provided by others at floor levels. Additional guide rail supports will be also provided, as required, to reduce vertical spacing between supports. Identify same on shop drawing submission

2.28 CAR AND COUNTERWEIGHT GUIDES

.1 Provide roller guides for car and counterweight, mounted top and bottom of respective frame.

.2 Use polyurethane or other roller tire material which will not develop flat spots after sitting idle for 24 hours under average environmental conditions.

.3 Provide roller guides with a minimum diameter of 150 mm for car roller guides and 90 mm for counterweight roller guides.

.4 Roller guides shall consist of tired wheels, maintained in uniform contact with three (3) finished rail surfaces and operate on dry, unlubricated rail surfaces. Each car roller guide shall be equipped with adjustable tensioning device, to allow for individual roller tensioning.

.5 Statically balance car and counterweight so that maximum roller guide pressure on any guide member does not exceed 12 kg when measured at half way point of travel in hoistway and car doors are in their fully closed position.

2.29 TRACTION (HOIST) ROPES OR COATED STEEL BELTS

.1 Provide traction steel hoisting ropes, or coated steel belts, of sufficient size and number to ensure proper traction qualities. All hoist ropes, or coated steel belts, shall be from same factory production run and suitably protected against rust and corrosion.

.2 Provide means for equalizing tension and sufficient blocking to insure car shutdowns for cable, or belt, shortening are minimized.

.3 Where steel hoist ropes are utilized, provide alternate length wedge type rope shackles which allow adjacent shackles to be at staggered heights.

.4 Tie up and restrain all rope ends with at least two (2) clips. Provide shackles with dampening springs and position shackle rods so as to provide for ready service access and adjustment.

2.30 COMPENSATION

.1 Where required, provide jacketed, shot filled chain compensation, complete with a guide mechanism to prevent chain from contacting or striking pit and hoistway equipment.

2.31 HOISTWAY ENTRANCES, FRAMES AND SILLS

.1 Entrance doors shall be two-speed side-opening, horizontal sliding type, giving clear opening of 915 mm wide x 2135 mm high, at all levels served.

.2 Lobby door panel finish shall be stainless steel.

.3 Provide doors with sight guards for each leading door panel. Sight guard shall be finished to match leading edge of each lobby door panel.

.4 Hoistway door operation shall be smooth at all times. Design all door equipment to operate with minimum of noise. Provide entrance strike jambs with raised rubber impact disks, designed to cushion final closing of doors.

.5 Entrance frames at all levels shall consist of a standard, three-piece knock-down style. Frame finish shall be stainless steel.

.6 Entrance frames and doors shall be properly rated and labelled from an approved testing laboratory. All entrance frame assemblies shall have a 1½ hours fire rating.

.7 Set entrance frames in alignment with elevator cab platform. Fasten frames and headers to structural supports and secure to building walls by substantial ties. Set frames in place prior to building lobby walls.

.8 Provide extruded aluminum sills for the car and lobbies.

.9 Sills shall have recessed slots to receive door guides. Guides shall be composed of composite material and be designed to allow for lateral adjustment of door panel in both directions. Door guides consisting of steel plates with felt isolation inserts are not acceptable.

.10 Securely fasten sills to the building structure and provide steel support and grout angles to allow floor finishes as provided by separate Sections.

.11 Provide fascia extending from top of hanger to sill above for every floor served.

.1 Provide pit floor toe guard panels extending from below lowest landing sill to top of pit floor slab.

.2 Fascia shall not be less than 16 gauge sheet steel and properly reinforced with supports and fastenings to secure it in place.

.3 At uppermost landing, provide hanger covers and bevel top section so it returns flush with front face of hoistway wall.

.12 In lieu of providing fascia as specified in 14 20 00, paragraph 2.31.11, provide car door interlocks conforming to item 2.14.4.2 of the CSA B44 Elevator Code. In electing to provide these car door interlocks in place of fascia, Elevator Trade Contractor assumes responsibility for acceptance of the installation by local jurisdictional authorities without further compensation from the DCC Representative.

2.32 DOOR HANGERS, TRACKS AND INTERLOCKS

.1 For each hall and car door panel provide a sheave two-point suspension hanger and track.

.2 Hanger rollers shall be a minimum 75 mm diameter, fabricated with steel, and shall contain an isolation insert or liner within each sheave's running surface. Hanger rollers consisting of hardened plastic (or similar material) shall not be accepted.

.3 Rollers shall be heavy-duty type, designed to operate on unlubricated surfaces and rotate on precision ball bearings. Hanger shall be equipped with ball bearing adjustable rollers to withstand door upthrust.

.4 Hangers shall be designed for power operation and have provisions for vertical and lateral adjustment.

.5 Door tracks shall be heavy section, cold drawn steel, with roller running surfaces contoured and shaped to conform to tread of door hanger sheaves and rollers.

.6 Provide each hoistway door with a self-closing device consisting of a spring-loaded sill closer or heavy-duty spirator. Weighted type closers are not acceptable.

.7 Provide rubber bumpers on the entrance strut assembly to serve as a physical stop for the landing doors to ensure the doors cannot be pushed more than 25 mm beyond edge of the return jamb.

.8 Provide eccentric or up-thrust rollers for each entrance.

.9 At each landing entrance, provide an approved type hoistway door interlock and related hardware capable of operating for at least 1 hour when subjected to standard fire exposure tests, as accepted by the governing Safety Authority and local fire authorities.

2.33 DOOR OPERATORS

.1 Provide heavy-duty motor driven door operators complete with solid-state car top adjustment controls.

.2 Door operators shall open and close car and hoistway doors simultaneously, quietly and smoothly. Doors shall be capable of opening automatically, when car is level at respective landing, and shall close after a predetermined interval. Door movements shall be cushioned and checked at both limits of travel. Car door shall be readily operated by hand from within, in event of power interruption, while car is within levelling zone.

.3 Door operators must be provided with two (2) heavy-duty crank arms and bearings. One (1) crank arm is to be secured to clutch door, with remaining crank arm being secured to slave door, such that both doors are directly driven by door operator. Provide additional means to ensure that elevator is unable to leave a floor unless car door panels are fully closed, including incidents when one (1) of the crank arms should fail.

.4 Adjust door equipment to attain specified door performance times. Include provisions to allow doors to perform satisfactorily under varying pressures generated by building stack effect or unbalanced building air pressures.

.5 Provide Door Open and Door Close buttons in car. Pressure on Door Open button shall re-open doors during their closing cycle. Pressure on Door Close button shall cancel or reduce

door dwell timing, except that a minimum interval of 4.0 seconds shall be maintained when the car is responding to a landing button.

.6 Door operator and components shall be specifically designed to minimize noise.

.7 If door protective device is interrupted, preventing doors from closing, a warning buzzer shall sound, after an adjustable period of time (initially 20 seconds), and doors shall close at a reduced speed, independent of protection devices, except the Door Open button.

.8 Activation of Door Open button, under interrupt operation, shall cause doors to immediately stop their reduced speed closing and return to their fully open position, but shall not override or cancel interrupt buzzer annunciation.

.9 Door operators must be located on top of cab canopy, to maximize available space within cab. Elevator Trade Contractor shall be responsible for providing required door operator equipment and related accessories (extended drive arms, linkages, etc.) to suit vertical distance between door operators and pick-up points, and adjust same to ensure smooth and quiet door operations.

2.34 CAR ENCLOSURE

.1 Provide cab enclosure finishes as follows:

.1 Stainless steel #4 cab returns, transom, column and car doors (front and rear).

.2 Modular stainless steel #4 exposed frames/reveals with flush recessed plastic laminate panels with decorative buttons to hold in place those panels and pad hooks.

.3 50 mm x 12 mm flat stainless steel handrails on cab non access walls.

.4 Solid 14 gauge satin coat canopy with a stainless steel #4 pan-type suspended ceiling, with LED pot lights.

.5 Flooring shall consist of sheet good flooring, provided by Division 9.

.2 Provide two-speed fan for cab ventilation, mounting entire fan assembly above cab canopy.

.1 Fan shall have sealed, self-lubricating motor bearings.

.2 Provide fan unit with reinforced top plate and steel cage.

.3 Provide 2-speed fan model, complete with low and high speed windings. Fan rating shall be 250 cfm on low speed and 350 cfm on high speed operation. Series resistance control type fans are not acceptable.

2.35 ALARM BELL

.1 Provide electric signal bell, located on car top and connected to alarm button in elevator. Activating this button shall cause car top bell to ring.

2.36 ACCESSIBLITY PROVISIONS

.1 Elevator shall comply with the most stringent of requirements amongst CSA B44 Appendix "E" Elevator Requirements for Persons with Physical Disabilities, CSA B651 Accessible Design for the Built Environment and any other Provincial Accessibility Act.

.2 Provide all devices including, but not limited to, tactile plates, chimes, car position indicators, in car riding lanterns, audible car call registration, voice annunciators and handrails, as outlined in Appendix "E".

.3 Provide elevator with digitized voice annunciator. Annunciator shall utilize latest digital technology to reproduce real human speech. As a minimum, annunciator shall be capable

of announcing floor levels, direction of travel, along with a list of special announcements, as selected by DCC Representative. Voice unit shall be capable of male voice, female voice, or a combination of both, as confirmed with DCC Representative. Final selection of special announcements shall be reviewed with DCC Representative, with Elevator Trade Contractor providing a complete list of special announcements, which are available (i.e. Elevator on Fire Recall Operation - When doors open please exit building in a safe and orderly manner; Please stand clear of closing doors; This elevator is on Independent Service; etc.) Annunciator shall have multiple message volume controls, such that volume for specific messages can be adjusted to appeal to specific user within cab or in lobby. Elevator Trade Contractor shall install complete unit, in accordance with manufacturer's instructions, and be responsible for maintaining complete system as part of the preventive maintenance agreement. Elevator Trade Contractor shall include for four custom announcements, outside of the manufacturer's standard announcement selections, requiring programming from the equipment manufacturer.

.4 Provide audible soft toned signal in car to indicate car is passing a floor level. Provide an automatic verbal announcement that announces the floor at which car has stopped.

.5 Provide lobby entrance tactile plates, mounted on both entrance jambs, at all levels served, with no visible fastening devices. Provide samples of tactile plate finishes for Architects review.

2.37 MANUFACTURER'S NAME AND TRADEMARKS

.1 Manufacturer's name shall not appear in elevator cab, entrances, elevator landing sills, or any other location visible to the public.

2.38 CAR OPERATING DEVICES

.1 Provide elevator with one (1) applied car operating station, located on west side wall, containing a set of flush mounted car operating devices. Provide station with hidden piano type hinge, designed to allow access to car operating controls for servicing. Secure hinged faceplate with tamper-proof fasteners.

.2 Station shall contain car operating buttons, a position indicator, firefighter's operation cabinet, communication system perforations, service cabinet and provisions for future installation of security card reader. Final configuration of panels will be confirmed at time of shop drawing reviews.

.3 Provide illuminating car call buttons using LED's, corresponding to each level served. Car button controls shall match hall landing buttons. Registration of a car call shall result in a momentary audible signal and cause corresponding light to illuminate. Once call has been answered, call shall cancel and light extinguish.

.4 In addition to car call buttons, provide the following control items:

.1 Emergency alarm button.

.2 Door open buttons (front and rear).

.3 Door close buttons (front and rear).

.4 Help button, which activates hands-free telephone.

.5 All of the above fixtures shall be illuminating type buttons.

.5 Provide a lockable cabinet, flush-mounted at top of car operating panel. Cabinet faceplate finish shall match car operating panel and be equipped with a concealed hinge. Cabinet shall contain the following:

.1 Door open buttons (front and rear).

.2 Door close buttons (front and rear).

.3 Firefighter's Emergency Operation Phase 2 key-switch, indicator and signage.

.4 "Call Cancel" Button.

.5 Stop switch.

.6 Firefighters' Emergency Operation engraving, as described in CSA B44 Safety Code for Elevators, clause 2.27.7.2.

.7 Fixtures in panel shall be arranged as outlined in CSA B44 Safety Code for Elevators, Figure 2.27.3.3.7 and other requirements identified in the Elevator Code.

.8 Permanently identify function and key-switch positions (i.e. "STOP", "RUN") for all key-switches, either by engraving or collar ring.

.9 Key-switch on cabinet door shall be keyed the same as Firefighters' Emergency Operation key-switch within.

.6 Provide a lockable service cabinet, flush-mounted at bottom of car operating panel. Cabinet faceplate finish shall match car operating panel and be equipped with a concealed hinge. Cabinet shall contain the following:

.1 Keyed stop switch.

.2 Independent Service key-switch, with key removable in both positions.

.3 Car battery lighting test switch.

.4 Three-position fan switch ("OFF", "LOW", "HIGH").

.5 Car light switch, with a dimmer switch.

.6 GCFI duplex receptacle.

.7 Security override key-switch.

.8 Any other switch required to operate or service elevator. When maintenance switch is provided, it shall be a keyed switch.

.9 Permanently identify function and key-switch positions (i.e. "LIGHTS", "ON", "OFF") for all key-switches, either by engraving or collar ring.

.10 Key-switch on service cabinet door shall be keyed the same as Independent Service key-switch within.

.7 All in-car signage shall be surface engraved (or etched) on car operating panel. Signage shall include, but not be limited to: elevator number, no smoking signage, communication instructions, capacity (in kg and persons), installation number, as required by Code. Surface mounted signage plaques are unacceptable.

.8 Provide raised Arabic numerals (characters), and equivalent Braille marking, corresponding to each button and control switch within elevator. Braille tags shall be mounted to the left of respective button or key-switch. Markings shall have no backing plate or visible fastenings. Submit full size sample of tactile plate, for DCC Representative's review.

2.39 POSITION INDICATOR

.1 Provide elevator with a flush mounted manufacturer's standard LED type dot matrix or digital vacuum fluorescent car position indicator, located in car operating panel, so distance from fixture centre-line to finished cab floor is not less than 1830 mm.

.2 Position indicator shall constantly indicate relative elevator position to level stopped at or being by-passed and have a minimum 50 mm high display.

2.40 ELEVATOR EMERGENCY COMMUNICATION

.1 Provide a complete emergency communication system inside the elevator cab with hands-free two-way voice communication, and the ability to communicate with a passenger(s) who cannot verbally communicate or hear with video and messaging features. Voice, video and messaging features must be available to authorized personnel responding to the call. Include a battery back-up capable of operating system for a minimum period of four (4) hours, in the event of a power loss.

.2 Hands-free telephone unit shall be securely mounted behind main car operating panel, while a circular pattern of perforations shall be made directly in front of the speaker and microphone.

.3 In the general area of speaker perforations, surface engrave elevator number (25 mm high), and phrase "In case of emergency, press phone button, wait for answer" in letters at least 6 mm high. Engraving shall be filled in black.

.4 Provide shielded wiring running between in-car telephone and controller. Assume responsibility for final installation and hook-up of complete system and co-ordinate, with DCC Representative, where calls are to be automatically directed. Calls initiated from inside the cab will be programmed to dial an appropriate Point of contact with system having the ability for programming of a second number. For the moment the second number will be the Elevator Maintenance Contractors 24-hour call centre.

.5 In addition to the in-car station, system must include:

.1 Master Station inside the Campus Security office where required to support voice, video, and messaging features.

.2 Remote station in the elevator controller room.

.3 Stations provided outside of the elevator cab must be configured to initiate two-way voice communication with the elevator cab.

.6 System shall accommodate LCD displays, lettering, voice prompts and manuals, with manuals provided in digital format and hard copy.

.7 Supply and install wiring to support the complete system.

.8 Develop a drawing which confirms the location of all system connectivity and power supply requirements.

.9 While the preference is for an onsite emergency communication system with no connection to the Cloud, where connection to the Cloud is required include for same as part of Tender.

.10 Where a subscription-based system is provided, subscription costs shall be covered as part of the preventive maintenance agreement and complete system maintenance, support, and repairs included as part of the preventive maintenance agreement.

2.41 REMOTE LOCATION OF ELEVATOR LICENSE CERTIFICATES

.1 Co-ordinate with DCC Representative and arrange with TSSA to allow elevator license certificate to be mounted in a location other than within elevator cab. It is proposed that certificate be kept in the control room, and that Elevator Trade Contractor provide a stainless steel certificate frame, mounted on elevator controller cabinet.

.2 Ensure that design registration submitted to TSSA identifies proposed mounting location for license certificate.

2.42 DOOR PROTECTION DEVICE

.1 Provide a 3D door protection device for both car doors consisting of multiple infra-red light beams, effective through full car door height.

.2 Detector devices shall be mounted using continuous steel angles, and provided with a formed sight guard, designed to minimize gap between car and adjacent landing door, and accommodate two-speed side opening door arrangement.

.3 Door protection device, including warning buzzer, shall be inoperative when elevator is operating under Firefighters' Emergency Operation or Independent Service, as door closing, in these instances, is controlled by constant pressure.

2.43 IN-CAR DIRECTIONAL LANTERNS

.1 Provide elevator cab entrance with two (2) sets of arrow shaped vandal resistant in-car directional lanterns, flush mounted within one entrance jamb post on both sides of cab.

.2 Directional lantern shall be mounted so that fixture centerline is no less than 1830 mm above car sill.

.3 Fixture finish shall be stainless steel and shall be fastened with a minimum of two (2) tamper-proof screws.

.4 Directional arrows shall be a minimum of 60 mm high in smallest direction.

.5 Design lanterns to illuminate to indicate actual and intended car direction of travel. "UP" lantern shall illuminate green or white, to manufacturer's standard, while "DOWN" lantern shall illuminate red. Lantern illumination must consist of light emitting diodes (LED's).

.6 In-car directional lantern assembly must be provided with an internal baffle, which prevents light from bleeding between adjacent light chambers.

.7 Directional lanterns shall be provided with dual stroke electronic chimes, sounding once for UP direction and twice for DOWN direction.

.8 Lanterns shall illuminate from commencement of door opening operation and extinguish once doors are fully closed and locked. Lanterns shall not illuminate during car travel.

2.44 BATTERY POWER CAB LIGHTING

.1 Provide elevator with battery powered cab lighting as follows:

.1 Use battery operated emergency lighting equipment, per governing Electrical Safety Code, to provide illumination in elevator at operating panel for four (4) hours minimum.

.2 Emergency battery pack shall be engineered to immediately energize a minimum of two of the cab lamps in closest proximity to the car operating station.

.1 Alternatively, emergency lamps shall consist of two LED's, with an approximate light output of 135 lumens, which shall be immediately energized upon loss of normal power supply. When normal power supply returns, emergency lamps shall extinguish and battery unit recharge.

.2 For the alternative system, in-car emergency lighting fixture lens shall be flush mounted within car operating panel, directly above car operating buttons.

.3 Battery unit shall be of sufficient strength to support a 90 kg person without causing malfunction or damage, where unit is located on car-top.

.4 Include means for convenient manual operation and testing of emergency lighting unit from within elevator. Testing means shall consist of a spring return key-switch, located within in-car service cabinet.

.5 Provide sealed rechargeable battery, however, include means of containing leakage or spillage of electrolyte.

2.45 EXTINGUISHING OF CAR LIGHTS AND CAB VENTILATION

.1 In-car lights and cab ventilation fan shall automatically extinguish when all conditions detailed in Item 2.14.7.2.2 of the Elevator Code are met. Lights shall automatically illuminate and fan shall operate (if key-switch in service cabinet is in either “HIGH” or “LOW” position) when there is momentary interruption of any of these conditions.

2.46 PROTECTIVE PADS

.1 Provide elevator with in-car protective pad hooks, finished in stainless steel. Mount pad hooks directly below suspended ceiling panels.

.2 Provide one (1) complete set of protective pads, in accordance with the following:

.1 Protective pads shall be specifically sized to suit platform dimensions completely covering all cab non-access walls.

.2 For access walls, protective pads shall be provided to cover return panels and header transom, with a cut out for car operating station, hands-free telephone speaker, car position indicator, firefighters’ panel and service cabinet.

.3 Pads shall hang from cab suspended ceiling to 100 mm above car floor.

.4 Each wall shall be covered by a single piece pad.

.3 Protective pads shall be manufactured from heavy-duty fire-resistant canvas, padding, edging and thread. Pads shall be quilted, with all edges selvaged and all seams shall be doubled. Pad colour to be selected by DCC Representative, from manufacturer's standard catalogue.

2.47 HALL CALL BUTTONS

.1 Provide one (1) riser of hall call buttons at all front and rear door openings.

.2 Hall stations shall be mounted adjacent to elevator entrance, such that fixture centreline is 1070 ±25 mm above finished floor.

.3 Provide manufacturer’s standard top of the line landing buttons in all hall landing stations.

.4 Intermediate level hall stations shall contain UP and DOWN direction landing buttons, while terminal floor hall stations shall contain single buttons.

.5 Upon registration of a hall call, perimeter of button (as a minimum) shall illuminate. Illumination shall consist of LED's, which shall extinguish when call is answered.

.6 Buttons shall be mechanical action type flush mounted with hall push button fixture. Buttons polished metal surfaces shall be stainless steel at all landings.

.7 Provide fixture faceplates finished in stainless steel, with tamper-proof fastenings and rounded edges, at all levels served.

.8 In addition to the hall buttons, provide Level G fixture with:

.1 Firefighters' Emergency Operation key-switch, visual indicators and required engraving and operating instructions.

.2 An LED and engraving labeled "ELEVATOR COMMUNICATIONS FAILURE" in red letters a minimum of 5 mm (0.25 in.) high.

.9 Provide a spare fixture for Level G incorporating all features indicated above plus an emergency power LED indicator and engraving "ELEVATOR EMERGENCY POWER". Spare fixture faceplate is to match the fixture provided as part of the installation and is to be stored inside the Elevator Controller Room.

2.48 PIT AND HOISTWAY ACCESS

.1 Provide pit and car top access provisions complying with Elevator Code clauses 2.12.6 and 2.12.7.

.2 Provide new retractable type pit access ladder engineered and installed in accordance with requirements of CSA B44 Safety Code for Elevators and OHSA.

.3 Hoistway access key-switches shall be provided at terminal floors as a minimum and comply with the following:

.1 Key-switch shall be installed adjacent to entrance frame as coordinated with DCC Representative.

.2 Key-switch must be capable of running elevator in both directions (i.e. to return elevator back to floor level).

.3 Where activation of more than one key-switch is required for hoistway access (i.e. car and lobby key-switches), key barrels must be identical.

.4 Engrave key-switch, indicating function and direction of operation (i.e. "Access", "Up", "Down").

2.49 HALL POSITION INDICATOR

.1 At Level G, provide a manufacturer's standard LED type dot matrix, or digital vacuum fluorescent, hall position indicator. Indicator shall have a minimum character display height of 50 mm and constantly indicate level being served or by-passed by elevator.

.2 Fixture faceplate shall be finished in stainless steel and provided with tamper-proof fastening devices to permit servicing fixtures from elevator lobby. Faceplate shall have rounded corners.

2.50 KEY-SWITCHES

.1 Key-switches for elevator maintenance, inspection, etc. shall be manufacturer's standard type and grouped as required by Elevator Code item 8.1.

.2 Provide DCC Representative with a minimum of five (5) copies of keys for each key-switch utilized on this elevator, including the in-car stop switch and hoistway access switch, to conform to requirements of Elevator Code item 8.1.1(d). Keys shall be kept on the premises in a location readily accessible to the personnel in the assigned group, but not where they are accessible to the general public, with Elevator Trade Contractor coordinating where these keys are to be maintained with the DCC Representative. Elevator Trade Contractor must advise DCC Representative which keys are to be restricted for use by elevator personnel.

.3 Provide DCC Representative with a minimum of ten (10) copies of keys used for:

.1 Security Override.

.2 Firefighters' Emergency Operation.

2.51 PAINTING

.1 Exposed metalwork, provided under these Specifications, shall be painted a minimum of one (1) coat of prime enamel after fabrication. Use oil resistant enamel on machinery and rust resistant primer on structural parts of equipment.

.2 Paint following equipment with a minimum of one (1) finishing coat of rust resistant enamel, manufacturer's standard colour, after final equipment clean up:

.1 Hoist machine yoke and support frame.

.2 Pit equipment, including support channels, buffers and buffer stands, governor tension weight, tension weight carriage and assembly, counterweight screens and guides.

.3 Hoistway equipment, including guide rails, except for running surfaces. Paint fishplates, guide rail brackets, car plank, car crosshead, car top, door operator, car door track supports, counterweight bricks and counterweight frame.

.4 Paint machine beams, overhead deflector beams and all other support beams, provided by Elevator Trade Contractor.

.5 Paint entire surface of all hoistway fascia plates and car aprons in flat black paint.

.3 Elevator identification number (minimum of 100 mm high) shall be permanently stencilled on car crosshead, car buffers, machine, controller and disconnects, in a prominent colour (yellow), once final coat of paint has dried.

.4 Permanently stencil floor levels on hoistway side of all landing doors and fascia plates, once final coat of paint has dried. Floor numbers shall be a minimum of 100 mm high and in a prominent colour (such as yellow).

.5 Prior to painting equipment, ensure that all signage, nameplates, labels and tags are covered and protected from paint splashes or being painted over. Protective coverings shall be removed once painting is complete.

2.52 ENGRAVING

.1 All key-switch, signage and signal/control device engraving shall be filled in black colour, except where required by Code to be filled red or specified otherwise.

.2 Engraving filler shall consist of permanent adhesive epoxy paint. Provide engraved identification and instructions on car operating panel and on all elevator signal equipment.

.3 Where possible, engraving shall be minimum 6 mm high and in manufacturer's standard font style.

2.53 POLISHED METAL AND SHEET STEEL

.1 Reinforce polished metal panels to prevent noticeable distortions.

.2 Stainless steel shall have a No. 4 brushed finish, with final selection and grain direction being confirmed by the Architect, at time of shop drawing reviews.

.3 Sheet steel used shall also be to ASTM A366. Steel sheets shall be uncoated and pickled to allow for on-site painting. Sheet steel members shall be free of all defects.

.4 Provide typical floor fixture faceplates and handicapped signage entrance tactile markings finished in satin or brushed stainless steel on all floors served.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Take critical site dimensions to ensure tolerances and clearances to other building site work. Ensure that anchors, inserts, pockets, bearings, services and similar provisions, installed by separate trades are adequate.

3.2 CO-ORDINATION

.1 Ensure that all construction and service requirements related to elevator installation but not performed by Elevator Trade Contractor are explicitly communicated to relevant trades and Construction Manager, through the following, before installation of related work commences:

- .1 Drawings.
- .2 Diagrams.
- .3 Engineering data sheets.
- .4 Other forms of special instruction.

.2 Construction requirements shall include, but are not restricted to the following:

- .1 Location or position of hoist machine.
- .2 Location of operating devices.
- .3 Framing.
- .4 Loadings.
- .5 Hoistway and pit dimensions.
- .6 Guide rail supports.
- .7 Cutting and patching.
- .8 Access for installation of elevator equipment.
- .9 Holes and sleeving requirements in pits, walls and other constructions.
- .10 Temporary protection.
- .11 Top of hoistway support pocket locations and elevations.

.3 Assist in location, means of construction and installation as provided by other trade contractors, specifically for installation of elevator equipment. Provide all required templates.

3.3 DELIVERY STORAGE AND HANDLING

.1 Package and crate elevator fabrications to prevent damage during handling and storage.

- .1 Brace entrance door frames, doors, and car components to prevent distortion in handling and storage.
- .2 Protect finished surfaces with protective wrappings.
- .3 Protect finished surfaces of car doors, cab enclosures, controls and accessories with removable covering that will not damage finish.

.2 Leave all protective coverings in place until its removal is directed at time of final cleaning.

.3 Store elevator materials in locations and areas as designated by Construction Manager, co-ordinating delivery of these materials with Construction Manager.

.4 Elevator Trade Contractor will be responsible for protection of all equipment on site. DCC Representative will not assume responsibility for elevator equipment as stored on site.

3.4 PROTECTION OF FINISHES

.1 Ensure all routes are kept clean and protected.

.2 Elevator Trade Contractor shall be responsible for protection of DCC Representative's property from injury, loss and damage as arising out of execution of this Contract.

.3 Make good all such losses, injuries and damage, except such as are directly attributed to actions of DCC Representative's agents, employees, vandalism or are beyond reasonable control of Elevator Trade Contractor.

.4 Protect elevator cab and lobby finishes until such a time that elevator has been accepted and signed for by DCC Representative.

3.5 RUBBISH REMOVAL AND EQUIPMENT DELIVERY

.1 Remove all rubbish, as quickly as it accumulates, and maintain all work areas clean during execution of this Contract.

.2 Equipment deliveries cannot be made without Contractors prior consent. All materials movement must be co-ordinated with Contractor, and only be scheduled after Contractors approval.

3.6 HOISTING

.1 Required hoisting and movement of elevator equipment, for purposes of installation, warranty and maintenance work shall be the complete responsibility of Elevator Trade Contractor.

3.7 INSTALLATION

.1 Arrange equipment in machine space and control room so that equipment can be removed for repairs or replacement without dismantling other equipment components. When provided, review electrical construction drawings to be aware of where disconnects, transfer switches and other electrical services are to be located. Where modifications to these elements are required bring this to the Contractors attention in writing at the time of submitting your bid.

.2 Erect guide rails so faces of all rails are plumb and parallel from top to bottom of hoistway, within 6 mm. Rails shall be plumbed so maximum distance between guides (d.b.g.) variation does not exceed 2 mm. Each rail shall be plumbed to the highest available standard, ideally 1.5 mm over any 4000 mm section.

.3 Provide fastening devices for rail brackets to attach to either masonry, concrete or steel beam sections as provided.

.4 In concrete structures, supply and install required inserts, as concrete formwork is completed. Alternatively, provide self-drilling expansion shell bolt anchors for support of rail brackets. Where DCC Representative considers a concrete fastener improperly installed, either replace fastening or demonstrate stability of fastener by performing on-site test under which fastener is subjected to four times manufacturer's rated safe pull-out or working load.

.5 Provide steel anchor plates, flanges, girts and angles, as required, to fasten rail brackets to steel support beams.

.6 Guide rail fastenings shall incorporate isolation pads between the guide rail brackets and supporting structure.

.7 Use metal shims only to a maximum of 25 mm and provide lock-washers under all nuts and tap bolts.

.8 Compensate for expansion and contraction of guide rails and building movement.

.9 Anchor guide rails in pit so as not to reduce effectiveness of waterproofing, with all fittings being installed before waterproofing is applied.

.10 Include steel reinforcement and backing for car guide rails, where required. Use splice plates and guide rails with contact surfaces accurately machined to form a smooth joint.

.11 Install entrance frames in alignment with elevator cab platform prior to completion of in-fill of lobby walls, including provision of temporary frame supports, required to maintain frames in proper position. Provide permanent fastenings including a minimum of two (2) wall anchor fastenings, per side, for installation by others.

.12 Set entrance frames in alignment with elevator cab platform. Fasten frames and headers to structural supports and secure to building walls by substantial ties. Set frames in place prior to building lobby walls.

.13 Set entrance frames in alignment with car openings and true and plumb hoistway lines. Maximum variation from plumb for each entrance shall be 2 mm, measured vertically for entrance frames and horizontally for landing sills.

.14 Ensure all fixture faceplates are free of sharp edges and burrs.

.15 Where flush mounted installation is specified, fixture faceplate shall be in same plane as adjacent finishes (applied faceplate is not acceptable).

.16 Install controller wiring in a neat fashion including the following:

.1 All wiring shall be laced and wrapped.

.2 All spare wires shall be tagged or otherwise clearly marked.

.3 All wire connections shall be fastened to studs or terminal strips using solder or mechanical fasteners.

.4 All connection points, components, relays, fuses and printed circuit boards shall be clearly and permanently marked. Use designations corresponding to those used on electrical prints and wiring diagrams.

.5 All fuse ratings shall be marked and all fuses shall be installed so that their fuse ratings are clearly visible.

.17 Co-ordinate with Mechanical Trade Contractor regarding installation of machine room ventilation and cooling equipment in machine room space.

.18 Co-ordinate with Electrical Trade Contractor regarding positioning of controllers in control room and routing of associated conduit for conductors and wiring running to hoistways.

3.8 ERECTION

.1 Erect elevator closures in accordance with Code requirements.

.2 Exposed work in car and at entrances shall be fabricated in true planes, flat and straight, free of buckles, waves and other visible imperfections.

.1 Joints shall be accurately fitted and properly aligned.

.2 All fasteners shall be concealed unless permitted by DCC Representative to be exposed.

.3 All welds shall be undetectable in finished work.

.3 Set fixture boxes in vertical alignment and install cover plates so they are plumb, parallel and square with entrance frames and lobby finish grid.

3.9 TOUCH-UP

.1 Upon completion, touch up and restore to new condition damaged or defaced factory finished surfaces.

.2 Remove protective coverings and clean exposed surfaces after completion and leave in first class condition.

.3 Clean running faces of all guide rails before final acceptance of elevator installation.

3.10 QUALITY CONTROL

.1 Perform and meet tests required by CSA B44 Safety Code for Elevators.

.2 Submit test and approval certificates issued by jurisdictional authorities.

.3 Notify DCC Representative, in writing, one (1) week prior to all safety inspections.

.4 Provide for a period of four (4) hours, one (1) technically competent person, thoroughly conversant with installed control system, to carry out performance and acceptance inspections. One (1) technically competent person, thoroughly conversant with control system, shall also be made available for all re-inspection work.

.5 Elevator Trade Contractor shall be held responsible for additional cost of subsequent re-inspections performed by DCC Representative for deficiencies which were not completed at time of initial re-inspection.

.6 Provide a minimum of five (5) working days notice to DCC Representative to arrange for scheduling acceptance and performance inspections.

.7 Performance and acceptance reviews shall be carried out in the presence of the DCC Representative, only after successful completion of governing Authority's acceptance inspections.

.8 Supply instruments, including test weights and carry out DCC Representative's performance and acceptance reviews on all equipment as noted above.

.9 Make available for the following performance checks, test weights equal to 100% of car's full rated capacity. Checks shall be done for, but not limited to, the following:

.1 Car flight times under full load condition in both directions of travel.

.2 Car door operating times.

.3 Door dwell times.

.4 Rated speed performance with full rated load in car.

.5 Car ride quality.

.6 Control operation including performance of all control features.

.10 Elevator Trade Contractor shall be responsible for correcting all noted deficiencies.

.11 Prior to calling for an acceptance reviews, record a complete set of performance criteria (as identified below). This recorded data shall be forwarded to the DCC Representative along with a written request for the elevator review. As a minimum, the following data shall be recorded:

.1 Elevator number.

.2 Running speed with full load (UP and DOWN).

.3 Running speed with empty car (UP and DOWN).

.4 Single typical floor flight times with full load (UP and DOWN).

.5 Single typical floor flight times with empty car (UP and DOWN).

.6 Single typical floor brake to brake times with full load (UP and DOWN).

.7 Single typical floor brake to brake times with empty car (UP and DOWN).

.8 Door performance including Door Open and Close times and Closing Force.

.9 Car and Hall call dwell times.

.10 Door re-opening device Interrupt Time and Door Close time on Nudging Operation.

.11 Confirmation of 6 mm levelling accuracy (on initial stop) at all floors in both directions of travel with full load, no load and any load between.

.12 Full load starting and running currents.

.12 Per TSSA's Code Adoption Document, "Where category 5 (CAT5) tests require the use of load for testing purposes, alternative no load methods shall be permitted where the alternative method is acceptable to the Director." Alternative CAT5 tests may be performed without load if the elevating device (at some point in time) was tested with load and directly afterwards was tested using alternative testing tools (and no load). The documentation of the load test followed by the no load test forms the "baseline" documents to be used going forward (i.e. at the next 5 year anniversary). Therefore, prior to handing over the elevator to the DCC Representative, Elevator Trade Contractor shall establish a procedure for these tests and submit same for approval from TSSA. Once approved, Elevator Trade Contractor must provide a copy of same in the Maintenance Control Program on site and a second copy to the DCC Representative for their records. Elevator Trade Contractor must then perform all required full load tests followed immediately by the no load tests in order to establish the "baseline" identified above, and mitigate the need to carry out full load CAT5 tests in the future.

3.11 CROSSHEAD DATA PLATE

.1 Once final equipment adjustments are made, and immediately in advance of the jurisdictional authorities' acceptance inspection, weigh elevator car and counterweight to determine the actual weight of each.

.2 In addition to information required by the CSA B44 Elevator Safety Code, ensure that car top data tag contains the following information:

.1 measured car weight immediately prior to jurisdictional authorities' acceptance inspection.

.2 measured counterweight weight immediately prior to jurisdictional authorities' acceptance inspection.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Read and comply with Conditions of the Contract.

.2 Conform to all conditions stated under all Sections of Division 01 of these Specifications.

.3 These Specifications are arranged generally in accordance with the specification-writing standard MasterFormat, latest edition. Sections of this Division are not intended to delegate functions or to delegate work to any specific trade.

.4 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.5 Scope of Work:

.1 General provisions applicable to all Sections of this Division and of Divisions 22 and 23.

.6 The terms “Mechanical Work”, “Mechanical Contractor”, “Mechanical Division” or their derivatives includes all the Work of Divisions 20, 22 and 23 unless otherwise specified.

1.2 DEFINITIONS

.1 “Provide” means to supply and install the products and services specified.

.2 “Work” means the total construction required by the Contract Documents, and includes all labour, products, and services.

.3 “Products” means all material, machinery, equipment, and fixtures forming part of the completed Work as required by the Contract Documents.

1.3 INTENT

.1 Provide all Work, including items, articles, materials, operations, and methods listed, mentioned, and scheduled in the Contract Documents. Include all labour, equipment, tools, scaffolds, and other incidentals necessary and required for the complete installation.

.2 Consider the Specifications as an integral part of the Drawings, which accompany them. Do not use the Drawings or the Specifications alone. Consider any item or subject omitted from one, but mentioned or reasonably implied in the other, as properly and sufficiently specified and provided under the Mechanical Work.

.3 This installation shall be made in strict accordance with the Drawings, Specifications, and all applicable codes, regulations, standards, bylaws, including the requirements of Authorities having jurisdiction, DCC Representative’s Insurer, and NFPA regulations.

.4 All equipment and devices used shall be UL/cUL listed and/or CSA certified where applicable.

.5 Each Contractor performing any part of the Mechanical Work is considered an expert in their field.

1.4 CODES, REGULATIONS AND STANDARDS

.1 Comply with the requirements of the following codes, regulations and standards:

.1 National Building Code of Canada, 2015;

.2 Canadian Occupational Health and Safety Regulations;

.3 Treasury Board Fire Protection Standard

.4 National Fire Protection Authority (NFPA) standards;

.5 National Fire Code of Canada, 2010;

.6 National Energy Code of Canada for Buildings, 2011;

.7 Municipal and Provincial Regulations and/or Codes;

.8 Rules and Regulations of Authorities having jurisdiction;

.9 Relevant CSA Standards;

.10 Applicable standards of the Underwriters' Association.

.11 ASHRAE 62.1 Standard 2013 Ventilation for acceptable Indoor Air Quality

.2 Codes, standards, and regulations referenced by these Specifications shall be the latest edition as applicable at the time of building permit application unless noted otherwise or specifically defined under the Provincial or National Building Code.

.3 Codes, regulations and standards constitute an integral part of these Specifications. In case of conflict; codes, regulations and standards take precedence over the Contract Documents.

.4 In no instance reduce the level of construction standard established by the Drawings and Specifications by applying any of the codes, regulations and standards referred to herein.

1.5 ABBREVIATIONS

.1 Abbreviations with respect to government agencies, testing agencies, technical societies, and approval agencies are as listed below:

.1	AMCA	Air Moving and Conditioning Association
.2	ANSI	American National Standards Institute
.3	ARI	Air Conditioning and Refrigeration Institute
.4	ASHRAE	American Society of Heating, Refrigerating, and Air Conditioning Engineers
.5	ASME	American Society of Mechanical Engineers
.6	ASTM	American Society for Testing and Materials
.7	AWWA	American Water Works Association
.8	CSA	Canadian Standards Association
.9	FM	Factory Mutual, FM Global
.10	IAO	Insurers' Advisory Organization (CGI Information systems and Management Consultants Inc.)
.11	MICA	Midwest Insulation Contractors Association

.12 NBC National Building Code

.13 NBFU National Board of Fire Underwriters (currently American Insurance Association)

.14 NEMA National Electrical Manufacturers Association

.15 NFPA National Fire Protection Association

.16 SMACNA Sheet Metal and Air Conditioning Contractors National Association

.17 ULC/cUL Underwriters' Laboratories of Canada

1.6 **EXAMINATION OF SITE AND CONTRACT DOCUMENTS**

.1 Before Bid submission, visit the Site of the proposed Work and obtain all information as to existing conditions and limitations.

.2 Examine the Specifications and all Drawings including the Specifications and Drawings of all other Divisions before commencing any portion of the Mechanical Work.

.3 No allowance will be made for any consideration that may have been overlooked.

.4 Unless exceptions are specifically noted at the time of Bid, the submission of a Bid confirms that the Bid Documents and site conditions are accepted without qualification.

1.7 **CONTRACT DRAWINGS AND DOCUMENTS**

.1 The Contract Drawings are diagrammatic performance drawings; they describe the design intent, indicate general arrangement and approximate location of apparatus, fixtures, and pipe runs, but do not show the exact details for the installation. The Contract Drawings are not fabrication or installation drawings.

.2 The Work is suitably outlined on the Drawings with regard to sizes, locations, intended arrangements, and the routing of services has been generally coordinated. The routing of ductwork and piping, and equipment arrangement represent a close approximation of the intent, except in certain cases the Drawings may include details conveying the exact locations and arrangements required.

.3 Final and exact location of equipment and services shall be determined by the Contractor using the reviewed shop drawings together with actual site conditions. The DCC Representative reserves the right to make reasonable adjustment of up to 1 m to the location of equipment, fixtures, routing of major piping and ductwork, at no additional cost to the DCC Representative.

.4 In order to depict a clear arrangement of the Work, plans and sections do not show each valve, thermometer, pressure gauge and other accessories. Refer to schematic Drawings, to standard details and to the Specification for these requirements.

.5 Where specific installation dimensions for the location of equipment and access space requirements are indicated on the Drawings, the installation shall adhere to these requirements.

.6 Standard details show the general installation requirements, and are applicable to each occurrence in the Work, unless otherwise specified or shown.

.7 Do not scale Drawings; obtain information involving accurate dimensions to structure from dimensions shown on architectural and structural drawings, or by site measurements. Consult general construction Drawings as well as detail drawings to become familiar with all conditions affecting the Mechanical Work and verify spaces in which the Work will be installed.

1.8 **PERMITS AND INSPECTIONS**

.1 Apply for, obtain, and pay for all permits, licenses, inspections, examinations, and fees required.

.2 Material approvals

.1 Obtain special inspection and approvals by CSA and/or local authorities, for materials where specified.

.2 Obtain such approval for the particular installation with the co-operation of the material supplier.

.3 Permits

.1 Before starting any work apply for permits. Submit drawings and specifications to the Authorities for their approval and comments. Comply with any changes requested as part of the Work, but notify the DCC Representative immediately in writing of such changes for proper processing of these requirements. Prepare and furnish any additional drawings, details or information as may be required.

.4 Inspections

.1 Arrange for inspection of all Work by the Authorities having jurisdiction over the Work. On completion of the Work, present to the DCC Representative the final unconditional certificate of approval of the Inspection Authorities.

.2 Arrange, provide documentation, and pay for registration and inspection of the following systems and equipment:

.1 Plumbing and drainage

.2 HVAC

.3 Electrical installation

1.9 **CONTRACTOR COORDINATION RESPONSIBILITIES**

.1 Provide the services of a mechanical/electrical coordination supervisor, to coordinate the Mechanical Work, as well as providing coordination with Contractors of other Divisions. This supervisor may be full time or part time on site, as appropriate for the work stage and complexity of the Work, at the discretion of the DCC Representative.

.2 Where multiple Subcontractors are required to execute the Mechanical Work, the mechanical coordinating supervisor shall be the lead coordinator.

.3 The DCC Representative reserves the right to require the coordinating supervisor to increase their attendance at the Site, at no cost to the DCC Representative, if in the DCC Representative's opinion, the current level of coordination is insufficient for the progress of the Work.

.4 Make changes and modifications to location and routing of equipment and services as necessary to ensure that the installation of the Mechanical Work is coordinated, to avoid

interference and conflicts with the Work performed by Contractors of other Divisions while maintaining the design intent.

.5 Make, at no additional cost to the DCC Representative, all changes or additions to materials and/or equipment necessary to accommodate structural conditions such as runs around beams or columns.

.6 The arrangement and layout of equipment and systems shown on the Contract Drawings is based on the requirements of one manufacturer for each equipment type. The installation on Site shall follow each manufacturer's installation requirements for the specific equipment supplied by the Contractor.

1.10 **INSTALLATION, INTERFERENCE AND FABRICATION DRAWINGS**

.1 Coordinate Mechanical Work such that items will properly interface with the Work performed by Contractors of other Divisions.

.2 Architectural Drawings, or in their absence, Mechanical Drawings govern all equipment and service locations.

.3 Prepare dimensioned installation, interference and fabrication drawings, coordinated with the Contractors of other Divisions as required.

.4 Provide sufficient details highlighting critical interferences of major equipment and services to ensure adequate accessibility.

.5 Maintain specific dimensions for equipment location or access which are shown on the Contract Drawings.

.6 Indicate sleeves, the size and locations of all openings required in concrete floor slabs, roof slabs/decks and walls for piping, ductwork and equipment, and stress points such as anchors, guides and inserts. Any additional cost incurred due to omitting to provide this information in advance of construction of these structural elements (the concrete is poured) shall be at the expense of this Contractor.

.7 Prepare drawings of pump pits, equipment bases, anchors, inertia slabs, floor and roof curbs pertaining to the Mechanical Work. Base drawings upon reviewed Shop Drawings. Indicate all loads transferred to the structure.

.8 Prepare installation drawings to maximum 1:50 scale for mechanical rooms showing plan and sections of the plant, services, bases, curbs, drains, motor terminals.

.9 Prepare interference drawings for shafts, ceiling spaces, and wherever there is a possible conflict between the positioning of mechanical equipment, piping or ductwork, and architectural or structural features or the Work of Contractors of other Divisions

.10 Before fabricating ductwork or piping for installation, make certain that such items can be installed as shown on the Drawings without interfering with the structure or the Work of Contractors of other Divisions. Problems that cannot be solved in agreement with the Contractors of other Divisions affected, shall be submitted for decision to the DCC Representative. If ductwork or piping is prefabricated prior to this investigation and reaching of a solution to possible interference problems, necessary changes to such prefabricated items shall be made at no additional cost to the DDC Representative.

.11 Indicate deviation in size and weight, and deviation in requirements for water, drainage, electric power or other service connection requirements for all equipment proposed, from the requirements show on the Contract Drawings.

.12 Provide installation, interference and fabrication drawings to Contractors of other Divisions for coordination with their Work.

.13 Update installation, interference and fabrication drawings as part of the record drawings, showing actual location of major equipment, services, access doors, shut-off valves.

.14 The installation, interference and fabrication drawings are not to be submitted as shop drawings. Make them available for viewing at site when requested by the DCC Representative.

1.11 **MEASUREMENTS AND DEVIATIONS**

.1 Where any part of the Mechanical Work is specifically located by dimensions on the Drawings, check and verify these dimensions on the Site prior to installation.

.2 Where site conditions require minor deviations from indicated arrangements or locations, make such changes upon approval by the DCC Representative without additional cost to the DCC Representative.

.3 If a substantial interference or existing, unforeseen condition is encountered during the installation of the Mechanical Work that necessitates a major revision to the Mechanical Work or the Work of Contractors of other Divisions, notify the DDC Representative immediately and obtain written authorization before proceeding with the Work.

1.12 **PROVISION FOR FUTURE**

.1 Where a space is indicated as reserved for future equipment or services, leave the identified space clear and install piping, ductwork and equipment in such manner that future connections can be made without dismantling the existing piping, ductwork and equipment, and without removing existing floors, walls and ceilings.

1.13 **SUBMITTALS**

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

.2 Assume responsibility for accuracy of equipment dimensions related to available space and accessibility for maintenance and service, and for compliance with code and inspection authority requirements.

.3 Shop drawings showing more than one size or model will not be considered unless the exact model and options to be provided are clearly marked.

.4 Shop drawings shall be certified by the manufacturers as ready for construction.

.5 Identify equipment shop drawings with designations (tags) as shown on the Drawings or in the Specifications.

.6 For all equipment, include the following:

.1 Manufacturer’s name and model number.

.2 Equipment dimensions and weights.

.3 Itemized product description with optional items clearly marked as being included.

.4 Time required to fabricate and to deliver.

.5 All variations from Contract Documents.

.6 Field connection details

.7 Clearly indicate the materials and/or equipment being supplied:

.1 Details of construction, finish, accurate dimensions, capacities and performance.

.8 For electrically driven appliances provide the following information:

.1 Electrical characteristics including voltage, phase, frequency and power rating. Provide maximum overcurrent protection requirement.

.2 For motors: NEMA rating, class and efficiency ratings. Indicate whether the motor is rated for use with variable frequency drives.

.3 Equipment performance ratings, including flow rates, pressures, efficiencies, part load values and/or efficiencies (IPLVs), plotted flow characteristics (pump and fan curves) with operating points clearly marked.

.9 For other equipment include the following information:

.1 Equipment performance ratings, including flow rates, pressures drops.

.2 Electrical control power requirements

.10 Provide wiring shop drawings:

.1 Wiring diagrams and schematics for all equipment which has electrical controls or devices furnished with the equipment.

.2 Wiring diagrams alone are not sufficient; schematic and interconnecting drawings, sequence of operation of equipment are also required for review.

.11 The DCC Representative's review shall not relieve the Contractor from responsibility for deviations from the Contract Drawings and Specifications, unless written permission for such deviations is obtained at the time of submission. The DCC Representative's review shall be construed to only apply to general arrangement and shall not relieve the Contractor from the entire responsibility for correctness of details and dimensions. Any fabrication, erection, setting out or other work done in advance of the receipt of stamped shop drawings shall be done entirely at the Contractor's risk.

1.14 **RECORD DRAWINGS**

.1 Submit record drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Prepare record drawings showing the following:

.1 Dimensioned location of all services embedded in the structure.

.2 Dimensioned location of all services left for future Work.

.3 All Addendum changes.

.4 All changes to the Work due to Change Orders.

.5 All changes to the Work during construction.

.6 Location and designation of all electrically supervised valves, and smoke, fire/smoke and motorized dampers.

.7 Location and designation of all items requiring access or service in a hidden location.

.8 All changes to Specifications, details and equipment schedules.

.9 All duct traverse points and associated airflow rates as reported in final Air Balancing reports.

.10 Designation for each piece of equipment as provided by the DCC Representative.

.3 Prior to Testing, Adjusting and Balancing (TAB), provide printed copies of all current record drawings to the Contractor performing the Testing and Balancing Work (TAB Contractor) and to the Commissioning Agent.

1.15 **INSTALLATION AND START-UP INSTRUCTIONS**

.1 Submit installation instructions and start-up instructions for all equipment in accordance with Section 01 33 00 – Submittal Procedures.

1.16 **OPERATING AND MAINTENANCE MANUALS**

.1 Submit operating and maintenance manuals in accordance with Section 01 77 00 - Contract Closeout.

.2 In addition, include the following in the manuals:

.1 Non-dimensional layout showing location of all electrical devices on mechanical equipment.

.2 Operating instructions, including start-up and shut-down procedure.

.3 Lubricating instructions and recommended cycle of lubrication for each equipment, including various types of lubricants.

.4 List of spare parts.

.5 For refrigeration equipment:

.1 Operating instructions detailing the procedures to be followed for:

.1 Charging

.2 Changeover from one season to another

.3 Night operation

.4 Maintenance

.2 List of safety devices and instructions for their testing and adjusting.

.3 Control sequence with description of the sequences of operation.

.4 Detailed layout and sections indicating all maintenance, cleaning and lubrication points.

.5 List of parts (bill of material) indicating the catalogue number and manufacturer, complete with drawings indicating the location of each part in the complete assembly.

.6 Recommended chemical analysis of chilled water.

.6 For pumps and fans for each different type and size:

.1 List of parts indicating the catalogue number and manufacturer, complete with drawings indicating the location of each part in the complete assembly.

.2 Performance curves.

.7 For valves and fittings:

.1 Three (3) copies of framed valve charts for the project.

.2 A list of valves as per the valve chart indicating size, type, catalogue number, make of each valve, strainer and steam trap.

.8 For instrumentation and control equipment:

.1 Complete instrument list for all gauges, thermometers, gauge glasses and other instruments.

.2 Sequence and description of operation for each control system.

.3 Instructions and schedules for inspections, cleaning, lubricating and calibration.

.9 For other equipment:

.1 Description of start-up and activating procedures, commissioning procedures, as well as follow-up instructions to the DCC Representative's operating staff to slowly break-in each unit.

.2 Maintenance instructions for all other equipment containing moving parts, requiring lubrication or chemical charging.

.3 Include a list of parts indicating catalogue number and manufacturer, complete with drawings indicating the location of each part in the complete assembly, and performance curves.

.10 A copy of the following:

.1 Certificates from all equipment manufacturers, authorities having jurisdiction.

.2 All pipe and duct pressure test reports.

.3 Warranties and letters of guarantee from contractors and equipment manufacturers.

.4 Copies of permits, licenses and certificates.

.5 Start-up and activation and commissioning procedures and check sheets.

.3 All the above applies to component parts of equipment whether they are manufactured by the supplier of the equipment or are supplied as a component part of an equipment.

1.17 **CLEANING, TESTING AND APPROVAL RECORDS**

.1 Maintain records of all pressure tests and flushing and sterilization tests, glycol/water concentrations, inspections and approvals by the Plumbing Inspector.

.2 Upon completion of each test and cleaning operation, forward a copy of each record to the DCC Representative for review.

.3 Forward the reviewed records to the DCC Representative upon completion of the Work in accordance with Section 01 33 00 – Submittal Procedures.

1.18 **DIMENSIONS AND QUANTITIES**

.1 Dimensions

.1 Dimensions shown on Drawings are approximate.

.2 Verify dimensions by reference to shop drawings and field measurement.

.2 Quantities

.1 Quantities or lengths indicated in any of the Contract Documents are approximate only and shall not be held to gauge or limit the Work.

.3 Technical Standards and Safety Authority Act 2000

.1 Manufacturers and installers of regulated pressure piping parts and systems regulated shall hold certificates of authorization under Boilers and Pressure Vessels O.Reg. 220/01, for:

.1 Refrigeration piping systems, CSA B52 Mechanical Refrigeration Code.

PART - 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

.1 Use new materials and equipment, free from defects impairing strength and durability, as specified or specified equivalent.

.2 Material and equipment shall be of Canadian manufacture wherever possible, and labelled or listed as required by applicable Codes and/or have special approval of the inspection authority having jurisdiction for their respective functions and environments.

.3 Provide products of same manufacture for similar applications unless noted otherwise.

.4 Design of the mechanical systems is based on the listed supplier and/or model number/size stated on the equipment schedules and in the Specifications. Bear all costs due to physical or performance differences between stated equipment and proposed equipment. These differences may include but are not limited to physical size, layout, arrangement, connection size, location and/or quantity of connections, or performance differences such as noise, power requirements, flow, throw.

2.2 ALTERNATES AND SUBSTITUTIONS

.1 Substitute products will only be considered when tendered products become unobtainable.

.2 Provide detailed specifications and Shop Drawings with complete performance characteristics of the proposed alternate with the submission to the DDC Representative

.3 Assume responsibility and pay for any additional installation cost incurred by the Contractors of all other Divisions resulting from the substitution.

2.3 EQUIPMENT AND STRUCTURE COORDINATION

.1 Locations and dimensions of curbs, roof and floor openings, where indicated on the Drawings, are based on the equipment used as basis for design.

.2 Verify the actual size requirements for all curbs and openings. Notify the DDC Representative immediately if the dimensions of curbs and openings required for the unit supplied and for the connecting ductwork/piping differ from the dimensions given on the Drawings.

.3 Bear all costs of required curb or floor/roof opening modifications resulting from a failure to notify the DDC Representative prior to fabrication or construction of curbs and framing.

2.4 STANDARD SPECIFICATIONS

.1 Ensure that the chemical and physical properties, design, performance characteristics and methods of construction of all products provided comply with the latest issue of applicable Standard Specifications issued by the authorities having jurisdiction.

.2 Do not apply such Standard Specifications to decrease the quality of workmanship, products and services required by the Contract Documents.

2.5 **MANUFACTURER'S NAMEPLATES**

.1 Metal nameplates

.1 Provided with raised or recessed lettering, on each piece of equipment.

.2 Mechanically fasten nameplate on a metal stand-off bracket arranged to clear insulation.

.3 Mount on the same stand used for ULC and/or CSA registration plates.

.2 Nameplate data to indicate:

.1 Size

.2 Capacity

.3 Equipment model

.4 Manufacturer's name

.5 Serial number

.6 Voltage

.7 Cycle

.8 Phase and power of motors

PART - 3 EXECUTION

3.1 **CONSTRUCTION REVIEW**

.1 The construction review will include milestone and periodic reviews.

.2 Milestone reviews:

.1 Specific milestone reviews will be performed by the DDC Representative to ascertain reasonable conformity with the Contract Drawings and Specifications, and the applicable Municipal, Provincial and Federal Codes and Standards. Milestone reviews may include the following:

.1 Buried drainage

.2 Before installation of roofing membrane

.3 Before closure of service shafts and pipe chases

.4 Before closure of walls

.5 Before closure of ceilings

.6 Equipment demonstration and training

.7 Substantial Performance and Deficiency Review

.8 Total Performance

.2 Reviews will include portions of the Mechanical Work which may be concealed. If the Work is enclosed prior the DDC Representative reviewed the installation, the DDC Representative may direct the Contractor to expose the Work for it to be examined, at no additional cost to the DDC Representative including rework affecting the Work of Contractors of other Divisions.

.3 If deficiencies are noted during any review related to Work that will be enclosed, correct noted deficiencies and have them reviewed by the DDC Representative prior to the Work being enclosed.

.4 Provide a minimum of seven (7) calendar days of written notice to the DDC Representative when requesting a review date.

.5 The DDC Representative will provide a check-list to the Contractor of required milestone reviews which must be completed. Maintain this list on Site along with identified test reports, and make available for DDC Representative's review when requested. When completed, include this checklist form with the Test Reports forms specified in Section 20 05 83 - Start-Up and Performance Testing.

.3 Periodic reviews

.1 The DDC Representative will conduct periodic reviews as required for the project. These reviews are for the benefit of the DDC Representative to describe the progress and workmanship of the Mechanical Work, and are not intended as any form of quality assurance for the Contractor. The DDC Representative is not responsible for quality control. The Contractor shall perform their own quality control and will be responsible for the execution of the Work in conformity with the Contract Documents and with the requirements of authorities.

.2 Deficiencies will generally not be reported as part of this review, as the work has not been reported by the Contractor as being complete. However, deficiencies may be reported where it may not be possible to correct the work at a later date, or without a great expense.

.3 The Contractor shall not rely on these periodic reviews to identify deficiencies during the progress of the Work.

.4 Deficiency review

.1 The DDC Representative will conduct a deficiency review only after the Contractor submits an application for Substantial Performance. As part of this application, the Contractor shall submit their own comprehensive deficiency list of incomplete or incorrect work. Failure by the Contractor to list any deficiency does not relieve the Contractor from correcting or completing the Work.

.2 The DDC Representative shall review the Work and any deficiencies noted will be classified as major or minor.

.1 Major deficiencies are required to be corrected as part of obtaining Substantial Performance.

.2 Minor deficiencies, as long they are not related to life safety systems and do not affect the occupancy of the Site in any way, may be corrected after Substantial Performance.

.5 Final review

.1 The DDC Representative will conduct a final review only after the Contractor submits a declaration that all of the following has been completed:

.1 Noted deficiencies have been corrected,

.2 Final Record Drawings have been submitted to the DDC Representative,

.3 Final Operating and Maintenance Manuals have been submitted to the DDC Representative,

.4 All systems have been balanced, tested, commissioned and are operational,

.5 The DDC Representative has been instructed in the operation and maintenance of all equipment,

.6 All tags and nameplates are in place and all data submitted and reviewed,

.7 Cleaning up is finished in all respects,

.8 All spare parts and replacement parts specified have been provided,

.9 Final test reports, including alternate season tests have been submitted to the DDC Representative.

.2 The DDC Representative will only review the deficiency list to confirm that these deficiencies have been corrected.

3.2 ADJUSTMENT AND OPERATION OF SYSTEMS

.1 When the Work is complete, adjust equipment of the various systems for proper operation within the framework of the design intent and the operating characteristics as published by the equipment manufacturers.

.2 The DDC Representative reserves the right to require the services of an authorized representative of manufacturers in the event any equipment is not adjusted properly.

.1 Arrange for such services and pay all costs thereof.

.2 After completion of adjustments, place systems in full operating condition and advise the DDC Representative that the Work is ready for acceptance.

3.3 MANUFACTURER'S CERTIFICATION

.1 Submit letters from the manufacturers of all equipment certifying that their technical representatives have inspected and tested their equipment, and have approved the methods of installation and operation. Where existing systems are extended, provide letters covering both the new and existing equipment and connections.

.2 These letters shall state the names of persons present at the inspection and testing, methods used and a list of functions performed with location and room numbers where applicable.

.3 Refer to the respective equipment Specification Sections for specific requirements for these letters.

3.4 ACCEPTANCE

.1 After all equipment has been installed, adjusted and all systems balanced:

.1 Conduct performance tests in the presence of the Commissioning Agent and the DDC Representative.

.2 Arrange a time for these tests at the convenience of the Commissioning Agent and the DDC Representative.

.2 During these tests:

.1 Demonstrate the correct performance of all equipment and of the systems they comprise.

.2 Should any system or equipment fail to function as required, make changes, adjustments or replacements necessary to meet the performance requirements.

.3 Repeat the tests until all requirements have been fully satisfied and all systems have been accepted by the DDC Representative.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section 20 00 13 – Mechanical General Provisions shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 Articles that are of a general nature, applicable to each Section of Divisions 20, , 22and 23.

1.2 RELATED WORK

.1 The following work is provided under other Sections or Divisions of the Work:

.1 Installation of access doors on walls and ceilings: Section 09 21 16 - Gypsum Board Assemblies

.2 Concrete curbs: Section 03 30 00 – Cast-in-place Concrete

.3 Duct access doors: Section 23 30 00 – Duct Accessories

1.3 SUBMITTALS

.1 Shop Drawings

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

.2 Submit product data for all products described in this Section of the Specification. Submittal shall include dimensions, weights, capacities, ratings, electrical characteristics, metal gauges, finishes of materials, and construction details.

.3 Submit detailed and coordinated drawings showing location and type of all access doors.

.4 Submit fire stopping shop drawings, including ULC/cUL listing number, installation drawings for each type of penetration and description of installation materials.

.5 Submit results of electromagnetic scans and x-rays.

1.4 MATERIALS AND EQUIPMENT

.1 Use only new materials and equipment of manufacture as specified or shown on the Drawings. Ensure that equipment and materials for similar applications are of the same manufacturer.

.2 If the Contractor wishes to substitute materials of manufacturers other than those listed for specific products, the name of the alternate manufacturer and a complete description of the materials to be substituted shall be listed in the Contractor’s Tender submission, along with the amount representing the adjustment to the Bid price.

.3 Ensure that materials not specified to a specific manufacture are of high commercial standard and quality.

1.5 **REFERENCE STANDARDS**

.1 ASTM A53/A53M - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A269 - Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

.3 ASTM A307 - Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.4 ASTM E84 / UL 723 - Standard Test Method for Surface Burning Characteristics of Building Materials.

.5 CAN/CSA-G40.20/G40.21 - General Requirements for Rolled or Welded Structural Quality Steel.

.6 CAN/ULC-S115 - Fire Tests of Fire stop Systems

PART - 2 PRODUCTS

2.1 **ACCESS DOORS AND PANELS**

.1 General service access doors shall be constructed of steel, prime coated as follows:

.1 600 mm x 600 mm for personnel entry.

.2 300 mm x 450 mm for hand entry.

.3 In plaster, gypsum board, tiled or masonry walls for exposed flush installation, 1.6 mm access door with 1.2 mm mounting frame, continuous concealed hinge.

.4 In plaster or tiled walls for recessed installation, 1.6 mm access door recessed by 25mm with 2.1 mm mounting frame, concealed pivoting rod type hinge.

.5 In areas not accessible by public, 1.6 mm access door recessed by 25mm with 2.1 mm mounting frame with drywall taping bead an all sides, concealed pivoting rod type hinge, and flush-to-surface screwdriver operated stainless steel cam latch.

.6 In areas finished with tile or marble surfaces provide doors constructed of stainless steel.

.7 In damp and high humidity areas provide doors constructed of stainless steel with neoprene gasket.

.8 Access doors shall be fitted with screwdriver operated stainless steel latches, except in areas subject to security risks (public corridors, psychiatric patient areas, public washrooms). In these areas doors shall be fitted with keyed cylinder locks with similar keys.

.9 For fire rated walls, provide 1.6 mm rated access door, ULC listed "B" label for 1-1/2 or 2 hours. Door shall be complete with 1.6 mm mounting frame, concealed hinge, spring closer, and knurled knob operated universal self-latching bolt.

.10 Standard of Acceptance

.1 Acudor

.2 Mifab

.3 Nystrom

.4 Cendrex

.5 Milcor

.6 Williams Brothers

.2 In gypsum board surfaces in public areas, provide architectural access door with concealed hardware and gypsum board inlay. Standard features shall include cam latch flush with surface, aluminum frame and glass fibre-reinforced nylon hardware, fully hinged removable door panel and integrated safety catches, perimeter gasket installed onsite.

.1 Standard of Acceptance

.1 Access Panel Solutions, bauco plus series

2.2 DRAIN VALVES

.1 Drain valves shall be 20 mm for piping up to and including 75mm, and minimum 50mm for larger piping; straight pattern bronze with hose end male thread, cap and chain.

2.3 SLEEVES

.1 General

.1 Provide sleeves for pipes, ducts and conduits passing through masonry walls, concrete floors, and where required by STC rated ceilings and partitions.

.2 Maintain fire rating integrity where pipes and ducts pass through fire rated walls, floors and partitions.

.2 Floor and wall sleeves

.1 Sleeves in fire separations shall be:

.1 Sized to suit fire stopping methods employed for bare pipes, conduits, insulated pipes, bare and insulated ducts without fire dampers, and

.2 Sized to suit conditions of approval given in manufacturer's installation instructions for fire and smoke dampers.

.2 Sleeves in other construction shall be:

.1 Sized to clear insulated pipes and ducts by 13 mm all around, and

.2 Sized to clear conduits, bare pipes, and bare ducts by 6 mm all around.

.3 Sleeves for pipes, conduits and ducts smaller than 0.4 m2 through solid walls and floors shall be Schedule 40 steel pipe or 1 mm (minimum) sheet metal, lapped and spot welded.

.4 Sleeves for pipes, conduits and ducts smaller than 0.4 m2 through gypsum board partitions shall be 1 mm minimum sheet metal, lapped and spot welded with 20 mm lip flange at one end.

.5 Sleeves for ducts 0.4 m2 and larger through walls and floors shall be 1.6 mm minimum sheet metal, lapped and spot welded with 20 mm lip flange at one end.

.3 Modifications for existing construction:

.1 Annular fins and flanges attached to sleeve at point equivalent to surrounding floor level or curb.

2.4 **FIRE STOPPING AND SMOKE SEALS**

.1 Fire stopping and smoke seal assemblies shall be approved in accordance with CAN/ULC-S115, ULC/cUL listed with rating to suit the fire resistance rating of the wall or floor assembly they are applied to.

.2 Standard of Acceptance:

.1 Nelson Firestop Products

.2 Royal Quickstop

.3 3M

.4 A/D Fire Protection System

.5 Hilti

2.5 **SMOKE AND ACOUSTICAL SEALANT**

.1 Smoke and acoustical sealant to be paintable water-based caulking material with low shrinkage after curing, white colour. Application temperature range 5°C - 40°C. Allowable movement +/-12.5% (ISO 11600). Temperature resistance rating -20°C – 80°C. Flame spread rating of 10, smoke development rating of 10 per UL 723 (ASTM E84).

.2 Standard of Acceptance

.1 Hilti

.2 3M

.3 Tremco

.4 Dow Corning

.5 Johns Manville

2.6 **WALL AND FLOOR PLATES**

.1 Fit pipes passing through walls, floors and ceilings in finished areas with escutcheon, wall or floor plates.

.2 Supply plates:

.1 At floor chrome plated two piece split type with hinge.

.2 At walls and ceilings similar to floor plate but with set screw to fasten plate to pipe.

PART - 3 EXECUTION

3.1 **GENERAL**

.1 Execute the Work in accordance with requirements specified in the various Sections of Divisions 20, 22and 23.

.2 Lay out Work of each mechanical trade Contractor so that it does not interfere with Work of other Divisions' Contractors.

.3 Make good any damage to DCC Representative's property or other Contractor's Work caused by improperly locating or carrying out Work.

.4 Location of pipes, ductwork, raceways and equipment may be altered without extra cost provided the alteration is made before installation.

3.2 **WORKMANSHIP**

.1 The Contract Drawings and instructions govern the general location of all items.

.2 Install ducts and pipes parallel and perpendicular to the building planes and concealed in chases, behind furring or above ceiling, except in unfinished areas. Install all exposed systems neatly and grouped together, to present a neat appearance. No exposed piping or ductwork shall be installed in areas with dropped ceiling unless specifically reviewed and accepted by the DCC Representative. No piping shall be concealed within outside walls. Installation shall permit free use of space and maximum headroom.

.3 Install all equipment and apparatus requiring maintenance, adjustment, or replacement with sufficient clearance for servicing.

.4 Do not use explosive activated tools.

.5 Install all ceiling mounted components (diffusers, grilles,) in accordance with reflected ceiling drawings reviewed by the DCC Representative. Layout of each device in finished areas is critical in terms of symmetry and location.

.6 Leave space clear and install all Work to accommodate future materials and/or equipment as indicated and to accommodate equipment and/or material supplied under the scope of another Division of Work. Verify space requirements in which Work is to be installed. Install all pipe and duct runs to maintain headroom and clearances, and to conserve space in shafts and ceiling spaces.

.7 Confirm on Site the exact location of outlets and fixtures.

.8 Vent pipes and fans mounted on the roof, or housing for such equipment shall not be closer to the edge of the roof than a distance equal to the height of the pipe, hood or equipment, unless specifically reviewed and accepted by the DCC Representative.

.9 The location and size of existing services shown on the Drawings are based on the best available information. The actual location of existing services shall be verified on Site before work is commenced. Particular attention shall be paid to buried services.

.10 Adequate space and provision shall be left for removal of coils and servicing of equipment, with minimum inconvenience to the operation of systems.

.11 Cap off and seal all open ends of installed ductwork, piping and conduits to prevent entrance of foreign matter.

.12 Do not install piping in a location or manner which might result in freezing.

.13 Equipment Installation

.1 Align, level and adjust equipment as required for satisfactory operation.

.2 Install equipment in such a manner that connecting and disconnecting of piping and accessories can be made readily, and that all parts are easily accessible for inspection, operation, maintenance and repair.

.3 Install and start up items of equipment in accordance with the manufacturer's printed installation and operating instructions.

.14 Noise and Vibration

.1 Noise and vibration levels of equipment and systems shall be within design intent.

.2 If noise or vibration levels created by any mechanical equipment and systems, transmitted to occupied portions of building or other mechanical work are over the allowable noise levels set out for this Project, make all necessary changes and additions as approved by the DCC Representative without additional cost.

.15 Lubrication

.1 Lubricate all equipment prior to start up in accordance with the manufacturer's printed instructions.

.2 Supply all lubrication including sufficient quantity for drainage and refilling of oil sumps when required by manufacturer's instructions.

3.3 ACCESS DOORS AND PANELS

.1 Access doors in ductwork are provided under the work of Section 23 33 00 – Duct Accessories.

.2 Supply access doors in walls and ceilings where access is required for the operation and/or maintenance of concealed mechanical equipment. Access doors to be installed under the work of Section 09 21 16 - Gypsum Board Assemblies.

.3 Install systems and components to result in a minimum number of access panels. Indicate access panel locations on Record Drawings.

.4 Size and locate access doors in applied tile, block or glazed or unglazed structural tile to suit joint patterns.

.5 Access doors in ceilings, where acoustic tile is applied to plaster or gypsum board, to be recessed type designed to receive tile insert.

.6 Access doors are not required in removable ceilings. Provide coloured marking devices after completion of ceilings, at four corners of each panel below point requiring access. Colour code markers to show service or device above.

.7 Access doors installed in fire separations, fire-rated walls and ceilings to have the appropriate fire rating.

.8 At time of training, hand over and obtain signed receipt for 4 sets of each type of key used to lock access doors in secure areas.

3.4 DIELECTRIC COUPLINGS

.1 Provide dielectric isolation between pipes of dissimilar metals with suitable couplings, insulating dielectric unions, insulating flanges, or insulating gaskets between flanges.

.1 Place dielectric isolation between steel piping, and bronze or brass valves.

.2 Do not use bronze or brass valves as dielectric fittings.

.2 Dielectric coupling shall consist of:

.1 Insulating unions for pipe sizes 50mm and under

.2 Insulating flanges for pipes sizes 65mm up to 100mm

.3 Insulating gaskets for pipe sizes 150mm and over:

.1 Compatible with pressure and temperature service;

.2 Flange bolts placed in insulating sleeves with insulating washers under nuts.

3.5 DRAIN VALVES

.1 Provide drain points for piping systems with drain valves at low points and at section isolating valves.

3.6 SLEEVES

.1 Place and secure sleeves in concrete form work.

.2 Supply sleeves to be set in concrete and masonry walls with installation detail drawings.

.3 Regular sleeves:

.1 Terminate flush with surfaces of concrete and masonry walls.

.2 Through exterior walls above grade use Schedule 10 steel pipes, machine cut, flush with finished structure inside and to suit flashing on outside.

.3 Through exterior walls below grade and other waterproof walls use extra heavy weight cast iron or PVC sleeves, machine cut. Check flashing details for further information.

.4 Sleeves in existing concrete and masonry walls and floors:

.1 Installed in neatly cut or drilled holes in existing construction.

.2 Cutting and drilling of structural elements, such as floors, slabs, walls, columns, or beams to be carried out in accordance with the procedure set out in Article “Cutting and Patching” included in this Section.

.3 Terminate sleeves flush with surfaces of concrete and masonry walls.

.4 Extend waterproof sleeves 75 mm above finished floor in mechanical spaces with flange, countersunk, and bolted down flush into floor surface.

.5 Coordinate filling of future-use sleeves with weak concrete, gypsum plaster or similar material with Division 03 - Concrete.

.6 Pipes and ducts passing through waterproof floors except where furred in or enclosed in a shaft shall be furnished around by a watertight concrete curb, 100mm high by 100mm wide with 19mm chamfered edges, provided under the Work of Division 03 – Concrete. Coordinate with Section 03 30 00 – Cast-in-place Concrete Contractor. Extend sleeves where used to be flush with the top of the curb.

.7 Coat exposed exterior surfaces of plain finish ferrous sleeves with heavy application of zinc rich paint in compliance with ASTM A780.

.8 At fire separations and smoke separations, pack and seal void between sleeve and pipe, duct without fire damper, conduit, or insulation as set out in Article "Fire Stopping and Smoke Seals" included in this Section.

.9 At other locations, pack void between sleeve and pipe, conduit, duct or insulation for full depth of sleeve, with mineral wool and seal with silicone-free caulking compound.

.10 Install fire dampers in accordance with conditions of approval given in manufacturer's instructions.

.11 Brace duct sleeves and box-outs to retain their position and shape during the pouring of concrete and other work.

.12 Provide bracing for each duct at each passing through structure to prevent sagging.

.13 Cover exposed duct sleeves and openings in exposed areas only. Use 1.3mm galvanized steel escutcheons in form of a duct collar. Over curbs extend the collar 25mm down the side of the curb, similar to counter flashing. Fix collar in position with cadmium plated screws.

.14 Provide escutcheons at all penetrations of exposed piping into finished areas; at insulated pipes make the escutcheons large enough to fit around the insulation.

3.7 FIRE STOPPING AND SMOKE SEALS

.1 Install fire dampers and intumescent pipe sleeves.

.2 Seal space between piping, ductwork, conduit, miscellaneous support steel penetrating fire separations, and sleeve or opening with firestop and smoke sealing system. Materials shall be supplied, worker training shall be arranged and installation shall be supervised by a specialist firm with an established reputation in this field.

.3 Install fire stopping and smoke seal in accordance with manufacturer’s instructions and ULC listing requirements.

.4 Select thickness and arrangement of back-up materials to suit size of service, length of sleeve and anticipated movement.

.5 Select fire stopping system to allow insulation and vapour barrier to pass un-broken through assembly.

.6 Surfaces shall be clean, dry and free from dust, oil, grease, lose or flaking paint and foreign materials at time of application of materials.

.7 Do not apply fire stopping materials to fire or smoke dampers.

.8 Provide a written report on completion of the fire stopping and smoke seal, by area or floor if necessary, indicating the work has been completed and ready for inspection. Do not cover over fire stopping and smoke seal, including installation of walls and ceilings, until work has been inspected.

3.8 WALL AND FLOOR PLATES

.1 Size plates to cover sleeves.

.2 Secure plates tight against finished surfaces and fit to cover sleeve extensions where sleeves extend above finished floor.

3.9 CUTTING AND PATCHING

.1 Do not cut, remove or burn structural parts or sections of the building, whether they are steel, concrete or masonry without the written authorization of the DCC Representative.

.2 Should cutting, repairing, and patching of previously finished work of other trades be required to allow installation of mechanical work, pay all costs for the trade concerned to perform the work.

.3 Layout cutting of structural elements, such as floors slabs, walls, columns or beams and obtain approval before starting work. Conduct an electromagnetic scan of reinforcing rods and submit results to the Structural Engineer's review. Based on these results, arrange and pay for supplemental x-ray examination as necessary, to locate concrete reinforcement and embeds. X-rays shall be performed by a qualified technician, in a safe manner and in accordance with all applicable regulations governing this activity. Submit x-rays and obtain approval prior to starting any work. Make adjustments to location of openings as required to minimize cutting of rebar and completely avoid electrical conduits.

.4 Neatly cut or drill holes in existing construction to accommodate piping, ductwork or conduits. Cut holes through slabs only. Do not cut holes through beams.

.5 Holes to be cut shall be 200 mm (diameter) or smaller only.

.6 Maintain at least 100 mm clearance from beam faces. Spacing shall be at least 3 hole diameters on centre.

.7 Repair cut or damaged surfaces with materials and finishes to match existing.

.8 Refer to Section 01 73 29 – Cutting and Patching for additional requirements.

3.10 **FLASHINGS**

.1 Safety vents, plumbing vents and other pipes passing through roofs, stack flashings will be supplied and installed by roofing trade, unless otherwise shown on the Drawings. Provide counter-flashing over flashing. The use of pitch pockets is not acceptable.

3.11 **SPARE PARTS**

.1 Furnish the following spare parts:

.1 One set of packing glands for each size of pump gland;

.2 One casing joint gasket for each size pump;

.3 One set of V-belts for each drive;

3.12 **PROTECTION**

.1 Protect work and materials before, during and after erection from weather and other hazards, and keep workplace in a clean and orderly manner.

.2 Protect pipe ends, valves and parts of equipment left unconnected to prevent damage or intrusion of foreign matter. Provide pipe caps for threaded male connections and plugs for threaded female connections.

.3 Protect plumbing fixtures or mechanical equipment having a baked enamel finish by covering with polyethylene sheet securely held in place.

3.13 **GENERAL CLEANING**

.1 Perform exterior cleaning of mechanical fixtures and equipment in accordance with Article 2 of Section 01 77 00.

.2 Cleaning scope included in the work of the Mechanical Contractor covers all new equipment furnished and/or installed by the Mechanical Contractor, and all existing equipment as detailed in Appendix B CMMS List – Existing Mechanical and Electrical Equipment.

3.14 **PAINTING**

.1 With the exception of prime painting of miscellaneous steel or any other specific requirements as specified under the respective Sections of Divisions 20, 22 and 23, or equipment otherwise factory painted, all painting will be provided under Section 09 91 00 - Painting.

.2 Factory applied finish painting:

.1 Pumps, air handling units, uninsulated pressure vessels, unit ventilators, convectors and bare metal equipment items in boiler, mechanical and fan rooms shall be supplied with factory prime and final coats applied.

.2 Use heat resistant paint where conditions require.

.3 Protect factory finished equipment during construction and clean at completion of work.

.3 Factory applied prime painting:

.1 Factory prime paint other equipment fabricated from iron or steel including access doors, grilles, diffusers, dampers, metal radiation enclosures, and fire hose cabinets.

.2 In occupied areas of the building, touch up any damage to prime coat resulting from shipping or installation and leave ready for final painting under Division 09 - Finishes.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section 20 00 13 – Mechanical General Provisions shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 Provide installation within the confines of an existing building.

1.2 CO-ORDINATION BETWEEN NEW AND EXISTING INSTALLATION

.1 Check and co-ordinate all systems which are extended to or from existing systems to ensure their proper operation.

.2 Provide interfacing components between new and existing systems as necessary for proper performance and operation.

.3 Route pipes, ducts, conduits and other services to avoid interference with existing installation.

.4 Relocate existing services and equipment to suit installation of new Work without any adjustment to the Bid Price.

.5 Provide temporary dust screens, barriers, warning signs in locations where renovation and alteration Work is performed adjacent to areas that are operational during the time the Work is performed.

.6 Arrange Work to minimize interruption of physical access to the building.

1.3 PENETRATIONS THROUGH EXISTING STRUCTURE

.1 Do all cutting and core drilling for the Work of Divisions 20, 22and 23. Obtain DCC Representative's approval before proceeding.

.2 Provide sleeves and follow DCC Representative's instructions where necessary to completely penetrate existing floors, walls, ceiling, roof or structural members.

.3 Refer to Section 20 00 19 – Basic Materials and Methods for general requirements of cutting and patching Work.

.4 If any fire proofing material or insulation on building structure is damaged where mechanical equipment has been removed or added, Contractor to repair at this Division's expense.

.5 Provide fire stopping as required by code at each location where existing penetration through fire rated wall or floor assembly remains due to removal of existing piping, ductwork or other mechanical service.

1.4 USE OF EXISTING MATERIAL AND EQUIPMENT

.1 Test existing equipment which is to remain in areas being renovated for proper operation. Identify required repairs in written report to the DCC Representative.

.2 Clean, test for proper operation and repair existing equipment to be relocated before being put back into service. Identify required repairs in written report to the DCC Representative.

.3 Repair or replace, without any adjustment to the Bid Price, all existing equipment, which is damaged in the process of relocation.

.4 Unless noted otherwise provide additional equipment of the same type and manufacture where required to supplement existing equipment.

.5 Review existing equipment on site to determine operating conditions prior to Bid Submission.

1.5 **SALVAGE MATERIALS**

.1 Remove from the site all material in renovated areas of the existing building which are not to remain or be reused, unless noted as remaining the property of the DCC Representative.

1.6 **EXISTING SERVICES**

.1 Allow for all work necessary to complete the alterations, rerouting and/or repositioning of existing services and equipment, and all interconnections of new and existing systems.

.2 Verify the location and size of all existing services before proceeding with the Work.

.3 Maintain heating and cooling in the building as required to protect the building and equipment and to provide comfort conditions for the occupants.

.4 Protect all existing systems, indicated to remain, and finished new work from damage. Should any existing mechanical or electrical service, fire proofing or insulation on the building structure be damaged or interrupted by the Work carried out under the scope of Divisions 20, 22 or 23, make all required repair at no expense to the DCC Representative. Notify the DCC Representative immediately whenever an existing service was damaged.

1.7 **INTERRUPTION OF SERVICES**

.1 Maintain all mechanical services to all parts of the building which are in use. Provide temporary services as necessary.

.2 Notify the DCC Representative in writing minimum one (1) week in advance of any planned system shutdown, or as set out in the base building construction manual. Shutdowns of any portion of an existing base building system shall be performed by the building operations staff and/or coordinated with the DCC Representative in regards to time and duration. Arrange for all necessary signage to be posted. Perform shutdown of major services outside of regular working hours at the DCC Representative's request.

1.8 **FIRE PROTECTION**

.1 Maintain fire protection and life safety systems operational at all times in accordance with the governing authorities' rules and regulations.

1.9 **POWER WASHING AND VIDEOTAPING OF SANITARY SYSTEM**

.1 Power wash and videotape sanitary drainage system as indicated on plans in accordance with this Section :

.2 Coordinate and schedule with Work by plumbing trade. Power wash to remove existing drainage system debris and construction debris. Drainage systems is to be protected from debris at all times during construction.

.3 Repeat power washing and videotaping process where debris is not cleared to the satisfaction of DCC Representative.

.4 Prepare and submit the following in accordance with section 20 00 13 :

.1 Power washing report identifying level of debris encountered.

.2 Videotape confirming drainage system is clear of debris.

.3 Videotape index correlating videotape counter with drawing entry points and distance travelled through drainage system.

.4 Drawings indicating system entry points (video start points) and extent of videotaping (video stop points)

PART - 2 PRODUCTS (NOT USED)

PART - 3 EXECUTION (NOT USED)

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section 20 00 13 – Mechanical General Provisions shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 The Contractor performing the Work of Division 26 – Electrical will provide power wiring for all mechanical equipment supplied and installed under the scope of the Division 21, 22 and 23 Contract. Refer to the Division 26 – Electrical Drawings and to the Mechanical/Electrical coordination details on the Mechanical Drawings for the extent of the Electrical Work. Provide all additional power wiring and interlock wiring required for fully operational systems and equipment.

1.2 RELATED WORK

.1 The following work is provided under other Sections or Divisions of the Work:

.1 Field control wiring of local control and monitoring systems for packaged equipment: provided under the work of the respective Division under which the equipment is supplied unless otherwise specified.

.2 Power supply to Mechanical equipment and to associated control equipment: Division 26 – Electrical.

.3 Motor control centres: Division 26 – Electrical.

.4 Loose motor starters, variable frequency drives and soft starters: provided under the work of the respective Division under which the related mechanical equipment is supplied unless otherwise specified.

.5 Fused or unfused disconnects, except where specified as an integral component of the Mechanical equipment: Division 26 – Electrical.

1.3 SUBMITTALS

.1 Shop Drawings

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

.2 Submit product data for all components including technical specification data sheets for each system component, sequence of operation, wiring diagrams, control device arrangements, control device locations on floor plans to scale.

1.4 REFERENCE STANDARDS

.1 CSA C22.1 - Canadian Electrical Code

1.5 **QUALITY ASSURANCE**

.1 Provide electrical and electronic equipment which is CSA approved where such approval is required by the authorities having jurisdiction.

.2 Conduit and wiring materials and methods shall be in strict accordance with the requirements of Division 26 – Electrical and the applicable provincial and federal electrical codes and standards.

PART - 2 PRODUCTS

2.1 **WIRING AND CONDUIT**

.1 Conduit and wiring materials shall be in strict accordance with the requirements of Division 26 – Electrical and the applicable provincial and federal electrical codes and standards. Consider this Specification as minimum requirements.

.2 Wire

.1 RW-90 X-link type, 1000V insulation for 600 Volt systems and 600V insulation for 120/208 Volt systems, installed in conduit, sized to carry 125% of full load running current in accordance with the applicable Electrical Code.

.2 Minimum No. 12 AWG for power

.3 Colour coded No. 14 AWG for control power, 120VAC and lower

.4 Individually identify conductors on each end with slip-on, plastic wire markers. Identification to match wiring diagrams.

.3 Conduit

.1 Electrical metallic tubing (EMT):

.1 Up to 32mm size in ceilings, furred spaces, in hollow walls and partitions and where not exposed to mechanical injury.

.2 Rigid galvanized steel:

.1 38mm size and larger.

.2 Sized to suit service where located in poured concrete.

.3 For inverter duty:

.1 Liquid tight, flexible metal conduit and cable specifically manufactured for this duty;

.2 Voltage rating: nominal 1000 V, and voltage spikes to 2000 V;

.3 Three (3) phase and three (3) ground conductors.

.4 Standard of Acceptance

.1 NEXANS

.2 LAPP USA

.3 ShowCor – Shawflex

.4 Rockbestos-Suprenant Cable

.4 Grounding:

.1 Provide insulated green bonding conductor in each power and control conduit sized per the applicable Electrical code. Minimum bonding conductor size #12AWG copper.

.5 Mineral Insulated Copper Cable (MICC):

.1 ULC listed 2 hour fire rating;

.2 Shipped with ends temporarily sealed and stored under dry conditions;

.3 Terminated using suitable terminating hardware;

.4 VC jackets for embedded cables.

.5 Standard of Acceptance

.1 Pyrotenax

PART - 3 EXECUTION

3.1 GENERAL

.1 Electrical materials, equipment and installation procedures shall conform to the requirements of the applicable Electrical code.

.2 Wiring methods and standards shall conform to those specified under the Division 26 - Electrical Specifications.

3.2 POWER CONDUIT AND WIRE

.1 Provided under the scope of the Mechanical Work:

.1 Power wiring from loose starters, variable frequency drives, soft starters and loose disconnects to mechanical equipment including termination and final connection.

.2 Line voltage thermostats, and wiring from thermostat to equipment, including termination and final connection.

.3 Hardwire interlock wiring between control devices (pressure switches, temperature switches, limit switches) and motor starters, including termination and final connection.

.2 Provided under the scope of Division 26 - Electrical:

.1 Power wiring ato packaged equipment, to loose starters, variable frequency drives, soft starters and loose disconnects, including termination and final connection.

3.3 CONTROL CONDUIT AND WIRE

.1 Provided under the scope of the Mechanical Work:

.1 Control wiring, conduit and relays to interlock starters and connect safety and operating controls.

.2 Provided under the scope of Division 26 - Electrical:

.1 Fan shut-down and start-up relays and wiring for operation by the Fire Alarm System

.2 Thermostats and wiring for electric heaters

3.4 **GROUNDING**

.1 Ground electrical equipment and wiring in accordance with the local authority's rules and regulations.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section 20 00 13 – Mechanical General Provisions shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 Provide contactors and control devices for packaged equipment supplied under the scope of Divisions 22 and 23.

1.2 SUBMITTALS

.1 Shop Drawings

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

.2 Submit product data for contactors and control devices.

1.3 QUALITY ASSURANCE

.1 Read together with the Division 26 – Electrical Specification and adhere to its requirements. Supply and install all electrical apparatus that is required for a complete installation of the Mechanical Work and is not covered under the Work of the Division 26 – Electrical Contractor.

PART - 2 PRODUCTS

2.1 NOT APPLICABLE.

PART - 3 EXECUTION

3.1 CONTACTORS AND CONTROL DEVICES

.1 Install all automatic devices such as thermostats, controlling electrical equipment, supplied under the scope of the Division 22 and 23 Contracts.

.2 Disconnect switches, starters, push button stations, cable lugs, pilot lights, and control circuit transformers shall be supplied and installed under the scope of the Division 26 – Electrical Contractor, except as detailed in the diverse Sections of the Division 21, 22 and 23 Specifications, and as noted below.

.1 The Contractors performing the Work of Divisions 21, 22 and 23 shall provide all starters, contactors, fuses, and equipment-mount pre-wired non-fused service switches as part of packaged equipment such as chillers, boilers, domestic hot water heaters, rooftop heating and air conditioning units, electric heating coils, computer room air conditioning units, as specified under their respective Sections. The Division 26 – Electrical Contractor will provide fused, remote disconnect switches for these equipment as required by the applicable provincial and federal electrical code.

.2 Provide the Division 26 – Electrical Contractor certified shop drawings for all motors and other equipment requiring line voltage power connection, supplied as part of the Mechanical Work, in support of selection of overload protection and sizing of power wiring.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section 20 00 13 – Mechanical General Provisions shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 Furnish and install bases, hangers and support for mechanical equipment and piping, all installed under the respective Sections' scope of Divisions 20, 22and 23.

1.2 RELATED WORK

.1 The following work is provided under other Sections or Divisions of the Work:

.1 Ductwork hangers: Section 23 31 00 - Ducts and Casings

1.3 SUBMITTALS

.1 Shop Drawings

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

.2 Hangers, supports, anchors, guides, and restraints shall be selected to withstand all static and dynamic loading conditions which act upon the piping system and associated equipment.

.3 Submit layout drawings showing types and placement of manufactured, pre-fabricated roof support systems. Submit details for roofing pad anchoring to roof structure.

.4 Submit a detailed design for anchors, guides, and their proposed connection to the structure, including reaction forces and loads imposed on structure prepared in conjunction with the expansion joint manufacturer. All drawings must be sealed by a professional engineer licensed in the project location jurisdiction.

.5 Provide the services of the professional engineer who sealed the custom trapeze hanger shop drawings to conduct a general review of the completed installation on site. Engineer to submit a report summarizing their findings to the DCC Representative.

1.4 REFERENCE STANDARDS

.1 ASME B31.1 – Power Piping

.2 ASME B31.9 – Building Services Piping

.3 ANSI/MSS SP 58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation.

.4 ASTM A780 - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

.5 AWS D1.1 – Structural Welding Code, Steel

.6 CAN/CSA-S16.1 - Limit States Design of Steel Structures.

.7 CAN/CSA-G40.20/G40.21 - General Requirements for Rolled or Welded Structural Quality Steel.

.8 CSA W47.1 - Certification of companies for fusion welding of steel.

.9 CSA W48.1 - Filler metals and allied materials for metal arc welding.

.10 CSA W59 - Welded Steel Construction (Metal Arc Welding).

.11 CSA W117.2 - Safety in welding, cutting, and allied processes.

PART - 2 PRODUCTS

2.1 GENERAL

.1 Hangers, supports, sway braces, to be made up from stock or production parts, manufactured and fabricated in accordance with ASME B31.1, ASME B31.9 and ANSI/MSS SP-58.

.2 Select elements of pipe support systems to provide adequate factors of safety under loads applied by gravity, by temperature induced expansion and contraction, by internal pressure in mechanically jointed plain end pipe, and by change of momentum in fluid flow.

2.2 QUALITY CONTROL

.1 Pipe support products shall be selected from manufacturers' standard product line.

.2 Model designations from the manufacturers' catalogues noted in this Section are used to establish the quality standard and construction details permitting assessment of products from other manufacturers.

.3 Standard of Acceptance

.1 Hangers:

.1 Anvil

.2 Myatt

.3 Taylor

.4 Carpenter & Paterson

.5 Pentair/Erico

.6 Eaton B-Line

.2 Insulation shields:

.1 Anvil

.2 Myatt

.3 Taylor

.4 Pipe Shields Inc.

2.3 **HANGERS**

.1 Horizontal pipe support – suspended

.1 Hot or cold suspended piping, including conduits, where horizontal movement is 25 mm or less and the hanger rod is longer than 300 mm.

.1 Clevis hanger – steel pipe

.1 Standard weight carbon steel clevis hanger with level adjustment and locknut, manufactured to ANSI/MSS SP 58 Type 1, equivalent to Anvil Figures 260 and 300. For Figure 260, provide clevis bolt spacer on insulated piping. Size hanger to include insulation thickness.

.2 For uninsulated fire suppression piping use standard weight galvanized carbon steel swivel ring hanger manufactured to ANSI/MSS SP 58 Type 10, ULC and FM approved, equivalent to Anvil Figure 69.

.2 Clevis hanger – copper pipe and tubing

.1 Light weight carbon steel epoxy-coated clevis hanger, with level adjustment and locknut (double bottom locknut), up to and including 100mm pipe dia. manufactured to ANSI/MSS SP 58 Type 12, equivalent to Anvil Figure CT-65.

.2 For copper tubing up to and including 25mm dia. use light weight carbon steel epoxy-coated swivel ring hanger manufactured to ANSI/MSS SP 58 Type 10, equivalent to Anvil Figure 97C.

.2 Suspended hot steel or copper piping having horizontal movement in excess of 25 mm or hot steel piping with hanger rod 300 mm or less.

.1 Roller hanger

.1 Shall be adjustable trapeze or yoke style roller type, 2-rod hanger with locknuts manufactured to ANSI/MSS SP 58 Type 41, equivalent to Anvil Figure 177 or 171 as applicable.

.2 Rollers of sufficient width to clear the outside diameter of the insulation on the piping.

.3 Support rollers at both ends, either by a yoke, swivel type hanger or by two adjustable rods with locknuts (double locknuts).

.4 On trapeze hangers and where pipe is supported from below, use adjustable pipe roller stand manufactured to ANSI/MSS SP 58 Type 46, equivalent to Anvil Figure 275.

.2 Horizontal pipe support – bottom supported

.1 Hot and cold, steel and copper piping.

.1 Adjustable pipe roller stand manufactured to ANSI/MSS SP 58 Type 44, equivalent to Anvil Figure 271.

.3 Hanger rod

.1 Carbon steel, machine threaded rods

.1 Galvanized finish in mechanical rooms and in areas exposed to outdoors.

.2 Black steel finish in all other areas.

.2 For vertical adjustment of hanger rods, use forged steel turnbuckle manufactured to ANSI/MSS SP 58 Type 13, equivalent to Anvil Figure 230.

.4 Upper Attachments

.1 Beam clamps

.1 For pipes 12mm to 50mm, bottom side attachment to standard I, M or W beams where thickness does not exceed 19mm, use malleable iron C-Clamp manufactured to ANSI/MSS SP 58 Type 23, ULC listed, equivalent to Anvil Figure 86. Maximum load 180 kg.

.2 For pipes 12mm to 50mm, top side attachment to standard I, M or W beams where thickness does not exceed 15mm, use malleable iron C-Clamp with zinc plated retaining clip manufactured to ANSI/MSS SP 58 Type 23, ULC listed, equivalent to Anvil Figure 86/89X. Maximum load 180 kg.

.3 For pipes 65mm to 200mm (to 100mm for FM approved applications), attach hanger rod centered under beam flanges using malleable beam clamp with steel tie rod and nuts manufactured to ANSI/MSS SP 58 Type 30, ULC listed, equivalent to Anvil Figure 218. Maximum beam width 178mm, maximum flange thickness 15mm. For FM approved application, use in combination with Figure 157 extension piece. Maximum load 619 kg.

.4 For pipes 65mm to 200mm, for centered support under beam flanges with beam width in excess of 178mm, and for pipes 150mm to 200mm in FM approved applications, use heavy duty carbon steel beam clamp with spacer, bolt and nuts manufactured to ANSI/MSS SP 58 Type 21, ULC listed and FM approved, equivalent to Anvil Figure 134. Maximum load 1,360 kg.

.5 For pipes 250mm and larger, provide supplementary steel members supported from structural steel.

.6 For cold pipes NPS 2 and under, supported from steel joists use carbon steel washer plates with double locking nuts, equivalent to Anvil Figure 60.

.7 For cold pipes NPS 2-1/2 and larger and for hot pipes, supported from steel joists use carbon steel washer plates with double locking nut, carbon steel clevis and malleable iron socket.

.2 Concrete clevis plates (existing concrete)

.1 Carbon steel plate with clevis and malleable iron socket and expansion case and bolt with minimum of two expansion cases and bolts for each hanger, equivalent to Anvil Figure 49. Used in conjunction with forged steel weldless eye nut manufactured to ANSI/MSS SP 58 Type 17, equivalent to Anvil Figure 290, or with carbon steel welded eye rod, equivalent to Anvil Figure 278.

.2 Do not use explosive driven anchors.

.3 Self-drilling expansion type concrete inserts

.1 To secure miscellaneous equipment and materials to masonry or concrete construction already in place.

.2 Of sufficient number and size to prevent concrete from breaking away.

.3 Standard of Acceptance

.1 ITW

.2 Tapcon

.3 Hilti

.5 Insulation Protection

.1 Insulation saddle, to be welded to pipe.

.1 Manufactured to ANSI/MSS SP 58 Type 39A and 39B, equivalent to Anvil Figure 160-165 as applicable.

.2 Insulation shields.

.1 Shop fabricated or manufactured plates of size required to properly fit the outside diameter of the pipe insulation, manufactured to ANSI/MSS SP 58 Type 40.

.2 Equivalent to Anvil figure 167, modified with holes at each end to suit 12mm wide stainless steel band clamps.

.3 Shop fabricate bearing plates conforming to the following table for various pipe sizes:

Pipe Size mm	Length of Plate mm	Thickness of Plate mm
12 to 50	300	1.2
75 to 100	300	1.52
150	450	1.52

.4 Form the bearing plates to the O.D. of the adjoining pipe insulation and extend the plate up to the horizontal centre line of the pipe.

2.4 **PIPE SUPPORT**

.1 Vertical pipe support

.1 Steel or cast iron pipe

.1 Floor supported carbon steel riser clamp manufactured to ANSI/MSS SP-58 Type 8, ULC listed, field-welded pipe lugs, equivalent to Anvil Figure 261.

.2 Suspended carbon steel riser clamp manufactured to ANSI/MSS SP-58 Type 42, ULC listed, 4- or 6-bolt construction, field-welded pipe lugs, equivalent to Anvil Figure 40.

.2 Copper pipe

.1 Carbon steel, copper plated riser clamp manufactured to ANSI/MSS SP-58 Type 8, equivalent to Anvil Figure CT-121.

.2 Pipe Guides

.1 Outer hinged housing with sliding spider clamp, carbon steel, equivalent to Anvil Figure 256.

PART - 3 EXECUTION

3.1 GENERAL

.1 Provide supports required for the erection and support of the mechanical Work. Construct supports of steel, masonry or concrete, as noted or required. Ensure that steel supports in contact with water or high humidity are galvanized, with members bolted together using cadmium plated bolts, and all other support is made of primed steel.

.2 Cut, drill, and fit miscellaneous metal fabrications for pipe anchors and equipment supports. Comply with AWS D1.1 for procedures of manual shielded metal-arc welding, appearance and quality of welds made, methods used in correcting welding work. Grind smooth welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours. Read Division 05 – Metals, for further information.

.3 Support or suspend piping with necessary hangers, structural supports and/or brackets, to prevent sagging, warping and vibration and to allow for movement due to expansion and contraction.

.4 Install building attachments within concrete or to structural steel. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping.

.5 In steel framed construction, support piping from structural members. Where structural members are not suitably located for upper hanger attachments and inserts of adequate capacity cannot be installed in floor slabs over, provide supplementary steel framing members fabricated as specified for trapeze hangers, mechanically fastened to structural steel. The used of diagonal hangers which will induce lateral stresses in the chord members of the joist is not permitted.

.6 Do not allow loads of any nature to be transmitted through the piping connections to equipment not specifically designed for such loads.

.1 Where flexible connections are not called for at connections to equipment, support the pipe by stands attached to both pipe and supporting structure so that force in any direction is not transmitted to the equipment.

.7 Do not use explosive drive pins in any section of the Work without obtaining prior approval from the DCC Representative.

3.2 HANGER INSTALLATION

.1 Support hangers directly from the structure only. Do not support pipes or equipment from other pipes, ducts, equipment, suspended ceiling, unless specifically shown on the Drawings.

.2 Suspend hanger rods generally from certified inserts in concrete or by beam clamps. Before welding to steel structure members obtain prior permission of welding method from the DCC Representative and ensure that loads do not exceed the limit set by the DCC Representative. Ensure that hanging from floors and roofs made from pre-cast concrete members is from inserts originally cast into the members and provided by the Division 22 or 23 Contractor, or by rods passing between the members connected to a steel plate resting on the upper surface. To prevent raising of the hanger rod, install a lock nut and a minimum 50mm dia. flat washer tight against the under surface of the precast material.

.3 Sliding guides must have sliding surfaces cleaned of all dirt, paint or corrosion and, except for Teflon, have coating of graphite paste added during erection. Adjust guides to allow for free sliding at operating conditions. After assembly, provide these guides with temporary protective cover or wrapping added to keep them free of debris during extent of construction work. When piping is ready to be put into service, remove this protective covering, blow out guides clean of all debris and add paste where applicable. Care must be taken that ample clearance is provided so as not to obstruct free sliding of guide.

.4 Install copper, brass, and stainless steel pipes with 3mm thickness of di-electric packing between the pipe and the pipe attachment or use special pipe attachments specific for that service.

.5 Install guides on pipes with expansion movement next to expansion joints. Consult with the expansion joint manufacturer and follow his instructions for number and spacing of guides. Use a minimum of two guides on each side of expansion joints.

.6 Set hanger rods on steel and copper lines with expansion movement out of plumb in ambient temperature position, a distance equal to one-half pipe movement calculated from anchor point. Base movement on 25mm expansion per 30m of pipe length and 37°C temperature difference. Use toggle type insert for beam clamp for such locations.

.7 Use roller type hanger only where shown on the Drawings or as described in this Specification.

.8 Install all hangers close to points where pipes change direction or where branch piping drops or rises from main.

.9 Install vertical riser suitably anchored and guided with manufactured or fabricated guides to maintain accurate vertical position. Protect insulated pipes with 2.2mm galvanized steel jacket at guides. Guide pipes with expansion movement and definite anchor points up to and including 100mm sizes, at every floor or 3m. Guide larger pipes and vertical cast iron pipes at every second floor or 7.5m.

.10 For horizontal cast ironor polypropylene pipes where packed or friction type mechanical joints are used, provide a support at every joint in straight runs with maximum 1.5m between supports. Where fittings are joined together (elbows, wyes, etc.) provide a separate support for a minimum of every second fitting.

.11 For horizontal cast iron, pipes where screwed or bolted type joints are used, the spacing or supports may be increased not to exceed 2.4m between supports, but provide a support for every joint and every second fitting as described above.

.12 Use lockwasher with single nut on all bolted connections for pipe supports, anchors, guides and support steel, or use double nuts. Adhere fastening nuts, including top and bottom load nuts, and clevis bolt nuts, to threaded rods or fittings with Loctite 242.

.13 During hydrostatic test on all air and vapour piping supported by springs or counterweights, install temporary rigid supports, blocking, or lock the spring against movement to prevent excessive strain on piping or equipment.

.14 Place hangers and supports close to fittings, elbows, valves and/or other heavy parts.

.15 Place suitably dampened spring hangers at the first three supports from the equipment connection on piping subject to excessive movement or shock from any source, thermal expansion and contraction.

.1 Where it is evident that no undue loads will be transmitted to the equipment by the system concerned, i.e. small bore connections to comparatively large equipment, cold service piping not subject to shock, etc., then spring hangers may be omitted and standard hangers used.

3.3 **HANGER SELECTION**

.1 Select lower attachment and insulation protection based on the following, unless otherwise shown on drawings:

Pipe Size NPS	Operating Temperature		
	Less than 21°C	Between 21°C and 43°C	Greater than 43°C
	Insulated	Non-insulated	Insulated
2 and less, steel	Clevis and Shield	Clevis only	Clevis
2-½ to 6, steel	Clevis and Shield	Clevis only	Roller and Saddle
½ to 4, copper	Clevis and Shield	Clevis	Clevis and Shield, or Roller and Shield

.2 Install temporary spacers between the insulation shield and the pipe equal to the thickness of insulation specified. Refer to Section 20 07 19 – Piping Insulation.

.3 Do not use pipe hooks, chains, or perforated straps.

3.4 **SADDLES AND ROLLER SUPPORTS**

.1 Place saddles at roller supports for steel pipes as specified above.

.2 Weld saddles to black or galvanized steel piping.

.3 Refinish galvanized surfaces destroyed by the welding with a zinc rich paint equivalent to W.R. Meadows "Galvafroid", Kerry Industries "ZRC" or Niagara Paint Inc. "PL052898".

3.5 **INSULATION SHIELDS**

.1 Place insulation shields at pipe supports as specified above.

.2 Field or factory punch a hole at each end of the shield to allow a 12mm stainless steel band clamp to pass through opening.

.3 Secure shields with two 12mm stainless steel band clamps per shield.

3.6 **HANGER SPACING**

.1 Horizontal runs of plumbing and drainage piping shall be supported as per the hanger spacing requirements described in the National Building Code.

.2 Place additional hangers in locations where there are concentrated loads such as valves, specialties, etc.

.3 Hanger spacing - black steel and galvanized pipe

.1 For horizontal runs of black or galvanized steel pipe, other than for plumbing service, the maximum distances between supports and with minimum diameter rods shall be as follows. Exception: fuel oil, natural gas, propane, and medical gas piping.

Pipe Size mm	Rod Size mm	Spacing	
		Water Service m	Steam or Air m
12	10	1.5	1.5
20	10	1.8	2.1
25	10	2.1	2.7
32	10	2.1	2.7
40	10	2.7	3.6
50	10	3.0	3.9
65	12	3.0	4.2
75	12	3.6	4.5
100	16	4.2	5.0
150	19	5.0	6.4

.4 Hanger spacing - copper and stainless steel tubing

.1 For horizontal runs of copper and stainless steel tubing for services other than plumbing, the maximum distances between supports and with minimum diameter rods shall be as follows. Exception: fuel oil, natural gas, propane, and medical gas piping.

Pipe Size mm	Rod Size mm	Spacing	
		Water Service m	Steam or Air m
Up to 20	10	1.5	1.8
25	10	1.8	2.4
32	10	2.0	2.7
40	10	2.4	3.0
50	10	2.4	3.3
65	12	2.7	3.9
75	12	3.0	4.2
100	16	3.6	4.8

.5 Hanger spacing – cast iron pipe

.1 Horizontal cast iron piping shall be supported with the following maximum horizontal spacing and minimum hanger rod diameters:

Pipe Size mm	Rod Size mm	Spacing m
40	10	1.5
50	10	1.5
65	12	1.5
75	12	1.5
100	16	1.5

.2 Provide hangers within 450 mm of each joint, at each change of direction, and within 450 mm of the terminal end of each pipe run.

.6 Hanger spacing and hanger rod diameter for steel or copper flexible joint roll groove pipe to be as shown in the tables above for appropriate pipe material with not less than one hanger between joints, and with anchors and guides located to maintain piping true to line and grade.

.7 Do not restrain axial movement.

.8 Spacing shown is based on fluids with specific gravity of 1.0 and 26°C. For other conditions, use other published data approved by the DCC Representative.

.9 For all drain pipe installed under structural slab on disturbed soil (up fill), suspend piping via galvanized clevis hangers embedded in the structural slab. Hanger spacing shall be per pipe manufacturer recommendations, maximum 1.5 m, with minimum of two (2) hangers per pipe length.

3.7 **VERTICAL PIPING SUPPORT**

.1 Support vertical plumbing and drainage piping to meet the requirements of the National Building Code, unless more stringent requirements are specified herein.

.2 Vertical support spacing:

.1 Cast iron soil pipes: at every floor with riser clamps, or maximum at every 3m.

.2 PVC and CPVC pipes: at every 1.2m.

.3 Other piping: at every floor with riser clamps or maximum at every 3.6m, unless otherwise required by expansion conditions or otherwise specified.

.3 Support bottom of risers with base fitting set on concrete pier or by hanger located at top of riser pipe as close to riser as possible.

.4 Install riser clamps bolted securely to pipes. Rest ends of clamp on the pipe sleeve or on the floor. Weld shear lugs to steel pipe to transfer load to riser clamp. Solder cut segments of copper tubing to the copper pipe to prevent slippage of riser through the copper riser clamps.

.5 Stabilize vertical piping laterally by fabricated brackets or malleable iron, extension type split hangers.

.6 Run vertical piping at columns in the column webs, on either or both sides of the column, unless otherwise directed by the DCC Representative.

3.8 **ANCHORS AND GUIDES**

.1 Use anchors where shown on the Drawings and/or as required to maintain permanent location of pipe lines.

.2 Take special care in locating anchors to avoid introduction of undue reaction forces into the structure of the building, to flanges of pumps and equipment, to expansion joints and to the pipe.

.3 Construct anchors for steel or galvanized pipe of approved steel straps and/or rods.

.4 For anchoring copper lines, use copper plated anchors, or use insulation bands between tubing and clamps if steel straps or rods are used.

.5 Provide minimum two (2) pipe guides on each side of an expansion joint or expansion compensator. Maintain 1200mm between each guide, and not more than 900mm between the last guide and the start of expansion joint or expansion compensator.

.6 For special expansion joint/compensator or for special applications, where more than two guides on each side are required, follow manufacturer's recommendations for the location of guides.

.7 Where guides are installed on cold piping, provide thermal break to prevent sweating.

.8 Do not proceed with the installation of guides and anchors until after receipt of reviewed shop drawings.

3.9 **INSERTS**

.1 Install inserts required for the attachment of hangers for suspensions of piping, ductwork or equipment. Size and space inserts for the loads to be supported.

.2 Set inserts for pipes and equipment hangers onto formwork prior to pouring of concrete. Provide a 200mm length of rebar and wire through insert. Secure inserts firmly to formwork before concrete is poured.

.3 In mechanical rooms, and other areas of multiple pipe runs:

.1 Provide continuous type insert channels at 1800mm intervals along the route of piping.

.2 Provide a 200mm length of rebar and wire through insert.

.4 Supply inserts and location drawings for precast concrete to the precast supplier for casting into the material. Otherwise, include the cost of having the precast concrete supplier install the inserts at the Site in the Contract price.

.5 For piping or equipment supported from existing concrete construction or from masonry drill and install threaded or expansion type inserts.

.6 Do not install inserts into metal pan floor slab decking.

3.10 **MISCELLANEOUS STEEL**

.1 Hang or support equipment, piping, ductwork with miscellaneous structural supports, platforms, braces as may be required unless Drawings or other Sections of the Specification state otherwise.

.2 Construction:

.1 Welded construction wherever practicable.

.2 Chip welds to remove slag, and grind smooth.

.3 Bolted joints allowed for field assembly using high strength steel bolts.

.3 Painting and cleaning

.1 Clean steel to Steel Structures Painting Council SSPC-SP6, Commercial Blast Cleaning requirements.

.2 Apply one coat of oil alkyd primer conforming to CISC/CPMA 2-75 - Quick-drying Primer for Use on Structural Steel, to all miscellaneous steel.

.3 In the field, touch up all bolt heads and nuts, previously unpainted connections and surfaces damaged during erection with primer as hereinbefore specified.

.4 Apply two coats of primer to all surfaces which will be inaccessible after erection.

.5 Thoroughly remove all foreign matter from steelwork on completion of installation.

3.11 **SET-UP AFTER INSTALLATION**

.1 Adjust hangers to equalize hanger loads, to support piping true to line and grade, and to minimize loads transferred through connections to equipment and outlets.

3.12 **COMPLETION**

.1 Immediately after erection of anchors and supports, clean welds and paint exposed areas with a rust inhibitive paint.

.2 Apply paint by brush to provide a minimum dry film thickness of 2.0 mils.

.3 For galvanized surfaces clean welds, bolted connections and abraded areas; apply galvanizing repair paint to comply with ASTM A780.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section 20 00 13 – Mechanical General Provisions shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 Furnish and install permanent nameplates for mechanical equipment, valve tags, identification for piping and ductwork, all installed under the scope of Divisions 20, 22, 23 and 25.

1.2 SUBMITTALS

.1 Shop Drawings

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

.2 Submit schedule of Equipment Identification Nameplates, including proposed wording.

.3 Submit Valve Directory and Chart including quantity, size, location, purpose and normal operating position (opened or closed) for each valve.

.4 Provide a list of all systems to be labelled with hazardous warning symbols.

.2 Samples

.1 Submit samples of equipment, piping, valve and ductwork identification markers.

1.3 REFERENCE STANDARDS

.1 CAN/CGSB-24.3 - Identification of Piping Systems.

.2 ANSI/ASME A13.1 - Scheme for the Identification of Piping Systems.

.3 CSA Z7396.1 - Medical Gas Pipeline Systems

.4 NFPA 13 - Installation of Sprinkler Systems

.5 NFPA 25 - Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

PART - 2 PRODUCTS

2.1 MATERIALS

.1 General

.1 Manufactured identification systems:

.1 Laminated vinyl or polyester

.2 Resistant to chemicals and ultraviolet light

.3 Minimum ambient temperature: -25°C

.4 Maximum ambient temperature: 121°C

.2 Equipment Nameplates

.1 Laminated phenolic plastic, 75mm x 50mm, with minimum 10mm high letters:

.1 Black lettering on white background for equipment on 'Normal' power supply

.2 White lettering on red background for equipment on 'Emergency' power supply

.2 Three rows of text, based as shown in equipment Schedules.

.1 Line 1: Equipment ID (e.g. P-1)

.2 Line 2: Equipment Name (e.g. Northwest Zone Heating Pump)

.3 Line 3: Optional, up to 15 characters (e.g. Standby Pump)

.3 For multiple equipment with the same identification number, located in the same space and performing the same service, use additional identifier such as letters or sub numbers.

.4 This identification is in addition to manufacturers' nameplate data.

.3 Ductwork Identification

.1 Painted stencil lettering: 50 mm high.

.2 Paint colour:

.1 Black paint on insulated ductwork with canvas cover or other, light coloured jacketing.

.2 White paint on insulated ductwork with metal cover or other dark coloured jacketing.

.3 White paint on uninsulated ductwork

.3 Two levels of text in accordance with designations shown on Schedules:

.1 Level 1: Abbreviated name of air handling system for supply systems (e.g. AHU-1), or fan number for exhaust or ventilation only systems (e.g. F-1)

.2 Level 2: System name (e.g. General Supply)

.4 Direction arrows: 65 mm high

.4 Pipe Identification – Adhesive Labels

.1 Pre-printed 6 mil thick vinyl cloth, plastic coated with pressure sensitive self-adhesive backing surface. On insulated pipe, use adhesive suitable for this application.

.2 Applicable WHIMS pictogram for identification of material hazard.

.1 Pipe diameter (including insulation) 75 mm or less: 29 mm width, 25 mm high lettering. Length of labels as dictated by legend.

.2 Pipe diameter (including insulation) greater than 75 mm: minimum width of 64 mm and with 50 mm high letters.

.3 Primary label colour: to CAN/CGSB-24.3 and ANSI/ASME A13.1.

.4 Legend: Black capitals to sizes and colours listed in CAN/CGSB24.3

.3 Direction arrow to show flow

.4 Outside pipe diameter 75mm or less: 100mm long x 50mm high.

.5 Outside diameter pipe or insulation 75mm and greater:150mm long x 50mm high.

.6 Materials for background colour marking, legend , arrows:

.1 Pipes and tubing 20mm and smaller: waterproof and heat resistant pressure sensitive plastic marker tags.

.2 Other pipes: pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100%RH and continuous operating temperature of 150C and intermittent temperature of 200C.

.7 Colours and legends:

System	Legend (text and background colour)
Sanitary Drainage	Drainage Sanitaire / Sanitary Drainage
Vent	Event / Vent
Condensate Drain	Drain Condense / Condensate Drain
Chilled Water supply	ALIM. EAU REF / CH. Water Sup.
Chilled Water Return	Ret. EAU REF. / CH. Water Ret.
Hot water heating supply	ALIM. EAU Chauf / Heat Water Sup.
Hot water heating return	Ret. EAU De Chauf / Heat Water Ret.
Domestic hot water supply	EU Chaude Dom. / Dom. Hot Water
Domestic hot water recirculation	Recirc. EAU Chaude Dom. / Dom.Hot Water Recirc
Domestic cold water supply	EAU Froide Dom. / Dom. Cold Water

.5 Pipe Identification – Coil Wrap Labels

.1 Reversible direction, semi-rigid plastic vinyl, with subsurface printing, and integral direction arrows.

.2 Applicable WHIMS pictogram for identification of material hazard.

.1 Up to 150mm diameter: coil wrap six rows of printing

.2 Over 150mm diameter: saddle type with two rows of printing, fastened with stainless steel springs

.3 Lettering Size:

Outside Dia.	Letter Height
Less than 19mm	6mm
19mm – 29mm	12mm
31mm – 35mm	19mm

63mm – 114mm	31mm

.4 Primary label colour: to CAN/CGSB-24.3 and ANSI/ASME A13.1.

.5 Pipe label to include service pressure for steam, compressed air, natural gas (if more than one gas service pressure inside of building), and vacuum.

.6 Legend: black with the legend printed in full wherever feasible.

.6 Standard of Acceptance:

.1 Brady

.2 Grainger

.3 S.M.S

.4 Seton

.5 Craftmark

PART - 3 EXECUTION

3.1 GENERAL

.1 Pipe and valve identification classification colour coding and service identifiers to be in accordance with CAN/CGSB-24.3 and ANSI/ASME A13.1, and with CSA Z7396.1 for medical gas service.

.2 Use existing coding system for building additions and alterations.

3.2 INSTALLATION

.1 Equipment Nameplates

.1 Identify nameplates describing the function or use of the particular equipment involved, including the identification number as provided by the DCC Representative.

.2 Do not commence fabrication of nameplates until after receipt of DCC Representative's review.

.3 Equipment includes but not limited to:

.1 Equipment as shown on schedules and specified

.2 Motor starters

.3 Pushbutton stations

.4 Control panels

.5 Disconnect switches

.6 Contactors or relays in separate enclosures

.4 Securely fasten nameplates to the equipment with round-head cadmium plated steel self-tapping screws where possible, or with double sided adhesive tape.

.5 Locate nameplates to be easily read.

.6 Do not paint over equipment manufacturers' or field installed nameplates.

.7 Provide standoffs on insulated equipment.

.8 Documented as follows (example given):

Equip.Type	Equip. #	Bldg #	Bldg Section	Floor #	Column #
(AHU)	(01)	(10)	(EAST)	(2)	(C10)
Section 1	|	Section 2		|	Section 3

.1 Label sections will be separated by dots:

.1 Sample: AHU01.10E2.C10

.2 Equipment types:

.1 SAF = Supply Fan

.2 RAF = Return Fan

.3 EXF= Exhaust Fan

.4 A/C=Split System Airconditioning

.5 P = Pump

.6 SP= Sanitary Pump

.2 Ductwork Identification

.1 Label ductwork to indicate the content and direction of flow.

.2 Locate labels as follows:

.1 Within 1.5 m of air handling units and free standing fans.

.2 Within 3 m of divisions in exposed ductwork.

.3 On each exposed duct passing through a wall, partition or floor (one on each side of such wall, partition or floor).

.4 At intervals not to exceed 15 m along every exposed duct run exceeding 15 m in length.

.5 On vertical exposed ducts at 1.8m above floor.

.6 On every concealed duct where it enters a floor area that it serves.

.3 Labels to be visible from 1.5 m above the adjacent floor or platform.

.4 Clean surfaces with a trisodium phosphate solution before application of paint. Stencilling to be performed in a neat, quality manner. Upon completion of the project, hand over one complete set of stencils used to the DCC Representative.

.3 Piping Identification

.1 Label all piping installed as part of the Mechanical Work to indicate the content and direction of flow.

.2 Locate labels as follows:

.1 At every end of pipe run, adjacent to the valve or item of equipment serviced.

.2 At valves, tees and changes of direction.

.3 On each exposed pipe passing through a wall, partition or floor (one on each side of such wall, partition or floor).

.4 At intervals not to exceed 15 m along every exposed pipe run exceeding 10m in length.

.5 On vertical exposed pipes at 1.8m above floor.

.6 At every access point on concealed piping.

.3 Labels to be visible from 1.5 m above the adjacent floor or platform.

.4 Adhesive Labels:

.1 Clean surfaces before application of labels.

.2 Secure label with direction arrow banding tape for full circumference of pipe, at each end of label.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section 20 00 13 – Mechanical General Provisions shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 Performance testing plumbing and ventilating, air conditioning systems;

.2 Survey of installed automatic controls and verification of functional performance;

1.2 RELATED WORK

.1 The following Work is provided under other Sections or Divisions of the Work:

.1 Factory testing and calibrating of equipment and control systems: reference each Specification Section for specific requirements.

.2 Testing and checking of equipment provided as part of the Work of other Divisions' Contractors, except where such equipment forms an integral part of the mechanical systems.

1.3 QUALITY ASSURANCE

.1 Use factory trained representatives and submit manufacturer's check sheets for starting all systems and equipment.

.2 Testing and certification of each backflow prevention device shall be by a "Certified Cross Connection Control Specialist". One copy of the certificate to be submitted to the municipal water department, and one copy is to be inserted into each O&M manual.

.3 Prior to the starting, testing, balancing, adjusting, and cleaning processes, verify with the DCC Representative any tests required to be witnessed. Provide sufficient notice to the DCC Representative prior to the commencement of the procedures.

.4 The DCC Representative shall be allowed to witness any testing, adjusting, starting, balancing, and cleaning procedure.

.5 Assume all costs associated with the starting and testing, including the supply of testing or cleaning medium, and potable water and fuel consumed.

.6 Prior to starting any equipment or systems, secure and review manufacturer's installation, operation, and starting instructions. Read in conjunction with the procedures defined in this Section.

.7 Use the equipment manufacturer's personnel for start-up where required by the manufacturer to ensure the integrity of the manufacturer's warranty.

.8 Compare final equipment installation to the published manufacturer's installation details and record discrepancies. Items potentially detrimental to equipment performance shall be corrected prior to starting of the equipment.

.9 Some processes involved in the starting procedures defined in this Section may be a duplication of authorities' verification. To facilitate expedient completion of the Project, arrange for authorities to assist or witness these procedures.

.10 All starting and testing procedures shall be performed in accordance with the applicable ASME, ASHRAE, CAABC, CSA, NFPA, SMACNA, ASTM, ASPE, NEEB, AWWA standards, and as required and outlined in these Specifications.

.11 Personnel involved in the starting, testing, balancing and adjusting procedures shall be experienced in the installation and operation of mechanical equipment and systems being checked, and shall be able to interpret results of readings and tests.

.12 Assume all liabilities associated with the starting, testing and balancing procedures.

PART - 2 PRODUCTS

2.1 **NOT APPLICABLE**

PART - 3 EXECUTION

3.1 **GENERAL**

.1 Conduct performance tests to demonstrate that equipment and systems meet the specified requirements after mechanical installations have been completed and pressure tested. Conduct tests as soon as conditions permit. Make changes, repairs, and adjustments required prior to operating tests.

.2 Operate and test motors and speed switches for correct wiring and sequences and direction of rotation. Check and record overload heaters in motor starters.

.3 Confirm voltages and operating amperages at full load.

.4 Failure to follow instructions pertaining to correct starting procedures may result in re-evaluation of equipment by an independent testing agency selected by DCC Representative at Contractor's expense. Should the results reveal that equipment has not been properly started, equipment may be rejected, removed from site, and replaced at the Contractor's cost. Replacement equipment shall also be subject to full starting procedures, using the same procedures as specified for the originally installed equipment.

3.2 **EQUIPMENT START-UP REPORT**

.1 Report format

.1 Prepare test forms in MS Excel or Word format.

.2 Include the following header information for each test report:

.1 Owner's name

.2 Project name

.3 Contractor's name

.4 DCC Representative's name

.5 Title of report

.6 The following statement: “The undersigned certifies that the test results recorded in this report are correct, and that results have been witnessed by the Contractor responsible for this test.”

.7 Name and signature of the person submitting the report

.2 Submit the above reports in a hardcopy form, separately bound from the Operations and Maintenance Manuals, and in Adobe Acrobat PDF format, in accordance with Section 01 33 00 - Submittal Procedures.

.3 Provide a consolidated test report for all equipment, including the following start-up tests:

.1 Equipment / system summary tests;

.2 Equipment / system start-up tests;

.3 Manufacturer’s start-up tests.

.4 Equipment / system summary tests

.1 Provide a report with the following data for each piece of equipment which is powered or has automatic controls:

.1 Equipment designation and name

.2 Motor rotation (bump test) - result and initialed by contractor

.3 Equipment start-up report status - status and initialed by contractor

.4 Manufacturer start-up report status – status and initialed by contractor

.5 Test completion date

.2 Provide a report with the following data for pressure testing of piping systems:

.1 System name

.2 System limits (if system is not tested in its entirety)

.3 Type of test (pneumatic, hydrostatic)

.4 Pressure at start of the test

.5 Pressure at end of the test

.6 Duration of the test

.7 Test completion date

.8 Contractor’s testing staff’s name and initials

.5 Equipment / system start-up tests

.1 Provide a separate start-up report for each piece of the following equipment, and each system. The SMACNA “Systems Ready to Balance Check List”, where applicable, may be used for this report. Provide the following tests in cooperation with the Contractor performing the Work of Section 20 05 93 - Testing, Adjusting and Balancing:

.1 Fans

.1 Check radiated and discharge sound power levels

.2 Determine rpm, air flow rates, static pressure and record on the fan curves

.3 Conduct fan performance test for total system volume on main air supply and exhaust units

.4 Conduct smoke control test to meet occupancy requirements

.2 Duct systems

.1 Motorized control dampers

.1 Verify that damper strokes to fully open position

.2 Verify damper access

.3 Verify damper operation under fire alarm condition

.2 Fire dampers

.1 Test each damper to ensure proper blade movement and damper closure

.2 Verify damper accessibility for changing of the fusible links

.3 Plumbing systems

.1 Perform tests as detailed in the respective Sections of the Division 22 – Plumbing Specifications

.6 Manufacturer's start-up tests

.1 Provide a separate start-up report for each piece of the following equipment, utilizing the manufacturer's start-up check list. This report may be prepared by the manufacturer's service representative.

.1 A/C Split System Unit

3.3 AUTHORITIES' REVIEW

.1 Submit copies of inspection and test reports prepared by the authorities having jurisdiction, including but not limited to:

.1 Plumbing and drainage municipal inspector reports

.2 HVAC municipal inspector reports

.3 ESA field certification reports

3.4 DEFICIENCIES

.1 Immediately report to DCC Representative any deficiency in the systems or equipment performance resulting in design requirements being unobtainable.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section 20 00 13 – Mechanical General Provisions shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 Performance testing and balancing of air distribution. Requirements include measurement and establishment of the air quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.

1.2 RELATED WORK

.1 The following work is provided under other Sections or Divisions of the Work:

.1 Factory testing and calibrating of equipment and control systems: reference each Specification Section for specific requirements.

.2 Testing and checking of equipment provided as part of the Work of other Divisions' Contractors, except where such equipment forms an integral part of the mechanical systems.

1.3 QUALITY ASSURANCE

.1 The testing and balancing of the air systems shall be performed by the same Testing, Adjusting and Balancing (TAB) Contractor.

.2 The TAB Contractor must be an independent agency and member in good standing with the National Environmental Balancing Bureau (NEBB), the Canadian Associated Air Balance Council (CAABC) or the National Building Comfort Testing Association (NBCTA).

.3 The TAB Contractor shall have a minimum three years of documented experience in the field of TAB work. The Contractor shall provide suitable evidence of past performance, including references, justifying the TAB Contractor's capabilities.

1.4 SUBMITTALS

.1 Submit all documentation in accordance with Section 01 33 00 – Submittal Procedures.

.2 Submit proof of certification for the TAB Contractor's CAABC / NBCTA / NEBB membership within 14 days after the award of the TAB contract.

.3 Submit a report prepared by the TAB Contractor within thirty (30) days after the award of the TAB contract, summarizing TAB Contractor's comments and recommendations regarding their review of the Contract Documents. The TAB Contractor shall meet with the Mechanical Contractor, the DCC Representative and the DCC Representative as necessary to discuss.

.4 Submit an outline of the proposed TAB procedures, or alternatively, provide a copy of the latest edition of the CAABC / NBCTA / NEBB procedural standards, within thirty (30) days after the award of the TAB contract.

.5 Submit layout drawings and report format a minimum 14 days prior to the commencement of the TAB Work.

.1 Layout drawings

.1 Identify specific location of all adjusting, balancing and permanent measuring devices, neatly marked on a set of plans. A set of reproducible drawings will be furnished by the DCC Representative for this purpose upon request.

.2 Propose additional devices deemed necessary for satisfactory operation and completion of the Mechanical Work.

.2 Report format

.1 Submit the proposed format of each report type.

.2 Include a complete list of instruments and tests for which they are to be used as they relate to this project, including proof of date for the last calibration.

.6 Submit start-up reports, performance testing reports, and draft, interim and final TAB reports as detailed in this Section of the Specification.

1.5 PERFORMANCE STANDARDS

.1 Perform TAB Work in accordance with the current issue of:

.1 CAABC / NBCTA / NEBB procedural standards

.2 SMACNA HVAC Systems Testing, Adjusting and Balancing guidelines.

.3 ASHRAE Guide - Testing, Adjusting and Balancing from the latest ASHRAE Application Handbook

.4 ANSI/ASHRAE Standard 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems

1.6 DEFINITIONS

.1 For the purposes of this Section, the following definitions apply:

.1 “Balancing” - To proportion and regulate flows within the distribution system (subsystems, branches, mains, terminals) at appropriate pressures in accordance with the design intent. This includes setting discharge volume and patterns of terminal devices, and individual return and exhaust air volumes.

.2 “Testing" - To measure, interpret and report in writing, such parameters as may be required to verify design compliance and as specified herein.

1.7 COORDINATION

.1 The TAB Contractor shall:

.1 Review with each Mechanical Subcontractor before fabrication, the location of balancing devices, test connections, access openings, and report conditions which could negatively affect optimum system performance.

.2 By inspection, ensure that all testing, balancing and metering devices have been installed properly and in their pre-selected locations. The Mechanical Contractor shall obtain the approval of the TAB Contractor prior to adjusting the location of these devices due to field conditions.

.3 Coordinate efforts so that items requiring replacement or have long delivery time (sheaves, motors) are tested as early as possible.

.2 The Mechanical Contractor shall provide the following assistance and services to the TAB Contractor:

.1 Schedule sufficient time so that the initial testing and balancing can be completed before occupancy begins and coordinate with all Subcontractors involved.

.2 Keep the TAB Contractor informed of any major change made during construction. Furnish the TAB Contractor with a set of Record Drawings and with reviewed Shop Drawings.

.3 Furnish balancing devices, test connections access openings, balancing probe inlets and plugs.

.4 Ensure that all Mechanical systems are complete and ready for testing, adjusting and balancing by the TAB Contractor. Associated tasks shall include:

.1 Confirm the complete operational readiness of the building, including sealed walls, doors and ceilings to allow the balancing to be performed and required pressures to be set and maintained.

.2 Allow access to all components requiring testing, balancing, and servicing. This includes permanently installed ladders and catwalks.

.3 Verify that installation conforms with the design Drawings and Specifications.

.4 Promptly correct deficiencies of materials and Work that may delay the completion of the TAB Work.

.5 Provide Operation and Maintenance Manuals. Manuals must include the following:

.1 The manufacturers' method for adjusting and setting components for correct operation under actual load conditions.

.2 The manufacturers' recommended tolerance for maximum and minimum operating conditions.

.3 The recommended correction or Ak factors, to allow adjustment of flow, rpm, etc.

.4 A list of spare parts, identification numbers, and diagrams of their proper locations.

.5 Pressure drops for air flows through the component or unit at design flow rate.

.6 Start up all mechanical systems, according to the following conditions:

.1 Proper lubrication of rotating or sliding parts has been verified.

.2 Motors, fans, and all equipment have the correct rotation.

.3 Installation of the correct drive (package) has been checked.

.4 Belt tension is appropriate for the type of drive.

.5 Vibration isolators and bases are properly installed and are the correct type.

.6 Volume and control dampers (left in a neutral or wide-open position) function properly.

.7 Verification that duct-leakage test has been performed and ducts are sealed to the minimum tolerance specified.

.8 Verification that all registers, grilles, and diffusers are of the correct type, have been properly installed, and are in the open position.

.9 Verification that motors, starters with overload safety devices are the correct size and are operating properly.

.10 Verification that automatic controls have been installed correctly and include all components specified, including interlocks, freeze stats, damper controllers, minimum positioning switches, control valves, actuators, and sensors.

.11 Verification that pumps and related components have been properly installed and operate correctly.

.12 The motor, amps, volts, and rpm, have been compared with nameplate data and have been adjusted within a motor-rated hp or amperes.

.13 Verification that fan and pump power and speed are within design range.

.14 Verification that the controls are complete and operational.

.5 Provide a copy of all start-up reports for each piece of equipment, including initial tabulated data required for the start-up of the systems, to the TAB Contractor to be used as reference for the TAB Work.

.6 Provide immediate labour from pertinent Mechanical Subcontractors, tools, equipment and materials to make equipment and system alterations and adjustments as required including control adjustments.

.7 Technical representative of the Building Automation System (BAS) Contractor shall operate the BAS during air and water balancing testing.

.8 Make available all equipment data (Shop Drawing performance data and operating instructions) to the TAB Contractor.

.9 Service representative of the refrigeration machine manufacturer shall operate their equipment for performance testing of the refrigeration equipment. TAB Contractor shall witness and record all test results.

.3 As part of the coordination effort, the Mechanical Contractor will be fully responsible for the Mechanical systems constructed, installed and adjusted to provide optimum performance as required by the design intent. Any re-adjusting required as the result of spot checks by the DCC Representative shall be done at no additional cost to the DCC Representative. Provide all equipment, labour, instruments and incidentals and pay for all power and fuel to carry out the tests.

PART - 2 PRODUCTS

2.1 **NOT APPLICABLE**

PART - 3 EXECUTION

3.1 REQUIRED REPORTS

.1 Provide the following reports:

.1 Air balancing report

.2 Report format

.1 Prepare test forms in MS Excel or Word format.

.2 Include the following header information for each test report:

.1 Owner's name

.2 Project name

.3 Contractor's name

.4 DCC Representative's name

.5 Title of report

.3 Submit the above reports in a hardcopy form, separately bound from the Operations and Maintenance Manuals, and in Adobe Acrobat PDF format, in accordance with Section 01 33 00 - Submittal Procedures.

3.2 GENERAL REQUIREMENTS

.1 Site visits

.1 The TAB Contractor shall visit the Site as required prior to the testing and balancing of systems, and advise the respective Subcontractors of their requirements for probe inlets. Submit a report to the DCC Representative after each site visit.

.2 Balancing tolerances

.1 Balance all systems to the performance parameters indicated on Drawings and in the Specifications.

.2 If interpretation, clarification or additions to performance parameters are required, request such information from the DCC Representative.

.3 Air flow rates

Under 70 L/S	±10% of flow
Over/at 70 L/S	±5% of flow

.3 Drawing review

.1 Review all pertinent Drawings, Specifications, Shop Drawings and other documentation to become fully familiar with the systems and their specified and intended performance.

.4 Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.

.5 Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.

.6 Patch insulation, ductwork, and housings, using materials identical to those removed.

.7 Seal ducts and piping, and test for and repair leaks. Seal insulation to re-establish integrity of the vapour barrier.

.8 Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.

.9 As part of the scope of this Section, the Contractor shall make any changes in the pulleys, belts, or sheaves, as required, for correct balance at no additional cost to the DCC Representative.

3.3 MEASUREMENTS

.1 Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified. Instruments shall be properly maintained and protected against damage.

.2 Use only those instruments that have the maximum field measuring accuracy and are best suited to the function being measured.

.3 Apply instrument as recommended by the manufacturer.

.4 Use instruments with minimum scale and maximum subdivisions and with scale ranges proper for the value being measured.

.5 When averaging values, take a sufficient quantity of readings that will result in a repeatability error of less than 5%. When measuring a single point, repeat readings until two (2) consecutive identical values are obtained.

.6 Continuous recording

.1 Set-up trend logs on the BAS to record temperature and humidity levels on a 24-hour basis, in areas as directed by the DCC Representative.

3.4 AIR BALANCING

.1 General

.1 Test relative barometric pressures in various building areas, as deemed necessary by the DCC Representative and at least in all areas served by different systems.

.2 Operate, test and balance all air systems over their entire design range.

.2 Test procedures

.1 Air quantities in main ducts shall be measured using Pitot tube traverses of the entire cross section area of the duct. Openings in ducts for Pitot tube insertion shall be sealed with approved plugs. Outlet and inlet air quantities shall be determined in accordance with the CAABC / NBCTA / NEBB procedures.

.2 Total air quantities shall be obtained by adjustment of fan speeds. Damper positions shall be permanently marked after TAB Work is complete.

.3 Perform the tests and compile the data required. In addition to the tabulation forms, provide schematic diagrams showing all system components cross-referenced to form tabulations. The lists provided hereinafter shall be considered minimum requirements. All information required to prove system balance shall be provided.

.3 Data Required

.1 Submit the following data as a minimum. If contractor's standard forms provide for additional data, also submit such additional data. Indicate if tests were not specifically made. Do not repeat design data or other values not specifically tested.

.2 Fans:

.1 Identification

.2 Manufacturer

.3 Location

.4 System served

.5 Model or serial number

.6 Rated airflow L/S

.7 Rated speed RPM

.8 Rated pressures (suction and discharge, or differential)

.9 Measured airflow L/S

.10 Measured speed RPM

.11 Measured pressures (suction and discharge, or differential)

.12 Pulley size, type and manufacturer

.13 Belt size and quantity

.3 Motors:

.1 Manufacturer

.2 Model or serial number

.3 NEMA rating

.4 Rated amperage and voltage for each phase

.5 Rated horsepower

.6 Rated speed RPM

.7 Corrected full load amperage

.8 Measured amperage and voltage for each phase

.9 Calculated BHP kW

.10 Measured speed RPM

.11 Sheave size, type and manufacturer

3.5 DEFICIENCIES

.1 Immediately report to DCC Representative any deficiency in the systems or equipment performance resulting in design requirements being unobtainable.

3.6 DRAFT REPORT

.1 Make provision for submittal of clean partial TAB reports if required by the DCC Representative and the Commissioning Authority for partial handover of systems to the DCC Representative.

.2 Upon completion of the start-up, testing, adjusting and balancing of all systems, submit to the DCC Representative, two (2) typewritten copies of a full report on all testing, adjustments, and balancing performed, including the following:

.1 Testing methods and instrumentation

.2 Air systems testing and balancing data

.3 Attachments including systems schematics with numbered terminals for referring to data above.

.3 At the request of the DCC Representative, repeat the balancing procedure on 10% of any system or portion of a system (as selected by the DCC Representative). If the re-measured data is within the required tolerance of the reported data, the system shall be considered acceptable and the report accepted. If the data is not within the required tolerance of the reported data, the DCC Representative can request that the entire system or systems be rebalanced.

3.7 **INTERIM REPORT**

.1 After completion of any retesting described above, submit three (3) typewritten copies of the interim report, in a 3-hole “D” style binder, and an electronic copy in Adobe Acrobat PDF format.

.2 This report is required to obtain Substantial Performance of the Contract.

3.8 **FINAL REPORT**

.1 Submit the final report to the DCC Representative following the completion of the alternate season testing and balancing. Submit three (3) typewritten copies and an electronic copy in Adobe Acrobat PDF format as the draft report specified above.

3.9 **SPOT CHECKS**

.1 Before acceptance of the air balancing report, the DCC Representative may request to witness spot-checks of the report results.

.2 If the spot check results indicate, in the opinion of the DCC Representative, unusual testing inaccuracy, omissions, or incomplete balancing/adjustment, re-balance the entire affected system(s) at no additional cost to the DCC Representative.

3.10 **ACCEPTANCE**

.1 The Substantial Performance of the Mechanical Work will be considered reached when the Interim TAB Report has been accepted by the DCC Representative and all systems have been satisfactorily installed, operated, tested, balanced, and adjusted to meet the specified and design performance.

.2 The Substantial Performance will not depend upon alternate season testing, however, make such relevant repairs or modifications deemed necessary during this re-checking as part of the guarantee of the Work.

.3 The Total Performance of the Mechanical Contract will not be considered reached until the alternate season testing and balancing has been completed and the Final Report submitted and accepted by the DCC Representative.

3.11 **ADDITIONAL TESTING**

.1 The DCC Representative may request such additional testing in connection with this project as deemed necessary.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section 20 00 13 – Mechanical General Provisions shall apply to and govern this Section.

.2 All insulation shall comply with the maximum k-value requirements listed in the National Energy Code of Canada for Buildings.

.3 Insulation material and installation shall meet the requirements of all applicable codes and standards, and be appropriately labelled.

.4 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.5 Scope of Work:

.1 Furnish and install thermal insulation including piping insulation, duct insulation, adhesives, tie wires, tapes, sealer coatings, finishes, and mechanical protection, for services installed under the scope of Divisions 22 and 23.

1.2 WORK NOT INCLUDED

.1 The following items shall not be insulated, or are factory insulated.

.1 Piping:

.1 Vertical sections of exposed sanitary drainage piping

1.3 RELATED WORK

.1 The following Work is provided under other Sections or Divisions of the Work:

.1 Internal acoustic insulation of ductwork: Section 23 33 00 – Duct Accessories.

.2 Factory insulated ductwork: Section 23 33 00 – Duct Accessories.

.3 Insulation saddles and shields: Section 20 05 29 – Bases, Hangers and Supports

1.4 SUBMITTALS

.1 Shop Drawings

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

.2 Submit product data for insulation products, recovery jackets, adhesives and sealants.

.3 Submittal shall include product description, manufacturer's installation instructions, and appropriate specification compliance.

.2 Samples

.1 Before ordering insulation materials prepare sample board on which mount cross-section sample of types of insulation, including samples of vapour barrier installation with coatings (indoors), mastics (outdoors), reinforcing membranes, properly identified for various services and equipment on project, , including ‘k’ factors. State types of adhesives.

.2 Submit sample board to DCC Representative for review. After review and acceptance keep sample board in DCC Representative's site office for duration of project for reference. No deviation from accepted samples will be allowed.

1.5 **REFERENCE STANDARDS**

.1 Thermal Insulation Association of Canada (TIAC) National Insulation Standard, excluding Section 12

.2 Midwest Insulation Contractors Association (MICA) Standards Manual

.3 NFPA 90-A - Standard for the Installation of Air-Conditioning and Ventilating Systems

.4 NFPA 255 / UL 723 / ASTM E84 - Standard Method of Test of Surface Burning Characteristics of Building Materials

.5 CAN/ULC-S102 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

.6 ASTM C165 - Standard Test Method for Measuring Compressive Properties of Thermal Insulations

.7 ASTM C335/C335M - Standard Test Method for Steady-State Heat Transfer Properties of Pipe Insulation

.8 ASTM C411 - Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation

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

.10 ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation

.11 ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

.12 ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation

.13 ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications

.14 ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation

.15 ASTM C795 - Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel

.16 ASTM C892 - Standard Specification for High-Temperature Fiber Blanket Thermal Insulation

.17 ASTM C1136 - Standard Specification for Flexible, Low Permeance Vapour Retarders for Thermal Insulation

.18 ASTM C1290 - Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts

.19 ASTM C1393 - Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks

.20 ASTM C1617 - Standard Practice for Quantitative Accelerated Laboratory Evaluation of Extraction Solutions Containing Ions Leached from Thermal Insulation on Aqueous Corrosion of Metals

.21 ASTM C1729 - Standard Specification for Aluminum Jacketing for Insulation

.22 ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers

.23 ASTM D1000 - Standard Test Methods for Pressure-Sensitive Adhesive-Coated Tapes Used for Electrical and Electronic Applications

.24 ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials

.25 CGSB 51-GP-52MA - Vapour Barrier, Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation

.26 CAN/CGSB 51.11 - Mineral Fibre Blanket Thermal Insulation

.27 CGSB 51.53 – Poly (Vinyl Chloride) Jacket Sheet, for Insulated Pipes Vessels and Round Ducts

.28 National Energy Code of Canada for Buildings

.29 ASHRAE 90.1 – Energy Standard for Buildings

1.6 **QUALITY ASSURANCE**

.1 Qualified installers shall have successfully completed three or more similar type jobs within the last 5 years.

.2 Insulation material shall be fire retardant with flame spread/smoke developed ratings not exceeding 25/50 when tested in accordance with CAN/ULC-S102, and complying with the requirements stated in the building code having jurisdiction. Insulation materials shall not flame, smolder, glow or smoke at their service temperatures.

.3 Identify insulation, coverings and adhesives where required by Federal and/or Provincial health and safety WHMIS legislation.

.4 All insulation materials, adhesive sealants and coatings, shall be ULC listed, non-hygroscopic, and mould-proof. Insulation products shall not contain asbestos, lead, mercury, mercury compounds, or formaldehyde.

.5 Products shall contain no polybrominated diphenyl ethers (PBDE) such as Penta-BDE, Octa-BDE or Deca-BDE fire retardants.

.6 Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C795. Insulation materials applied to carbon steel shall be Mass Load Corrosion Rate (MLCR) tested per ASTM C 1617.

.7 Contractor shall take precaution to protect insulation materials from moisture exposure or physical damage. Any glass mineral wool insulation that becomes wet or damaged shall be replaced at no additional cost.

.8 HVAC ductwork insulation used in the air stream shall be discarded if exposed to liquid water.

.9 Insulation shall not be applied until all surfaces are clean, dry, and free of dirt, dust, grease, frost, moisture, and other extraneous elements.

.10 Work shall be performed at the temperatures recommended by the product manufacturer.

.11 Standard of acceptance, unless otherwise noted for specific products, shall be:

.1 Fibreglass insulation and related products:

.1 Owens Corning

.2 Johns Manville

.3 Knauf Fibreglass

.4 Manson

.2 Elastomeric cellular foam insulation and related products:

.1 Armaflex

.2 Rubatex

.3 Nomaco

.4 K-Flex

.12 All sealants and adhesives shall meet LEED requirements for low VOC emitting materials 80 g/l for fibreglass adhesive 250 g/l for sealants.

1.7 **DEFINITIONS**

.1 For the purposes of this Section, the following definitions apply:

.1 “Ambient” - as applied to temperatures means outdoor design temperature.

.2 “Coating” - light-consistency compound for indoor applications used in conjunction with reinforcing fabric, to provide either a breathable or vapour barrier finish to insulation.

.3 “Cold” – a system or equipment carrying medium at temperatures below 16°C.

.4 “Compression Fit Method” - to allow for expansion and contraction of sheet and roll insulation, leave a 12mm wide uncoated border at the butt-edge seams on the surface to be insulated and the insulation surface. Overlap the insulation 6mm at the butt-edge and compress the edges into place. Apply adhesive to the butt-edges of the insulation.

.5 “Conditioned supply duct" - ductwork conveying air which has either been heated or cooled.

.6 “Concealed" - mechanical services and equipment located in ceiling space above solid drywall and T-bar ceilings, in space beneath raised floor, in vertical service shafts, in trenches, and in non-accessible chases and furred spaces.

.7 “Ductwork” - includes ducts, fans, supply unit casings and plenums.

.8 “Exposed" - mechanical services and equipment in all other spaces not considered to be “concealed" as defined above.

.9 “Exposed to weather or dampness” – mechanical services and equipment located in air intake, relief, and exhaust plenums directly connected to the outside of the building, in underground service trenches, buried below ground level, in areas

subject to high humidity, and outside the building envelope in direct contact with the outdoor environment.

.10 "Finish Jacket" - final finish protective layer for insulation, including lagging fabric, PVC, metal, and adhesive films, that provides weather-protective finish depending on the application.

.11 "Hot" – a system or equipment carrying medium at temperatures above 20°C.

.12 "Mastic" - heavy-consistency waterproof compound for outdoor applications used in conjunction with reinforcing fabric that remains adhesive and generally pliable with age, to provide either a breathable or vapour barrier finish to insulation.

.13 "Service temperature" - for purpose of ductwork and piping temperature, is equal to the design operating temperature.

.14 "Unconditioned space" - rooms or spaces that are not supplied with conditioned air, including ceiling spaces which are not part of a ceiling return plenum system.

1.8 **PRODUCT DELIVERY, STORAGE AND HANDLING**

.1 Retain insulation materials in original cartons or containers until immediately prior to application and store in dry location.

.2 Keep adhesives in their original containers with manufacturer's name and catalogue number clearly stated. Protect contents against freezing.

PART - 2 PRODUCTS

2.1 **FIELD APPLIED FINISHES**

.1 PVC (Polyvinyl Chloride) jacket – indoor/outdoor

.1 Minimum thickness: 20 mil

.2 Maximum permeability: 0.09 perms

.3 Flexible flat-sheets, pre-moulded one-piece fitting covers

.4 Tape: vinyl, pressure sensitive, colour matched

.5 For outdoor application UV resistant, with solvent weld closure

.6 Standard of Acceptance

.1 Johns Manville

.2 Sure Fit Systems

.3 Proto PVC – LoSmoke

.2 Canvas jacket – indoor only

.1 ULC listed plain weave cotton fabriceight: 220 gm/m²Or, re-wetable fibreglass lagging fabric with water activated self-adhesive

.2 Suitable for field painting

.3 Standard of Acceptance

.1 Fattal Canvas

.2 Alpha Assoc.

.3 Robson Thermal

.4 Clairmont Corp.

.5 Newtex

.3 Laminated self-adhesive jacket (SAJ) - indoor/outdoor

.1 Permanent acrylic self-adhesive jacketing system

.2 UV resistant, water proof, zero permeability

.3 High puncture and tear resistance

.4 Standard of Acceptance

.1 Venture Tape

.2 PolyGuard

.3 K-Flex

.4 Protective finish for elastomeric cellular foam insulation - indoor/outdoor

.1 Standard of Acceptance

.1 Armaflex

.2 Nomaco

2.2 **FACTORY APPLIED FINISHES**

.1 All service jacket with advanced closure system self-sealing lap (ASJ+)

.1 Aluminum foil reinforced with glass scrim bonded to a Kraft paper interleaving with an outer film layer

.2 Conforming to ASTM C1136 Type I, II, III, IV, and VIII

.3 Vapour retarder with a self-sealing adhesive

.2 All service jacket (ASJ)

.1 White Kraft paper bonded to aluminum foil and reinforced with glass fibres

.2 Conforming to ASTM C1136 Type I

.3 Vapour retarder

.3 Foil scrim Kraft (FSK)

.1 Aluminum foil, fiberglass reinforced scrim with Kraft backing

.2 Conforming to ASTM C1136 Type II

.3 Vapour retarder.

.4 Poly scrim Kraft (PSK)

.1 Metalized polypropylene, fiberglass reinforced scrim with Kraft backing

.2 Conforming to ASTM C1136 Type II

.3 Vapour retarder

2.3 DUCTWORK INSULATION

.1 Type D1

.1 Fiberglas flexible blanket: to ASTM C1290

.2 FSK or PSK finish

.3 Service temperature: 4 to 121°C

.4 Density: 12 kg/m³

.5 k-value: 0.042 W/m°C @ 24°C

.2 Type D2

.1 Fiberglas semi-rigid board for flat surfaces, scored board for curved surfaces: to ASTM C612

.2 ASJ, FSK or PSK finish

.3 Service temperature: 4 to 121°C un-jacketed

.4 Density: 48 kg/m³

.5 k-value: 0.033 W/m°C @ 24°C

.3 Type D4

.1 Phenolic board rigid board for flat surfaces: to ASTM C1126 Group 1

.2 Service temperature: -73 to 121°C un-jacketed

.3 Density: 37 kg/m³

.4 k-value: 0.022 W/m°C @ 10°C

.5 Standard of Acceptance

.1 Kingspan

2.4 PIPE INSULATION

.1 Type P1

.1 Fiberglas rigid, factory molded, split formed with pressure sensitive longitudinal adhesion strip: to ASTM C547 Type I

.2 ASJ finish

.3 Pipe size application: up to and including NPS 24

.4 Service temperature: -40 to 454°C

.5 k value: 0.04 W/m°C @ 93°C

.2 Type P2

.1 Inorganic mineral fibre rigid, split formed, moulded insulation: to ASTM C547

.2 ASJ+ or FSK finish

.3 Pipe size application: up to and including NPS 30

.4 Maximum operating temperature: 650°C

.5 k value: 0.064 W/m°C @ 204°C

.6 Standard of Acceptance

.1 Roxul

.2 Johns Manville

.3 RockWool

.4 Knauf

.5 Thermafiber

.3 Type P3

.1 Closed cell elastomeric preformed insulation, roll type sheet or tubular with self-closing adhesion strips: to ASTM C534

.2 k value: 0.039 W/m°C @ 24°C

.3 Service temperature: up to 82°C

2.5 **ADHESIVES**

.1 Contact bond cement

.1 Quick setting for metal surfaces

.2 Standard of Acceptance

.1 Henry

.2 Foster

.3 Johns Manville

.2 Lap seal adhesive

.1 For joints and lap sealing of vapour barriers

.2 Standard of Acceptance

.1 Henry

.2 Foster

.3 Johns Manville

.3 Contact adhesive

.1 For fibrous insulation

.2 Standard of Acceptance

.1 Henry

.2 Foster

.3 Johns Manville

.4 Lagging adhesive

.1 Water based

.2 Standard of Acceptance

.1 Henry

.2 Foster

.3 Design Polymerics

.4 Robson Thermal

.5 Waterproof vapour retarder

.1 For flexible elastomeric closed cell foam

2.6 **MASTIC, COATING**

.1 Interior, with vapour barrier:

.1 Fire resistant meeting 25/50

.2 Permeance rating 0.02 perms maximum

.3 White in colour

.4 Standard of Acceptance

.1 Henry

.2 Foster

.3 Johns Manville

.4 Robson

.2 Exterior, with vapour barrier:

.1 Asphalt cutback

.2 Permeance rating 0.02 perms maximum

.3 Grey in colour

.4 Standard of Acceptance

.1 Henry

.2 Foster

.3 Johns Manville

.4 Robson

.3 Interior, breather type:

.1 White in colour

.2 For insulation except elastomeric closed cell foam

.3 Standard of Acceptance

.1 Henry

.2 Foster

.3 Johns Manville

.4 Robson

.4 Exterior, breather type:

.1 Abrasion resistive, flexible

.2 UV resistant

.3 Grey in colour

.4 Standard of Acceptance

.1 Henry

.2 Foster

.3 Johns Manville

.4 Robson

2.7 MISCELLANEOUS PRODUCTS

.1 Reinforcing Membrane:

.1 Synthetic fibre:

.1 Leno weave

.2 Indoor and outdoor use

.3 Standard of Acceptance

.1 Henry

.2 Foster

.2 Glass-fibre fabric:

.1 Indoor use

.2 Standard of Acceptance

.1 Henry

.2 Foster

.3 Glass-fibre fabric for use with elastomeric closed cell foam:

.1 Indoor use.

.2 Standard of Acceptance

.1 Henry

.2 Foster

.2 Vapour barrier tape

.1 Colour matched

.2 75 mm wide

.3 Vinyl backed or foil backed to suit insulation

.4 UL 181A listed

.5 Standard of Acceptance

.1 Johns Manville

.2 MacTac Canada Ltd

.3 Compac Corp

.4 Fattal Canvas

.3 Bands

.1 Stainless steel or galvanized metal, 12 mm wide with mechanical cinch locks.

.4 Weld pins, studs and clips

.1 Standard of Acceptance

.1 Midwest Fasteners Inc

.2 Continental Jordahl

.3 AGM Jordahl

.5 Tie Wire

.1 1.6 mm stainless steel with twisted ends

.6 Caulking

.1 Fast-drying colour matched flexible butyl elastomer based vapour barrier sealant.

.2 Standard of Acceptance

.1 Tremco

.2 Foster

.3 Henry

.4 Dow Corning

.7 Staples

.1 Monel, flare type, minimum size 12 mm.

PART - 3 EXECUTION

3.1 GENERAL

.1 Perform insulation work in accordance with the latest trade application methods published by TIAC and MICA, and to the DCC Representative's approval.

.2 Remove grime, grease, oil, moisture or other matter to ensure that insulation is applied to clean and dry surfaces.

.3 Apply insulation under ambient temperature conditions in accordance with insulation, mastic, coating or adhesive manufacturer's recommendations.

.4 Apply insulation after the installation, pressure and leakage testing of piping, ductwork and equipment has been completed, heat tracing has been installed and tested, and the installation has been accepted by the DCC Representative.

.5 Do not apply insulation on chrome plated surfaces of piping, valves, fittings, and equipment.

.6 Cut and bevel insulation around nameplates and pressure vessel stamps.

.7 Neatly finish insulation at supports, protrusions, sensors and interruptions.

.8 Apply insulation neatly and tightly in unbroken lengths and with ends of sections firmly and squarely butted together. Lap canvas (or other specified wrapping) over joints and cement down with adhesive. Seal insulation exposed to weather or dampness with reinforced vapour barrier or breather coating/mastic.

.9 On cold surfaces where a vapour seal must be maintained, insulation shall be applied with a continuous, unbroken moisture and vapour retarder.

.10 Finish bare insulation with field installed jackets as specified in this Section. All aluminum, stainless steel and PVC recovery jackets shall be removable and reusable.

.11 At walls, ceiling or floor openings, and sleeves extend insulation including coatings and finishes through to make insulation continuous, except where firestop material is required.

.12 At fire separations, terminate insulation at the wall or floor, and pack the space between the sleeve and duct or pipe as specified in Section 20 00 19 – Basic Materials and Methods. Provide finishes in accordance with the fire stopping manufacturer's listing requirements.

.13 Dampers, supports, anchors that are secured directly to cold surfaces shall be adequately insulated and vapour sealed to prevent condensation.

.14 Treatment of existing insulation

.1 Where new piping or ductwork connects to existing, and where the existing insulation is damaged through the installation of new work or through repair work performed on the existing piping and ductwork, remove damaged sections of insulation for a minimum of 1 m replace with new insulation and finish to match existing.

3.2 DUCTWORK

.1 General

.1 Insulate ductwork in accordance with the requirements noted for duct insulation at the end of this Section. Repair existing insulation on existing ductwork to the same standard as applied for new ducts.

.2 Insulate access doors or removable panels in ductwork as separate units to permit opening or removal without damage to adjoining insulation.

.3 Cover angles or standing seams on the outside of plenums, casings and ducts which extend beyond face of applied rigid insulation with the same material and thickness as adjacent ductwork.

.1 Extend this insulation 75 mm on each side of the angle and place tight around the projecting leg of the angle.

.2 Apply rigid insulation overlapping the edge of the flexible insulation on angle so that the outstanding part of the insulated angle projects through the work.

.4 Cut and mitre rigid insulation at elbows and fittings. Attach to ductwork with 50% coverage of adhesive, and using mechanical fasteners with weld pins, speed clips and washers.

.5 When using pins to secure the insulation, cut off protruding ends of welded pins and cover speed washers with vapour barrier tape.

.6 At junctions between external insulation and acoustic insulation, overlap external insulation 300 mm over acoustic lining.

.7 Insulate all silencer casings where no internal media contacts the wall of the silencer.

.2 Type D1

.1 Overlap insulation 50 mm on each lap joint; tightly butt end edges and joints. Seal with interior coating and scrim foil tape.

.2 On rectangular ducts 600 mm and wider, and on round ducts 450 mm and wider:

.1 Secure insulation to the underside of duct with weld pins, studs, and clips at 300 mm centres in both directions, with not less than 2 rows per side and bottom.

.2 Secure insulation laps with mechanical fasteners (staples).

.3 For round ductwork, the underside of duct is measured as being half the circumference of the duct.

.3 For other ductwork, fasten insulation with adhesive, applied in 150 mm wide strips at 300 mm centres.

.4 Tying cord may be used to temporarily hold insulation until adhesive has set.

.3 Type D2

.1 Fans, ducts, and casing:

.1 Overlap horizontal boards over vertical boards; tightly butt all edges and joints and seal with interior coating and scrim foil tape.

.2 Secure insulation with welded pins and speed washer type fasteners at 300 mm centres. Provide a minimum of two rows of fasteners on each side of duct.

.2 Outside air duct and plenums:

.1 As above for fans, ducts, and casings, and;

.1 Apply first layer of insulation without integral vapour barrier,

.2 Apply second layer of insulation with integral vapour barrier with staggered joints.

.3 Exhaust air plenums:

.1 As above for fans, ducts, and casings.

.4 Type D4

.1 Outside air duct and plenum - as above for fans, ducts, and casings, but with only one layer of insulation board.

3.3 **PIPING**

.1 General

.1 Insulate piping systems including pipe, valves, fittings, and pipeline accessories in accordance with the requirements noted for pipe insulation at the end of this Section.

.2 Insulate straight pipe sections by staggering adjacent longitudinal seams 1/4 turn at each butt joint. Locate longitudinal joints on top of the pipe for all piping installed indoors, and on the bottom of the pipe for all piping installed outdoors.

.3 Secure insulation at centre of each section, at each end, and at not more than 600 mm intervals with:

.1 Vapour barrier tape in addition to jackets with self-adhering lap joints for Type P1 insulation on Cold and Dual Temperature piping,

.2 Mechanical fastened (stapled) or jackets with self-adhering lap joints on Type P1 insulation on Hot piping,

.3 Bands or wire for Types P2, P4 insulation,

.4 Self-adhered or provide 100% coverage of contact adhesive for Type P3 insulation,

.4 Cold and Dual Temperature Piping Systems Insulation

.1 For greater clarity, domestic hot water, domestic hot water recirculating, non-potable hot water, and non-potable hot water recirculating piping systems shall be treated as “Cold and Dual temperature” for the purpose of application of vapour barriers to both hot and cold domestic and non-potable water piping.

.2 Types P1 and P3

.1 Lap and seal all joints (longitudinal and transverse).

.3 Fittings, Flanges, Couplings, and Strainers

.1 Insulate fittings including elbows and tees:

.1 40 mm and smaller:

.1 Mitre cut insulation to create tight fit.

.2 For PVC cover, trim backside of insulation on elbows to suit cover but do not reduce total thickness less than that of adjacent pipe insulation.

.2 50 mm and larger:

.1 Use matching preformed insulation inserts, or fabricate mitred insulation segments made from same material as pipe insulation.

.2 Number of mitred segments to be sufficient to maintain thickness of insulation around throat of elbow.

.3 Secure inserts and fabricated segments with wire prior to application of coatings or finishes.

.2 Insulate flanges and grooved joint couplings:

.1 Insulate with preformed inserts or build-up insulation with same material as on adjacent pipe:

.1 Butt pipe insulation to each side of flange, coupling, valve, or strainer.

.2 Build up rigid insulation blocking on each side of fitting, coupling, valve or strainer, with a width dimension same as pipe insulation thickness.

.3 Apply insulation layer over outside of flange, coupling, valve or strainer to a thickness equal to pipe insulation thickness.

.4 Provide removable insulation section on strainer head.

.2 Where phenolic insulation is used;

.1 Same as above except use factory made insulation inserts, or fabricate inserts to suit fixture.

.3 Where elastomeric insulation is used;

.1 Same as above except adhere insulation to flange, coupling, or strainer with full coverage of adhesive.

.2 Do not adhere insulation across bolted connections. Insulate on each side of connection, add additional insulation layer across connection and fix it in place with bands.

.4 Pipeline Accessories

.1 Insulate pipeline accessories:

.1 Valves

.2 Strainers

.3 Pressure reducing valves

.4 Safety valves

.2 Terminate insulation on pipe at 75 mm from line size accessories. Butt pipe insulation to each side of flange or joint of accessories. Bevel insulation at 45 degree angle away from accessories. Finish exposed face with appropriate mastic or coating.

.3 No insulation is required on pipeline accessories for Hot Piping systems with design temperatures of 93°C or less.

.4 Insulate accessories for Cold and Dual Temperature Piping systems for chilled water and liquid refrigerant piping with:

.1 Detachable insulated box type with embossed aluminum or stainless steel jacket, with vapor barrier tape applied to seams when installed;

.2 Lined with two layers of 25 mm P3 elastomeric blanket or one layer of 25 mm thick P4 phenolic insulation, with no voids at corners or joints.

.3 At locations requiring access, extend insulation to create collar around bolted connection, and install a compression fit piece of insulation to cover equipment.

.5 Insulate accessories for all other Cold and Dual Temperature Piping systems:

.1 Insulate with flexible blanket of same material and thickness of insulation applied on adjacent piping. Seal with reinforced vapour barrier sealer.

.2 At locations requiring access including valve handles, valve actuators, drain valves, cut back insulation and seal exposed edges.

.5 Hangers and Supports

.1 Provide insulation protection in accordance with the requirements noted for hangers at the end of this Section, based on pipe size and service process temperature.

.2 For cold and dual temperature pipe systems, insulate the pipe anchor plates and frames with a flexible blanket of Type P3 insulation and seal with vapour barrier coating. Extend insulation along the anchor steel to a minimum distance of 150 mm outside the piping insulation thickness.

.3 Pipe saddle insulation protection

.1 Insulate the interior void spaces of pipe saddles, of same material as adjacent pipe insulation.

.2 Butt insulation up to sides and end of pipe saddle, and leave bottom surface of saddle exposed for direct contact with pipe support.

.4 Pipe shield insulation protection

.1 Install insulation shield between the outside of insulation and the pipe support. Pipe support shall be sized for the outside dimension of the insulation.

.2 Provide high density insulation insert of the same thickness as the adjacent pipeline insulation material, fabricated from Type P5 (phenolic) insulation:

.1 300 mm long for pipe sizes 75mm and smaller

.2 450 mm long for pipe sizes 100mm and larger

.3 Bond the insulation shield to the insulation insert with adhesive. Finish and seal complete assembly with breather or vapour barrier insulation coating, depending on application.

.1 Alternatively, finish insulation insert as part of the main pipe insulation. Provide two metal band clamps for each insulation shield and strap the shield to the finished pipe insulation.

3.4 SEALING OF INSULATION

.1 Cold or dual temperature ducts, casings, and plenums - Indoors:

.1 Service temperature: ambient to 20°C

.2 Apply reinforced vapour barrier coating to all corners, lap edges and butt edges, overlapping joint by minimum 50 mm each side.

.3 Cover mechanical fastener (staple) penetrations with reinforced vapour barrier coating.

.4 Insulate flanges and standing seams with overlapping strips of flexible insulation, and cover with reinforced vapour barrier coating.

.2 Cold and dual temperature piping:

.1 Tightly seal insulation with factory applied all-purpose jacket using self-adhering or field applied adhesive on longitudinal laps and butt joint.

.2 Where sealing strips are damaged, apply secondary layer of colour matched vapour barrier tape.

.3 Seal insulation without factory applied jackets with 100% coverage of vapour barrier coating/mastic as applicable, complete with reinforcing membrane.

.4 Seal insulation butt ends with vapour barrier coating every four (4) lengths of insulation but not to exceed 2400 mm of pipe length.

.3 Elbows, tees, flanges, and fittings:

.1 Apply applicable breather or vapour barrier coating/mastic with reinforcing membrane over fitting insulation and overlap 50 mm onto adjacent pipe insulation.

.2 The use of vapour barrier tape to seal insulation is not permitted.

.3 Apply coating/mastic and reinforcing membrane regardless of final finish application.

.4 Mastic application

.1 Do not allow mastic materials to come in contact with single ply membrane roofs.

.2 Clean up accidental spills immediately.

.3 Provide temporary drop sheets to protect the roof.

3.5 **INSULATION FINISH COVERINGS**

.1 Install protective finish coverings on insulation in accordance with the requirements noted for finishes at the end of this Section, after breather and vapour barrier sealing is completed.

.2 Cut finish jacket materials used for covering to allow 50 mm to 100 mm longitudinal overlap and similar circumferential overlap onto adjacent sheets.

.3 On vertical tanks, vessels, and vertical pipes, arrange circumferential overlap on adjacent sheets outside of sheet below and under sheet above.

.4 PVC jacket:

.1 Cold and dual temperature ducts, equipment and piping:

.1 Overlap longitudinal edges and adjacent sheets and seal longitudinal edges with vapour barrier coating adhesive for full depth and 100% coverage of overlap.

.2 Seal circumferential edges of PVC fitting covers with reinforced vapour barrier coating adhesive extending over adjacent pipe insulation section with an overlap of at least 50 mm.

.3 Seal PVC fitting covers at throat and heel seams by solvent bonding and secured over insulation with reinforced vapour barrier coating/mastic overlapping adjacent pipe insulation a minimum of 50 mm.

.5 Laminated self-adhesive jacket:

.1 Apply in accordance with manufacturer’s instructions.

.6 Canvas jacket:

.1 Do not apply canvas to elastomeric closed cell foam insulation.

.2 Cotton lagging:

.1 Apply cotton lagging with minimum two coatings of breather or vapour barrier coating adhesive as applicable to the duct or piping system, and finish to provide a smooth surface, free of wrinkles and sags. Do not use metal bands.

.2 Where cotton lagging with appropriate coating is used, this satisfies the requirements of a sealer coating for hot or cold/dual temperature duct and piping systems.

.3 Fibreglass lagging:

.1 Apply re-wetable fibreglass lagging in accordance with manufacturer's instructions. Finish to provide a smooth surface, free of wrinkles and sags.

.2 Where re-wetable fiberglass lagging is used, this satisfies the requirements of a sealer coating for hot duct and piping systems.

.4 Seal canvas jacket with off-white coating to leave a smooth, non-porous surface ready to receive paint application.

.7 Flexible elastomeric closed cell foam insulation:

.1 Apply thin coat of lagging adhesive and glass mesh.

.2 When dry, apply indoor or outdoor finish at 10 square meters per liter.

.3 Apply second coat of same material, at same rate of application, after four hours.

.4 Finish with one coat of white acrylic latex as recommended by insulation manufacturer.

.8 Finish all exposed insulation applied on piping beneath barrier free plumbing fixtures with a white, fitted antimicrobial pipe cover meeting requirements of accessibility guidelines.

3.6 MECHANICAL DAMAGE PROTECTION

.1 Protect exposed insulated ductwork, piping and equipment located in high traffic areas, from floor level up to 1200 mm above floor with 1.2 mm stainless steel jacket, secured to floor slab.

.2 Do not overlap fire damper slip joint with protective sheeting.

3.7 FIELD QUALITY CONTROL

.1 The DCC Representative reserves the right to have protective finish coverings removed on up to 5% of all fittings, flanges, couplings, valves, and pipeline accessories to review the sealing of the insulation, at no change in cost.

.2 If insulation sealing is found to be incorrect at any one location, remove the protective finish on all fittings, flanges, couplings, valves, and pipeline accessories for review.

.3 Repair defective sealing and replace protective coverings at no change in cost.

3.8 INSULATION SELECTION

HVAC Duct Insulation			
System Description	Service Temp. °C	Insulation Type	Insulation Thickness mm
Rectangular conditioned supply ducts, concealed Rectangular return ducts, in unconditioned space Rectangular conditioned supply ducts, less than 36" wide, exposed Tempered supply ducts, in unheated space	5 to 65	D1	38 Note 1
Ducts and plenums housing heating and cooling coils	5 to 65	D2	25

HVAC Duct Insulation			
System Description	Service Temp. °C	Insulation Type	Insulation Thickness mm
Fresh air intake plenums, casings Fresh air supply ducts from outside air louvre to mixing plenum of air handling unit, or to motorized damper in other systems	Ambient to 65	D2	Two layers each 50
		D4	75
		D4	38

Note 1: thickness is “out of box” before installation

Plumbing Piping Insulation				
System Description	Max. Serv. Temp. °C	Pipe Size NPS	Insulation Type	Insulation Thickness mm
Storm and sanitary drainage Equipment condensate drains	38	All sizes	P1, P3	25

Note 1: thickness and installation in strict accordance with ULC listing requirements.

3.9 **HANGER PROTECTION**

Hanger protection				
System Temperature °C	Pipe Size NPS	Pipe Saddle	Insulation Shield	High-Density Insert
61 to 93	≥8	●	-	-
	≥1½ and ≤6	-	●	●
	≤1 1/4	-	●	-
26 to 60	≥1½	-	●	●
	≤1 1/4	-	●	-
Cold and Dual Temperature	≥1½	-	●	●
	≤1 1/4	-	●	-

Duct Insulation Field Applied Finishes			
Arrangement	Environment	Location	Finish
Concealed	Indoors	Any	None
Exposed	Indoors	Service Rooms	Canvas, PVC, or SAJ
	Indoors	Public Spaces	PVC or SAJ

Duct Insulation Field Applied Finishes			
Arrangement	Environment	Location	Finish
	Outdoors	Any	SAJ

Piping Insulation Field Applied Finishes			
Arrangement	Environment	System Type	Finish
Concealed	Indoors	Any	None
Exposed	Indoors	All except steam over 860 kPa	PVC or SAJ
	Indoors	Steam over 860 kPa	Canvas

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section 20 00 13 – Mechanical General Provisions shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 This Section supplements all Sections of Division 22 – Plumbing.

.2 The intent of the Division 22 – Plumbing Specifications and the accompanying Drawings is to provide complete and workable plumbing systems as shown, specified and required by applicable codes. Include all work specified under Division 22 - Plumbing and shown on the accompanying Drawings.

.3 The Drawings that accompany the Division 22 – Plumbing Specifications are diagrammatic. It is the responsibility of this Contractor to ensure that adequate and appropriately sized plumbing vent system and valving for the plumbing systems as per provincial and federal codes, and requirements of authorities having jurisdiction are provided. Provide additional valves and resize all plumbing piping as required. The Contract Drawings do not show each offset, bend, tee, or elbow which may be required to install the Plumbing Work in the space provided and to avoid conflicts. Follow the Drawings as closely as is practical to do so and install additional bends, offsets and elbows where required by local conditions from measurements taken at the Site, subject to approval, and without additional cost to the DCC Representative.

.4 Major aspects of the Plumbing Work shall include but not necessarily be limited to, the following items:

.1 Sanitary drainage and venting system within the building and associated drainage specialties;

.2 Domestic cold, hot and recirculating water supply and distribution systems

.3 Plumbing fixtures, faucets, trim and other accessories;

.4 Refer to the following Sections of the Division 22 – Plumbing Specification for further details:

.1 Sanitary Waste and Vent Piping – Section 22 13 16

.2 Sanitary Waste Piping Specialties – Section 22 13 19

1.2 RELATED WORK

.1 The following Work is provided under other Sections or Divisions of the Work:

.1 Finish painting: Section 09 91 00 – Painting.

.2 Electrical power wiring: Division 26 - Electrical.

1.3 **QUALITY ASSURANCE**

.1 Manufacturer Qualifications:

.1 Companies specialized in manufacturing plumbing and drainage products specified under the Sections of Division 22 – Plumbing with minimum three years of documented experience.

.2 Conform to CSA, municipal and federal plumbing codes', DCC Representative's Plumbing Standard requirements as applicable for this project.

.3 Layout drawings:

.1 Plumbing systems arrangement as shown on the Contract Drawings is diagrammatic. Refer to latest Architectural Drawings for final layout of walls, partitions, and building areas. The Division 22 – Plumbing Contractor must check and verify all dimensions and conditions on the Site, and ensure that the Work can be performed as indicated. Report all discrepancies to the DCC Representative before proceeding with the Work.

.2 Prepare complete plumbing systems layout drawings, arranging piping runs in proper relation to other equipment such as light fixtures and ducts to ensure clear ceiling heights indicated on the Drawings. Maintain maximum headroom in areas with no ceilings. Refer to additional design requirements contained in other sections of the Division 22 Specification.

.3 Plumbing systems layout drawings shall take into consideration architectural, structural, mechanical and electrical layouts of the building. Piping mains and branches must be arranged to not interfere with any of the aforementioned systems and equipment.

.4 Obtain water pressure and supply temperatures form the base building maintenance and confirm deasing requirements are met as per below.

1.4 **SUBMITTALS**

.1 Shop Drawings

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

.2 Submit product data for flashing system.

1.5 **PERMITS AND INSPECTIONS**

.1 Submit layout drawings to the municipal Building Department; apply for and obtain permits required for Plumbing Work and pay all costs levied for permits and inspections.

1.6 **REFERENCE STANDARDS**

.1 CSA B272 - Pre-Fabricated Self Sealing Roof Vent Flashings

.2 NSF/ANSI 61 - Drinking Water System Components

1.7 **QUALITY ASSURANCE**

.1 Material or equipment used shall not contain lead in building domestic water system and shall be certified in accordance with NSF 61 or NSF 372. Endpoint devices used to dispense water for drinking shall meet the requirements of NSF 61, Section 9.

PART - 2 PRODUCTS

2.1 HANGERS AND SUPPORTS

.1 In accordance with Section 20 05 29 - Bases, Hangers and Supports.

2.2 THERMAL INSULATION

.1 In accordance with Section 20 07 00 - Mechanical Insulation.

2.3 IDENTIFICATION FOR EQUIPMENT, VALVES AND PIPING

.1 In accordance with Section 20 05 53 - Mechanical Identification

2.4 ELECTRIC WIRING

.1 In accordance with Section 20 05 13 - Common Wiring Requirements

2.5 ESCUTCHEONS

.1 Escutcheons shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

2.6 FLASHING

.1 Flashing for through-roof penetration and other waterproofed areas:

.1 Manufactured from composite material;

.2 Minimum dimensions of 500 mm x 500 mm;

.3 With sleeve extending at least 150 mm above roof.

PART - 3 EXECUTION

3.1 GENERAL

.1 Execute the Plumbing Work in accordance with requirements specified in the various Sections of Division 22 – Plumbing.

.2 Install drainage and vent piping in accordance with the municipal and federal plumbing codes, standard trade practice and as specified in this Specification.

.3 Connect to existing main risers concealed behind partition walls or above ceilings, except in service rooms and access spaces where piping shall be exposed.

.4 Anchor, guide and support vertical and horizontal runs of piping to resist dead load and absorb thrust.

.5 Generally, small diameter pipe runs from drips and drains, water cooling, and other services are not shown but must be provided.

.6 If required by the authorities having jurisdiction, provide building traps complete with cleanout and fresh air inlet with special grilles as approved by the DCC Representative.

.7 Electrical interconnection of controls and instruments: is generally not shown but shall be provided. This includes interconnection of sensors, transmitters, transducers, control devices, control and instrumentation panels, alarms, instruments and computer workstations.

3.2 **FLASHING**

.1 Provide flashing for piping penetrations through roofs and other waterproofed areas. Leave flashing ready for the Contractor performing the roofing Work to make watertight connections.

3.3 **VENT TERMINATION (VTR)**

.1 Fit vents passing through the roof with vent stack sleeves terminating not less than 150 mm above the finished roof level and above the flood level of the roof. Locate VTRs 900 mm above and 3500 mm horizontally from any air intake, door or operable window.

3.4 **ESCUTCHEONS**

.1 Install escutcheons at finished surfaces where bare or insulated exposed piping passes through floors, walls, or ceilings in finished areas. Escutcheons shall be fastened securely to pipe or pipe covering. In wet or humid areas such as washrooms, housekeeping rooms, pool areas, seal pipe penetrations through unrated walls behind escutcheons using plumber's putty.

3.5 **PAINTING**

.1 Coordinate the finish paint of plumbing piping with the Contractor performing the Work of Section 09 91 00 – Painting as follows:

.1 Concealed from view: not painted.

.2 Exposed to view: bare, uninsulated cast iron pipe and associated hangers exposed to view in finished areas shall be painted with one coat approved rust inhibiting primer.

3.6 **TESTING**

.1 Furnish pumps, gauges and other equipment required to complete test.

.2 Charge system with water only when there is no possibility of freeze-up.

.3 Perform tests after plumbing pumps have been tested.

.4 Prior to testing, ensure that shut-off valves, pressure reducing valves, balancing valves, backflow prevention and control devices are functioning.

.5 Check horizontal pipe with an accurate level for any alterations in pitch. Inspect laterals, cross arms, and eliminate pockets. Correct any cases of water hammer.

.6 Execute tests in the presence of the DCC Representative's authorized representative.

.7 Testing of sanitary drain and vent piping:

.1 Securely close all openings on pipe ends throughout the systems by means of approved plugs and fill the entire piping system, including stacks, branches to fixtures and all horizontal runs with water, up to the highest opening. Let this water stand at this level for not less than two (2) hours. Perform another test after the fixtures are set, connected, and connections are made to all equipment. Test by

running water into all pipes, fixtures, traps, and apparatus in order to detect any imperfect material or workmanship. Where it is impossible to test the whole system at one time, divide into parts. Perform a smoke or ball test or any other test required by authorities having jurisdiction.

.8 Promptly repair defects which develop during tests, and then re-test system to complete satisfaction of authorized inspectors. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes is not acceptable.

.9 Connect fixtures and faucets with integral strainer only after the initial flushing out has been completed.

3.7 **COMPLETION**

.1 Provide written certification to the DCC Representative that the plumbing systems were installed, flushed and tested in accordance with appropriate codes, approved plans and calculations, and confirming the following:

.1 Water pressure test performed and plumbing systems are leak free.

.2 Plumbing inspections completed. Issue the necessary certificates.

3.8 **DEMONSTRATION**

.1 Prior to final acceptance of the Plumbing systems, the Division 22 - Plumbing Contractor shall provide operational training in all aspects of these systems to the DCC Representative's key personnel. Training shall include emergency procedures, safety requirements, and demonstration of the systems, including all interfaces with the Control and Building Automation Systems.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Sections 20 00 13 – Mechanical General Provisions and 22 05 00 - Common Works for Plumbing shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 Furnish and install sanitary waste and vent piping systems.

1.2 SUBMITTALS

.1 Shop Drawings

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

.2 Submit product data for waste and vent piping, fittings, joints and related material.

1.3 REFERENCE STANDARDS

.1 CAN/CSA B70 - Cast Iron Soil Pipe, Fittings, and Means of Joining

.2 CSA B158.1 - Cast Brass Solder Joint Drainage, Waste, and Vent Fittings

.3 CAN/CSA-B181.2 - PVC Drain, Waste and Vent Pipe and Pipe Fittings

.4 CAN/CSA B182.2 - PSM Type Polyvinylchloride (PVC) Sewer Pipe and Fittings

.5 CSA B602 - Mechanical Couplings for Drain, Waste, and Vent Pipe and Sewer Pipe

.6 ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless

.7 ASTM A74 - Standard Specification for Cast Iron Soil Pipe and Fittings

.8 ASTM A888 - Standard Specification for Hubless Cast Iron Pipe and Fittings for Sanitary and Storm Drain, Waste and Vent Piping Applications

.9 ASTM B32 - Specification for Solder Metal

.10 ASTM B306 - Standard Specification for Copper Drainage Tube (DWV)

.11 ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings

.12 ASTM C564- Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings

.13 ASTM C1540 - Standard Specification for Heavy Duty Shielded Couplings Joining Hubless Cast Iron Soil Pipe and Fittings

.14 ANSI/ASME 16.29 - Wrought Copper and Wrought Copper Alloy Solder-Joint Drainage Fittings – DWV

.15 ULC S102.2 - Standard Method of Test for Surface Burning Characteristics of building Materials and Assemblies

.16 Canadian Pipe Institute Standard Specification

.17 Cast Iron Soil Pipe Institute (CISPI) Technical Manual

PART - 2 PRODUCTS

2.1 CAST IRON PIPING AND FITTINGS

.1 Cast iron waste, drain, and vent pipe and fittings shall be used for the following applications:

.1 General service pipe buried in or in contact with earth.

.2 General service interior waste and vent piping above grade.

.2 Above grade

.1 Pipe: hubless (plain end or no-hub) cast iron to CAN/CSA-B70, ASTM A74 or ASTM A888.

.2 Mechanical sleeve joints: to CSA B602 and ASTM C1540, with neoprene or butyl rubber compression gaskets to ASTM C564, with stainless steel sleeve, and not less than four stainless steel drive clamps with stainless steel worm gears on sizes 150mm and larger.

.3 Tie rods

.1 Fabricated using double bolted riser clamps and 10mm carbon steel rods, with riser clamp placed on each side of joint; or pre-manufactured restraint system equivalent to Holdrite.

2.2 COPPER TUBE AND FITTINGS

.1 Copper tube sanitary waste, drain and vent pipe may be used for all above grade general service gravity drain application except for urinal drains, and pressure drains up to 50mm size.

.2 Pipe: hard drawn copper drainage tube (DWV) to ASTM B306

.3 Drainage fittings: wrought copper solder joint: to ANSI B16.29

.4 Cast brass solder joint: to CSA B158.1 with 50/50 solder to ASTM B32.

2.3 POLYVINYL CHLORIDE (PVC) PIPING AND FITTINGS

.1 PVC pipe and fittings are only permitted where the waste temperature is below 60°C for the following applications:

.1 General service pipe buried in or in contact with earth

.2 Buried

.1 Up to 150mm:

.1 Plain end DWV System 15 pipe with solvent weld joints to CAN/CSA-B181.2, or

.2 SRD35 gasketed pipe and fittings to CSA B182.2, or

.3 SDR35 solvent weld pipe and fittings to CSA B182.2.

.2 200mm and above:

.1 SRD35 gasketed pipe and fittings to CSA B182.2.

2.4 **GALVANIZED STEEL PRESSURE PIPE AND FITTINGS**

.1 Schedule 40 galvanized steel pipe; stretch reduced continuous weld, ASTM A53, for pressure drains 65mm and above.

.2 Fittings: Class 125, gray-iron threaded fittings to ASME B16.4.

.3 Unions: Class 150 hexagonal-stock body with ball and socket, metal to metal, bronze seating surface, malleable iron conforming to ASME B16.39 with female threaded ends.

.4 Flanges: Class 125 cast iron conforming to ASME B16.1.

.5 Flange gaskets: full face, flat non-metallic, asbestos free conforming to ASME B16.21.

.6 Flange nuts and bolts: carbon steel conforming to ASME B18.2.1

2.5 **EXPANSION JOINT FOR WASTE WATER PIPELINES**

.1 Joint to be constructed of ASTmA536 ductile iron suitable for installation on ductile iron, steel, PVC and HDPE pipes sizes from 75mm to 915mm.

.2 Joint connections to be flanged and flanges to conform to dimensional requirements of ANSI/AWWA C110/A21.10 (class150) with addition of an O-ring gasket which is provided to ensure a watertight seal or mechanical joint to conform to the dimensional requirements of either ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53 depending on size.

.3 Seals shall be constructed of EPDM and conforming to applicable requirements of ANSI/AWWA C111/A21.11.

.4 Unit to be self-restrained at full expansion without the use of external tie bars.

.5 Each unit shall be delivered tested to working pressure prior delivery; 75mm-500mm rated to 350PSI and grater to 250PSI.

.6 Product to be provided tested to maintain 4.3 psi of water pressure at 60 inch lb min/max torque bolt tightness.

.7 All “wetted” parts to be coated min 15mils of approved fusion bonded epoxy conforming to the applicable requirements of ANSI/AWWA C213.

.8 All exterior surfaces shall be coated with min 6mils of fusion bonded epoxy conforming to applicable requirements of ANSI/AWWA C116/A21.16.

PART - 3 EXECUTION

3.1 **GENERAL**

.1 Install drainage and vent systems in accordance with the requirements of the applicable federal plumbing code.

.2 Size vent lines based on developed pipe length and hydraulic load.

.3 Arrange piping within pipe spaces behind washroom fixtures to allow unimpeded access to piping for servicing.

.4 All traps and fittings shall be of same material or equal in quality and thickness to the pipe to which they are connected.

3.2 **PIPE INSTALLATION**

.1 Consider the piping layout shown on the Drawings as diagrammatic, indicating the general runs and connections, and that the piping may, or may not, in all parts be shown in true position.

.2 Ream all piping and keep plugged to prevent entry of dirt.

.3 Accurately cut pipe to the established measurements and work into place without springing or forcing. In any situation where bending of the pipe is required, use a standard pipe-bending template. Pipe hangers, supports, shall be installed accordance with Section 20 05 29 - Bases, Hangers and Supports.

.4 Anchor, guide and laterally support vertical and horizontal piping to support filled weight and absorb thrust under operating conditions.

.5 Erect piping so that gravity forces and thrust from changes in direction do not stress connections to apparatus.

.6 Changes in direction for soil and waste drainage and vent piping shall be made using appropriate branches, bends and long sweep bends. Sanitary tees and short sweep quarter bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Long turn double wye branch and eighth bend fittings shall be used if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Proper size of standard increaser and reducers shall be used if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

.7 Cast iron

.1 Install in accordance with the requirements of CISPI Chapter IV, “Installation of Cast Iron Soil Pipe and Fittings”.

3.3 **LINES, GRADES AND SLOPES**

.1 Install piping in conformity with elevations and grades indicated on the Drawings using axis lines and bench marks provided under General Construction.

.1 Verify such axis lines and bench marks.

.2 Lay out work and be responsible for lines, elevations, measurements, etc., required for installation of the Work.

.2 Slopes:

.1 Slope piping drains and sewers as indicated on the Drawings.

.2 Install so that slope between elevations shown on the Drawings is even and constant.

.3 Minimum slopes:

.1 As shown on the Drawings. If not shown, then as follows:

.1 Drainage piping, 75mm and less: 1:50.

.2 Drainage piping, 100mm and larger: 1:100.

.1 In special circumstances as provided for under the applicable plumbing code, and at the express approval of the DCC Representative, drains of 100mm size and larger may be laid at a lesser slope.

3.4 JOINTS, UNIONS, FLANGES AND COUPLINGS

.1 Pipe joints

.1 Preparation

.1 Ream pipe ends and thoroughly clean all dirt, cuttings and foreign matter from pipe after cutting and threading.

.2 Thoroughly clean all fittings, valves and equipment before connections are made.

.3 Cut copper tubing with a tube cutter and clean the joining surfaces of the tubing and fitting with fine emery cloth. Wipe clean with a dry cloth.

.2 Cast iron pipe sleeve joints

.1 For cast iron plain end soil pipe, install sleeve type couplings in strict accordance with manufacturer's instructions.

.3 Mechanical joints:

.1 Assemble mechanical joint on ductile iron pressure pipe with cast iron gland, rubber sealing gasket and high strength malleable iron bolts in accordance with the manufacturer's recommendations.

.4 Threaded joints:

.1 Use Teflon tape or Masters metallic compound with the compound applied to the male threads only and particular care taken to prevent the compound from reaching the interior of the pipe or fittings.

.2 Unions and flanges

.1 Provide unions or flanges in the following locations:

.1 At connections to equipment.

.2 In screwed or solder joint drainage tubing at inlet side of trap.

.2 If unions are concealed in walls, partitions or ceilings, build access thereto.

.3 Provide dielectric unions or isolating type companion flanges at all connections between copper tubing and ferrous piping.

.4 Flange joints

.1 Assemble joints with appropriate flanges, gaskets and bolting.

.2 Allow clearance between flange faces such that the connections can be gasketed and bolted tight without undue strain on the piping system, with flange faces parallel and bores concentric.

.3 Centre gaskets on the flange faces so as not to project into the bore.

.4 Lubricate bolts before assembly and provide 2 hardened steel washers under the head of each unit to assure uniform bolt stressing.

.5 Machine off raised face flanges when joining to a flat companion flange and use a full face gasket.

.6 Follow gasket manufacturer's instructions for correct bolting procedure.

.7 Use calibrated torque wrench and tighten bolts in recommended sequence in four equal steps to required final torque value.

3.5 EXPANSION JOINT FOR WASTE WATER PIPELINES

.1 Install expansion joints where required.

.2 Assemble joints with flanges or mechanical joints, seals and bolts.

.3 Allow clearance between flange faces such that the connections can be gasketed and bolted tight without undue strain on the piping system, with flange faces parallel and bores concentric.

.4 Follow manufacturer's instructions for correct installation and bolting procedure. Use calibrated torque wrench and tighten bolts in recommended sequence in four equal steps to required final torque value.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Sections 20 00 13 – Mechanical General Provisions and 22 05 00 - Common Works for Plumbing shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 Provide sanitary sewage pumps, associated level controllers and control panels.

1.2 RELATED WORK

.1 The following work is provided under other Sections or Divisions of the Work:

.1 Concrete sewage sumps: Division 03 – Concrete.

1.3 SUBMITTALS

.1 Shop Drawings

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

.2 Submit product data for all products. Shop drawings shall include, but not be limited to: pump curves, individual computer data sheets, system drawings, and complete description of control panel, with wiring diagram, sequencing data, instrumentation and alarms.

PART - 2 PRODUCTS

2.1 PUMP GENERAL REQUIREMENTS

.1 The following are minimum construction requirements, unless specified elsewhere.

.2 Pump casings:

.1 Close grained cast iron or cast bronze as specified.

.2 Fitted with casing or impeller wear rings, or both.

.3 Impellers:

.1 Enclosed bronze or duralloy.

.2 Dynamically balanced.

.3 Mounted on carbon steel shaft fitted with stainless steel or bronze sleeves.

.4 Seals:

.1 Fitted with mechanical seals.

.5 Performance

.1 Characteristic curve to be continuously rising to from run-out to shut-off.

.2 Select pump to operate within flow range from 30% below point of maximum efficiency to 10% above that point for impeller diameter chosen.

.3 Installed impeller diameter not to exceed 90% of maximum impeller diameter catalogued for pump casing.

.4 Motors to be sized for continuous operation without motor overload at runout condition for impeller size and rotational speed selected.

2.2 SANITARY SUMP PUMPS

.1 Construction

.1 Duplex pump set

.2 Centrifugal sewage pump, vertical, shaft driven, single stage, non-clog

.3 Cast iron casing and cast iron semi-open impeller, alloy steel shaft

.4 Ball thrust bearing, bronze guide bearings, grease lubrication

.5 Cast iron motor support

.6 Motor

.7 Schedule 40 black steel pump leg and discharge pipe.

.8 Integral cast base to support pump on sump pit floor.

.2 Fitments

.1 Hinged steel cover plate complete with structural steel curb frame suitable for grouting into a concrete sump, and heavy gasket

.2 Coordinate delivery of curb frame to meet construction requirements. Frame will be installed by General Trades when pouring concrete sump

.3 Cover plate free from holes, conduit penetrations, or other raised elements.

.3 Duplex Pump Control

.1 Duplex Pumps automatically controlled by an electric alternator panel.

.2 Automatically alternates lead pump and operates both pumps on high flow demand.

.3 Provide alternator control assembly complete with starters, mounting bracket, brass float rod, limit stops, float rod guide, copper float and control transformer.

.4 Single point power supply.

.5 Provide industrial quality heavy gauge painted steel panel meeting EEMAC 1 requirements. The panel shall include a quarter turn latch.

.6 The panel is to be an indoor rated TECP series pump controller complete with intrinsically safe circuitry for the floats

.7 Control panel to be complete with visual and audible alarm and push to silence button.

.8 Dry contacts for the following points to be monitored by the BAS:

.1 Pump 1 running

.2 Pump 2 running

.3 High Level alarm

.4 General Status alarm

.9 Manufacturers

.1 S.A. Armstrong

.2 Taco Leitch

.3 Paco

.4 Aurora.

.5 Goulds

PART - 3 EXECUTION

3.1 INSTALLATION

.1 General

.1 Make piping and electrical connections to pumps.

.2 Check pump rotation.

.3 Set up and adjust controls.

.4 Pipe drain tapping to drain.

.5 Install gauges.

.2 Sanitary Sump Pumps

.1 Power wiring between starters and pump motors. Line side wiring will be connected to starters under Division 26. Provide wiring from pump control panel to pumps.

.2 Provide gate valve and non-slam counterweighted check valve and flexible metal in discharge line from each pump. Set counterweight arm in horizontal position. Locate piping concealed in wall complete with access door.

.3 Keep discharge piping clear of pumps to facilitate removal from sump.

.4 Align pump assembly after mounting and securing cover plate.

.5 Configure floats for operation of pumps as per the following sequence:

.1 Float 4 – High alarm – Alarm at Controller and BAS.

.2 Float 3 – Lag pump - start lag pump

.3 Float 2 – Lead pump – start lead pump

.4 Float 1 – Pumps off – Turn off lead and lag pump.

.6 Test operation of pumps by activating floats (manually or with water). Ensure alternation and High alarm features are operational.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section 20 00 13 – Mechanical General Provisions shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 This Section supplements all Sections of Division 23 – HVAC.

.2 The intent of the Division 23 – HVAC Specifications and the accompanying Drawings is to provide complete and workable HVAC systems as shown, specified and required by applicable codes. Include all work specified under Division 23 - HVAC and shown on the accompanying Drawings.

.3 The Drawings that accompany the Division 23 – HVAC Specifications are diagrammatic. It is the responsibility of this Contractor to ensure that adequate and appropriately sized air distribution systems are provided. The Contract Drawings do not show each offset, bend, tee, or elbow which may be required to install the HVAC Work in the space provided and to avoid conflicts. Follow the Drawings as closely as is practical to do so and install additional bends, offsets and elbows where required by local conditions from measurements taken at the Site, subject to approval, and without additional cost to the DCC Representative.

.4 Major aspects of the HVAC Work shall include but not necessarily be limited to, the following items:

.1 Stairwell pressurization system

.2 Elevator machine room cooling system, , consisting of split system air conditioner with wall mounted evaporator unit.

.3 HVAC modifications at new fire separations.

1.2 RELATED WORK

.1 The following Work is provided under other Sections or Divisions of the Work:

.1 Finish painting: Division 09 - Finishes.

.2 Electrical wiring: Division 26 - Electrical.

1.3 QUALITY ASSURANCE

.1 Manufacturer Qualifications:

.1 Companies specialized in manufacturing heating, ventilation, air conditioning, natural gas, and fuel oil products specified under the Sections of Division 23 – HVAC with minimum three years of documented experience.

.2 Equipment certification

.1 Equipment and fittings designated as pressure vessels or Class “H” fittings as per CSA B51, Part 1 shall:

.1 Be ASME stamped, and

.2 Have CRN registration.

.3 Conform to CSA, municipal, provincial and federal building codes', DCC Representative's HVAC Standard requirements as applicable for this project.

.4 Layout drawings:

.1 HVAC systems arrangement as shown on the Contract Drawings is diagrammatic. The Division 23 – HVAC Contractor must check and verify all dimensions and conditions on the Site, and ensure that the Work can be performed as indicated. Report all discrepancies to the DCC Representative before proceeding with the Work.

.2 Maintain maximum headroom in areas with no ceilings. Refer to additional design requirements contained in other sections of the Division 23 Specification.

.3 HVAC systems layout drawings shall take into consideration architectural, structural, mechanical and electrical layouts of the building. Piping and ductwork mains and branches must be arranged to not interfere.

1.4 DESIGN CRITERIA

.1 Noise and vibration

.1 Noise levels due to equipment and ductwork shall permit attaining sound pressure levels in all eight (8) octave bands in occupied spaces conforming to noise criteria (NC) levels listed in the below table.

Noise Criteria	
Space Usage	**Max. Noise Level (NC)**
Library	25-30
Private Office	30-35
Open Plan Office	35-40
Conference, Meeting Room	25-30
Classroom	25-30
Hall, Corridor	35-40
Locker Room, Washroom	40-45

.2 Install equipment, piping and ductwork in accordance with good noise and vibration control engineering practices in order to meet the requirements specified in this Section.

.3 If noise or vibration levels created by any mechanical equipment and systems transmitted to the occupied portion of the building or to other mechanical work, are over the maximum allowable levels, make all necessary changes to reduce the noise and vibration levels without any additional cost to the DCC Representative.

1.5 **SUBMITTALS**

.1 Shop Drawings

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

.2 Submit product data for flashing system.

1.6 **PERMITS AND INSPECTIONS**

.1 Submit layout drawings to the municipal Building Department; apply for and obtain permits required for HVAC Work and pay all costs levied for permits and inspections.

PART - 2 PRODUCTS

2.1 **HANGERS AND SUPPORTS**

.1 In accordance with Section 20 05 29 - Bases, Hangers and Supports.

2.2 **THERMAL INSULATION**

.1 In accordance with Section 20 07 00 - Mechanical Insulation.

2.3 **IDENTIFICATION FOR EQUIPMENT, VALVES AND PIPING**

.1 In accordance with Section 20 05 53 - Mechanical Identification.

2.4 **ELECTRIC WIRING**

.1 In accordance with Section 20 05 13 - Common Wiring Requirements.

2.5 **EXPANSION COMPENSATION**

.1 In accordance with Section 20 05 16 - Expansion Control.

2.6 **ESCUTCHEONS**

.1 Escutcheons shall be satin-finish, corrosion-resisting steel, polished chromium-plated zinc alloy, or polished chromium-plated copper alloy. Obtain Interior Designer's approval for the required finish. Escutcheons shall be either one-piece or split-pattern, held in place by internal spring tension or setscrew.

2.7 **FLASHING**

.1 Flashing for through-roof penetration and other waterproofed areas:

.1 Manufactured from composite material;

.2 Minimum dimensions of 500 mm x 500 mm;

.3 With sleeve extending at least 150 mm above roof.

PART - 3 EXECUTION

3.1 **GENERAL**

.1 Execute the HVAC Work in accordance with requirements specified in the various Sections of Division 23 – HVAC.

.2 Install complete HVAC ductwork and piping in accordance with the municipal, provincial and federal building codes, standard trade practice and as specified in this Specification.

.3 Anchor, guide and support vertical and horizontal runs of piping to resist dead load and absorb thrust.

.4 Electrical interconnection of controls and instruments: is generally not shown but shall be provided. This includes interconnection of sensors, transmitters, transducers, control devices, control and instrumentation panels, alarms, instruments and computer workstations.

3.2 **FLASHING**

.1 Provide flashing for piping penetrations through roofs and other waterproofed areas. Leave flashing ready for the Contractor performing the roofing Work to make watertight connections.

3.3 **ESCUTCHEONS**

.1 Install escutcheons at finished surfaces where bare or insulated exposed piping passes through floors, walls, or ceilings in finished areas. Escutcheons shall be fastened securely to pipe or pipe covering. In wet or humid areas such as washrooms, housekeeping rooms, pool areas, seal pipe penetrations through unrated walls behind escutcheons using plumber's putty.

3.4 **PAINTING**

.1 Coordinate the finish paint of plumbing piping with the Contractor performing the Work of Section 09 91 00 – Painting as follows:

.1 Concealed from view: not painted.

.2 Exposed to view: bare, uninsulated cast iron pipe and associated hangers exposed to view in finished areas shall be painted with one coat approved rust inhibiting primer.

3.5 **TESTING**

.1 Execute HVAC systems and equipment tests in accordance with the requirements of municipal, provincial and federal plumbing codes. For testing procedures of specialty systems refer to the respective Sections of the Division 23 - HVAC Specifications.

.2 Charge system with water only when there is no possibility of freeze-up.

.3 Check horizontal pipe with an accurate level for any alterations in pitch. Inspect laterals, cross arms, and eliminate pockets. Correct any cases of water hammer.

.4 Execute tests in the presence of the DCC Representative.

.5 Test ductwork following the procedure described under Section 23 31 00 - HVAC Ducts and Casings.

.6 Promptly repair defects which develop during tests, and then re-test system to complete satisfaction of authorized inspectors. Repairs to piping shall be made with new materials. Caulking of screwed joints or holes is not acceptable.

3.6 **COMPLETION**

.1 Provide written certification to the DCC Representative that the HVAC pipe systems were installed and tested in accordance with appropriate codes, approved plans and calculations, and confirming the following:

.1 HVAC pipe systems are leak free.

.2 HVAC inspections completed. Issue the necessary certificates.

3.7 **DEMONSTRATION**

.1 Prior to final acceptance of the Plumbing systems, the Division 23 - HVAC Contractor shall provide operational training in all aspects of these systems to the DCC Representative. Training shall include emergency procedures, safety requirements, and demonstration of the systems, including all interfaces with the Control and Building Automation Systems.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Sections 20 00 13 – Mechanical General Provisions and 23 05 00 - Common Works for HVAC shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 Provide commissioning for HVAC systems and equipment in accordance with the Contract Documents, and with Section 01 91 13 - General Commissioning Requirements.

1.2 GENERAL

.1 Commissioning work shall be a team effort to ensure that all HVAC equipment and systems have been completely and properly installed, function correctly to meet the design intent, and to document system performance parameters for fine tuning of control sequences and operational procedures.

.1 Refer to Section 01 91 13 - General Commissioning Requirements regarding Roles and Responsibilities of all parties involved in the commissioning process.

.2 The Commissioning process develops, coordinates, and documents the following:

.1 Equipment start-up

.2 Control system calibration

.3 Testing and balancing

.4 Verification and Performance Testing

.5 Operation documentation

.6 Operator training

.3 HVAC system installation, start-up, testing, balancing, preparation of O&M manuals and operator training are the responsibility of the Contractor performing the Work of Division 23 – HVAC; coordination of the commissioning process is the responsibility of the Commissioning Authority in conjunction with the Contractor.

.4 The Commissioning Program is divided into four parts:

.1 Part 1: Verification Testing

.2 Part 2: Performance Testing

.3 Part 4: Operator Training

1.3 SUBSTANTIAL COMPLETION

.1 Substantial completion of the HVAC Work requires the following parts of the Commissioning Program to be completed and accepted by the DCC Representative:

.1 Part 1: Verification Testing

.2 Part 4: Operator Training

.2 Part 2 – Performance Testing may begin before Substantial Completion and extend upwards of nine (9) months after Substantial Completion, based on seasonal conditions required to obtain test load conditions.

1.4 **WORK INCLUDED**

.1 Commissioning Work of Division 23 – HVAC includes, but is not limited to:

.1 Testing and start-up of equipment.

.2 Testing, adjusting and balancing of air systems.

.3 Cooperation with the Commissioning Authority in developing and implementation of the commissioning plan.

.4 Providing qualified personnel for participation in commissioning tests, including seasonal testing required after the initial testing.

.5 Providing equipment, materials, and labor as necessary to correct construction and/or equipment deficiencies found during the commissioning process.

.6 Providing operation and maintenance manuals and as-built drawings to the Commissioning Authority for verification.

.7 Providing training and demonstrations for the systems specified in this Division.

.8 Complete and submit within 10 business days of the equipment being installed CMMS (Computerized Maintenance Management System) data sheets provided by the DCC Representative; a sample of this sheet is enclosed to this Section.

.2 Conduct complete and thorough evaluation and documentation of the operation and performance of all components, systems, and sub-systems, including the following equipment and systems:

.1 Air handling systems;

.2 Split system air conditioners

.3 Commissioning documentation includes but is not limited to:

.1 Progress and status reports, including deficiency lists

.2 Verification of Pre-start and Start-up procedures and results

.3 Performance testing procedures and results

.4 Training agenda and materials

.5 As-built records

.6 Final Commissioning report

.7 Operation and maintenance manuals

1.5 **RELATED WORK**

.1 Section 20 05 83 – Start-Up and Performance Testing

.2 Section 20 05 93 – Testing, Adjusting and Balancing

1.6 **REFERENCE STANDARDS**

.1 ASHRAE Standard 202 - Commissioning Process for Buildings and Systems

.2 ASHRAE Guideline 1.1 - HVAC&R Technical Requirements for the Commissioning Process

1.7 **DOCUMENTATION DELIVERABLES**

.1 Prepare and submit documentation in accordance with Section 001 91 13 General Commissioning Requirements.

PART - 2 PRODUCTS

2.1 **TEST EQUIPMENT - GENERAL**

.1 Furnish all special tools and equipment required during the commissioning process.

.2 Submit a list of tools and equipment to be used during the commissioning process to the Commissioning Authority for approval.

.3 Utilities (water, gas, fuel oil, electrical power) will be provided by the DCC Representative.

2.2 **TEST EQUIPMENT – PROPRIETARY**

.1 Provide any proprietary test equipment and software required by any equipment manufacturer for programming and/or start-up, whether specified or not.

.2 The Manufacturer shall provide the test equipment, demonstrate its use, and assist in the commissioning process as needed.

.3 Proprietary test equipment and software shall become the property of the DCC Representative upon completion of the commissioning process.

PART - 3 EXECUTION

3.1 **GENERAL**

.1 Complete all phases of work so that the system can be started, tested, balanced, and DCC Representative’s acceptance procedures be undertaken.

.2 Participate and assist in the development of the Commissioning Plan by the Commissioning Authority, by providing all necessary information pertaining to the equipment and installation. Provide commissioning schedule information to be incorporated into the overall Commissioning Plan schedule.

.3 Acceptance procedures may begin prior to completion of a system and/or sub-system. Start of acceptance procedures before system completion does not relieve the Contractor from completing those systems in accordance with the commissioning and construction schedule.

3.2 **COMMISSIONING MEETINGS**

.1 Participate in pre-commissioning and commissioning meetings as scheduled by the Commissioning Authority and the Construction Manager.

3.3 **PARTICIPATION IN ACCEPTANCE PROCEDURES**

.1 Provide skilled technicians to start-up and debug all systems provided within the Division 23 – HVAC scope of Work. Include for labour, materials, and subsistence costs for these same technicians to assist the Commissioning Authority in completing the commissioning program.

.2 Provide details regarding work schedules, time commitments, work sequence programming, to the Commissioning Authority, to permit the development and monitoring of a coordinated commissioning schedule.

.3 Ensure that qualified technicians are available and present during commissioning testing to complete the tests, make adjustments and to assist in problem resolutions.

.4 Should any equipment or system experience performance problems, or reconstruction or replacement of components is required, include for additional technician time for subsequent retesting of systems until the required system performance is achieved.

.5 The Commissioning Authority reserves the right to approve the proposed technicians with regard to the technical skill level required for each type of equipment and/or system.

3.4 **PROBLEM RESOLUTION**

.1 In the event that additional work is required to correct systems, misapplied equipment, and/or deficient performance under varying load conditions, this work will be carried out under the direction of the DCC Representative.. Assist the DCC Representative. and Commissioning Authority in developing an acceptable resolution to the problem, including the resources of equipment suppliers.

.2 The DCC Representative. has final jurisdiction over any additional work required to achieve the required level of performance.

.3 Complete corrective work in a timely fashion to permit completion of the commissioning process.

3.5 **ADDITIONAL COMMISSIONING**

.1 Additional commissioning activities may be required after the completion of system performance testing. Allow for a reasonable reserve to complete this work, including assistance from manufacturers' service technicians.

3.6 **SEASONAL COMMISSIONING**

.1 Commence initial performance testing commissioning at the completion of the installation Work and verification testing phase. Conduct performance testing, which is weather dependent, as applicable to current seasonal conditions. Complete performance testing on non-weather dependant systems in accordance with the agreed commissioning plan schedule.

.2 For out-of-season system performance testing, conduct initial performance tests to demonstrate off-peak load performance. Schedule peak load performance testing over the succeeding nine (9) months to ensure all equipment is tested at peak load prior to the expiry of the construction contract warranty.

.1 Test heating equipment/systems during winter design extremes.

.2 Alternatively, provide temporary equipment such as load banks to simulate full load conditions. Submit the proposed methodology for review by the Commissioning Authority and the DCC Representative.

3.7 **REPORT FORMAT**

.1 Prepare reports in accordance with Section 01 91 13 General Commissioning Requirements.

3.8 **TESTS PROCEDURES**

.1 Perform tests in accordance with Section 20 05 93 Testing, Adjusting and Balancing.

3.9 **OPERATING AND MAINTENANCE TRAINING**

.1 Conduct operator training with assistance from manufacturers' service technicians in accordance with Section 01 91 13 General Commissioning Requirements.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Sections 20 00 13 – Mechanical General Provisions and 23 05 00 - Common Works for HVAC shall apply to and govern this Section.

.1 Section includes Labour, products, equipment and services necessary to complete the work of this Section.

.2 Scope of Work:

.1 Design, supply, install, test and adjust all local control and monitoring systems specified under the diverse Sections of Division 23 – HVAC.

.2 Automatic control damper operators

1.2 RELATED WORK

.1 The following work is provided under other Sections or Divisions of the Work:

.1 Power supply to HVAC equipment and to associated control equipment: Division 26 – Electrical.

1.3 SUBMITTALS

.1 Shop Drawings

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

.2 Submit product data for all control components including technical specification data sheets for each system component, sequence of operation, wiring diagrams, control device arrangements, control device locations on floor plans to scale.

1.4 REFERENCE STANDARDS

.1 Ontario Electrical Safety Code

.2 Canadian Electrical Code

1.5 QUALITY ASSURANCE

.1 Provide electrical and electronic equipment which is CSA approved where such approval is required by the authorities having jurisdiction.

.2 Conduit and wiring materials and methods shall be in strict accordance with the requirements of Division 26 – Electrical and the applicable provincial and federal electrical codes and standards.

PART - 2 PRODUCTS

2.1 CONTROL AND INTERLOCK WIRING

.1 Provide control and interlock wiring for stair pressurization fan system with local control components supplied lose. Refer to specific requirements under the diverse Sections of Division 23 – HVAC.

.2 Wiring shall be in accordance with the requirements of Section 20 05 13 – Common Wiring Requirements and Division 26 – Electrical.

2.2 CONTROL DAMPERS

.1 General

.1 For dampers located near fan outlets, provide dampers rated for fan outlet velocity and close-off pressure, and recommended by damper manufacturer for fan discharge damper service.

.2 Control dampers used as smoke dampers shall comply with UL 555S. Control dampers used as fire dampers shall comply with UL 555.

.3 Modulating control dampers: opposed blades; parallel blades when directional mixing is desired (e.g. inside AHUs)

.4 Two-position control dampers: parallel blades

.2 Construction:

.1 Structurally formed steel or extruded aluminium, interlocking minimum 140 mm wide air-foil blades, complete with extruded, mechanically fastened EPDM or silicone seals, extruded silicone or spring stainless steel frame seals, structurally formed and welded galvanized steel or extruded aluminum frame.

.2 Dampers used in contact with outdoor air (intake and exhaust): Blades shall be internally insulated with expanded polyurethane foam and shall be thermally broken complete with silicone seals. Complete blade assembly shall have a thermal resistance of RSI-0.41 (R-2.3). The entire frame shall be thermally broken by means of polyurethane resin pockets complete with thermal cuts.

.3 Pressure fit self-lubricated bronze or Celcon bearings rotating within a polycarbonate outer bearing inserted into the frame. Single axle bearing, rotating in an extruded or punched hole is not acceptable.

.4 Linkage: galvanized steel tie rods, brass pivots and galvanized steel brackets, complete with galvanized steel control rod, outside the air stream and concealed within the frame.

.3 Performance:

.1 Dampers shall be AMCA rated for leakage class 1A at 250 Pa static pressure differential and class 1 at 1,000 Pa.

.2 Maximum pressure drop: 12.5 Pa at 5.1 m/s.

.4 Standard of Acceptance:

.1 Tamco Series 1000; 9000BF for outdoor air.

.2 Ruskin CD50; TED50 for outdoor air.

.3 Nailor 2010 / 2020; IBF for outdoor air.

.4 Greenheck VCD-42; ICD-45 for outdoor air.

.5 Alumavent 3160SI; 3960BFSS for outdoor air.

2.3 DAMPER ACTUATORS

.1 General:

.1 Provide dampers with low torque, fully modulating, floating (tri-state) or two position electronic actuators sized with sufficient reserve torque or force to assure smooth, positive operation over the entire operating range, without chatter or slamming, and to give tight shutoff at end positions against the system pressures to be encountered.

.2 Actuators shall include a visual scale indicating percent of travel and a 0-10 VDC feedback signal.

.3 Provide spring-return actuators with manual override to provide positive shut-off of devices.

.4 Failure position:

.1 Spring return, normally open or normally closed sequence as required so that systems will “Fail-safe” in case of power failure.

.2 Motorized dampers:

.1 Stair pressurization relief: spring open;

.2 Stair pressurization fan: spring open.

.3 Other applications: as required by the sequences of operation.

.5 Actuators shall be enclosed reversible gear drive type that can accept modulating control signals as required. Actuators using balance relays or mechanical travel limiting switches are not acceptable.

.6 Actuators to include current limiting or digital motor rotation sensing circuits to provide motor protection. End switches to deactivate the actuator at the end of rotation or magnetic clutch are not acceptable.

.7 Sequencing by spring range is prohibited.

.8 Proportional actuators shall be fully programmable through an EEPROM without the use of actuator mounted switches.

.9 Actuators installed in outdoor service application shall operate satisfactorily at a temperature range of -30°C through 50°C.

.2 Damper actuators

.1 Actuators shall be direct coupled (over the shaft), enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The actuator-to-shaft clamp shall use a "V" bolt and "V" shaped, toothed cradle to attach to the damper shaft for maximum holding strength. Single bolt or set screw type fasteners are not acceptable.

.2 Actuators with spring return mechanisms shall be capable of either clockwise or counter clockwise spring return operation by simply changing the mounting orientation.

.3 Proportional actuators shall accept a 2-10VDC, 4-20mA signal, or be of the 2 point floating type and provide a 2-10VDC actuator position feedback signal.

.4 All actuators shall have an external manual gear release (clutch) or manual crank to aid in installation and for allowing manual positioning when the actuator is not powered.

.5 All actuators shall have an external direction of rotation switch to aid in installation and to allow proper control response.

.6 Actuators shall be provided with a factory-mounted 3-foot electrical cable and conduit fitting to provide easy hook-up to an electrical junction box.

.7 Actuators shall be listed to UL 873.

2.4 **ELECTRICAL CONTROL DEVICES**

.1 Switches

.1 Provide switches for system monitoring, safety and operational interlocks.

.2 Relays

.1 Provide electric switching relays, ULC listed, as required and where indicated. Unless otherwise indicated, install relays within control cabinet. Provide line voltage or low voltage general purpose type relays unless heavy duty type are indicated.

.3 Control cabinets and panels

.1 Provide control cabinets and panels with mounting brackets sized to house all local control devices.

PART - 3 EXECUTION

3.1 **INSTALLATION**

.1 Install all components and make interconnections.

.2 Connect electric control equipment and interlocks accordance with the requirements of Division 26 – Electrical.

.3 Post a control diagram of each local control system, as prepared by manufacturer.

3.2 **CONTROL DAMPERS**

.1 When used in fan discharge applications, locate dampers at least one-half the fan diameter away from the fan.

.2 Install square and free from racking.

.3 Multiple section damper assemblies may require bracing to support the weight of the assembly and to hold against system pressure. Refer to the manufacturer's installation instructions.

.4 Seal between multiple damper modules and at damper frames using approved duct sealant.

.5 Install a duct access door adjacent to each damper installed in ductwork.

.6 All damper actuators shall be rigidly mounted and supplied with heavy-duty linkage consisting of a crank arm, pushrod, and swivel ball joint to connect to the damper shaft. Secure linkages to prevent slipping under normal operating torque.

.7 Install damper motors on the outside of ducts in protected areas, not in locations exposed to outdoor temperatures where possible.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Sections 20 00 13 – Mechanical General Provisions and 23 05 00 - Common Works for HVAC shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 Provide refrigerant pipe systems, including valves, fittings, accessories and connections to all equipment.

1.2 SUBMITTALS

.1 Shop Drawings

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

.2 Submit product data for refrigerant systems piping, fittings, joints, valves and related material.

1.3 REFERENCE STANDARDS

.1 ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service

.2 ANSI B31.5 - Code for Pressure Piping

.3 CSA B52-M - Mechanical Refrigeration Code

.4 ASHRAE 15 - Safety Standard for Refrigeration Systems

PART - 2 PRODUCTS

2.1 GENERAL

.1 Refrigerant piping, valves, fittings, and accessories shall be in accordance with ASHRAE 15 and ASME B31.5, except as specified herein. Refrigerant piping, valves, fittings, and accessories shall be compatible with the fluids used and capable of withstanding the pressures and temperatures of the service. Refrigerant piping, valves, and accessories used for refrigerant service shall be cleaned, dehydrated, and sealed (capped or plugged) prior to shipment from the manufacturer's plant.

2.2 REFRIGERANT PIPING

.1 Pipe - Copper

.1 Type ACR copper tubing, soft annealed or hard drawn

.2 Type ACR copper tubing, hard drawn: to ASTM B280

.3 Deoxidized and dehydrated, with ends factory sealed and identified by the manufacturer as being suitable for refrigeration service

.2 Fittings - Copper

.1 Heavy wrought copper, solder joint type

.2 Adapter fittings at screwed connections

.3 On NPS 5/8 and less, flareless compression type

.3 Unions

.1 Brass tail piece adaptors for copper tubing, forged steel flanges, steel bolts, bronze nuts and asbestos-free fibre gasket.

.2 Acceptable Manufacturers: Henry Valve Company Type P30.

.4 Flexible Hose

.1 Bronze construction with braided wire exterior jacket and union connection on one end.

.2 Minimum length: 6 times the diameter of the hose.

.3 Rating: suitable for 150°C maximum temperature and 2760 kPa working pressure.

.4 Acceptable Manufacturers: Flexonics or Anaconda.

.5 Coiled section of soft annealed tubing may be used instead of hose on lines not larger than NPS 5/8.

2.3 PIPING ACCESSORIES

.1 Vibration Dampeners

.1 Dampeners shall be of the all-metallic bellows and woven-wire type.

.2 Flexible Pipe Connectors

.1 Connector shall be a composite of interior corrugated phosphor bronze or Type 300 Series stainless steel, as required for fluid service, with exterior reinforcement of bronze, stainless steel or monel wire braid. Assembly shall be constructed with a safety factor of not less than 4 at 150°C (300°F). Unless otherwise indicated, the length of a flexible connector shall be as recommended by the manufacturer for the service intended.

.3 Strainers

.1 Strainers used in refrigerant service shall have brass or cast iron body, Y-or angle-pattern, cleanable, not less than 60-mesh noncorroding screen of an area to provide net free area not less than ten times the pipe diameter with pressure rating compatible with the refrigerant service. Screens shall be stainless steel or monel and reinforced spring-loaded where necessary for bypass-proof construction.

2.4 VALVES

.1 Valves shall be designed, manufactured, and tested specifically for refrigerant service. Valve bodies shall be of brass, bronze, steel, or ductile iron construction. Valves 25 mm (1 inch) and smaller shall have brazed or socket welded connections. Valves larger than 25 mm (1 inch) shall have butt welded end connections. Threaded end connections shall not be used, except in pilot pressure or gauge lines where maintenance disassembly is required and welded flanges cannot be used. Internal parts shall be removable for inspection or replacement without applying heat or breaking pipe connections. Valve stems exposed to the atmosphere shall be stainless steel or corrosion resistant metal plated

carbon steel. Direction of flow shall be legibly and permanently indicated on the valve body. Control valve inlets shall be fitted with integral or adapted strainer or filter where recommended or required by the manufacturer. Purge, charge and receiver valves shall be of manufacturer's standard configuration.

.2 Refrigerant Stop Valves

.1 Valve shall be the globe or full-port ball type with a back-seating stem especially packed for refrigerant service. Valve packing shall be replaceable under line pressure. Valve shall be provided with a handwheel operator and a seal cap. Valve shall be the straight or angle pattern design as indicated.

.3 Check Valves

.1 Valve shall be the swing or lift type as required to provide positive shutoff at the differential pressure indicated. Valve shall be provided with resilient seat.

.4 Liquid Solenoid Valves

.1 Valves shall comply with ARI 760 and be suitable for continuous duty with applied voltages 15 percent under and 5 percent over nominal rated voltage at maximum and minimum encountered pressure and temperature service conditions. Valves shall be direct-acting or pilot-operating type, packless, except that packed stem, seal capped, manual lifting provisions shall be furnished. Solenoid coils shall be moisture-proof, UL approved, totally encapsulated or encapsulated and metal jacketed as required. Valves shall have safe working pressure of 2,760 kPa (400 psi) and a maximum operating pressure differential of at least 1,375 kPa (200 psi) at 85 percent rated voltage. Valves shall have an operating pressure differential suitable for the refrigerant used.

.5 Expansion Valves

.1 Valve shall conform to ARI 750 and ASHRAE 17. Valve shall be the diaphragm and spring-loaded type with internal or external equalizers, and bulb and capillary tubing. Valve shall be provided with an external superheat adjustment along with a seal cap. Internal equalizers may be utilized where flowing refrigerant pressure drop between outlet of the valve and inlet to the evaporator coil is negligible and pressure drop across the evaporator is less than the pressure difference corresponding to 1°C (2°F) of saturated suction temperature at evaporator conditions. Bulb charge shall be determined by the manufacturer for the application and such that liquid will remain in the bulb at all operating conditions. Gas limited liquid charged valves and other valve devices for limiting evaporator pressure shall not be used without a distributor or discharge tube or effective means to prevent loss of control when bulb becomes warmer than valve body. Pilot-operated valves shall have a characterized plug to provide required modulating control. A de-energized solenoid valve may be used in the pilot line to close the main valve in lieu of a solenoid valve in the main liquid line. An isolatable pressure gauge shall be provided in the pilot line, at the main valve. Automatic pressure reducing or constant pressure regulating expansion valves may be used only where indicted or for constant evaporator loads.

PART - 3 EXECUTION

3.1 GENERAL

.1 Use pipes which conform to CSA and ASTM standards.

3.2 **PIPING INSTALLATION**

.1 Consider the piping layout shown on the Drawings as diagrammatic, indicating the general runs and connections, and that the piping may, or may not, in all parts be shown in true position.

.2 Ream all piping and keep plugged to prevent entry of dirt.

.3 Accurately cut pipe to the established measurements and work into place without springing or forcing. In any situation where bending of the pipe is required, use a standard pipe-bending template. Pipe hangers, supports, restraint of system piping and seismic bracing shall be installed accordance with Sections 20 05 29 - Bases, Hangers and Supports.

.4 All fittings shall be of same material or equal in quality and thickness to the pipe to which they are connected.

.5 Anchor, guide and laterally support vertical and horizontal piping to support filled weight and absorb thrust under operating conditions.

.6 Erect piping so that gravity forces and thrust from changes in direction do not stress connections to apparatus.

.7 Thoroughly clean the inside of fittings and outside of pipe with steel wool and coat with flux, before soldering or brazing any copper pipe work joint. Remove the working parts of valves before soldering or brazing commences, and replace after soldering or brazing is complete. Solder or braze joints with blow torch or oxy-acetylene flame.

.8 Copper Pipe – above grade

.1 Provide dielectric unions or couplings at all connections between copper tubing and ferrous piping.

3.3 **JOINTS, UNIONS, FLANGES AND COUPLINGS**

.1 Pipe joints

.1 Preparation

.1 Ream pipe ends and thoroughly clean all dirt, cuttings and foreign matter from pipe after cutting.

.2 Thoroughly clean all fittings, valves and equipment before connections are made.

.3 Cut copper tubing with a tube cutter and clean the joining surfaces of the tubing and fitting with fine emery cloth. Wipe clean with a dry cloth.

.2 Change of direction

.1 Use standard pipe fittings.

.2 Use long radius welded steel elbows unless short radius elbows are specifically authorized by the DCC Representative.

.3 Mitered joints or field fabricated pipe bends are not permitted.

3.4 **REFRIGERANT PIPING**

.1 Install piping to conform to applicable requirements of ANSI B31.5 Code for Pressure Piping Section 5 "Refrigeration Piping" and CSA B52-M "Mechanical Refrigeration Code" latest issue.

.2 Make solder type joints with "sil-fos" silver solder or similar high melting point solder having a melting point of at least 538°C. Remove all interior parts of refrigerant specialties and valves before applying heat to the joint.

.3 Provide refrigerant hoses on refrigerant line connections to equipment with reciprocating or rotating elements.

.4 Test procedure and evacuation procedures: conform to ANSI B31.5.

.5 Test pressure: in accordance with CSA Code B52-M.

.6 Provide all refrigerant required for testing and charging of the system.

.7 Purge refrigerant piping with anhydrous nitrogen prior to making connection to pre-evacuated equipment to ensure removal of all moisture and non-condensable gases.

.8 Completely evacuate to 0.5 torr (500 micron), seal and leave for 24 hours, re-evacuate to 0.5 torr, and charge all components of refrigeration system not evacuated by manufacturer, in accordance with manufacturer's printed recommendations.

.9 Do not use the refrigeration compressor to evacuate the system under any circumstances. Evacuation the system using a vacuum pump at an ambient temperature not less than 2°C to ensure removal of all moisture and non-condensable gases.

.10 After testing, evacuation and charging is completed, allow system to operate under normal conditions for a minimum period of 24 hours, at which time, moisture indicator should indicate a dry system. If it does not so indicate, change dryer and operate unit for another 24 hours. Repeat this procedure until moisture indicator indicates a thoroughly dry system.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Sections 20 00 13 – Mechanical General Provisions and 23 05 00 - Common Works for HVAC shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 Supply and install HVAC supply air, transfer air, return air, fresh air intake and exhaust duct systems, including:

.1 Galvanized steel ducts

1.2 SUBMITTALS

.1 Shop Drawings

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

.2 Submit product data for rigid and flexible ductwork, and all related materials.

1.3 REFERENCE STANDARDS

.1 SMACNA HVAC Duct Construction Standards, Metal and Flexible

.2 SMACNA HVAC Air Duct Leakage Test Manual

.3 AABC Test and Balance Procedures

.4 NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems

PART - 2 PRODUCTS

2.1 DUCT WORK

.1 Materials

.1 Galvanized steel sheet:

.1 Z275 (G60) for unpainted duct work, indoor

.2 ZF075 (A25) designation zinc coating to ASTM A653/A653M for painted duct work

.2 Plain mild carbon steel:

.1 To ASTM A1011, A283, A572 and A36 as applicable

.3 Solder for watertight duct work:

.1 To ASTM Standard B32

.4 Metal Duct Sealant – High Velocity Duct Sealer, Non-Solvent based.

.1 Faster 32-17

.2 Hardest Iron Grip # 601

.3 Duro Dyne DWN

.4 Transcontinental Equipment “MP”

PART - 3 EXECUTION

3.1 GENERAL

.1 Environmental Requirements

.1 Maintain a space work temperature not less than the minimum ambient working temperature as required by the duct sealant manufacturer requirements. Any duct work sealant installed where the space temperature is less than these recommendations will be removed and replaced.

.2 Field Measurements

.1 Make detailed field measurements for routing of new duct work, and provide all offsets and transitions which may be required to accommodate the new work with existing and new services.

.3 Protection

.1 Temporarily cap-off duct work openings to protect against dirt accumulation inside the duct work.

3.2 DUCT WORK

.1 General

.1 Install duct work in arrangement shown on Drawings in accordance with standards and recommended practices of ASHRAE and SMACNA. Provide required offsets and transitions, whether specifically indicated or not, to facilitate duct installation and to avoid interference with building structure, piping, equipment and services.

.2 Duct sizes as shown on Drawings. Where ducts are to have internal acoustical liner, adjust duct size to accommodate acoustic liner thickness; clear inside dimensions as shown on Drawings.

.3 Fabricate duct work free from vibration, rattle or drumming under operating conditions; reinforce, brace, frame, place gaskets, etc. to comply with performance criteria.

.4 Place galvanized screens of 13 mm x 13 mm mesh x 2.7 mm diameter wire for air intakes, exhausts and open ends of duct work.

.5 Install duct work in locations and at elevations appropriate to ceiling heights shown on Drawings. Where required to be concealed, install duct work in furred spaces provided in walls and ceilings. Where there is no provision for concealment install duct as close as possible to walls, partitions and overhead structures to attain maximum headroom and clearance.

.6 Where shape of duct changes, install transition piece so that angle of side of transition piece does not exceed 15 degrees from straight run of duct being connected, unless shown otherwise on Drawings.

.2 Pressure Class / Seal Class

.1 Seal all duct work in accordance with SMACNA Seal Class “A”: All transverse joints, longitudinal seams, and duct wall penetrations

.3 Sleeves

.1 Install sleeves where ducts pass through walls or floors. Pack space between duct and sleeve with mineral wool and seal both ends with non-inflammable fire resistant sealing compound. Install sheet metal closure plates on each side of wall to cover sleeve.

.2 Sleeves: of the same sheet material and thickness as for duct work.

.4 Equipment Connections

.1 Install neoprene gasketed flanged joints at duct connections to air conditioning units, coils. Fabricate flanges from mild steel angles to match equipment flanges.

.2 Install silencers independent of duct work, with rods or angles of sizes adequate to support load.

.5 Paint Finish and Touch-Up

.1 Paint interior of duct work for at least 300 mm behind supply and exhaust grilles with matte black paint to render duct work invisible from occupied space.

.2 Touch-up galvanized steel damaged as a result of fabrication, including welding, with zinc dust galvanized primer.

.6 Supports and Hangers

.1 Support intervals:

.1 Ducts up to 1500 mm in width: minimum 2400 mm centres

.2 Ducts 1500 mm in width and over: 1200 mm centres

.2 Strap Hangers:

.1 For duct size up through 760 mm width

.2 3 mm x 25 mm mild steel bar stock. Bend strap hanger around bottom of duct for a minimum of 38 mm and attach to sides and bottom of duct.

.3 Steel Angle Hangers:

.1 For duct sizes over 760 mm in width

.2 Mild steel rod hangers of 10 mm dia. minimum size, with 38 mm x 38 mm x 3 mm steel angle across bottom of duct and attach hanger to angle (not the duct).

.4 Install miscellaneous steel angles or channels as required between joists or building steel for structural support of duct where building framing spacing does not coincide with the required hanger spacing.

3.3 RECTANGULAR DUCT WORK

.1 General

.1 Material: galvanized steel for unpainted duct work, unless otherwise shown on drawings.

.2 Metal thickness and construction methods as specified herein for various size ranges of ducts.

.3 Cross-break flat surfaces of uninsulated duct between joints, or between joints and intermediate reinforcements, to prevent vibration or buckling.

.4 Seal joints on all rectangular duct work with high velocity duct sealer. Duct-tape will not be allowed.

.2 Joints

.1 Longitudinal joints: Pittsburgh Lock joints tightly closed along full length of seam.

.2 Transverse joints: Ductmate, Nexus or TDC connections of class to suit size of duct and pressure of system.

.3 Fittings

.1 Elbows, transition sections and take-off fittings: use metal one gauge heavier than thickness specified for duct in which they are installed.

.2 Radius elbows: standard radius design with inner radius equal to width of elbow unless shown otherwise, Pittsburgh Lock seams, and with ends to match transverse joints of duct.

.3 Square elbows: where elbows are shown as square type, fit elbows with air turning vanes of double blade construction.

3.4 INSPECTION, TESTING AND BALANCING

.1 Cleaning

.1 Wipe clean all ductwork internally before erection.

.2 Clean ducts after installation to remove any dust and debris.

.2 Balancing of Air Systems

.1 Balance air handling systems in accordance with Section 20 05 93 - Testing, Adjusting and Balancing.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section for the supply and installation of ductwork accessories.

.1 Balancing, backdraft, fire dampers

.2 Flexible duct connections

.3 Internal sound attenuation

.2 Sections 20 00 13 – Mechanical General Provisions and 23 05 00 - Common Works for HVAC shall apply to and govern this Section.

1.2 REFERENCE STANDARDS

.1 SMACNA HVAC Construction Standards – Metal and Flexible.

1.3 SUBMITTALS

.1 Shop Drawings

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

.2 Submit product data for all duct accessories. Shop drawings shall indicate dimensions, weights, required clearances, and location and size of pipe connections.

PART - 2 PRODUCTS

2.1 DUCT WORK ACCESSORIES

.1 Flexible Duct Connections

.1 Material:

.1 Heavy glass fabric double coated with neoprene and attached to 0.6 mm metal strips 75 mm wide.

.2 Fabric length between metal strips:

.1 Minimum 75 mm for ducts of maximum size in either dimension or diameter of 750 mm or less

.2 150 mm for ducts of 775 mm size and larger.

.2 Standard of Acceptance:

.1 Duro-Dyne "Grip-Loc Type SMFN"

.2 Ventfabrics "Ventglas"

.2 Access Doors in Duct Work and Plenums

.1 Hand Door:

.1 Construction: 0.7 mm galvanized steel, double flanged frame and insulated door complete with insulation backing plate.

.2 Fasteners: zinc plated cam-lock fasteners, minimum two per door, with safety retaining chain.

.3 Probe Inlets

.1 Material: Ventlok No. 699 or Duro-Dyne IP-1 or IP-2 Test Opening Enclosures complete with locking cap, chain, gaskets, insulating plug and extensions for insulated duct work.

2.2 OPERATING DAMPERS

.1 Manual Balancing Dampers

.1 Rectangular Duct Work:

.1 Galvanized channel type frames, non-binding pre-lubricated type interconnecting and operating linkages

.2 Blades: minimum 1.6 mm thick material, opposed blade style

.3 Manual operator and locking type quadrant as required for synchronous operation and setting of blades.

.4 Blade width: maximum 200 mm.

.5 Blade length: length coinciding with frame opening on horizontal plane to maximum length of 1200 mm.

.6 Locking quadrant: Galvanized steel locking quadrant with “Open – Closed” labels, 50 mm insulation stand-off.

.7 Acceptable Manufacturers:

.1 Nailor – Series 1810/1820 with HL2 quadrant

2.3 FIRE AND SMOKE DAMPERS

.1 Fire Dampers

.1 ULC labelled fire dampers of hinged, fusible link type with channel frames, blades and housing and conforming to NFPA 90A and UL555 requirements. Use "Type B" fire dampers for rectangular or square duct work and "Type C" fire dampers for round duct work.

.2 Dynamic dampers: designed to close while the system fans are operating.

.3 Static dampers: designed to close with no airflow through damper.

.4 Closure link: fusible link which can be released, tested and relatched for testing.

.5 Construct fire dampers and frames of same material as duct in which they are installed.

.6 Standard of Acceptance:

.1 Nailor – “D” series

.2 Ruskin

2.4 **ACOUSTIC TREATMENT**

.1 Acoustic Duct Insulation

.1 Facing for low velocity duct liner (max. 12.2 m/s - 2,400 fpm) shall be a tightly bonded mat, stenciled as per NFPA 90.

.2 Provide lining with minimum thickness and density as follows:

.1 In ductwork 25 mm at 24 kg/m^3, unless otherwise noted on drawings.

.2 In plenums 50 mm at 32 kg/m^3.

.3 In linear slot diffuser plenums 13 mm at 24 kg/m^3.

.3 Lining media shall have a flame spread classification of not greater than 25, when tested in accordance with ASTM E84, NFPA Standard 255, CAN 4-S102, or UL No. 723. Furthermore, fuel contribution and smoke development rating shall not be greater than 50, when tested in accordance with ASTM E84, NFPA Standard 255, CAN 4-S102, or UL No. 723.

.4 Lining shall be suitable for duct velocity of 30.5 m/s, without erosion damage.

.5 Media shall have the following physical properties:

.1 Maximum thermal conductivity of 1.42 W/m^2 °C at 25mm thickness and 24 kg/m^3 density.

.2 Sound absorption coefficient (NRC) of minimum 0.7, at 25mm thickness and 24 kg/m^3 density (ASTM C423).

.6 Fasteners:

.1 Fasten acoustic liner to inside of duct with plate type impaling pins and self-locking washers, by Eckels Industries "Stic-Klips", "Tactoo Series T", or Continental Stud Welding weld pins and self locking washers.

.2 Use fasteners or securing pins of size and length as required by insulation weight, thickness, fastener spacing and design.

.3 In addition to mechanical type fasteners, adhere insulation to inside of duct with Foster No. 82-00 or Monsey Bakor No. 230-04 fire retardant adhesive. Seal all joints with Foster No. 30-36 or Monsey Bakor No. 120-09 mastic sealant.

.7 Standard of Acceptance:

.1 Owens Corning

.2 Johns Manville

.3 Knauf Fibreglass

.4 Manson

PART - 3 EXECUTION

3.1 **GENERAL**

.1 Install miscellaneous steel framing, supports, braces, etc. as required to hang or support equipment and duct work as specified herein, and as shown on Drawings.

3.2 **FLEXIBLE DUCT CONNECTIONS**

.1 Use flexible duct connections between fans and/or air handling units and connecting duct work, between unit components, in ducts at building expansion joints, and in other locations shown on Drawings

.2 Install flexible connectors with fabric in folds, not drawn tight.

.3 Install internal guides to prevent flexible connection from collapsing on suction side of fans.

.4 For installation between sections of air handling units, install flexible connectors suitable for connecting to flanges of casings where so provided.

3.3 **ACCESS DOORS**

.1 Provide access doors in duct work and for plenums to allow servicing, maintenance, and inspection of:

.1 As shown on Drawings

.2 Provide “Hand Doors” in duct work of sizes as follows:

Access Type	Duct Dimension	Access Door Size
One hand and sight	Less than 400 mm	300x150 mm
Two hands and sight	Between 400 mm and 500 mm	450x250 mm
Head and Shoulders	Between 500 mm and 760 mm	530x356 mm
Body plus ladder	Between 760 mm and 1320 mm	635x430 mm

3.4 **BALANCING DAMPERS**

.1 Use rectangular opposed blade dampers at the following locations:

.1 At floor connections to riser shafts/ducts.

.2 In supply and return duct work where main ducts are split into two more trunks

.3 At rectangular branch duct connections to main or trunk ducts.

.4 As shown.

.2 Use medium pressure butterfly dampers at the following locations:

.1 At floor connections to supply air riser ducts.

.2 In supply and return duct work where main ducts are split into two more trunks

.3 At branch duct connections to main or trunk ducts

.4 At branch duct upstream of terminal box

.5 As shown.

.3 Use low pressure butterfly dampers at the following locations:

.1 At branch connections on the downstream side of terminal boxes

.2 At individual branch outlets serving grilles or diffusers

3.5 **PROBE INLETS**

.1 Install probe inlets in duct work at locations as follows:

.1 In main supply and return ducts

.2 Inlet and outlet side of fans

.3 Other locations as required by Testing and Balancing Trade, to permit testing, balancing and measurement of air quantities and static pressure in air handling systems.

.2 Locate probe inlets a sufficient distance from elbows or transition sections to ensure stable readings of non-turbulent air and install 75 mm from corners and at 150 mm centres across long side of duct.

3.6 **ACOUSTIC DUCT INSULATION**

.1 Furnish internal acoustic insulation in specific sections of duct work and/or plenums as follows:

.1 Downstream of air terminal control units (CAV, VAV and fan powered), except units supplied with integral attenuator, for min. 1,524mm length.

.2 All toilet exhaust branch ducts which serve different toilet rooms from same riser on the same level unless at least 5m of ductwork, including at least three (3) of 90 degree elbow separate the grilles in separate rooms.

.3 Air transfer ducts for full length.

.4 All ductwork serving spaces with noise criteria of NC-30 or lower.

.5 Where indicated on the Drawings.

.2 Install internal acoustic insulation using the following procedure:

.1 Adhere insulation to duct work or plenums by bedding in strips of adhesive supplemented by impaling clips or weld pins spaced at 300 mm centres with self-locking washers.

.2 Apply adhesive at 50% coverage, in 150 mm strips.

.3 Cut off ends of welded impaling pins after application of self-locking washers.

.4 Seal butt joints of insulation with mastic sealant applied to edges of insulation.

.5 Coat joints and self-locking washers after installation with two coat application of mastic sealant, and with open mesh glass fabric embedded in mastic between first and second coat.

.6 In high velocity duct work install perforated or expanded metal inner liner over acoustic lining.

.3 When acoustically lined duct is cut for installation of access doors, cut edges of acoustic lining shall be repaired using self-adhesive fibre glass tape and duct sealer.

.1 Adhere new acoustic lining to match existing to inside of access panel or door to ensure continuity of acoustic properties of system.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Sections 20 00 13 – Mechanical General Provisions and 23 05 00 - Common Works for HVAC shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 Supply and install stand-alone fans.

1.2 SUBMITTALS

.1 Shop Drawings

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

.2 Submit product data for fans and related equipment. Shop drawings shall include, but not be limited to:

.1 Complete information on fan construction and performance

.2 Performance curves over full range from shut-off to free delivery

.3 Drive details

.4 Make, type and catalogue number of bearings

.5 State hour rating of bearings when specified.

1.3 REFERENCE STANDARDS

.1 Fans: designed and constructed in strict conformity with the AMCA Standards and bearing the "Certified Rating Seal".

.2 Applicable sections of CSA C22.2 No. 113 for fan construction and installation.

PART - 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

.1 Performance Ratings

.1 Provide all fan ratings based upon tests performed in accordance with code adopted jointly by the ASHRAE and AMCA. Provide each fan with the AMCA seal. Provide fans with a high efficiency and a pressure characteristic that is constantly rising from free delivery to shut-off.

.2 Type, size and capacity shown on Drawings for each specific application and conforming to requirements of manufacture, operation and performance as specified.

.3 Select fan size, operating rpm and rating point on stable head flow curve with smooth characteristics.

.4 Operating at least 20% below first critical speed when operating at maximum speed for class of construction.

.5 Dynamically and statically balance wheels of free standing or unitary fans to acceptable tolerances relative to size and speed.

.6 The fan manufacturer shall check that the motor horsepower specified is sufficient to accelerate the fan to operating speed without motor overload within normal time limits. If it is found insufficient, the DCC Representative shall be notified, prior to Bid closing, and a larger motor and starter shall be provided to prevent overloading. If, when installed, motor overload and stopping occur due to fan inertia, the fan manufacturer shall pay all costs incurred for changing motors, starters, wiring.

.2 Cleaning and Metal Protection

.1 Thoroughly clean interior and exterior surfaces of fans including screens, at factory with approved de-greasing agent.

.2 Apply a coating of red oxide or zinc chromate primer unless special protective coating is specified.

.1 Exception: fans constructed of galvanized steel or aluminum

.3 Materials

.1 Fan casings: heavy gauge steel or spun aluminum construction, as specified by model number.

.2 Fans used for smoke exhaust shall be suitable for continuous operation at 205°C.

.3 Fan belts shall be oil and heat resistant, non-static type. Drives shall be precision-machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower.

.4 Bearings

.1 Service Life

.1 To L10 Life Standard in accordance with latest AFBMA Code.

.2 Unitary, axial and free standing fans: 200,000 hour service

.2 Type:

.1 Grease lubricated ball or roller type fan bearings with ample thrust provision to prevent end play during normal life of bearings.

.2 Smaller than 36 mm diameter: cartridge type.

.3 36 mm dia. and larger: shaft adapter sleeve type bearings utilizing horizontally split pillow blocks and mechanical flinger type grease valves.

.4 Shafts smaller than 56 mm dia., interference fit bearings may be used in lieu of adapter sleeve type.

.3 Bearings in air stream:

.1 Well secured extended grease lubricating lines unless bearing is easily accessible through man-size access door.

.2 Pack bearings with low temperature grease in factory.

.4 Axial flow fans

.1 Conform to these specifications except where inner cylinder mounting methods are used or dimensions do not permit it and special or flange mounted type bearings are required.

.5 Grease Fittings, for fans driven by motors 0.375 kW (1/2 HP) and larger

.1 Provide bearings with Zerk or Alemite grease fittings, with provision for automatic relief of lubricant pressure to outside of fan, away from wheel and visible from maintenance location.

.2 Use service fittings and relief fittings easily accessible from maintenance locations and at separate and opposite sides of bearing housing.

.5 Motors and Drives

.1 Motor ratings:

.1 In accordance with Section 20 05 12 - Common Motor Requirements.

.2 Type, kW (HP) rating, motor speed and electrical characteristics shown on Drawings.

.3 Capable of satisfactory operation over range of performance from shut-off to run-out at 110% of rated rpm at point of selection.

.2 Drive and belt guards: in accordance with Section 20 00 19 - Basic Materials and Methods.

.6 Accessories

.1 Casing Drains

.1 Fans discharging vertically through roof or as shown on drawings: fitted with 38 mm casing drains.

.2 Roof Mounted Fans

.1 Factory mounted unfused disconnect switches wired to motor terminals.

.2 Conduit or wiring post running through fan housing so that wiring may be run to line side of disconnect switch from below roof without disturbing roof construction.

.3 Roof Curbs for Roof Mounted Fans and Ventilators

.1 Prefabricated insulated galvanized steel sheet curbs for mounting to roof deck.

.2 Prefabricated insulated galvanized steel sheet curbs for mounting to roof deck.

.3 Minimum curb height: 300 mm on every side, or as dimensioned on drawings.

2.2 FAN TYPES

.1 Roof Top Fans and Ventilators

.1 Upblast exhaust and downward supply air fans

.1 Suitable for mounting on curbed roof openings

.2 Heavy gauge galvanized steel housing and windband

.3 Finished inside and outside with sprayed asphalt

.4 Heavy gauge curb cap

.5 Gravity or spring assisted steel dampers as required, with magnetic catches to dampers to prevent rattling in closed position

.6 TEAO motor

.7 Weatherproof protective motor cover and belt-drive

.2 Standard of Acceptance

.1 Twin City Fan

.2 Greenheck

.3 PennBarry

.4 Cook

.5 Carnes

PART - 3 EXECUTION

3.1 GENERAL

.1 Fan installation

.1 Install fans complete with resilient mountings and restraining snubbers in accordance with Section 20 05 48 - Vibration Control.

.2 Provide flexible connections on inlet and outlet ductwork: in accordance with Section 23 33 00 - Duct Accessories.

.3 Align shafts, belt drive and motor, adjust belt tension and check motor rotation before start-up.

.4 Protect motors and fans during construction and rotate fans, by hand, every month between delivery and acceptance of building.

.2 Air Balancing

.1 Adjust variable pitch fan/motor sheaves during balancing to achieve specified air quantities.

.2 Provide replacement sheaves and belts as required (one set) for final air balancing.

3.2 FABRICATED GOOSENECK TYPE FRESH AIR INTAKE AND EXHAUST AIR HOODS

.1 Fabrication: black steel construction.

.2 Size, shape and arrangement as shown on Drawings.

.3 Finish interior and exterior surfaces finished with rust inhibitive primer.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Sections 20 00 13 – Mechanical General Provisions and 23 05 00 - Common Works for HVAC shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 Supply and install all air inlet and outlet products.

1.2 RELATED WORK

.1 The following work is provided under other Sections or Divisions of the Work:

.1 Door grilles: provided under General Trades scope of work.

1.3 SUBMITTALS

.1 Shop Drawings

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

.2 Submit product data for grilles, diffusers and related accessories. Shop drawings shall include, but not be limited to: noise and airflow data, physical dimensions, finishes, installation details.

PART - 2 PRODUCTS

2.1 DIFFUSERS, REGISTERS AND GRILLES

.1 General

.1 Neck size, dimensions and capacity as shown on the Drawings. Catalogue numbers of first named supplier are listed on Drawings to show required type and style.

.2 Acoustic and airflow performance is based on catalogued information of the indicated manufacturer and model as shown on drawings or schedules. Other named manufacturer products must match these implied performance criteria.

.3 Border and frame as required to suit wall and ceiling construction. Frames with full perimeter gaskets, plaster stops where set into plaster or gypsum board, and concealed fasteners.

.4 Product of one manufacturer where same model or type identification is used.

.5 Standard catalogue products selected to meet capacity, throw, and noise level.

.6 Prime coated, stamped or cold rolled steel material with mitred corners and exposed joints welded and ground smooth.

.7 Extruded satin finish, clear anodized aluminum material with mitred corners and mechanical fasteners.

.2 Square and Circular Pattern Diffusers

.1 Steel construction with baked white enamel finish, unless otherwise shown.

.2 True imperial or metric sizes.

.3 Radial opposed blade damper

.3 Grilles

.1 Steel construction with baked white enamel finish, unless otherwise shown.

.2 Blade orientation parallel to the long dimension.

.3 Opposed blade damper in black finish.

.4 Standard of Acceptance:

.1 E.H. Price

.2 Nailor Industries Inc.

.3 Titus

.4 Tuttle & Bailey

.5 MetalAire

PART - 3 EXECUTION

3.1 GENERAL

.1 Supply diffusers and registers to deliver indicated air quantities shown with throw to reach intended space limits without increasing the sound level of room. Provide blank-off baffles where required and equalizing deflectors on diffusers and in other locations as shown or required.

.2 Coordinate placing of diffusers, registers and grilles in ceilings with electrical and ceiling installation trades and exact location to final approval of DCC Representative.

.3 Diffusers installed in open ceiling space shall be connected with rigid ductwork and shall be painted to match the ceiling color as per architectural drawings and schedules.

.4 Grilles, registers and diffusers penetrating fire rated walls and partitions shall have steel sleeves secured to structure in accordance with NFPA 90A.

3.2 INSTALLATION OF GRILLES AND REGISTERS

.1 Install registers and grilles with oval head cadmium plated screws in countersunk holes where fastenings are visible.

3.3 INSTALLATION OF DIFFUSERS

.1 Diffusers shall be installed with concealed fastenings.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Sections 20 00 13 – Mechanical General Provisions and 23 05 00 - Common Works for HVAC shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 Supply and install split-system air conditioning system. Provide all necessary refrigerant system components, relays, contactors, starters, disconnects.

1.2 SUBMITTALS

.1 Shop Drawings

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

.2 Submit product data for split-system air conditioning systems and related equipment. Shop drawings shall include, but not be limited to:

.1 Complete specifications.

.2 Product data sheets indicating rated capacities, weight, and sound power levels.

.3 Refrigerant piping diagram showing all required components (valving, filter-drier, sight glass, traps).

.4 Power and control wiring diagrams.

.5 Physical outline dimension drawing showing required clearances, weights, and location and size of connection entries.

PART - 2 PRODUCTS

2.1 SPLIT-SYSTEM AIR CONDITIONERS

.1 General

.1 The split air conditioning system shall consist of a ceiling mounted packaged evaporator section and matching outdoor unit.

.2 The units shall be made within North America. The units shall bear the ETL label. All wiring shall be in accordance with the National Electrical Code (N.E.C.). The units shall be rated in accordance with ARI Standard 210/240 and bear the ARI label. The units shall be manufactured in a facility certified to ISO 9001.

.3 The condensing unit shall contain refrigerant charge for the evaporator section and condenser section. System SEER shall meet or exceed requirements of the ASHRAE 90.1 latest edition.

.2 Warranty

.1 The units shall have a manufacturer's warranty for a period of one (1) year from date of installation. The compressor shall have a warranty of five (5) years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer.

.2 This warranty does not include labor.

.3 Indoor Unit

.1 The indoor unit shall be factory assembled and wired. The cabinet shall be fabricated of galvannealed steel, finished in "offwhite" with corrosion inhibiting polyester powder-coated paint.

.2 The evaporator fans shall be a forward curve centrifugal type, dynamically balanced and directly mounted to the motor shafts. The motors shall be PSC type with internal thermal overload protection. The supply louvers shall be dual adjustable for airflow direction. Return air shall be filtered by means of an easily removable electrostatic washable filter. The indoor unit shall have fresh air capability thru the top and back of the unit.

.3 The evaporator coil shall be on nonferrous construction with louvered fins bonded to rifled copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phoscopper or silver alloy. The coil shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil.

.4 System refrigerant flow shall be controlled by means of an orifice piston in the indoor unit.

.5 The unit electrical power shall be 208/230 volts, 1 phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 208/230 +/- 10% volts.

.4 Control System

.1 The control system shall consist of 24V wall thermostat control with anti-short cycle compressor protection; fan purge. Fan shall remain on for 60 seconds after heat/cool call is dropped for improved efficiency. An integral heating relay ensures that the fan operates whenever electric heat is energized.

.2 Wiring shall run from indoor unit to the 24V wall thermostat and to outdoor unit. When running low voltage wiring a double insulated wire should be used. The control voltage between the indoor unit and the outdoor unit shall be 24 Volts A.C. The 24 Volts shall be generated from the outdoor unit 24-Volt 40VA transformer.

.5 Outdoor Unit

.1 The outdoor unit shall be completely factory assembled, piped, wired and contain a low voltage transformer. The cabinet shall be fabricated of G60 galvannealed steel, finished in "off-white" with corrosion inhibiting polyester powder-coated paint.

.2 The unit shall be furnished with one (1) direct drive, propeller type fan arranged for horizontal discharge. The motor shall have inherent protection, be of the permanently lubricated type, and resiliently mounted for quiet operation. The fan shall be provided with a guard to prevent contact with moving parts. The compressor shall be of the high-performance reciprocating type with a thermal

overload. The compressor shall be mounted so as to avoid the transmission of vibration.

.3 The refrigeration system shall be equipped with a high pressure switch and have the capability to operate with a maximum height difference of 10.7m (35 feet) and overall refrigerant tubing length of 30.5m (100 feet) between indoor and outdoor sections without the need for line size changes or additional oil. The condenser coil shall be of nonferrous construction with louvered fins bonded to rifled copper tubing.

.4 The unit shall be controlled by an electronic circuit board located in the indoor matching unit.

.6 Drain pump

.1 Integral or External condensate pump

.2 Powered by evaporator unit to remove all condensate

.3 Pump lift minimum 3m (10')

2.2 **REFRIGERANT PIPING**

.1 In accordance with Section 23 23 00 - Refrigerant Piping.

PART - 3 EXECUTION

3.1 **INSTALLATION**

.1 Install unit and accessories neat and level, following manufacturer's instructions.

.2 Install evaporator and condenser units using hanger kit and rubber isolators provided by unit supplier.

.3 Install refrigerant piping between evaporator and condenser sections. Size piping as directed by unit's design manual. Refer to Section 23 23 00 - Refrigerant Piping for additional requirements.

.4 Provide all piping so units and circuits are serviceable without having to dismantle excessive lengths of pipe.

.5 Install and wire all accessories shipped lose with units for a fully operating system. Refer to Section 23 09 00 - Instrumentation and Control for HVAC for additional requirements.

.6 Install drain pump and provide drain connections to drain as shown.

.7 Furnish the services of factory-trained representatives to supervise the installation, starting, testing and commissioning of the split-system air conditioners in accordance with the manufacturer's instructions. Upon completion of the installation, the manufacturer shall provide to the DCC Representative a written report on the start-up of these units.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section 20 00 13 – Mechanical General Provisions shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 This Section supplements all Sections of Division 25 – Building Automation.

.2 The intent of the Division 25 – Building Automation Specifications and the accompanying Drawings is to modify the existing Johnson Controls DDC system and provide complete and workable Building Automation system utilizing Direct Digital Control (DDC).

.3 Include all work specified under Division 25 - Building Automation and shown on the accompanying Drawings.

.4 Control and monitor the following systems and equipment:

.1 Pressurization and ventilation equipment;

.2 Elevator Sump Pump

.3 Elevator Machine Room Air Conditioning;

.5 The Drawings that accompany the Division 25 – Building Automation Specifications are diagrammatic. Follow the documents as closely as is practical to do so and install additional hardware and software where required by local conditions from measurements taken at the Site, subject to approval, and without additional cost to the Owner.

.6 Provide networking to the DDC equipment using communication standards. System shall be capable of BACnet communication according to ANSI/ASHRAE Standard 135 for interoperability with smart equipment and for the main IP communication trunk to the BAS server. The system shall not be limited to only standard protocols but shall also be able to integrate to a wide variety of third-party devices and applications via drivers and gateways.

.7 Provide all communication units, communication interface to digital system controllers, field sensors, and controls as required to meet the specified performance.

.8 Provide all labour, including calibration, commissioning, software programming and data base generation, generation of colour graphics and additional work necessary to provide a complete and fully operating system.

.9 Supply, install and connect all necessary power and control wiring for a fully complete and functional control system.

.10 Refer to the following Sections of the Division 25 – Integrated Automation Specification for further details:

.1 Commissioning of Building Automation – Section 25 08 00

.2 Local Control Units – Section 25 14 00

.3 Software and Programming – Section 25 15 00

.4 Instrumentation and Terminal Devices for Mechanical Systems – Section 25 35 00

.5 Control Sequences – Section 25 95 00

.4 Refer to and comply with relevant requirements specified under the diverse sections of Division 26 – Electrical Specifications located on electrical drawings.

1.2 **ELECTRICAL WORK**

.1 The BAS Contractor shall be responsible for providing power supply to all control components furnished by the BAS Contractor. The BAS Contractor shall run the power run from distribution panels to the control device. The BAS Contractor shall coordinate with the Consultant for breakers at the appropriate distribution panels for BAS power. The BAS Contractor shall extend the power supply from the distribution panel.

.2 Provide control wiring between field-installed controls, indicating devices, and unit control panels.

.3 Coordinate control panel locations.

1.3 **QUALITY ASSURANCE**

.1 The installation of the Building Automation System (BAS) shall be performed under the direct supervision of the Building Automation manufacturer with the shop drawings, flow diagrams, bill of materials, component designation, or identification number and sequence of operation all bearing the name of the manufacturer.

.2 Installing Contractor shall be in the business of installing and servicing DDC controls for mechanical systems, temperature and ventilation control, environmental control, lighting control, access and security controls, and energy automation as their primary business.

.3 The installer shall be the authorized representative of the automatic control system manufacturer for both installation and maintenance of controls.

.4 Engineering, drafting, programming, and graphics generation shall be performed by the local branch engineers and technicians directly employed by the Building Automation Contractor.

.5 Supervision, checkout and commissioning of the system shall be by the local branch engineers and technicians directly employed by the Building Automation Contractor. They shall perform commissioning and complete testing of the BAS.

.6 The Building Automation Contractor shall maintain a service organization consisting of factory trained service personnel and provide a list of ten (10) projects, similar in size and scope to this project, completed within the last five years.

.7 Final determination of compliance with these specifications shall rest solely with the Consultant who will require proof of prior satisfactory performance.

.8 For any BAS equipment submitted for approval, the Building Automation Contractor shall state what, if any, specific points of system operation differs from the equipment specified.

.9 Operator interfaces shall use English language or be bi-lingual English/French as required for the specific project, using readily understood English and French language abbreviations and mnemonics.

1.4 **SUBMITTALS**

.1 Shop Drawings

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

.2 Commence installation of the BAS only after the shop drawings have been reviewed by the Consultant.

.3 Shop drawings shall include but not be limited to:

.1 Schematic flow diagrams showing fans, coils, dampers, valves, and control devices.

.2 Wiring diagrams covering power, signal, and control wiring for all systems. Include electrical components, control transformers, relays, overloads selector switches, running lights, thermostats which are necessary for a complete system.

.3 Details of control panel faces, including sizes, controls, instruments, and labeling.

.4 Schedule of dampers and actuators including damper and valve size characteristics.

.5 Written description of the Sequences of Operation.

.6 Network riser diagram showing wiring types, network protocols, locations of floor penetrations and number of control panels. Label control panels with network addresses and BACnet device instance numbers. Show all routers, switches, hubs and repeaters.

.7 Point list for each system controller including both inputs and outputs (I/O), point numbers, controlled device associated with each I/O point, and location of I/O device.

.8 Reduced size floor plan drawings showing locations of control panels, thermostats and any devices mounted in occupied space.

.9 Manufacturer's technical literature for each control device indicated, labeled with setting or adjustable range of control. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated. Submit a write-up of the application software that will be used on the operator workstation including revision level, functionality and software applications required to meet the specifications.

.10 Names of subcontractors, if any

.11 System capacity and identified points reserve

.12 Software programs included

.13 Sample of commissioning plan and documentation

.4 Use contact identification identical to the contacts shown in the manufacturers' shop drawings. List the reference shop drawing numbers on each schematic drawing.

1.5 **REFERENCE STANDARDS**

.1 Applicable provincial and federal Electrical Safety Code

.2 ASHRAE/ANSI 135 - The BACnet Standard

.3 ANSI C80.1 – American National Standard for Electrical Rigid Steel Conduit

.4 UL 916 - Standard for Energy Management Equipment.

.5 Input/Output devices:

.1 To ASCII (American Standard for Communication and Information Exchange) code and standard EIA (Electronic Industry Association) interfaces.

.2 All electronic equipment shall conform to the requirements of FCC Regulation, Part 15, Governing Radio Frequency Electromagnetic Interference and be so labeled.

1.6 **DEFINITIONS**

.1 For the purposes of this Division, the following definitions apply:

.1 “AAC” - Advanced Application Controller

.2 “ASC” – Application Specific Controller

.3 “BACnet” - an industry standard data communication protocol for Building Automation and Control Networks. Refer to ASHRAE Standard 135.

.4 “BAS” – Building Automation System

.5 “BAS Contractor” – the Contractor performing the Work of Division 25 – Building Automation

.6 “BC” – Building level Controller

.7 “BIBB” - BACnet Interoperability Building Blocks

.8 “DDC” - Direct Digital Controls

.9 “EEMAC” – Electrical Equipment Manufacturers Association of Canada

.10 “IC” - integrated circuit

.11 “IP” - Internet Protocol

.12 “I/O” - Input/Output

.13 “LAN” - Local Area Network

.14 “MS/TP” - master-slave/token-passing. Refer to AHSRAE Standard 135.

.15 “N.C.” – normally closed

.16 “N.O.” – normally open

.17 “OLED” - organic light-emitting diode

.18 “OWS” – operator’s workstation

.19 “PC” – commercially available personal computer

.20 “PWS” – portable workstation

.21 “TCP” - transfer control protocol

.22 Scope Terminology:

.1 “Provide” - furnish equipment, engineer, program and install

.2 “Furnish” - furnish equipment, engineer and program

.3 "Mount" - securely fasten or pipe

.4 "Install" - mount and wire

.5 "Wire" - wire only

1.7 **COORDINATION**

.1 Coordinate location of thermostats, humidistats, panels, and other exposed control components with plans and room details before installation.

.2 Coordinate and supply power for control units.

.3 Coordinate scheduling for all work. Submit a schedule for approval.

1.8 **WARRANTY**

.1 Conform to the warranty requirement of the Contract Documents and of this Section, whichever is more stringent.

.2 Warranty shall cover all costs for parts, labour, associated travel, and expenses for a period of one year from the completion of system demonstration.

.3 Hardware and software personnel supporting this warranty agreement shall provide on-site or off-site service in a timely manner after a failure notification to the vendor. The maximum acceptable response time to provide this service at the site shall be 24 hours.

.4 During normal building occupied hours, failure of items that are critical for system operation shall be provided within 4 hours of notification from the Owner.

.5 This warranty shall apply equally to both hardware and software.

1.9 **OWNERSHIP OF PROPRIETARY MATERIAL**

.1 Software and documentation supplied and generated under the Work of Division 25 – Building Automation, or required for ongoing system operation, maintenance and modification becomes the property of the Owner, including and not limited to graphic files, database files, custom application programs, project record documents, training manuals.

.2 Licensing shall permit an unlimited number of users to access the system without additional fees.

PART - 2 PRODUCTS

2.1 **STANDARD OF ACCEPTANCE**

BAS	
Manufacturer/Supplier	Product Line
Johnson Controls Inc.	JCI Building Control Manager System

2.2 **MATERIALS**

.1 New products: Non-beta versions currently under manufacture and have been applied in similar installations for a minimum period of one year.

.2 Revisions: Latest available revision for operator software, controller resident software and controller firmware at the start of Warranty.

.3 Replacement parts: Readily available and not scheduled for discontinuation at the time of Total Project Completion.

.4 Expansion: Expandable through additional inputs and outputs and to card access, security, fire alarm, lighting control systems and other building systems.

2.3 BAS PERFORMANCE REQUIREMENTS

.1 Fault tolerance:

.1 All system components shall be designed, built and installed to be fault tolerant as follows:

.1 Satisfactory operation without damage at 110% above and 85% below rated voltage and at +3 hertz variation in line frequency.

.2 Static, transient and short circuit protection on all inputs and outputs.

.3 Communications lines protected against incorrect wiring, static transients and induced magnetic interference.

.4 All real time clocks and data file RAM shall be battery backed for a minimum of 72 hours.

.5 Bus connected devices shall be AC coupled or equivalent so that any single device failure will not disrupt or halt bus communication.

.2 Reporting accuracy and stability of control:

Accuracy and Stability		
Space temperature	±0.5°C	±1°F
Ducted air	±0.5°C	±1°F
Outside air	±1.0°C	±2°F

2.4 BAS NETWORK

.1 All networked control products provided for this project shall be comprised of an industry standard open protocol internetwork. Communication involving control components (i.e. all types of controllers and operator interfaces) shall conform to ASHRAE 135. Networks and protocols proprietary to one company or distributed by one company are prohibited.

.2 The network architecture shall consist of three levels of networks:

.1 The Management level shall utilize BACnet/IP over Ethernet along with other standardized protocol, such as web services, html, JAVA, SOAP, XML, to transmit data to non-BAS software and databases.

.2 The Automation level network shall be BACnet/IP over Ethernet. It shall network the automation server, operator workstations, and BC level controllers. Provide network media converters, routers and switches as necessary for a complete network.

.3 The Floor level network shall be BACnet over MS/TP. It shall network to all of the DDC controlled equipment on a floor or in a system, and network to a router that connects to the Automaton level BAS backbone. Controllers for the central plant and large infrastructure air handlers shall reside on the backbone BACnet/IP network.

.3 The primary backbone network between the building level controllers, BAS server and operator workstations shall be based upon BACnet/IP. Ethernet network switches shall be strategically placed throughout the building to cover several floors or several mechanical rooms that are within 100m (300 ft) wiring-feet of each other.

.4 The building level controllers shall be able to support subnetwork protocols that may be needed depending on the type of equipment or application. Subnetworks shall be limited to:

.1 BACnet MS/TP

.2 Select manufacturers' proprietary protocol as approved by the Consultant.

.5 BACnet MS/TP setup rules

.1 Addressing for the MS/TP devices shall follow existing nomenclature for the number of devices on the subnetwork.

.2 No gaps shall be allowed in the addresses.

.3 Set the MaxMaster property to the highest address of the connected device.

.4 MaxMaster property shall be adjusted when devices are added to the subnetwork.

.6 Application specific controllers for smaller single zone, supplemental or special systems can reside on the BACnet/IP network or on a subnetwork.

.7 Floor level controllers, terminal units, packaged AC units, auxiliary equipment, VFDs, meters shall reside on one of the subnetworks above.

.8 Provide all communication media, connectors, repeaters, bridges, switches, and routers necessary for the internetwork.

.9 Use fiber optic cabling for all Ethernet runs longer than 100m (300 ft).

.10 Controllers and software shall be BACnet Testing Laboratories (BTL) listed at the time of installation.

.11 Provide all communication media, connectors, repeaters, bridges, switches, and routers necessary for the internetwork.

.12 The system shall meet peer-to-peer communication services in a way that the values in any one BC or AAC level controller can be read or changed from all other controllers without the need for intermediary devices. The software shall provide transparent transfer of all data, control programs, schedules, trends, and alarms from any one controller through the internetwork to any other controller, regardless of subnetwork routers.

.13 Systems that use variations of BACnet with Point-to-Point (PTP) protocol between controllers, gateways, bridges or networks that are not peer-to-peer, are not allowed.

2.5 DISTRIBUTED CONTROL REQUIREMENTS

.1 The loss of any one DDC controller shall not affect the operation of any other system, only the points connected to the particular DDC controller.

.2 The system shall be scalable in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, DDC controllers, and operator devices.

.3 System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. Each DDC controller shall operate independently by performing its own specified control, alarm management, operator I/O, and data collection. The failure of any single component or network connection shall not interrupt the execution of any control strategy, reporting, alarming and trending function, or any function at any operator interface device.

.4 DDC controllers shall be able to access any data from, or send control commands and alarm reports directly to any other DDC controller on the network without dependence upon a central processing device. DDC controllers shall also be able to send alarms to multiple operator workstations without dependence upon a central or intermediate processing device.

.5 The DDC control panel shall be mounted in the same mechanical room as the equipment being controlled, or in an adjacent location as approved by the Consultant.

.6 Multiple systems can be programmed on the same controller as long as they are in the same space or floor area, and are considered minor at the discretion of the Consultant. Systems located on separate floors shall have separate controllers unless noted otherwise.

.7 Remote sensors shall be wired to the control panel of the equipment it is controlling, not across the network.

.8 Terminal units shall each have their own controller. Only exceptions are:

.1 Groups of reheat coils

.2 Groups of exhaust fans

2.6 LOCAL CONTROL PANELS

.1 Type: wall or floor mounted

.1 EEMAC 1: sheet metal cubicles for indoor use, for panels located in general use spaces.

.2 Provide UL/ULC-listed cabinets for use with line voltage devices.

.2 Construction:

.1 1.6mm (16-gauge), furniture-quality steel or extruded-aluminum alloy, totally enclosed;

.2 Suitable knockouts and hinged, lockable doors with common keying;

.3 ANSI 61 gray polyester-powder painted finish, UL listed;

.4 Factory piped, wired, assembled and ready for field installation

.5 Interior compartment mounted DDC controllers, relays, gauges;

.6 Nameplates for components mounted in and on local control panels in accordance with the requirements described in this Section.

.7 Power supplies for controllers shall be a transformer with a fuse or circuit breaker. Power supplies for other devices can be plain transformers.

.8 All power supplies for 24V low voltage wiring shall be class 2 rated and less than 100VA. If low voltage devices require more amps, then provide multiple power supplies. If a single device requires more amps, then provide a dedicated power supply in a separate enclosure and run a separate, non-class 2 conduit to the device.

.9 Include surge transient protection to protect the electrical components in all DDC controllers.

.10 Where one panel serves more than one system, clearly separate the system components on the front of the panel.

.11 Provide a pocket to hold documentation.

.3 Panel wiring:

.1 Provide a 150mm x 150mm (6" x 6") minimum wireway (metal wiring/tubing) trough across the entire width of the panel mounted to the top of the panel with close nipples of sufficient size for additional 50% wiring and tubing capacity. Wireways shall be not less than 610mm (24") in length. Control panel wiring shall be installed and distributed in the wireway to minimize routing of wiring and tubing within the control panel. Wireway construction to be the same as the associated control panel.

.2 Wire electrical components mounted in local control panels.

.3 Terminate wire at terminal blocks located near the top or bottom of the panel to suit incoming conduit.

.4 Number and identify each terminal block point to tie in with the control drawings.

.5 Wire panels neatly, in conformance with the requirements of applicable codes and the Division 26 – Electrical Specification.

.6 Identify control wires terminating at terminal strips.

2.7 **WIRING**

.1 Low voltage analog wiring:

.1 18-gauge, twisted pair, 100% shielded, with PVC cover, Class 2 plenum-rated.

.2 Communication wiring:

.1 Communication wiring shall be provided in a customized colour jacketing material. Material colour shall be approved by Owner. In addition, all wiring jackets shall be labeled "BAS" at 1 m (3 ft) intervals along the length of the jacket material. An example is provided below:

BAS Wiring Color Coding			
Purpose	Function	Color	Label
Building Level	Communication	Orange	BAS Building Level Communication
Floor level	Communication	Blue	BAS Floor Level Communication
Inputs/Outputs	Panel to device	White	BAS Input/Output Device Cable

BAS Wiring Color Coding			
Purpose	Function	Color	Label
24VAC	Control power	White/Black tracer	BAS 24 VAC Control Power

.2 BACnet MS/TP networks: RS485 cabling, low capacitance, 20-24 gauge, twisted shielded pair, plenum rated.

.3 BAS Ethernet: CAT5E/CAT6, unshielded twisted pair (UTP) cable, or multimode fiber optic cable.

.3 Power wiring:

.1 Colour coded 14-gauge for control.

.4 Conduit:

.1 Rigid conduit shall be steel, hot dip galvanized, threaded with couplings, 20mm (¾ inch) minimum size, manufactured to ANSI C-80-1. Electrical metallic tubing (EMT) with compression fittings or intermediate metallic conduit (IMC) may be used as conduit or raceway where permitted by the applicable electrical codes.

.2 For wiring in inaccessible ceilings, furred spaces, in hollow walls and partitions and where not exposed to mechanical damage: thin wall up to 32 mm (1¼ in).

2.8 **IDENTIFICATION**

.1 Equipment, panels and valves:

.1 In accordance with Section 20 05 53 - Mechanical Identification.

.2 Data Cards:

.1 100 x 150 mm (4” x 6”) (nominal) pre-printed data card, mounted in a hard plastic case, secured to device with nylon tie-wraps. Include the following information:

.1 Device Tag Identification

.2 Device Name

.3 BCU or ECU address

.4 Power requirements

PART - 3 EXECUTION

3.1 **INSTALLATION**

.1 Execute work in accordance with manufacturer's instructions, roughing-in drawings and details shown on the Drawings, with requirements specified in the various Sections of Division 25 – Building Automation, and of Division 26 - Electrical.

.2 Lay out the Work so that it does not interfere with the Work performed by Contractors of other Divisions of the Specifications.

.3 Make good any damage to the Owner’s property or to other Contractor’s Work caused by improperly locating or carrying out the BAS Work.

.4 Location of pipes, ductwork, raceways and equipment shown on the Drawings may be altered without extra cost to the Owner, provided the alteration is made before installation and it is coordinated with the Work of other Contractors.

.5 Provide all relays, switches, sources of emergency and UPS battery back-up power, and all other auxiliaries, accessories and connections necessary to make a complete and operable system in accordance with the sequences specified. All related field wiring shall be performed under the scope of the BAS Contractor.

.6 Install controls so that adjustments and calibrations can be easily made. Ensure equipment does not interfere in any way with access to adjacent equipment and personal traffic in the surrounding space.

.7 Mount surface-mounted control devices for insulated services on brackets with sufficient clearance to accommodate the finished insulation thickness.

.8 Install equipment level and plumb. All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor.

.9 Control and status relays

.1 Install relays in designated enclosures only. Relays may be installed within packaged equipment control panels.

.2 Do not install relays within motor starter enclosures. Install relays in spare motor control centre (MCC) sections, or provide a control panel mounted adjacent to the MCC or starter.

.10 Install labels and nameplates on each control panel listing the name of the panel referenced in the graphics and a list of equipment numbers served by that panel.

3.2 **EXISTING MATERIALS**

.1 Obtain approval from the Consultant for the reuse of existing products.

.2 Performance: During construction check and verify that reused existing products are fully operational with performance matching new products. For existing product that is not operational at the required level, submit a proposal to replace the existing product to the Consultant.

.3 Existing wiring: Neatly coil, cap, identify and contain unused portion within cabinets.

.4 Existing cabinets: Remove unused cabinets from the Site and discard. Remove unused products within existing cabinets from site and discard. Patch holes on covers and doors. Apply two coats of spray paint to cabinet exterior; submit finish sample for approval.

.5 Existing sensor wells: Reuse; modify for proper fit and function.

.6 Existing electric thermostats: Deliver unused thermostats to the Owner.

.7 Existing sensors and transmitters: Remove unused sensors and transmitters from the Site and discard.

.8 Existing DDC controllers: Salvage and reuse. Deliver unused controllers to the Owner.

.9 Existing dampers, electric damper actuators and linkages: Salvage and reuse. Remove unused components from the Site and discard.

.10 Existing control valves and electric valve actuators: Salvage and reuse. Remove unused components from the Site and discard.

3.3 POWER SUPPLY COORDINATION

.1 Provide power supply under the Work of Division 25 – Building Automation as follows:

.1 Provide power to ceiling mounted junction boxes and wire to terminal unit controllers.

.2 Provide circuit breakers. Breakers shall have locks to prevent unauthorized use of the breakers.

3.4 WIRING

.1 General

.1 Supply, install and connect power transformers as required for each system and equipment.

.2 Sizing of conduits, selection of size and type of wiring is by the BAS Contractor in accordance with applicable code requirements.

.3 Install raceways, boxes, panels, wiring and cables to the requirements of Division 26 – Electrical.

.4 Conceal cable and conduit, except in mechanical rooms and other unfinished service areas where other conduit and piping are also exposed.

.5 Install exposed cable in raceway or conduit.

.6 Install concealed cable using plenum rated cable unless superseded in specific article.

.7 Conductors shall not be supported by the ceiling system or ceiling support system. Conductors shall be pulled tight and be installed as high as practically possible in ceiling cavities. Wiring shall not be laid on the ceiling or duct.

.8 Conductors shall not be installed between the top cord of a joist or beam and the bottom of roof decking.

.9 Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.

.10 Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.

.11 Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.

.12 All unsupported risers shall be rigid steel conduit. Supported risers shall be EMT.

.13 Interlock wiring shall be run in separate conduits from BAS associated wiring.

.14 Where existing wiring is reused for replacement sensors or actuators:

.1 Verify wiring is in good physical condition prior to reuse.

.2 Provide a continuity test for each wiring circuit to ensure proper operation of sensor.

.3 Submit results of continuity tests with O&M and close out submittals to document results.

.2 Termination at packaged equipment and systems

.1 Terminate wiring at packaged equipment and system controllers supplied under the Mechanical Work.

.2 For equipment and system panels supplied under the Work of other Divisions, pull the associated wiring into the panel as per the manufacturer's instructions. Final termination at equipment or panel will be by the Contractor supplying the equipment.

.3 Conduits

.1 Minimum size 12 mm (½").

.2 Support conduits at each end.

.3 Install conduits in parallel banks with all changes in directions made at 90 degree angles.

.4 Communication wiring

.1 All cabling shall be installed in a neat and workmanlike manner. Follow manufacturer's installation recommendations for all communication cabling.

.2 Do not install communication wiring in raceway and enclosures containing Class 1 wiring.

.3 Maximum pulling, tension and bend radius for cable installation, as specified by the cable manufacturer, shall not be exceeded during installation.

.4 Contractor shall verify the integrity of the entire network following the cable installation. Use appropriate test measures for each particular cable.

.5 Cable bundling

.1 RS485 cabling run open air in accessible areas can be bundled with other Class 2 low voltage cabling.

.2 RS485 cabling run between terminal units in conduits above ceilings, under floors or in inaccessible areas can be bundled with other Class 2 low voltage cabling.

.3 RS485 cabling run between floors shall be in a communication only conduit.

.4 RS485 cabling run for long distances between service rooms or between buildings shall be in a communication only conduit.

.5 Ethernet cabling shall be in a communication only conduit.

.6 Ethernet and RS485 are allowed to run together.

.7 Fibre optics is allowed to run with Ethernet and RS485 cabling as long as the conduit is bent to fibre optic standards and junction boxes are sized for fibre optic use.

.8 The BAS Contractor is fully responsible for noise immunity. Rewire runs in conduit if electrical or RF noise affects the performance of the BAS.

.6 RS485 Cabling

.1 The shields shall be tied together at each device.

.2 The shield shall be grounded at one end only and capped at the other end.

.3 Provide end of line (EOL) termination devices at each end of the RS485 network or subnetwork run, to match the impedance of the cable, 100 to 120ohm.

.7 Ethernet cabling

.1 Ethernet cabling shall not run with any Class 1 or low voltage Class 2 wiring.

.2 Solid wire shall be used for long runs, between mechanical rooms and between floors. Stranded cable can be used for patch cables and between panels in the same mechanical room for up to (15m)(50 feet) distance.

.3 When the BAS Ethernet connects to an Owner's network switch, document the port number on the BAS as-built documents.

.8 Fibre optic cabling

.1 Install cable to maintain the minimum cable and unjacketed fibre bend radii as specified by the manufacturer.

.2 Do not exceed maximum pulling tensions as specified by the manufacturer. Do not exceed manufacturer's ratings for post installation residual cable tension.

.3 Install fibre optic cabinets, hardware, and cable entering the cabinet as per manufacturer's instructions.

.4 All terminations shall to be made into a patch panel, designed for such use. Free air terminations with patch panels are prohibited.

.9 All runs of communication wiring shall be unspliced length when that length is commercially available.

.10 All communication wiring shall be labeled to indicate origination and destination data.

3.5 IDENTIFICATION

.1 Provide nameplates in accordance with Section 20 05 53 - Mechanical Identification.

.2 Labels and tags shall match the unique identifiers shown on the as-built drawings.

.3 All panels shall be labeled to match the as-built drawing by either control panel name or the names of the DDC controllers inside.

.4 All sensors and actuators not in occupied areas shall be tagged.

.5 Each device inside enclosures shall be tagged.

.6 Terminal equipment need only have a tag for the unique terminal number, not for each device. Match the numbering system on the control as-builts.

.7 Tags on the terminal units shall be displayed on the operator workstation graphics.

.8 Provide lamacoid type label:

.1 On each BAS control device, indicating device number.

.2 On the panel front to identify each system being controlled and to identify each front mounted component.

.9 Provide laminated data card for:

.1 Field devices

.2 Damper actuators

.3 DDC terminal unit box controllers

.4 Automatic control valve actuators

.10 Provide plastic adhesive-backed labels, black lettering on yellow background as follows:

.1 On each equipment automatically controlled through the BAS:

CAUTION This equipment is operating under automatic control and may start at any time without warning. Switch disconnect to “Off” position before servicing.

.2 On each starter and control panel connected to multiple power sources utilizing separate disconnects:

CAUTION This equipment is fed from more than one power source with separate disconnects. Disconnect all power sources before servicing.

.11 Identification of wires

.1 Tag each wire with a common identifier on each end of the wire, such as in the control panel and at the device termination.

.2 Tag each network wire with a common identifier on each end.

.3 Tag each 120V power source with the panel and breaker number it is fed by.

.12 Identification of conduits

.1 Identify the low voltage conduit runs as BAS conduit, power feeds not included.

.2 Identify each electric box, junction box, utility box and wiring tray with a blue paint mark or blue permanent adhesive sticker.

.3 For conduit runs that run more than 2.4 m (8 ft) between junction boxes in 1 room, place a blue identifier at least every 2.4 m (8 feet).

.4 Place a blue identifier on each side of where a conduit passed through a wall or other inaccessible path.

.5 Identify all BAS communication conduits in the same manner as described above.

3.6 TESTING AND REPORTING

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

.2 After the controls devices and panels are installed and power is available to the controls, perform a static checkout of all the points, including the following:

.1 Inspect the setup and reading on each temperature sensor against a thermometer to verify its accuracy.

.2 Inspect the reading of each status switch to verify the DDC reads the open and close correctly.

.3 Command each relay to open and close to verify its operation.

.4 Check and set zero and span adjustments for all transducers and transmitters.

.5 Command each 2-position damper actuator to open and close to verify operation.

.6 Command each 2-position valve to open and close to verify operation.

.7 Ramp each modulating actuator to 0%, 25%, 50%, 75% and 100% to verify its operation.

.8 Check valves and dampers for adequate installation including free travel throughout range and adequate seal. Where loops are sequenced, check for proper control without overlap.

.9 Verify proper electrical voltages and amperages, and verify that all circuits are free from faults.

.3 Document that each point was verified and operating correctly. Correct each failed point before proceeding to the dynamic startup.

.4 Verify that each DDC controller communicates on its respective network correctly.

.5 Prepare and submit for approval a complete acceptance test procedure including submittal data relevant to point index, functions, sequence, inter-locks, and associated parameters, and other pertinent information for the operating system.

.6 Conduct complete performance tests to demonstrate to the Consultant the correct operation of each individual control system and each item of control equipment. Repeat performance tests as necessary until all systems are proven satisfactory to achieve the sequences of operation specified. Remove malfunctioning units, replace with new units, and retest.

.7 Calibration-test controllers by disconnecting input sensors and stimulating operation with compatible signal generator.

.8 Report format

.1 In accordance with Section 20 05 83 - Start-Up and Performance Testing.

.9 Controls report:

.1 Provide a test report in spreadsheet format which summarizes the following data for each piece of controls operation.

.1 Equipment ID and name

.2 Device Location

.3 AAC/ASC reference

.4 BC reference

.5 I/O reference

.2 Record the following tests for each device as applicable:

.1 Communications loop integrity test

.2 Sensor range test

.3 Actuator stroke test

.4 Controls logic function test – single loop.

.5 Controls logic function test – equipment or system test.

.3 Communications loop integrity test

.1 Check communications between DDC controller and remote I/O device

.4 Sensor range calibration test

.1 Provide data for minimum and maximum sensor values, setpoint value, and current value at time of test.

.5 Actuator stroke test

.1 Provide data on actuator stroke from 0-100% full stroke.

.2 Indicate output value vs. actuator position (i.e. 20 mA = 100% open)

.6 Controls logic function test – single loop

.1 Two position actuators: use manual control function from operator's workstation to change current state of controller output.

.2 Modulating valves: vary setpoint of control variable to modulate valve from 0-100% opening, at nominal 25% increments.

.7 Controls logic function test – equipment or system test

.1 Create a point form checklist of the sequence of operation for each system.

.2 Operate system through each control sequence element specified.

.3 Operate each system through an actual power outage, and restart on power resumption.

.4 Operate each applicable system for automatic restart on emergency power.

.5 Operate each system through scheduled operation.

.8 Trend logs

.1 Provide a copy of each trend log specified or requested.

.10 Perform all program changes and debugging of the system for a fully operational system.

.11 Verify that all graphics at the operator workstations correspond to the systems as installed. Verify that the points on the screens appear and react properly. Verify that all adjustable setpoints and manual commands operate from the operator workstations.

3.7 OPERATING INSTRUCTIONS

.1 Provide Operating instructions for the BAS in accordance with Section 01 77 00 - Contract Closeout., and include a description of the sequence of operation, and reproducible drawings of the "as-built" system schematics.

.2 Maintain electronic copies of all data file and application software for reload use in the event of a system crash or memory failure. Deliver one copy to the Owner during the training sessions, and archive one copy in the BAS manufacturer's local software vault.

.3 "As-built" system schematics shall include:

.1 Changes made during construction.

.2 Component final set points.

.3 Controller sensitivity and authority settings.

.4 Include maintenance instructions for all control components supplied under the Work of Division 25 – Building Automation.

3.8 **SERVICE AND WARRANTY**

.1 The BAS shall be free from defects in workmanship and material under normal use and operation after the commissioning and acceptance have been achieved.

.2 After acceptance of the systems, provide any service required for the proper performance of the control systems for a period of one (1) year.

.3 Include replacement parts for defective components and any labour to remove and replace such parts at no cost to the Owner.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Sections 20 00 13 – Mechanical General Provisions and 25 05 00 - Common Works for Building Automation shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 This Section includes requirements for commissioning the building automation systems, subsystems and equipment. This Section supplements the general requirements specified under Section 23 08 00 - Commissioning of HVAC

.2 Commissioning of retrofit components must take place as components are connected to the BAS and put into service.

1.2 COMMISSIONED SYSTEMS

.1 Field devices including sensors, actuators, switches;

.2 Network devices and wiring.

PART - 2 PRODUCTS

2.1 NOT APPLICABLE.

PART - 3 EXECUTION

3.1 TESTING OF BUILDING AUTOMATION SYSTEMS

.1 Prior to replacement of existing electronic sensors and components, perform continuity test on existing wiring.

.1 Ensure that wiring is accurately connected to appropriate terminals;

.2 Verify connection integrity between existing controller and device;

.3 Identify any wiring that fails testing and is in need of replacement to Consultant prior to commencement of work.

.2 Test all new wiring and components.

.3 Testing requirements:

.1 The building automation system shall be fully tested and commissioned by the manufacturer’s technician to operate in the manner defined by the Specifications.

.2 Provide a print-out of general and critical alarm lists and all points connected to the BAS. The all-point log shall be sub-divided into points per system. One report shall be taken prior to the acceptance test.

.3 A point-to-point testing shall be completed. This test shall include, but is not limited to:

.1 Ensuring that wiring is accurately connected to appropriate terminals;

.2 Checking the function of each controller and controlled device (such as the beginning, end and extent of actuator travel);

.3 Connection integrity between actuator and device;

.4 Calibration of sensors;

.5 Output from sensors;

.6 Operation of relays;

.7 Data/information integrity at console;

.8 Remote reset integrity from console to field device;

.9 Interfacing with other systems such as life safety monitoring system.

.4 Testing procedure shall include but is not limited to:

.1 Check and verify that each input point is reporting to the BAS panels and workstations in the normal state and change or state;

.2 Create false alarms at each point and provide a print-out of the test;

.3 Command each output point via the workstation and verify the action at the device;

.4 Verify that each program is operational in software and at the devices;

.5 Verify that each system graphic is dynamically updating;

.6 Test each DDC loop and verify that it is controlling in a stable manner. Create set point changes on output points. False loads shall be introduced to observe the control loops response. Program trend logs at the BAS for a minimum of 30 minutes per control loop with a sampling time of 30 seconds. Provide a print-out of the results. Tune each DDC loop prior to acceptance test. Check each loop again, once during the heating and once during the cooling season and re-tune where necessary;

.7 Verify that all safeties are operating (i.e. firestats);

.8 Verify valve and damper actuation;

.9 Verify the calibration of each analog input point;

.10 Randomly test the response to the following sensor failures:

.1 Space temperature;

.5 Any sensor disconnected from the input terminal after completion of the performance test shall be retested.

.6 Provide a “signed-off” copy of the results of all tests to the Consultant. Acceptance test will not begin until the tests have been reviewed and accepted. The Commissioning Authority will witness these tests.

.7 Provide the calibration procedure for each analog sensor. Physically check the calibration of each analog sensor type using a calibrated instrument prior to testing.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Sections 20 00 13 – Mechanical General Provisions and 25 05 00 - Common Works for Building Automation shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 Furnish and install all local controllers including Building Controllers, Application Specific Controllers and Advanced Application Controllers as required for the BAS functions specified.

1.2 SUBMITTALS

.1 Submit shop drawings in accordance with Section 25 05 00 - Common Work for Building Automation.

PART - 2 PRODUCTS

2.1 ADVANCED APPLICATION CONTROLLERS

.1 The Advanced Application level control panel shall be able to operate as a standalone panel and shall not be dependent upon any higher level computer or another controller for operation.

.2 The Advanced Application Controller Software shall be capable of BACnet communications. The BACnet Advanced Application Controller (B-AAC) shall have demonstrated compliance to BTL through BTL listing and shall substantially conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ANSI/ASHRAE 135. Supported BIBBS shall include:

.1 Data sharing

.1 Data Sharing-Read Property-Initiate, Execute (DS-RP-A,B)

.2 Data Sharing-Read Property Multiple- Initiate, Execute (DS-RPM-A,B)

.3 Data Sharing-Write Property- Initiate, Execute (DS-WP-A,B)

.4 Data Sharing-Write Property Multiple- Execute (DS-WPM-B)

.5 Data Sharing-COV- Initiate, Execute (DS-COV-A,B)

.2 Scheduling

.1 Scheduling-Internal- Execute (SCHED-I-B)

.3 Trending

.1 Trending-Viewing and Modifying Trends Internal- Execute (T-VMT-I-B)

.2 Trending-Automated Trend Retrieval- Execute (T-ATR-B)

.4 Network management

.1 Network Management-Connection Establishment- Initiate (NM-CE-A)

.5 Alarming

.1 Alarm and Event-Notification Internal- Execute (AE-N-I-B)

.2 Alarm and Event-ACK- Initiate, Execute (AE-ACK-A,B)

.3 Alarm and Event –Enrollment Summary- Execute (AE-ESUM-B)

.4 Alarm and Event –Information- Execute (AE-INFO-B)

.6 Device management

.1 Device Management-Dynamic Device Binding- Initiate, Execute (DM-DDB-A,B)

.2 Device Management-Dynamic Object Binding- Initiate, Execute (DM-DOB-A,B)

.3 Device Management-Device Communication Control- Execute (DM-DCC-B)

.4 Device Management-Time Synchronization- Execute (DM-TS-B)

.5 Device Management-Reinitialize Device- Execute (DM-RD-B)

.6 Device Management-Backup and Restore- Execute (DM-BR-B)

.7 Device Management-List Manipulation- Execute (DM-LM-B)

.8 Device Management-Object Creation and Deletion- Execute (DM-OCD-B)

.7 The Advanced Application Controller shall be able to interact with all of the BACnet objects in the controllers. In addition, the software shall be able to support the following objects as they relate to features in the workstation software:

.1 Calendar – Creatable, Deletable

.2 Command – Creatable, Deletable

.3 Event Enrollment – Creatable, Deletable

.4 Notification Class – Creatable, Deletable

.5 Schedule - Creatable, Deletable

.8 The Advanced Application Controller shall support transmitting and receiving segmented messages.

.3 Communication

.1 BAS network: The Advanced Application Controller shall support the following data link layers:

.1 MS/TP Master

.2 Serial communication: Temporary use of portable devices shall not interrupt the BAS communication, nor the normal operation of permanently connected printers or terminals.

.1 Provide at least one EIA-232C serial data communication port for operation of operator I/O devices such as industry standard printers, operator terminals, and portable laptop operator's terminals.

.2 A USB port shall alternatively be available to support local HMI tools connection.

.4 Software

.1 The software programs specified in this Section shall be provided as an integral part of Advanced Application Controllers and shall not be dependent upon any higher level computer or another controller for execution.

.2 Advanced Application Controllers shall have the ability to perform energy management routines including but not limited to:

.1 Scheduling, calendar-based scheduling, holiday scheduling, temporary schedule overrides;

.2 Automatic daylight savings time switch over;

.3 Night setback control;

.4 Economizer switch over using enthalpy, dry bulb or a combination;

.5 Peak demand limiting;

.6 Temperature-compensated duty cycling;

.7 Heating / cooling interlock;

.8 Supply temperature reset;

.9 Priority load shedding;

.10 Power failure restart.

.3 The software shall have a routine for automatic tuning of control loops.

.4 System security in the field panel

.1 User access shall be secured using individual security passwords and user names.

.2 Passwords shall restrict the user to the objects, applications, and system functions as assigned by the system manager.

.3 The system shall protect itself from unauthorized use by automatically logging off following the last keystroke. The delay time shall be user-definable.

.4 Use of workstation resident security as the only means of access control is not an acceptable alternative to resident system security in the field panel.

.5 User defined control applications

.1 Controllers shall be fully-programmable. Controllers shall execute custom, job-specific sequences to automatically perform calculations and special control routines. Factory installed or pre-configured sequences shall only be allowed if they exactly match the sequence specified in this Section.

.2 Programs shall combine control logic, control loop algorithms, and energy management routines

.3 Each controller shall support plain language text comment lines in the operating program to allow for quick troubleshooting, documentation, and historical summaries of program development.

.4 Controller shall provide a HELP function key, providing enhanced context sensitive on-line help with task oriented information from the user manual.

.5 Adaptive loop control

.1 Each AAC controller shall come standard with an adaptive control loop algorithm

.1 Tuning parameter shall automatically adjust for non-linear applications.

.2 Model-Free Adaptive (MFA) algorithm

.1 The algorithm shall not require modeling of the non-linear system in order to maintain control at all points of the non-linear load.

.2 The controlled variable, setpoint, and weighting parameters shall be user-selectable.

.3 Output shall be analog or shall stage a series of outputs.

.4 Adaptive control shall take the place of Proportional, Proportional + Integral, and PID type algorithms for non-linear applications. Adaptive control routines shall:

.1 Improve response time;

.2 Improve system efficiency;

.3 Improve stability;

.4 Result in consistent outputs;

.5 Reduce cycling and repositioning;

.6 Reduce wear and tear on actuators.

.5 Adaptive control shall auto-adjust to compensate for:

.1 Mode changes;

.2 Load changes;

.3 Seasonal changes;

.4 Heating and cooling changeover;

.6 This level of controller shall be used for the following types of systems:

.1 Integration with Third Party systems (eg. Fire Alarm)

.2 BAS network or architecture or sequences do not require the system to be on an IP network;

.3 Integration to smart thermostats is allowed.

.7 Input/Outputs

.1 Inputs shall be 16-bit minimum digital resolution.

.2 Outputs shall be 10-bit minimum digital resolution.

.3 The following I/O port types shall be available on the controller:

.1 Universal Input (software configurable):

.1 Digital Input choices:

.1 Pulse accumulator

.2 Contact closure sensing

.3 Dry contact/potential free inputs only

.4 Digital Input (10 ms settling time)

.5 Counter inputs up to 20 Hz, minimum pulse duration 20 ms (open or closed)

.2 Analog Input choices:

.1 0-10 VDC

.2 4-20 mA

.3 1K Ni RTD @ (0°C)(32°F) (Siemens, JCI, DIN Ni 1K)

.4 1K Pt RTD (375 or 385 alpha) @ (0°C)(32°F)

.5 10K NTC Type 2 or Type 3 Thermistor

.6 100K NTC Type 2 Thermistor

.2 Universal Input or Output (software configurable):

.1 All of the above input types;

.2 Analog Output types:

.1 0 to 10 VDC @ 1 mA max

.3 Super universal Input or Output (software configurable):

.1 All of the above input types;

.2 All of the above output types.

.3 Super digital Output type:

.1 0 to 24 VDC, 22 mA max. (for controlling pilot relay)

.4 Super analog Output choices:

.1 0 to 20 mA @ 650 Ω max.

.4 Provide software configurable I/O ports such that a programmer can make a port either an input or an output.

.8 Each system level control panel shall, at a minimum, be provided with:

.1 Appropriate NEMA rated metal enclosure.

.2 A 32-bit, multi-tasking, real-time 100 MHz digital control microprocessor with plug-in, enclosed processors.

.3 Each Advanced Application Controller shall have sufficient memory, a minimum of 24 megabyte, to support its own operating system and databases, including control processes, energy management applications, alarm management applications, historical/trend data for points specified, maintenance support applications, custom processes, and operator I/O.

.4 Real time clock and battery.

.5 Data collection / data trend module sized for 10,000 data samples.

.6 Power supplies as required for all associated modules, sensors, actuators.

.7 Monitoring of all industry standard types of analog and digital inputs and outputs, without the addition of equipment to the primary control panel.

.8 Local status indication for each digital input and output for constant, up to date verification of all point conditions without the need for an operator I/O device.

.9 Each control panel shall perform diagnostics on all inputs and outputs and a failure of any input or output shall be indicated both locally and at the operator workstation.

.10 Graduated intensity LEDs or analog indication of value for each analog output.

.9 Power loss

.1 In the event of the loss of power, there shall be an orderly shutdown of all controllers to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for the operating system software and firmware.

.2 Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.

.3 Brownout protection and power recovery circuitry protect the controller board from power fluctuations.

.4 Battery backup shall be provided to support the real-time clock for 10 years.

.5 The program and database information stored SDRAM memory shall be battery backed for a minimum of 30 days and up to 60 days. This eliminates the need for time consuming program and database re-entry in the event of an extended power failure.

.10 Each AAC shall automatically save the latest programmed database. The controller shall be able to automatically restore a lost or corrupt database without involvement from the operator.

.11 Each system level control panel shall continuously perform self-diagnostics on all hardware modules and network communications. The system level control panel shall provide both local and remote annunciation of any detected component failures, low battery conditions or repeated failure to establish communication with any system.

.12 Each control panel shall support firmware upgrades without the need to replace hardware.

.1 The AAC level controller shall be upgradable to a BC level controller with a flash upgrade of the firmware.

.13 System level control panels shall provide at least two RS 232C serial data communication ports for operation of operator I/O devices such as operator terminals, and additional memory. Control panels shall allow temporary use of portable operator interface devices without interrupting the normal communications.

.14 Immunity to noise

.1 Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at (1 m)(3 ft).

.2 Isolation shall be provided at all primary network terminations, as well as all field point terminations to suppress induced voltage transients consistent with:

.1 RF-Conducted Immunity (RFCI) per ENV 50141 (IEC 1000-4-6) at 3V.

.2 Electro Static Discharge (ESD) Immunity per EN 61000-4-2 (IEC 1000-4-2) at 8 kV air discharge, 4 kV contact.

.3 Electrical Fast Transient (EFT) per EN 61000-4-4 (IEC 1000-4-4) at 500V signal, 1 kV power.

.4 Output Circuit Transients per UL 864 (2,400V, 10A, 1.2 Joule max).

.3 Isolation shall be provided at all Advanced Application Controller's AC input terminals to suppress induced voltage transients consistent with:

.1 IEEE Standard 587

.2 Voltage sags, surge, and dropout per EN 61000-4-11 (EN 1000-4-11)

.15 Agency Compliance

.1 UL UL916 PAZX (all models)

.2 UL916 PAZX7 (all models)

.3 FCC Compliance CFR47 Part 15, Subpart B, Class B

.4 Australian EMC Framework

.5 European EMC Directive (CE)

.6 European Low Voltage Directive (LVD)

.7 BACnet Testing Laboratories (BTL) Certified

.16 Local operator interfaces: Provide if called for elsewhere in the Specification or the sequences of operations.

.1 Controllers shall support an optional operator interface module.

2.2 **APPLICATION SPECIFIC CONTROLLERS**

.1 Each application specific controller shall operate as a standalone controller capable of performing its user selectable control routines independently of any other controller in the system. Each application specific controller shall be a microprocessor based, multi-tasking, real-time digital control processor.

.2 This controller shall have the BTL listing and meet the BACnet device profile of an Application Specific Controller and shall support the following BACnet BIBBs:

.1 Data sharing

.1 Data Sharing-Read Property-B (DS-RP-B)

.2 Data Sharing-Read Property Multiple-B (DS-RPM-B)

.3 Data Sharing-Write Property-B (DS-WP-B)

.2 Device management

.1 Device Management-Dynamic Device Binding-B (DM-DDB-B)

.2 Device Management-Dynamic Object Binding-B (DM-DOB-B)

.3 Device Management-Device Communication Control-B (DM-DCC-B)

.3 The Application Specific Controller shall support the following data link layers:

.1 MS/TP Master or Slave (Clause 9)

.3 Provide an Application Specific Control Panel for each of the following types of equipment (if applicable):

.1 Constant air volume (CAV) terminals

.2 Fan coil units

.3 Supplemental AC units

.4 Sump pump monitoring

.5 Other similar terminal equipment

.4 Each Application Specific Controller shall, at a minimum, be provided with:

.1 Appropriate NEMA rated enclosure;

.2 Floor level network communications ability;

.3 Power supplies as required for all associated modules, sensors, actuators;

.4 Software as required for all sequences of operation, logic sequences and energy management routines;

.5 A portable operator terminal connection port.

.6 Auxiliary enclosure for analog output transducers, isolation relays. Auxiliary enclosure shall be part of primary enclosure or mounted adjacent primary enclosure.

.7 Each controller measuring air volume shall include provisions for manual and automatic calibration of the differential pressure transducer in order to maintain stable control and insuring against drift over time.

.8 Each controller measuring air volume shall include a differential pressure transducer.

.9 Approvals and standards: UL916; CE; FCC.

.5 Each Application Specific Controller shall continuously perform self-diagnostics on all hardware and secondary network communications. The Application Specific Controller shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failure to establish communication to the system.

.6 Provide each Application Specific Controller with sufficient memory to accommodate point databases, operating programs, local alarming and local trending. All databases and programs shall be stored in non-volatile EEPROM, EPROM and PROM. The controllers shall be able to return to full normal operation without user intervention after a power failure of unlimited duration. Provide uninterruptible power supplies (UPSs) of sufficient capacities for all terminal controllers that do not meet this protection requirement. Operating programs shall be field selectable for specific applications. In addition, specific applications may be modified to meet the user's exact control strategy requirements, allowing for additional system flexibility. Controllers that require factory changes of all applications are not acceptable.

.7 The Application Specific Controller shall be powered from a 24 VAC source provided under the Work of the BAS Contractor and shall function normally under an operating range of 18 to 28 VAC (25% to +17%), allowing for power source fluctuations and voltage drops. Install plenum data line and sensor cable in accordance with applicable electrical codes. The controllers shall also function normally under ambient conditions of (0°C to 50°C)(32°F to

122°F) and 10% to 95%rH (non-condensing). Provide each controller with a suitable cover or enclosure to protect the intelligence board assembly.

PART - 3 EXECUTION

3.1 GENERAL

.1 Install controllers in secure enclosures in accordance with the manufacturer's installation instructions.

.2 AACs and ASCs may be mounted directly to fixed building elements, including columns and walls.

.3 ASCs may be mounted directly on terminal unit equipment being controlled.

.4 Do not mount or attach controllers or mounting frames to any equipment subject to vibration.

.5 Provide the necessary power from local 120 V branch circuit panel for equipment.

.6 Install tamper locks on breakers of circuit breaker panel.

.7 Furnish and install any power supply surge protection and filters as necessary for proper operation and protection of all AACs, ASCs, routers, gateways, and other hardware and interface devices. All equipment shall be capable of handling voltage variations 10 percent above or below measured nominal value, with no effect on hardware, software, communications, and data storage.

3.2 LAN DEVICE DENSITY

.1 Total number of devices on each LAN not to exceed 80% of maximum device limitations with the use of repeater devices.

3.3 CONTROLLER TUNING

.1 Tune each controller in a manner consistent with industry practices and as described in the manufacturer's instruction manual.

.2 Tuning must consist of adjustment of the proportional, integral, and where applicable, the derivative (PID) settings to provide stable closed-loop control. Each loop must be tuned while the system or plant is operating at a high gain (worst case) condition, where high gain can generally be defined as a low-flow or low-load condition. Upon final adjustment of the PID settings, in response to a change in controller setpoint, the controlled variable must settle out at the new setpoint with no more than two (2) oscillations above and below setpoint. Upon settling out at the new setpoint the controller output must be steady. With the exception of naturally slow processes such as zone temperature control, the controller must settle out at the new setpoint within five (5) minutes. Set the controller to its correct setpoint and record and submit the final PID configuration settings with the O&M Instructions and on the associated Points Schedule.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Sections 20 00 13 – Mechanical General Provisions and 25 05 00 - Common Works for Building Automation shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 Furnish and install all operator interface and server software as required for the BAS functions specified. Scope includes software programming and data base generation, and generation of colour graphics.

1.2 SUBMITTALS

.1 Submit shop drawings in accordance with Section 25 05 00 - Common Work for Building Automation.

1.3 LICENSING

.1 Provide or upgrade all licensing for all software packages at all required workstations. BAS licensing shall allow unlimited simultaneous users for access to all aspects of the system including system access, workstations, points, programming, database management, and graphics. No restrictions shall be placed on the licensing. All operator interfaces, programming environment, networking, database management, and any other software used by the Contractor to install the system or needed to operate the system to its full capabilities shall be licensed and provided to the Owner.

.2 All software should be available on all Operator's Workstations and BAS servers provided. Hardware and software keys to provide all rights shall be installed on all workstations. At least two (2) sets of CDs shall be provided with backup software for all software installed, so that the Owner may reinstall any software as necessary. Include all licensing for workstation operating systems, and all required third-party software licenses.

.3 Provide licensing and original software copies for each OWS, PWS and BAS server.

.4 Provide licensing and original software copies for each remote graphic workstation. Licenses for remote graphic workstations shall allow for access to any site and shall not be restricted to accessing only the LANs included in this Project.

PART - 2 PRODUCTS

2.1 SOFTWARE FOR BUILDING CONTROLLER, DDC CONTROLLERS AND FIELD PANELS

.1 Provide a full capability user license to the Owner to see, modify, create, upload, download and save control programs to the DDC controllers. Include cost for and additional licences required to expand the existing system as required.

.2 The software program shall be provided as an integral part of DDC controllers and shall not be dependent upon any higher level computer or another controller for execution.

.3 The software application shall be accessible from a PC using the Windows environment, but shall use all of its own services and data files so as to not be susceptible to Microsoft Windows operating systems based viruses.

.4 User defined control applications:

.1 The applications software shall program DDC routines to meet the sequences of operations.

.2 Building Controllers shall have the ability to perform energy management routines including but not limited to time of day scheduling, calendar-based scheduling, holiday scheduling, temporary schedule overrides, start stop time optimization, automatic daylight savings time switch over, night setback control, enthalpy switch over, peak demand limiting, temperature-compensated duty cycling, heating/cooling interlock, supply temperature reset, priority load shedding, and power failure restart.

.3 The Building Controllers shall have the ability to perform the following pre-tested control algorithms:

.1 Two position with differential control and time delays

.2 Floating control

.3 Proportional control

.4 Proportional plus integral control

.5 Proportional, integral, plus derivative control

.6 Automatic tuning of control loops

.7 Model-free adaptive control

.4 Controllers shall be able to execute custom, job-specific processes defined by the user, to automatically perform calculations and special control routines.

.5 Each controller shall support plain language text comment lines in the operating program to allow for quick troubleshooting, documentation, and historical summaries of program development.

.5 Peer-to-peer access to other DDC controllers

.1 It shall be possible to use any actual or virtual point data or status, any system calculated data, a result from any process, or any user-defined constant in any controller in the system.

.2 Any process shall be able to issue commands to points in any and all other controllers in the system.

.3 Processes shall be able to generate operator messages and advisories to other operator I/O devices. A process shall be able to directly send a message to a specified device or cause the execution of an advanced annunciation feature, such as:

.1 Generate a report

.2 Annunciate an alarm

.3 Issue a text message or email

.6 Alarm management

.1 Alarm management shall be provided within the controller software to monitor and direct alarm information to operator devices. Existing alarm settings shall be maintained and extended for new alarm notifications.

.2 Each Building Controller shall perform distributed, independent alarm analysis, minimize network traffic and prevent alarms from being lost. At no time shall the Building Controllers ability to report alarms be affected by either operator or activity at a PC workstation, local I/O device or communications with other panels on the network.

.3 Conditional alarming shall allow generation of alarms based upon user defined multiple criteria.

.4 An alarm history log shall report the start of the alarm condition, acknowledgement by a user and return of the alarm to normal condition.

.7 Scheduling

.1 Not applicable.

.8 Control loop algorithm

.1 Provide a PID (proportional-integral-derivative) closed-loop control algorithm with direct or reverse action and anti-windup. The algorithm shall calculate a time-varying analog value that is used to position an output or stage a series of outputs. The controlled variable, setpoint, and weighting parameters shall be accessible from the OWS.

.9 Logic programming

.1 Provide a software routine that can build ladder logic to control using many conditional statements.

.2 The logic programming syntax shall be able to combine ladder logic with other software features, such as combining status, scheduling, PDL and alarm conditions into one conditional decision.

.3 Logic programming shall be able to reference conditions in any other controller in the system.

PART - 3 EXECUTION

3.1 SYSTEM CONFIGURATION

.1 The BAS Contractor shall thoroughly and completely configure the BAS system software, to include new devices and systems.

3.2 GRAPHIC SCREENS

.1 Floor plan screens:

.1 The Contract Drawings will be made available to the BAS Contractor in AutoCAD format upon request. These Drawings may be used only for developing backgrounds for specified graphic screens; however, the Owner does not guarantee the suitability of these Drawings for the BAS Contractor’s purpose. Graphic screens shall be submitted for approval.

.2 Provide graphic floor plan screens for each floor of each building.

.3 Indicate the location of all equipment that is not located on the equipment room screens.

.4 Indicate the location of temperature sensors associated with each temperature-controlled zone (i.e. VAV terminals, fan-coils, single-zone AHUs) on the floor plan screens.

.5 Display the space temperature point adjacent to each temperature sensor symbol. Use a distinct line symbol to demarcate each terminal unit zone boundary. Use distinct colours to demarcate each air handling unit zone.

.6 Provide a drawing link from each space temperature sensor symbol and equipment symbol shown on the graphic floor plan screens to each corresponding equipment schematic graphic screen.

.2 System schematic screens:

.1 Provide graphic system schematic screen for each subsystem controlled with each I/O point in the Project appearing on at least one graphic screen. System graphics shall include flow diagrams with status, setpoints, current analog input and output values, operator commands, as applicable. General layout of the system shall be schematically correct. Input/output devices shall be shown in their schematically correct locations. Include appropriate engineering units for each displayed point value. Verbose names (English/French language descriptors) shall be included for each point on all graphics; this may be accomplished by the use of a pop-up window accessed by selecting the displayed point with the mouse. Indicate all adjustable setpoints on the applicable system schematic graphic screen or, if space does not allow, on a supplemental linked-setpoint screen.

.2 Provide separate graphic screens for each additional system schematic such as sump pump and stair ventilation.

.3 Alarms

.1 Each programmed alarm shall appear on at least one graphic screen. In general, alarms shall be displayed on the graphic system schematic screen for the system that the alarm is associated with (for example, ventilation alarm shall be shown on graphic for stair pressurization screen). For all graphic screens, display analog values that are in a ‘high alarm’ condition in a red colour, ‘low alarm’ condition in a blue colour. Indicate digital values that are in alarm condition in a red colour.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.2 Supply and install instrumentation and terminal devices related to the BAS, including but not limited to:

.1 Control dampers and actuators;

.2 Sensors;

.3 Electric control components - switches, thermostats, relays;

.4 Transducers;

.5 Current switches;

.6 Testing equipment.

.2 Related requirements:

.1 Comply with Conditions of the Contract and Division 01 - General Requirements.

.2 Sections 20 00 13 – Mechanical General Provisions and 25 05 00 - Common Works for Building Automation shall apply to and govern this Section.

1.2 SUBMITTALS

.1 Submit shop drawings in accordance with Section 25 05 00 - Common Work for Building Automation.

1.3 REFERENCE STANDARDS

.1 AMCA 500-D - Laboratory Methods of Testing Dampers for Ratings

.2 ANSI/FCI 70-2 - Control Valve Seat Leakage

.3 UL 873 – Temperature Indicating and Regulating Equipment

PART - 2 PRODUCTS

2.1 GENERAL SPECIFICATIONS FOR DEVICES

.1 Provide field devices for input and output of digital (binary) and analog signals into controllers (AACs, ASCs). Provide signal conditioning for all field devices as recommended by the device manufacturers and as required for proper operation in the BAS.

.2 It is the BAS Contractor's responsibility to ensure that all field devices are compatible with controller hardware and software.

.3 Field devices specified in this Section are generally ‘two-wire’ type transmitters, with power for the device to be supplied from the respective controller. If the controller provided is not equipped to provide this power, is not designed to work with ‘two-wire’ type transmitters, if field device is to serve as input to more than one controller, or where the length of wire to the controller will unacceptably affect the accuracy, the BAS Contractor shall provide ‘four-

wire' type equal transmitter and necessary regulated DC power supply or 120 VAC power supply, as required.

.4 For field devices specified in this Section that require signal conditioners, signal boosters, signal repeaters, or other devices for proper interface to controllers, the BAS Contractor shall furnish and install all necessary devices, including 120V power as required. Such devices shall have accuracy and repeatability equal to, or better than, the accuracy and repeatability listed for respective field devices.

.5 Accuracy stated for each device shall include the combined effects of nonlinearity, non-repeatability and hysteresis.

.6 Provide mounting hardware for all devices, including actuator linkages, wells, installation kits for insertion devices, wall boxes and fudge plates, brackets.

2.2 DAMPER ACTUATORS

.1 General:

.1 Provide dampers with low torque, fully modulating, floating (tri-state) or two position electronic actuators sized with sufficient reserve torque or force to assure smooth, positive operation over the entire operating range, without chatter or slamming, and to give tight shutoff at end positions against the system pressures to be encountered.

.2 Actuators shall include a visual scale indicating percent of travel and a 0-10 VDC feedback signal.

.3 Select spring-return actuators with manual override to provide positive shut-off of devices.

.4 Failure position:

.1 Spring return, normally open or normally closed sequence as required so that systems will "Fail-safe" in case of power failure.

.2 Motorized dampers:

.1 Outdoor air intake: normally closed;

.2 Exhaust air: normally closed;

.3 Other applications: as required by the sequences of operation.

.5 Actuators shall be enclosed reversible gear drive type that can accept modulating control signals as required. Actuators using balance relays or mechanical travel limiting switches are not acceptable.

.6 Actuators to include current limiting or digital motor rotation sensing circuits to provide motor protection. End switches to deactivate the actuator at the end of rotation or magnetic clutch are not acceptable.

.7 Actuators shall be capable of being mechanically and electrically paralleled to increase torque if required.

.8 Sequencing by spring range is prohibited.

.9 Proportional actuators shall be fully programmable through an EEPROM without the use of actuator mounted switches.

.10 Actuators installed in outdoor service application shall operate satisfactorily at a temperature range of -30°C (-22°F) through 50°C (122°F).

.2 Damper actuators

.1 Actuators shall be direct coupled (over the shaft), enabling it to be mounted directly to the damper shaft without the need for connecting linkage. The actuator-to-shaft clamp shall use a "V" bolt and "V" shaped, toothed cradle to attach to the damper shaft for maximum holding strength. Single bolt or set screw type fasteners are not acceptable.

.2 Actuators with spring return mechanisms shall be capable of either clockwise or counter clockwise spring return operation by simply changing the mounting orientation.

.3 Proportional actuators shall accept a 2-10VDC, 4-20mA signal, or be of the 2 point floating type and provide a 2-10VDC actuator position feedback signal.

.4 All actuators shall have an external manual gear release (clutch) or manual crank to aid in installation and for allowing manual positioning when the actuator is not powered.

.5 All actuators shall have an external direction of rotation switch to aid in installation and to allow proper control response.

.6 Actuators shall be provided with a factory-mounted 3-foot electrical cable and conduit fitting to provide easy hook-up to an electrical junction box.

.7 Actuators shall be listed to UL 873.

2.3 POSITIONERS

.1 Provide positive positioning relays on damper motors and valves when required to provide sufficient power, sequencing, repeatability, or speed of response. Positioner shall allow field adjustment of both starting pressure and operating span. Positioner shall provide an antilock feature and shall provide accurate positioning without excessive air bleed.

2.4 ELECTRONIC SENSORS

.1 General requirements

.1 Input/output sensors and devices: closely matched to the requirements of the controller for accurate, responsive, noise free signal input/output.

.2 Control input response: high sensitivity and matched to the loop gain requirements for precise and responsive control.

.3 In no case shall computer inputs be derived from pneumatic sensors. In no case shall thermocouples or thermistors be used.

.2 Temperature Sensors

.1 All temperature sensors shall meet the following specifications:

.1 Accuracy: +/- 0.2% at calibration point;

.2 Wire: twisted, shielded-pair cable;

.3 Vibration and corrosion resistant.

.2 Space temperature sensors:

.1 10k ohm type 2 thermistors or 1k RTD.

.3 Insertion elements in ducts:

.1 Single point 10k ohm thermistor;

.2 Use where not affected by temperature stratification;

.3 The sensor shall reach more than 1/3 the distance from the duct wall;

.4 Junction box for wire splices.

2.5 SWITCHES

.1 Flow switches

.1 Airflow:

.1 Paddle actuated with snap acting single-pole, double-throw contacts rated at 120 Volts, 15 Amps AC full load;

.2 Stainless steel vane, galvanized steel base, ABS housing;

.3 Wiring connection with screw terminal and cable gland;

.4 Flanged duct connection for horizontal flow installation;

.5 Maximum medium velocity: (9.1 m/s)(1800 fpm).

2.6 ELECTRICAL RELAYS

.1 Current sensing (switch)

.1 Status inputs for direct drive electric motors: current-sensing relay with current transformers, adjustable and sized for 175% of rated motor current.

.2 Status inputs for belt drive electric motors: current sensing transmitter with linear 4-20mA output.

.3 Metering transformer ranged to match load being metered:

.1 Plug-in base and shorting shunt to protect current transformer when relay is removed from socket;

.2 Current transformer for single or three phase metering into single relay;

.3 Adjustable latch level, adjustable delay on latch and minimum differential of 10% of latch setting between latch level and release level;

.4 Discrimination between phases in three phase applications to allow worst case selection;

.5 Mounted in motor starter cabinet and fed from starter control transformer;

.6 Relay contacts shall be compatible with control circuit voltage;

.7 Rating 10A at 240 VAC.

.2 General relays

.1 Relays for control and status indication

.1 Double voltage DPDT.

.2 Relays for implementation of control strategy

.1 Single voltage with appropriate number of contacts.

.3 Time delay relay (TDR)

.1 TDRs shall be capable of “On or Off” delayed functions, with adjustable timing periods, and cycle timing light. Contacts shall be rated for the application with a minimum of two (2) sets of Form C contacts, enclosed in a NEMA 1 enclosure.

.2 TDRs shall have silver cadmium contacts with a minimum life span rating of one million operations. TDRs shall have solid state, plug-in type coils with transient suppression devices.

.3 TDRs shall be ULC and CSA listed, Crouzet type.

2.7 ANCILLIARY DEVICES

.1 Duct smoke detectors

.1 Construction and performance as noted for Space smoke detectors.

.2 Listed to UL 268A for the use in air handling systems.

.3 Air sampling chamber with sampling tubes extending through the width of the air duct.

.4 Key controller test and reset switches plus an easily accessible test jack.

.5 Double-pole double-throw alarm relay contacts capable of handling loads of up to 5A at 120 VAC or 28 VDC resistive.

.6 Power: self-contained power supply requiring 120/220/240V power.

.2 Damper status switches

.1 Damper status switches shall be lever operated, activated by damper blade movement, and mounted securely on damper frame.

.2 Damper switch shall have a contact rating of 5A at 120V AC.

.3 Control transformers

.1 Furnish and install control transformers as required. Control transformers shall be machine tool type, and shall be ULC and CSA listed. Primary and secondary sides shall have replaceable fuses in accordance with the NEC. Transformer shall be properly sized for application, and mounted in minimum NEMA 1 enclosure.

.4 Testing equipment

.1 Furnish test equipment required to perform field device tests and calibrations. Test equipment used for testing and calibration of field devices shall be at least twice as accurate as respective field device (e.g. if a field device is +/- 0.5% accurate, test equipment shall be +/- 0.25% accurate over same range).

PART - 3 EXECUTION

3.1 GENERAL

.1 Supply equipment to be installed by Contractors performing the Work of other Divisions to meet their Work Schedule.

.2 Install devices in accordance with manufacturer’s instructions.

.3 Unless otherwise noted, install wall mounted thermostats, humidistats and any other device requiring user interaction 1.2m (48") above the finished floor level measured to the center line of the device.

.4 Make sensors and elements accessible for replacement and servicing. Provide access doors as required in accordance with Section 20 00 19 - Basic Materials and Methods.

.5 Install transmitters, transducers, controllers and relays with wiring within panels as described in Section 25 05 00 - Common Work for Building Automation.

.6 Support field mounted transmitters on pipe stands or channel brackets.

.7 Where the BAS Work includes the provision of auxiliary contacts, provide all instrumentation, wiring, conduit, power supplies and services as required to integrate these points into the BAS.

.8 Provide interposing and motor control relays at the location of the equipment or at the associated motor control centre or remote starter as applicable. Provide all relays, wiring, conduit, power supplies and services as required integrating these points into the BAS.

3.2 CONTROL DAMPERS

.1 All damper actuators shall be rigidly mounted and supplied with heavy-duty linkage consisting of a crank arm, pushrod, and swivel ball joint to connect to the damper shaft. Secure linkages to prevent slipping under normal operating torque.

.2 Install damper motors on the outside of ducts in protected areas, not in locations exposed to outdoor temperatures where possible.

3.3 SENSORS AND SWITCHES

.1 General

.1 Locate all sensing elements to correctly sense measured variable. Isolate elements from vibrations and temperatures that could affect measurement.

.2 Install temperature sensing elements with thermal paste to ensure accurate reading.

.3 Install averaging type RTDs in serpentine configuration with adequate provision for the mechanical protection of the sensor. Support along its entire length.

.4 Modifications to plenums and ductwork must achieve the intent of the Contract Documents and adhere to the following:

.1 Mount sensors with extension necks such that access to sensors is not restricted by insulation.

.2 Keep cutting to a minimum and perform in a neat and workmanlike manner.

.3 Provide patches and access covers of the same material and thickness as adjoining ductwork. Provide necessary reinforcing and fastening materials.

.4 Repair insulation to maintain integrity of insulation and vapour barrier jacket. Use hydraulic insulating cement to fill voids and finish with material matching or compatible with adjacent jacket material.

.5 Provide gaskets, seals, and insulation to restore to, or exceed as found conditions in areas where modifications were made.

.2 Duct sensors

.1 Do not mount in dead air space.

.2 Thermally isolate elements from brackets and supports so they respond to in-duct air temperature only.

.3 Support sensor element independently from coils and filter racks.

.4 Provide element guard for relative humidity sensors as recommended by the manufacturer for high velocity installations. For high limit humidity sensors, position remote enough to allow full moisture absorption into the air stream before reaching the sensor.

.3 Pressure switches and transmitters

.1 For supply duct pressure transmitters, install pressure tips with at least four (4) 'round equivalent' duct diameters of straight duct with no take-offs upstream. Install static pressure tips securely fastened with tip facing upstream in accordance with manufacturer's installation instructions. Locate the transmitter at an accessible location to facilitate calibration.

.4 Current switches

.1 Adjust current switches for motor status monitoring so that setpoint is below the minimum operating current and above the motor no-load current.

3.4 TESTING

.1 Perform testing in accordance with Section 25 05 00 - Common Work for Building Automation.

.2 Test and calibrate all signalling circuits of all field devices to ascertain that required digital and accurate analog signals are transmitted, received, and displayed at system operator terminals, and make all repairs and recalibrations required to complete test.

.3 Check, set zero and span adjustments for all transducers and transmitters.

.4 For dampers check for adequate installation including free travel throughout range and adequate seal. Where loops are sequenced, check for proper control without overlap.

.5 For actuators ensure that the actuated device seals tightly when the appropriate signal is applied. Check the fail position, and that the stroke and range is as required. For sequenced electronic actuators, calibrate per manufacturer's instructions to the required ranges.

.6 Submit a report detailing the tests performed and results obtained to the Consultant. Consultant will verify results at random. Provide all testing equipment and manpower necessary for this verification.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section 20 00 13 – Mechanical General Provisions shall apply to and govern this Section.

.2 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.3 Scope of Work:

.1 Furnish and install all hardware, software and programming necessary to achieve the specified control functions as detailed in below sequences of operation and shown on the associated drawings.

1.2 DEFINITIONS

.1 For the purposes of this Section, the following definitions apply:

.1 System Start: actions required at system start-up under schedule control or on re-start after power failure.

.2 Normal Operation: normal control sequence after initial start-up requirements are satisfied.

.3 System Stop: shut-down of system under schedule control and fail-safe position of system in event of loss of normal power.

.4 Fire Alarm: action required in the event of a signal from the fire alarm system.

.5 Schedule: scheduled operation of system.

.6 Alarm: minimum alarms required.

.7 Emergency Power: BAS control elements to be fed from emergency power source.

.8 Load Shedding Priority: load shedding category – ‘0’ expendable to ‘5’ essential.

.9 Demand Limiting: special operation parameters during utility power outage (emergency power operation).

PART - 2 PRODUCTS

2.1 NOT APPLICABLE

PART - 3 EXECUTION

3.1 GENERAL

.1 When motorized equipment is operating, the BAS shall totalize runtime in hours for use in maintenance operations.

.2 When an end position switch is not used, provide adjustable time delay between damper or valve opening and start/stop of associated equipment to avoid operation with a closed system.

.3 Select components to fail safe. Priority in descending order is: life safety, protection of equipment, and comfort.

.4 Schedule operation of systems according to schedules provided by Owner, and/or optimal start/stop program, and/or Operator keyboard entry.

.5 Shut down fans upon detection (via BAS sensors) of supply or return air temperatures in excess of 67°C (135°F).

.6 Co-ordinate fire alarm system fan shutdown or start where provided via the BAS with the Contractor performing the Work of Division 28 - Electronic Safety and Security.

.7 Fan systems shall not be started if motorized damper end switch indicates that the damper is not fully open. Alarm abnormal status of damper to BAS and start standby system if applicable.

.8 All noted setpoints shall be operator-adjustable, and subject to tuning during system commissioning.

.9 Status of motors shall be by current draw unless noted otherwise.

3.2 **SEQUENCES OF OPERATION**

.1 The following control sequences describe required control and monitoring functions of the BAS for all building systems.

.2 Stair Pressurization (Area of Refuge)

.1 Refer to sequence of operation as indicated on Stair Pressurization Fan Schedule

.2 Provide all points required to meet the intent of the sequence of operation, but not less than the following:

.1 DO - Fan Start/Stop

.2 DI - Fan Status (current sensor)

.3 DO – Outdoor air intake damper Open/Close

.4 DI - Outdoor air intake damper end switch

.5 DO – Relief air damper Open/Close

.6 DI – Relief air damper end switch

.7 AI – Supply air temperature

.3 Annunciate all alarms at Operator Workstation.

.1 Provide alarm if system fails to operate.

.3 Elevator Sump Pumps

.1 Monitor sump pump controller for status and alarms.

.2 Provide all points required to meet the intent of the sequence of operation, but not less than the following:

.1 DI – Pump 1 running

.2 DI – Pump 2 running

.3 DI – System status (general alarm)

.4 DI – High level alarm

.3 Annunciate all alarms at Operator Workstation.

.4 Elevator Machine Room

.1 Monitor elevator machine room split AC unit for status and alarms. Provide independent temperature sensor within the room directly reporting to BAS.

.2 Provide all points required to meet the intent of the sequence of operation, but not less than the following:

.1 DI – AC unit running (current sensor)

.2 DI – AC unit alarm

.3 AI – AC unit space temperature.

.4 AI – BAS space temperature sensor.

.3 Alarm at Operator Workstation if space temperature exceeds 28°C (Adjustable)

3.3 **LIFE SAFETY INTERFACE**

.1 The Fire Detection and Alarm System provided under the scope of Division 28 - Electronic Safety and Security will monitor and control all mechanical systems dedicated to life safety, notably the Stair Pressurization system.

.2 The BAS will control all fan shutdowns on fire alarm based on fire alarm zone annunciation via the fire alarm system.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.2 Related Requirements:

.1 Comply with Conditions of the Contract and Division 01 - General Requirements.

.3 Related Sections

.1 Section 05 50 00: Metal Fabrications.

.2 Section 09 91 23 Interior Painting.

1.2 CODES, PERMITS AND INSPECTIONS

.1 Applicable Codes

.1 Ontario Electrical Safety Code

.2 Canadian Electrical Code with applicable regional amendments

.3 Ontario Building Code

.4 National Building Code

.5 Ontario Fire Code

.6 National Fire Code and Fire Commissioner Canada requirements

.2 Comply with Ontario Electrical Safety Code, all local, provincial and federal laws, where applicable and with authorities having jurisdiction. Make any changes or alterations required by authorized inspector of authority having jurisdiction.

.3 Equipment and material must be acceptable to Electrical Safety Authority.

.4 Where materials are specified which require special inspection and approval, obtain such approval for the particular installation with the co-operation of the material supplier.

.5 Obtain and pay for permits and inspections required for work performed.

.6 Supply and install warning signs, nameplates and glass covered Single Line Diagrams as required by Electrical Safety Authority.

.7 Submit required Documents and shop drawings to authorities having jurisdiction in order to obtain approval for the Work. Copies of Contract Drawings and Specifications may be used for this purpose.

1.3 REFERENCE STANDARDS

.1 These Specifications supplement the referenced standards.

.2 Where standards differ between authorities, the most rigid apply.

.3 Where requirements of the specifications exceed referenced standards, the specifications apply.

1.4 **COORDINATION**

.1 Carefully examine Work and Drawings of all related trades and thoroughly plan the Work so as to avoid interferences. Report defects which would adversely affect the Work. Do not commence installation until such defects have been corrected.

.2 Coordinate Work of this Division such that items will properly interface with Work of other Divisions.

.3 Architectural Drawings, or in the absence of Architectural Drawings, Mechanical Drawings govern all locations.

.4 Coordinate work of this Division to ensure that damage does not occur to the fireproofing work of any other Division.

1.5 **SUBSTITUTIONS**

.1 When only one manufacturer’s catalogued trade name is specified, provide only that catalogued trade name, material or product.

.2 When more than one manufacturer’s trade name is specified for a material or product, the choice is the bidders.

.3 No substitution is allowed upon award of contract.

1.6 **DIMENSIONS AND QUANTITIES**

.1 Dimensions shown on Drawings are approximate. Verify dimensions by reference to shop drawings and field measurement.

.2 Quantities or lengths indicated in Contract Documents are approximate only and shall not be held to gauge or limit the Work.

.3 Make necessary changes or additions to routing of conduit, cables, cable trays, and the like to accommodate structural, mechanical and architectural conditions. Where raceways are shown diagrammatically run them parallel to building column lines.

1.7 **EQUIPMENT LOCATIONS**

.1 Devices, fixtures and outlets may be relocated, prior to installation, from the location shown on the Contract Drawings, to a maximum distance of 3 m, without adjustment to Contract price.

.2 Switch, control device and outlet locations are shown diagrammatically.

1.8 **WORKING DRAWINGS AND DOCUMENTS**

.1 Where the word "HOLD" appears on Drawings and other Contract Documents, the Work is included in the Contract. Execute such Work only after verification of dimensions and materials and obtaining DCC Representative's written permission to proceed.

1.9 **INSTALLATION DRAWINGS**

.1 Prepare installation drawings for equipment, based upon approved Vendor drawings, to check required Code clearances, raceway, and cable entries, sizing of structure openings. Submit installation drawings to DCC Representative for review.

.2 For existing buildings, verify locations of existing junction boxes, pull boxes etc., to ensure existing access requirements are maintained. Identify these locations to other disciplines.

1.10 **"AS BUILT" RECORD DRAWINGS**

.1 Maintain a set of Contract Drawings on site and record all deviations from the Contract Documents. **As a mandatory requirement, recording must be done on the same day deviation is made. Be responsible for full compliance with this requirement.**

.2 Mark locations of feeder conduits, junction and terminal boxes and ducts or conduits run inside the building and underground either below the building or outside the building.

.3 Where conduit and wiring are underground or underfloor, furnish field dimension with respect to building column lines and inverts with respect to finished floor levels or grades.

.4 Record deviations from branch circuit numbers shown on Drawings.

.5 Prepare diagrams of interconnecting wiring between items of equipment including equipment supplied by DCC Representative and under other Specification Sections.

.6 Provide drawings in Autocad format as as-built record drawings at time of building turnover.

1.11 **SINGLE LINE DIAGRAM**

.1 Reproduce this diagram in drawing form under glazed frame and mount in main Switchgear Room. Provide a copy of this diagram to the DCC Representative and include in the Maintenance Manuals.

1.12 **TEST REPORTS**

.1 For each check and test performed prepare and submit a Test Report, signed by the Test engineer, and where witnessed, by the DCC Representative.

.2 Include record of all tests performed, methods of calculation, date and time of test, ambient conditions, names of testing company, test engineer, witnesses, also calibration record of all test instruments used together with manufacturers name, serial number and model number.

.3 Include calibration record, percentage error and applicable correction factors.

.4 Submit a Certified Test Report from each manufacturer, signed by the certifying inspector, confirming correct installation and operation of each product and part of Work. Include name of certifying inspector, date and times of inspection, ambient conditions.

1.13 **SHOP (VENDOR) DRAWINGS AND PARTS LISTS**

.1 Submit for review, manufacturer's or vendor's drawings for all products being furnished except cable, wire and conduit. Include rating, performance, specification sheets, descriptive literature, schematic and wiring diagrams, dimensional layouts and weights of components as well as complete assembly.

1.14 **FACTORY WITNESS TESTS**

.1 Prior to DCC Representative attendance at factory for witness testing, perform the following:

.1 Successfully conduct test to be witnessed.

.2 Following successful testing, inform the DCC Representative, in writing, that tests to be witnessed have been successfully performed.

1.15 **OPERATING AND MAINTENANCE MANUALS**

.1 Refer to and comply with Section 01 33 00 and related Sections.

1.16 **AREA CLASSIFICATION**

1.17 **SERIES RATED COMBINATIONS**

.1 Series rated combination of over-current protective devices are not permitted.

1.18 **WARRANTY**

.1 In addition to the warranty requirements of Division 00 and 01, warranties for work of Division 26, 27, 28 to begin after equipment is commissioned, training is complete and building handover is substantially complete.

PART - 2 PRODUCTS

2.1 **APPROVALS AND QUALITY**

.1 Provide new materials bearing certification marks or labels acceptable under Ontario Electrical Safety Code.

.2 Equipment must bear, on manufacturer’s label, certification mark or label acceptable under Electrical Safety Authority.

.3 Provide units of same manufacture where two or more units of same class or type of equipment are required.

.4 Manufacturer's names are stated in this Specification to establish a definite basis for tender submission and to clearly describe the quality of product that is desired for the work.

2.2 **STANDARD SPECIFICATIONS**

.1 Ensure that the chemical and physical properties, design, performance characteristics and methods of construction of all products provided comply with latest issue of applicable Standard Specifications issued by authorities having jurisdiction, but such Standard Specifications shall not be applied to decrease the quality of workmanship, products and services required by the Contract Documents.

2.3 **SPRINKLER PROOF EQUIPMENT**

.1 Ensure that electrical equipment installed in electrical rooms and other areas containing sprinklers is constructed such that exposure to water from the sprinkler heads does not impair the effectiveness of the enclosed equipment.

.2 Where penetrations are made in drip shields, flash and seal using manufacturer's approved caulking to maintain drip shield integrity.

.3 Ensure that enclosure louvres are of outdoor design such that falling water or water running down the sides will not enter the enclosure.

.4 Where enclosure openings in the top or sides are required for outgoing conduits, provide waterproof conduit fittings.

.5 In electrical rooms containing sprinklers provide wall mounted equipment such as pull boxes, junction boxes, splitter troughs, wireways, auxiliary gutters, cable troughs and disconnect switches located below the level of the sprinkler heads with the following accessories:

.1 Gaskets on doors and drip shields on equipment, panelboards, panels and enclosures.

.2 Louvres facing outward and downward where openings are required for heat dissipation. Expanded metal screening is not acceptable.

2.4 FIRE BARRIERS

.1 Where electrical material or devices pass through fire rated separations, make penetrations and provide fire barrier seals with a fire resistance rating equivalent to the rating of the separation.

.2 Prior to installation, submit for review, proposed fire barrier seal materials, method of installation and ULC system number. For additional information refer to Division 07.

.3 Acceptable Manufacturers:

.1 A/D Fire Protection Systems

.2 Dow Corning

.3 Fire Stop Systems

.4 IPC Flamesafe Firestop

.5 Nelson Electric

.6 3M

.7 Tremco

.4 Firestop Putty Pad

.1 Hilti CP-617 series to suit outlet box.

.2 3M MPP+ series to suit outlet box.

.3 STI Firestop SpecSeal SSP to suit outlet box.

2.5 MISCELLANEOUS METAL FABRICATIONS

.1 Provide miscellaneous structural supports, platforms, braces, brackets and preformed channel struts necessary for suspension, attachment or support of electrical equipment in accordance with Section 05 50 00.

2.6 ACCESS DOORS

.1 Minimum size: 200 mm x 200 mm size, unless otherwise specified on the Drawings or in other divisions of the Specifications, or as required to replace or repair said equipment.

.2 Material:

.1 Fabricated of 2.5 mm bonderized steel.

.2 Fabricated of 2.5 mm stainless steel in areas finished with tile or marble surfaces.

.3 Flush mounted, concealed hinges and screwdriver lock.

.4 Plast lock and anchor straps.

.3 Doors to be of a type and fire rating to suit the particular type of wall or ceiling construction in which they are to be installed.

.4 Doors in painted partitions to be painted to match adjacent partition. Doors shall be installed prior to final painting. Bear all costs for repainting of partition/ceiling and doors resulting from failure to do so.

PART - 3 EXECUTION

3.1 MANUFACTURER'S ATTENDANCE

.1 Provide manufacturer's representatives to initially start-up each part of the Work, as specified, to check, adjust, calibrate and balance as applicable all components including controls and field wiring. Provide these services for such period and for as many visits as necessary to achieve complete working order in the subject Work.

3.2 FIELD INSPECTION

.1 Provide field engineer for inspection and certification of equipment during installation, testing and commissioning as required.

3.3 MOUNTING HEIGHTS

.1 Mounting heights of equipment is from finished floor to centre line of equipment unless noted otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding.

.3 Install electrical equipment at following heights unless indicated otherwise.

.1	Local switches:	1100 mm.
.2	Wall receptacles:	450 mm.
.3	Receptacles above continuous baseboard heater:	200 mm.
.4	Receptacles above top of counters or backsplash:	175 mm.
.5	Receptacles in mechanical rooms:	1100 mm.
.6	Telecommunications outlets:	450 mm.
.7	Wall mounted telephone and interphone outlets:	1200 mm.
.8	Fire alarm stations:	1100 mm.
.9	Wall mounted Fire alarm speaker and strobes:	2100 mm.

3.4 ACCESS DOORS

.1 Supply access doors for installation by other trades in walls or ceilings where accessibility is required for the accessibility to electrical components.

3.5 PAINTING

.1 Touch up finishes on electrical equipment found to be marred on completion of the Work using same colour and type of finish as originally used.

.2 Prime paint field fabricated metalwork.

.3 Other painting will be provided under Section 09 91 00.

3.6 **TRAINING**

.1 Arrange for training of systems as detailed in technical sections.

.2 Provide for a minimum of two training sessions for each item.

.3 Training to be videotaped. Contractor to record and edit to suit.

.4 Training to take place after system has been commissioned

.5 Schedule training 3 weeks in advance of training date.

.6 Attendance of participants to be recorded.

3.7 **CORE DRILLING**

.1 Refer to Section 01 73 00 – Execution, for requirements

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.2 Related Requirements:

.1 Comply with Conditions of the Contract and Division 01 - General Requirements.

1.2 RELATED SECTIONS

.1 Section 26 05 01: Common Work Results for Electrical.

.2 Section 26 05 54: Electrical identification for Electrical Systems.

1.3 REFERENCES

.1 Conform to latest issues, amendments and supplements of following standards:

.1 CISC/CPMA 2.75 - Canadian Institute of Steel Construction/ Canadian Paint Manufacturers Association, A Quick Drying Primer for Use on Structural Steel

.2 CAN/CGSB-1.40-M - Primer, Structural Steel, Oil Alkyd Type

.3 CAN3-C21.1-M - Control Cable - 600V

.4 CAN3-C21.2-M - Control Cable for Low Energy Circuits 150V and 300V

.5 CAN/CSA C22.2 No. 18 - Outlet Boxes, Conduit Boxes, and Fittings

.6 CAN/C22.2 No. 26 - Wireways, Auxiliary Gutters and Associated Fittings

.7 CSA C22.2 No. 38-M - Thermoset Insulated Wires and Cables

.8 CSA C22.2 No. 40-M - Cutout, Junction and Pull Boxes

.9 CSA C22.2 No. 42-M - General Use Receptacles, Attachment Plugs and Similar Wiring Devices

.10 CSA C22.2 No. 45-M - Rigid Metal Conduit

.11 CSA C22.2 No. 49 - Flexible Cords and Cables

.12 CAN/CSA C22.2 No. 51-M - Armoured Cables

.13 CSA C22.2 No. 56 - Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit

.14 CSA C22.2 No. 65 - Wire Connectors

.15 CSA C22.2 No. 75-M - Thermoplastic Insulated Wires and Cables

.16 CSA C22.2 No. 76-M - Splitters

.17 CSA C22.2 No. 83-M - Electrical Metallic Tubing

.18 CAN/CSA-C22.2 No. 85-M - Rigid PVC Boxes and Fittings

.19 CAN/CSA C22.2 No. 94-M - Special Purpose Enclosures

.20 CSA C22.2 No. 123-M - Aluminum Sheathed Cables

.21 CSA C22.2 No. 127 - Equipment Wires

.22 CAN/CSA-C22.2 No. 131-M - Type Teck 90 Cable

.23 CSA C22.2 No. 182.3-M - Special Use Attachment Plugs, Receptacles, and Connectors

.24 CSA C22.2 No. 208-M - Fire Alarm and Signal Cable

.25 CSA C22.2 No. 211.2-M - Rigid PVC (Unplasticized) Conduit

.26 CSA C22.2 No. 211.3 - Rigid Fiberglass Reinforced Epoxy (RE) Conduit and Associated Fittings

.27 CSA C22.2 No. 227.1 - Electrical Nonmetallic Tubing

.28 CSA C22.2 No. 227.2 - Flexible Liquid-Tight Nonmetallic Conduit

.29 CSA C22.2 No. 227.3-M - Flexible Nonmetallic Tubing

.30 SSPC - Steel Structures Painting Council “Steel Structures Painting Manual, Vol. 2"

1.4 SUBMITTALS

.1 DCC Representative reserves the right to require Contractor to submit samples of any materials to be used in this project.

.2 Cable pull and tension calculations for all cables under vertical tension.

PART - 2 PRODUCTS

2.1 WIRE - LOW VOLTAGE UP TO 1000V SERVICE

.1 Conductors

.1 ASTM Class B, soft drawn, electrolytic copper

.2 Stranded

.2 Insulation

.1 CSA type RW90 XLPE (-40°C)

.1 Heat and moisture resistant

.2 Low temperature, chemically cross-linked thermosetting polyethylene material

.3 600V rated

.4 For maximum 90°C conductor temperature

.5 For installation at minimum -40°C temperature

.6 To CSA C22.2 No. 38

.2 CSA type T90 NYLON (-10°C):

.1 Heat resistant

.2 Flame retardant

.3 Thermoplastic PVC material with extruded nylon cover

.4 600V rated

.5 For maximum 90°C conductor temperature dry and 75°C in wet locations

.6 For installation at minimum -10°C

.7 To CSA C22.2 No. 75-M

.3 CSA type TEW:

.1 Heat resistant

.2 600V rated

.3 For maximum 105°C conductor temperature

.4 To CSA C22.2 No. 127

.4 CSA type SEW-2

.1 Heat resistant

.2 600V rated

.3 For maximum 200°C conductor temperature

.4 To CSA C22.2 No. 127

.3 Acceptable Manufacturers

.1 Alcan Cable

.2 Alcatel Canada Wire

.3 Pirelli Cables

2.2 CABLE - LOW VOLTAGE UP TO 1000V SERVICE

.1 CSA Type AC90 XLPE (-40°C)

.1 Conductors

.1 ASTM Class B, soft drawn, electrolytic copper

.2 Solid for sizes #10 AWG and smaller

.3 Stranded for sizes #8 AWG and larger

.2 Insulation

.1 Heat and moisture resistant

.2 Low temperature, chemically cross-linked thermosetting polyethylene material

.3 600V rated for sizes #10 AWG and smaller

.4 600V rated for sizes #8 AWG and larger

.5 For maximum 90°C conductor temperature

.6 For installation at minimum -40°C temperature

.7 To CSA C22.2 No. 38

.3 Construction

.1 2, 3 or 4 insulated conductors

.2 Bare ground conductor

.3 Overall interlocking aluminum armour

.4 To CSA C22.2 No. 51

.4 Acceptable Manufacturers

.1 Alcan Cable

.2 Alcatel Canada Wire

.3 Pirelli Cables

.2 CSA Type TECK90 (-40°C)

.1 Conductors

.1 ASTM Class B, soft drawn, electrolytic copper

.2 Stranded

.2 Insulation

.1 Heat and moisture resistant

.2 Low temperature, chemically cross-linked thermosetting polyethylene material

.3 600V or 1000V rated

.4 For maximum 90°C conductor temperature

.5 For installation at minimum -40°C temperature

.6 CSA type RW90 XLPE

.7 To CSA C22.2 No. 38

.3 Construction

.1 1 or more insulated conductors

.2 Bare, stranded, copper ground conductor for multi-conductor cables

.3 Bare, solid, served copper ground conductors for single conductor cables

.4 Fillers with binder tape to produce a circular cross-section for multi-conductor cables

.5 Power cables

.1 1, 2, 3 or 4 conductors

.2 Conductors 1000V rated

.6 Control cables

.1 2 or more conductors

.2 Conductors 600V rated

.7 Composite cables

.1 3 power conductors

.2 3 #14 AWG control conductors

.3 Conductors 600V rated

.8 Extruded PVC inner jacket over conductor assembly

.9 Interlocking aluminum armour over inner jacket

.10 Extruded PVC overall jacket over armour

.1 FT4 flame test rated

.2 Colour black unless otherwise indicated

.11 Cable assembly for installation at minimum -40°C temperature

.12 To CSA C22.2 No. 131 and CSA C22.2 No. 174

.4 Acceptable Manufacturers

.1 South Wire

.2 Texcan

.3 Nexans

.4 General Cable

.5 Northern Cable

.3 CSA Type RA90 XLPE (-40°C)

.1 Conductors

.1 ASTM Class B, soft drawn, electrolytic copper

OR

.2 CSA type ACM aluminum alloy

.3 Stranded

.2 Insulation

.1 Heat and moisture resistant

.2 Low temperature, chemically cross-linked thermosetting polyethylene material

.3 600V rated

.4 For maximum 90°C conductor temperature

.5 For installation at minimum -40°C temperature

.6 CSA type RW90 XLPE

.7 To CSA C22.2 No. 38

.3 Construction

.1 Single conductor

.2 Continuous, corrugated aluminum sheath of minimum cross-sectional area to comply with Electrical Code Table 16

.3 Extruded PVC overall jacket over armour

.1 FT4 flame test rated

.2 Colour black unless otherwise indicated

.4 Cable assembly for installation at minimum -40°C temperature

.5 To CSA C22.2 No. 123 and CSA C22.2 No. 174

.4 Acceptable Manufacturers

.1 Alcan Cable

.2 Alcatel Canada Wire

.3 BICC Phillips

2.3 CABLE CONNECTORS

.1 Connectors for Type AC90 Cable

.1 Steel or malleable iron

.2 Insulated throat

.3 Acceptable manufacturers

.1 Efcor 1000B series

.2 Elliott 65200 series

.3 Thomas & Betts 3110 series

.2 Connectors for Type TECK90 Cable

.1 Copper free aluminum body

.2 Steel or copper free aluminum fittings and locknut

.3 Connectors for Type RA90 Cable

.1 Copper free aluminum body

.2 Steel or copper free aluminum fittings

.3 Acceptable manufacturers

.1 Alcatel Canada Wire

.2 Crouse-Hinds, type TMC

.3 Nexans Canada CORFLEX

2.4 WIRE AND CABLE CONNECTORS

.1 Copper compression type wire and cable terminations for #8 AWG and larger conductors, colour keyed, sized to suit. Long barrel NEMA 2 hole lugs for sizes #1/0 AWG and larger.

.1 Acceptable Manufacturers

.1 Thomas & Betts series 54000

.2 Ideal Powr-Connect

.3 Burndy Hylug

.2 Twist type splicing connectors, copper, sized to suit, with nylon or plastic shroud for tee connections in #10 AWG and smaller conductors.

.1 Acceptable Manufacturers

.1 Thomas & Betts spring type

.2 Ideal Twister

.3 Marr Marrette

.3 Conductor compression splice for #10 AWG or smaller.

.1 Acceptable Manufacturers

.1 Thomas & Betts STA-Kon series

.2 Ideal Splices

.3 Burndy

2.5 HEAT SHRINKABLE TUBING INSULATION, HEAVY WALL

.1 Acceptable Manufacturers

.1 Thomas & Betts, Shrink-Kon series

.2 Ideal Thermo-Shrink, TS-46

.3 Raychem tubing WCSM

.4 3M cable sleeve ITCSN

2.6 MOTOR LEAD CONNECTION KITS, 600 VOLT

.1 Connection kits for low voltage motors.

.2 Acceptable Manufacturers

.1 3M, motor lead splice kit, pigtail, 5300 series

.2 Raychem, motor connection kit, MCK, type V

.3 ABB, motor connection kit, Shrink-Kon

2.7 CONDUIT AND FITTINGS

.1 Rigid Steel Conduit

.1 To CSA C22.2 No. 45-M

.2 Rigid thickwall galvanized steel threaded conduit

.2 Coated Steel Conduit

.1 Corrosive resistant coated rigid thickwall steel threaded conduit, CSA approved.

.2 Acceptable Manufacturers

.1 Rob Roy Plastibond PVC coated

.2 Columbex Green Guard II epoxy polyester coated

.3 Atkore Calbond PVC coated

.3 Rigid PVC Conduit

.1 To CSA C22.2 No. 211.2-M

.2 Rigid PVC conduit

.4 Flexible Steel Conduit

.1 To CSA 22.2 No. 56

.2 Liquid-tight flexible steel conduit with PVC cover

.5 Non-Metallic Flexible Conduit

.1 Non-metallic extra flexible PVC conduit

.2 Acceptable Manufacturers

.1 Carlon, Carflex X-Flex

.2 Hubbell, Polytuff Black

.3 ABB, Xtra flex

.6 Rigid Steel Conduit Fittings

.1 To CAN/CSA C22.2 No. 18

.2 Galvanized or polymer coated cast steel fittings

.3 Expansion fittings, watertight with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions

.4 Sealing condulets for hazardous areas

.5 Corrosive resistant coated cast steel fittings for corrosive resistant conduit

.7 Rigid PVC Conduit Fittings

.1 To CSA C22.2 No. 85-M

.2 Rigid PVC fittings of same manufacture as rigid PVC conduit

.8 Liquid Tight Flexible Steel Conduit Fittings

.1 Watertight connectors with nylon insulated throat

.1 Acceptable Manufacturers:

.1 T & B Series 5331 with Sealing O-ring Series 5262

.2 Commander/Iberville Series 6300-IT with nitrile O-ring

.3 ABB 01 41 Series with O-ring

2.8 EMT AND FITTINGS

.1 EMT

.1 To CSA C22.2 No. 83-M

.2 EMT galvanized cold rolled steel tubing

.2 EMT Fittings

.1 Compression type, steel

.1 Gland compression connectors with insulated throats

.2 Compression couplings

.3 Acceptable manufacturers:

.1 T & B Series 5123 & 5120

.2 O-Z/Gedney type ZTC series

.3 Commander/Iberville Series 5600-IT and 5700

2.9 **WIREWAY**

.1 To CSA C22.1 No. 94-M.

.2 Steel with hinged cover to give uninterrupted access.

.3 Elbows, tees, couplings and hanger fittings manufactured as accessories for wireway supplied.

.4 Acceptable Manufacturers:

.1 Amalgamated Electric

.2 Canadian Electrical Raceways

.3 Schneider Square D

.4 Pilgrim

.5 Pursley

2.10 **FASTENINGS, SUPPORTS AND SLEEVES**

.1 Fastenings

.1 Galvanized steel straps, beam clamps and threaded rods

.2 Sleeves

.1 Schedule 40 steel pipe, minimum I.D. 13 mm larger than O.D. of conduit or cable passing through.

.3 Strut

.1 Continuous slotted channel

.2 12 gauge pre-galvanized steel

.3 41.2 mm x 41.2 mm minimum

.4 Acceptable manufacturers:

.1 B-Line

.2 Pilgrim

.3 Pursley

.4 Unistrut

2.11 **JUNCTION BOXES**

.1 Galvanized steel EEMAC Type 1 size as required by code for number and size of conduits, conductors and devices, complete with covers, corrosion resistant screws, terminal blocks and mounting rails.

.2 Screw-on sheet steel covers to match enclosure for surface mounting boxes.

.3 Covers with 25 mm minimum extension around for flush-mounted junction boxes.

.4 Galvanized steel barriers as required.

2.12 **PULL BOXES**

.1 Galvanized sheet steel welded construction, EEMAC Type 1.

.2 Screw-on galvanized sheet steel covers for surface mounting boxes.

.3 Covers with 25 mm minimum extension around, for flush mounted pull boxes.

.4 Galvanized steel barriers as required.

2.13 **CONDUIT BOXES - GENERAL**

.1 Boxes for EMT

.1 Galvanized pressed steel

.2 Boxes for Rigid Steel Conduit

.1 Galvanized cast iron alloy FS boxes with mounting feet for surface mounted switches and receptacles

.2 Gasketted cover plate for exterior location

.3 For corrosive resistant coated conduit: cast boxes with same finish as conduit

.3 Boxes for Rigid PVC Conduit

.1 PVC boxes

2.14 **OUTLET BOXES - SHEET STEEL**

.1 Pressed steel single and multi-gang flush device boxes, minimum size 100 mm x 50 mm x 38 mm . 100 mm square outlet boxes where more than 1 conduit enters 1 side, with extension rings as required.

.2 100 mm square or octagonal outlet boxes.

.3 119 mm square outlet boxes with extension and plaster rings as necessary for flush mounting devices in gypsum board, plaster or panelled walls.

2.15 **MASONRY BOXES**

.1 Pressed steel masonry single and multi-gang boxes for devices flush mounted in exposed masonry walls with extension and plaster rings as required.

2.16 **CONCRETE BOXES**

.1 Pressed steel concrete type boxes for flush mount in concrete with extension and plaster rings as required.

2.17 **OUTLET BOXES - FITTINGS**

.1 Bushings and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of foreign materials.

.3 Double locknuts and insulated bushings for sheet steel metal boxes.

2.18 **WIRING DEVICES - SWITCHES**

.1 Specification grade, general purpose AC switches, manual rocker operated, white colour, 15A, 20A, 120-277V, 347V, single pole, double pole, 3 way, 4 way switches as required.

.2 Acceptable Manufacturers

.1 Bryant, 120-277V, Fashion Series 9000

.2 Hubbell, 120-277V, Style Line 2100 Series

.3 Leviton, 120-277V and 347V, Decora Plus 5600 Series

.4 Pass & Seymour, 120-277V and 347V, Sierraplex Decorator, 2600 and 2600000 Series

2.19 **WIRING DEVICES - RECEPTACLES FOR GENERAL SERVICE**

.1 Receptacles: specification grade suitable for back and side wiring, complete with grounding terminal, colour as required for type of area for straight blade devices and black colour for twistlock devices.

.2 Receptacles of one manufacturer.

.3 Acceptable Manufacturers:

.1 15A, 125V, (5-15R) Single Straight Blade

.1 Arrow Hart 5261

.2 Leviton 5261

.3 Hubbell 5261

.4 Pass & Seymour 5261

.2 20A, 125V, (5-20R) Single Straight Blade

.1 Arrow Hart 5361

.2 Leviton 5361

.3 Hubbell 6331

.4 Pass & Seymour 5361

.3 20A, 125V, (5-20R) Duplex Straight Blade

.1 Arrow Hart 5392

.2 Leviton 5362

.3 Hubbell 5392

.4 Pass & Seymour 5362

.4 15A, 125V, (5-15R) Duplex GFCI, Straight Blade

.1 Arrow Hart GF5242AH

.2 Leviton 6599-W

.3 Hubbell GF-5252

.4 Pass & Seymour 1591

.5 15A, 125V, (5-15R) Duplex Isolated Ground Straight Blade

.1 Arrow Hart IG5262AH

.2 Leviton 5262-IG

.3 Hubbell IG-5262

.4 Pass & Seymour IG6200

.6 15A, 125V (5-15R) Quad straight blade, 2 pole, 3 wire grounding

.1 Bryant 1254

.2 Hubbell 415 series

.3 Pass & Seymour 1254

.7 15A, 125V, (5-15R) Duplex straight blade

.1 Arrow Hart 26262

.2 Leviton Decora Plus

.3 Hubbell 2152 series

.4 Pass & Seymour 885

2.20 **WIRING DEVICES - COVER PLATES**

.1 Stainless steel Type 302 alloy, vertically brushed, 0.8 mm thick cover plates.

.2 Pressed steel, galvanized.

.3 Cast covers for cast boxes with gaskets.

.4 Cover plates of same manufacture as devices.

2.21 **PLYWOOD BACKBOARDS**

.1 Plywood backboards, good one side, 4' x 8' x ¾" unless indicated otherwise. Treat with primer and two coats of fire retardant paint.

.2 Mount plywood on vertical strapping, on 40 mm centres to provide 10 mm clearance between wall and rear of plywood. Treat strapping similar to plywood.

2.22 **FINISH**

.1 Equipment enclosure finish: baked grey enamel, ANSI 49 or ANSI 61.

PART - 3 EXECUTION

3.1 **WIRE AND CABLE**

.1 Install wiring in raceways unless noted otherwise.

.2 Minimum wire sizes:

.1 Power and lighting No. 12 AWG

.2 Control No. 14 AWG

.3 Fire alarm No. 18 AWG

.3 Wire and cable application and type:

Application	Type
Lighting branch circuit where connection to luminaire is AC90 cable	T90 nylon
Receptacle branch circuit	T90 nylon
Ceiling boxes to luminaires in suspended ceiling	T90 nylon or AC90 cable
Wiring inside high temperature equipment	TEW or SEW-2
Branch circuits other than those covered above	RW90
Equipment feeders, circuits	RW90

.4 Type AC90 cable length limitations:

.1 Ceiling box to luminaire:

.1 1.2 m maximum in non-accessible ceilings;

.2 1.8 m in accessible ceilings

.2 Junction box to outlet:

.1 3.6 m maximum

.5 Load current limitations:

.1 Conductors rated for more than 90°C:

.1 90°C code ampacity rating

.2 Motor connection:

.1 75°C code ampacity rating

3.2 TECK CABLES

.1 Store cables in a clean, dry environment

.2 Install per manufacturer’s written instructions, taking care to not exceed pulling tension nor bend radius.

.3 Install cable in tray unless noted otherwise on the drawings.

.4 Do not use cable splices.

.5 Where TECK cable is not installed in tray, provide support at a minimum of 600 mm intervals.

.6 Use cable reels and sheaves at bends.

.7 Submit cable pulling tension calculations for all cables under vertical tension. For horizontal installations, submit calculations when requested by the Engineer.

.8 Perform insulation resistance (megger test) on each TECK low voltage (<1001V) cable.

3.3 CONNECTORS

.1 Install compression terminations and splices in accordance with manufacturer's written instructions.

.2 Make splices in junction boxes.

.3 Make connections in lighting circuits with twist type splicing connectors.

.4 Terminate and splice conductors No. 8 and larger at terminal blocks in junction boxes.

.5 Seal terminations and splices exposed to moisture, corrosive conditions or mechanical abrasions with heavy wall heat shrinkable insulation.

.6 Install fixture type connectors and tighten. Replace insulating cap.

3.4 **MOTOR LEAD CONNECTION KITS, 600 VOLT**

.1 Install motor lead connection kits for low voltage motors.

3.5 **CONDUIT AND EMT - GENERAL**

.1 Run parallel or perpendicular to building lines.

.2 Group raceways wherever possible. Support on channels.

.3 Install expansion joints as required.

.4 Run raceways in web portion of structural steel columns and beams.

.5 Do not drill structural members to pass through.

.6 Locate raceways behind infrared or unit heaters with 1500 mm clearance.

.7 Locate raceways not less than 125 mm clear where parallel to steam or hot water lines with a minimum of 75 mm at crossovers.

.8 Do not install horizontal runs in masonry walls.

.9 Use metallic raceway where temperatures exceed 75°C or where enclosed in thermal insulation.

.10 EMT and non-metallic conduits to contain insulated green ground wire.

.11 Install 6 mm diameter nylon pull cord in empty raceways.

3.6 **CONDUIT AND FITTINGS**

.1 Minimum conduit sizes:

.1 Surface installation: 21 mm trade size conduit

.2 Embedded in concrete: 27 mm trade size conduit

.2 Conduit application and type:

Application	Type
Outdoor areas	rigid steel
Embedded in concrete, other than grade slab	rigid steel (PVC)
In or below grade slab	PVC
Exposed in unfinished areas up to 3 m above finished floor. Use EMT above 3m	rigid steel

Connection to motors and equipment subject to vibration	liquid tight flexible steel conduit
Block walls and stud partitions	EMT

.3 Use field threads on rigid conduit of sufficient length to draw conduits up tight.

.4 Do not bend coated steel conduit. Use elbows for deflections.

.5 Do not install conduit in or under slab.

.6 Use factory "ells" where 90° bends are required for 27 mm trade size and larger conduits.

.7 Bend conduit offsets cold. Do not install crushed or deformed conduits and avoid trapped runs in damp or wet locations. Prevent the entrance of water and lodging of concrete, plaster, dirt, or trash in conduit, boxes, fittings, and equipment during course of construction.

.8 Where conduit joints occur in damp or wet locations, make joints watertight by applying an approved compound on the entire thread area before assembling. Draw up all conduit joints as tightly as possible.

.9 Cap exposed empty conduits which do not terminate in outlets, panels, cabinets, etc., with standard galvanized plumber's pipe caps.

.10 Plug empty conduits which terminate flush with floors or walls with flush coupling and brass plug.

.11 Install conduit sleeves for all exposed conduits and cables passing through walls, ceilings, or floors, and fill void between sleeve and conduit with caulking. If fire-rated caulking is required by code, use same class as walls, ceilings or floors.

.12 Terminate conduit stubbed up through concrete floor for connection to free standing equipment with a coupling flush with finish floor, and extend rigid conduit to equipment, except where required, use flexible conduit from a point 150 mm above floor.

.13 Install double locknuts and bushings on all rigid conduit terminations into threadless openings. Increase length of conduit threads at terminations sufficiently to permit bushing to be fully seated against end of conduit.

.14 Mechanically bend steel conduit.

.15 Install sealing condulets in conduits at hazardous area boundaries.

.16 Conduits in Poured Concrete

.1 Locate to suit reinforcing steel. Secure firmly to prevent movement during pour.

.2 Clear each conduit with mandrel and brush before concrete sets.

.3 Protect conduits from damage where they stub out of concrete.

.4 Install sleeves where conduits pass through slab or wall.

.5 Provide oversized sleeve before membrane is installed where conduits pass through waterproof membrane. Use cold mastic between sleeve and conduit.

.6 Encase conduits completely in concrete; provide 50 mm minimum concrete cover.

.7 Replace with exposed conduit, any conduit run found to be obstructed after concrete sets.

3.7 **EMT AND FITTINGS**

.1 Minimum EMT size: 21 mm trade size conduit.

.2 EMT Application

.1 Exposed in unfinished areas, above truss level and for drops in column web to 3 m above finished floor. Use rigid steel conduit below 3 m .

.2 In block walls and stud partitions.

3.8 **WIREWAYS**

.1 Install per manufacturer's recommendations.

.2 Keep number of elbows, offsets and connections to a minimum.

.3 Install barriers where required by Code.

.4 Install gutters to full length of equipment.

3.9 **FASTENINGS AND SUPPORTS**

.1 Provide supports and fastenings for the Work of this Division. Do not use supports or equipment provided by other Trades.

.2 Equipment fastenings and supports shall conform to manufacturers recommendations.

.3 Do not attach to, or suspend any electrical product or service from the roof deck, mechanical ductwork or piping.

.4 Do not use wire lashing or perforated strap to support or secure raceways or cable.

.5 Support rods for any suspended item must not be attached to or extended through steel pan type roofs or through concrete slab roofs.

.6 For surface mounting of two or more raceways or cables use channels.

.7 Where there is no wall support for raceways and cables dropped vertically to equipment, provide channel properly secured to floor and structure.

.8 Hang supports from structural members. Where location does not permit direct support from structure provide necessary brackets, frames, channels secured to structural members.

.9 Fasten exposed conduit and cables to building construction or support systems using straps. Use beam clamps on exposed steelwork.

.10 Masonry, tile and plaster surfaces: use lead anchors.

.11 Poured concrete: use expandable inserts. Low velocity powder activated fastenings may be used only in poured concrete.

.12 Steel structures: use clips, spring loaded bolts, cable clamps, designed as accessories to basic channel members.

.13 Do not use powder activated fasteners in, tile, precast concrete or steel structure.

.14 Do not install conduits or cables on the bottom chord of joists or trusses.

.15 Use beam clamps of the 2-bolt design and of such type that the rod load is transmitted only concentrically to the beam web centreline. The use of "C" and "I" beam side clamps will not be allowed.

.16 Where the roof or floor framing consists of open web or long span steel joists and/or trusses, ensure that hangers are located at or within 150 mm of the joist or truss top or bottom chord panel points, otherwise provide additional structural steel as required where hanger spacing does not coincide with joist or truss spacing. Design suspension assembly such that the hanger load is transmitted only concentrically to the supporting joist or truss. The use of "C" and "I" beam clamps, brackets, etc., will not be allowed.

.17 SH-Type Conduit Hangers

.1 Provide SH-type conduit hangers for supporting conduit runs where required. Hangers shall be sized to fit EMT conduits from 16mm to 103mm.

.2 Hangers shall be fabricated from carbon steel or stainless steel and finished with zinc plating, hot-dip galvanizing, or stainless steel as appropriate for the environment.

.3 Install hangers using threaded rod or beam clamps secured to structural members. Do not attach to mechanical systems, roof decks, or non-structural elements.

.4 Support conduit in accordance with the Canadian Electrical Code (CEC).

.5 Ensure hangers do not interfere with conduit bonding or grounding.

.6 Do not use wire lashing, perforated strap, or powder-actuated fasteners for hanger installation.

.7 Provide CSA-certified or UL/cUL-listed hangers conforming to CSA C22.2 No. 18.4 or equivalent.

.8 Install per manufacturer’s instructions and ensure all fasteners are corrosion-resistant and appropriate for the mounting surface.

.18 Locate secondary structural steel members between joists or trusses at or within 150 mm of top or bottom chord panel points. Where the secondary structural steel member cannot be located at or near a joist or truss panel point, provide additional diagonal structural steel web member/members designed for the applicable load to the nearest panel point in the opposite chord member. Diagonal hangers which will induce lateral stresses in the chord members of the joist will not be permitted. Submit shop drawings of the suspension assembly indicating the location of suspension or support points, the maximum load at each suspension point, location and size of hangers, brackets and intermediate framing members when required, and also details of connection to building structure.

3.10 SPLITTER BOXES

.1 Install splitters as indicated and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement.

3.11 JUNCTION BOXES

.1 Install junction boxes in inconspicuous but accessible locations. Secure to structure.

.2 Install terminal blocks on mounting rails, for termination of each wire and cable regardless of size.

.3 Only one voltage source is permitted in a junction box.

.4 Install barriers to separate different auxiliary systems.

3.12 **PULL BOXES**

.1 Install pull boxes in inconspicuous but accessible locations. Secure to structure.

.2 Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

.3 Only one voltage source is permitted in a pull box.

.4 Install barriers to separate different auxiliary systems.

3.13 **OUTLET AND CONDUIT BOXES**

.1 Install conduit outlet boxes for conduit up to 32 mm and pull boxes for larger conduits.

.2 Support boxes independently of connecting conduits.

.3 Seal boxes during construction to prevent entry of debris, dust and dirt.

.4 For flush installations mount plaster rings to box, flush with wall surface to permit wall finish to come within 6 mm of opening.

.5 Provide correct size of openings in boxes for conduit, armoured cable connections. Reducing washers will not be acceptable.

.6 Install switches and other controls close to door lock or latch jambs and other openings, maintaining a minimum of 100 mm from trims of doors (except where installed in door frames of metal partitions) check door swings.

.7 Install 100 mm square or octagonal outlet boxes for lighting fixture outlets.

3.14 **MASONRY BOXES**

.1 In block walls use deep boxes to provide clear space around knockout for AC90 cable entry.

3.15 **WIRING DEVICES - SWITCHES**

.1 Install single throw switches with handle in UP position when switch is closed.

.2 Install switches in gang type outlet box when more than one switch is required in a location.

.3 Mount toggle switches at height indicated.

.4 Install switch colours as follows:

Area	Colour
Gypsum board, plaster or panelled	White
Office	White
Factory, service	White

3.16 **WIRING DEVICES - RECEPTACLES**

.1 Install receptacles vertically, use gang type outlet box where more than one receptacle is required in a location.

.2 Coordinate with architectural and interior design drawings for final positioning and mounting heights of power and voice/data receptacles. Where there is disagreement between electrical and architectural drawings, take the architectural drawings as correct.

.3 Maintain clearances between receptacle outlet boxes and millwork as stipulated on the drawings.

.4 Align and evenly space outlet boxes that are mounted as a group.

.5 Install receptacle colours as follows:

Area	Colour
Gypsum board, plaster or panelled	White
Office	White
Factory, service, exterior	White

3.17 **WIRING DEVICES - 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.

.3 Do not use cover plates designed for flush outlet boxes on surface-mounted boxes.

.4 Provide plaster ring where necessary.

.5 Install cover plates as follows:

Area	Cover Plate Type
Gypsum board, plaster or panelled	stainless steel
Factory, service	galvanized steel
Exterior	cast cover

3.18 **CONTROL DEVICES**

.1 Install as indicated.

3.19 **PLYWOOD BACKBOARDS**

.1 Install plywood backboards.

3.20 **FIELD FABRICATED METAL WORK**

.1 Clean and prime paint field fabricated metal work.

.2 After fabrication deburr, scrape, grind smooth, wire brush with power brush and degrease metal work.

.3 Prime paint steel with 1 coat of CISC/CPMA 2.75 oil alkyd primer.

.4 Prime paint aluminum as follows: wash with detergent solution and wipe down with SSPC-SP1 solvent. Apply alkyd tank and structural enamel based paint in white, galvanized iron primer to 1.5 mils DFT.

.5 For brass and bronze alloy materials, prepare as for aluminum but apply 1 coat of CAN/CGSB-1.40-M zinc chromate primer.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.2 Modifications, demolition and installation of services within this building require utmost care due to vital operation of systems involved. Removal and installation of systems require constant communication with DCC Representative.

1.2 CO-ORDINATION BETWEEN NEW AND EXISTING INSTALLATIONS

.1 Provide interfacing components between new and existing systems as necessary for proper performance and operation.

1.3 EXISTING SERVICES

.1 Ensure existing services remain undisturbed and energized except where indicated to be disconnected.

.2 Disconnect and remove abandoned wiring materials and devices.

.3 Cut raceways flush where embedded in structure.

.4 Retain abandoned embedded outlet boxes and close with pressed steel coverplates.

.5 Make safe all circuit wiring left for future use.

1.4 INTERRUPTION OF SERVICES

.1 Obtain DCC Representative's written approval before interrupting any service. Long outages are not acceptable.

.2 Provide temporary services to maintain continuity in the event that services must be interrupted.

1.5 PREMIUM TIME

.1 Include cost of premium time in tender price for work during nights, weekends or other time outside normal working hours necessary to do the work and maintain electrical services in operation.

PART - 2 PRODUCTS

2.1 USE OF EXISTING MATERIAL AND EQUIPMENT

.1 Unless noted otherwise, existing panels, boxes and wiring materials may be reused if acceptable to Inspection Authority.

.2 Unless noted otherwise, provide additional equipment of same type and manufacture to supplement existing equipment.

.3 Reused Luminaires: Furnish new lamps.

PART - 3 EXECUTION

3.1 EXAMINATION

.1 Visit the site, examine the existing conditions and become familiar with the extent of the necessary removal, relocation, reconnecting, and rerouting of electrical equipment and wiring as necessary for the completion of the project.

.2 Review and confirm with the Architect/Designer's drawings for the complete extent of demolition and alteration.

3.2 EXISTING MATERIAL AND EQUIPMENT

.1 Equipment to be reused or relocated: test for proper operation and repair as necessary.

.2 Repair or replace existing equipment which is damaged in process of relocation.

.3 Reused Luminaires: Install lamps, clean fixtures and touch up damaged finish.

.4 Relocate existing junction, pull or terminal boxes which become inaccessible due to new mechanical ductwork or equipment.

.5 Ensure all electrical, life safety services, and services for existing equipment, in areas outside the areas of this work, that are required to remain in service, shall be kept in service and without interruption.

.6 Relocate any electrical feeders or equipment that are required to remain in service that are secured to existing walls, floors or ceilings to be demolished or that are buried and required to be excavated for new work.

.7 When deleting and/or making safe existing electrical work, ensure that it includes all wiring back to the associated panel boards or control panel. Update associated panel directory as required.

.8 Disconnect and remove existing light fixtures, devices, outlets, etc., which are not to be reused. Such items shall be cartoned and turn over to the DCC Representative at a place designated by the DCC Representative. Cut back and cap unused raceway and outlets and removed unused wiring back to panel board in approved manner.

3.3 DEMOLITION

.1 Make safe and disconnect all power and systems, as and when, and to the extent required to facilitate with the demolition.

.2 Disconnect all power and system back to source and update associated distribution equipment tags and directories.

.3 Demolish existing work, where indicated, and remove from site.

.4 Execute all demolition work so as to create minimum vibration or dust within and outside the building. Obtain DCC Representative's approval of methods before proceeding.

.5 Include in demolition work for removal of all communication devices, outlets, and cables etc., which are not be reused. Remove all unnecessary cables and equipment in hub rooms and/or telephone rooms with extreme care to avoid any accidental shutdown to existing services serving other parts of the building.

.6 All existing electrical equipment which is no longer required shall be removed and disposed of, off site.

.7 Be responsible and pay for any damage to the Base Building incurred by work of this Division, or repair to the satisfaction of the DCC Representative.

.8 Carry out the work with minimum of noise, dust and disturbance.

3.4 **PENETRATIONS IN EXISTING STRUCTURE**

.1 Perform cutting, patching and repairing. Before proceeding obtain DCC Representative's approval.

.2 Where necessary to penetrate existing floors, walls, ceiling, roof or structural members provide sleeve and follow DCC Representative's instructions.

.3 Restore surfaces to same finish and condition as existed prior to penetration.

3.5 **SALVAGE MATERIALS**

.1 Remove from site materials in renovated areas that are not to remain or be reused, unless noted as remaining property of DCC Representative.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.2 This specification Section governs requirements for electrical equipment provided as part of a mechanical equipment package.

.3 Provide complete electrical work within confines of mechanical equipment package. Where package does not have a rigid enclosure, ship items that can be shipped in one piece preassembled and prewired. Mechanical Specification for individual items of equipment takes precedence wherever it specifies exceptions or additions to the following list:

.1 Electrical enclosures and devices compatible with mechanical equipment location and exposure.

.2 Assembly and wiring.

.3 Identification.

.4 Testing.

1.2 REFERENCES

.1 Comply with requirements of Canadian Electrical Code, local codes and local authorities.

.2 Electrical ratings, construction and testing of each mechanical package to be in accordance with latest applicable standards and publications of organizations as follows:

.1	CSA C22.2 No. 4-85	-	Enclosed Switches
.2	CSA C22.2 No. 5-M86	-	Moulded Case Circuit Breakers
.3	CSA C22.2 No. 38-M86	-	Thermoset Insulated Wires and Cables
.4	CSA C22.2 No. 39-72	-	Fuseholder Assemblies
.5	CSA C22.2 No. 45-M81	-	Rigid Metal Conduit
.6	CSA C22.2 No. 51-81	-	Armoured Cable
.7	CSA C22.2 No. 56-77	-	Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit
.8	CSA C22.2 No. 59-M84	-	Fuses (Both Plug and Cartridge-Enclosed Types)
.9	CSA C22.2 No. 75-M83	-	Thermoplastic Insulated Wires and Cables
.10	CSA C22.2 No. 83-M85	-	Electrical Metallic Tubing
.11	CSA C22.2 No. 127-81	-	Equipment Wires

.3 Furnish electrical equipment bearing approval of Canadian Standards Association. Where CSA approval is not available, secure approval by applying for special inspection from the local Electrical Safety Authority (ESA).

.4 Compliance with provisions of this Specification does not relieve vendor of responsibility of furnishing equipment of proper design, mechanically suited to meet operating guarantees at design service conditions.

1.3 **PERMITS**

.1 Obtain and pay for permits and inspections required for work performed by Electrical Trade including special inspections.

1.4 **COORDINATION**

.1 Carefully examine work and Drawings of related trades to ensure material and equipment being supplied is compatible with that being supplied by other trades.

.2 Advise DCC Representative in writing of any special requirements that his equipment may require such as:

.1 Any limitation to voltage fluctuation

.2 Any frequency variation limit

.3 Any limitation to amount of harmonics on system

.4 Any special grounding requirement.

.3 Coordinate fuse and circuit breaker selection with those being supplied by other contracts to ensure that protective equipment operates as required.

1.5 **DESIGN CONSIDERATIONS**

.1 Harmonic Levels

.1 Design circuitry to minimize generation of harmonics. Harmonic content at output terminal is not to exceed 10% of minimum voltage, current and frequency output. At maximum output values, these values are not to exceed 5% of output voltage, current and frequency.

.2 For individual equipment, limit total harmonic content feed back in power system to less than 5% THD (% total harmonic distortion) with odd harmonic content limited to less than 3% of voltage and even harmonic content limited to less than 1% of voltage.

.3 Limit telephone interference factor due to harmonics to balance TIF* of less than 2000 with a residual TIF of less than 100 per individual equipment. TIF is a factor to identify relative objectionable effect of inductive and capacitive coupling of harmonic frequency with telephone communications.

.2 Design

.1 Design control and alarm circuits to fail safe. That is, open-circuiting of one wire, short-circuiting of wiring or failure of a component shall not cause machinery to start up. Failures shall shut down machinery, or render equipment inoperative, or sound an alarm.

.2 Provide for manual operator control of all functions on automatic or semiautomatic equipment design.

.3 Select electrical devices on the basis that a 15% voltage dip of 3 seconds or less, or 10% undervoltage indefinitely, does not cause equipment to shut down.

.4 Furnish suitable circuit protection for controls so that one electrical fault does not affect more than one unit or system. Furnish protection by either circuit breaker or fuse.

.5 Furnish a disconnecting means to permit servicing of individual systems or control components.

.6 Furnish contacts such as relays, starters, etc. on 208 volt and 600 volt service for rating of 600 volts minimum; on 120 volt service, provide rating for 300 volts minimum.

1.6 **SUBMITTALS**

.1 Typical manufacturer drawings are not acceptable unless revised to show specific equipment being furnished.

.2 Submit shop drawings showing:

.1 Equipment outline drawings showing locations of electrical equipment including dimensioned conduit stub-up locations as applicable. Identify components by suitable numbering system of same system used for schematics.

.2 Certified dimension prints of electrical equipment.

.3 Base and/or mounting dimensions, including weight of components.

.4 Schematic diagrams of systems, including power and control equipment supplied.

.5 Interconnection diagrams showing external connections to equipment furnished and with terminal block properly identified and showing in their true physical relationship within equipment.

.6 Complete electrical material and equipment list including individual item electrical ratings, manufacturer name and catalogue number.

.7 Recommended spare parts list; start-up and operation.

.8 Installation operating and maintenance instruction manuals for electrical equipment as part of equipment manuals.

.3 Submit detailed specification and data for motors and controls for special application if such are required for mechanical equipment, even if not described in detail in equipment Specification but required for proper operation of equipment.

.4 Do not start with equipment fabrication before above listed documents have been submitted and formally reviewed and returned by DCC Representative.

.5 After work is complete and testing has been executed:

.1 Submit final certified drawings

.2 Submit test data reports.

PART - 2 PRODUCTS

2.1 **GENERAL**

.1 Furnish new materials, and furnish like materials by the same manufacturer.

2.2 **WIRE AND CABLE**

.1 Conductors: ASTM Class B, soft, stranded electrolytic copper.

.2 Furnish wiring sized in accordance with Canadian Electrical Code, except as follows:

.1 Power and lighting: No. 12 AWG minimum.

.2 Control: No. 14 AWG minimum.

.3 Fire alarm: No. 18 AWG minimum.

.3 Furnish type TWH for control, lighting and receptacle branch circuits, RW90 for other branch circuits.

.4 Furnish type TEW and SEW2 for wiring inside high temperature equipment only.

.1 TEW, 105°C rated, to CSA C22.2 No. 127

.2 SEW2, 200°C rated, to CSA C22.2 No. 127

.5 For conductors of #8 AWG and larger furnish chemically cross-linked thermosetting polyethylene insulation material to CSA C22.2 No. 38 as follows:

.1 RW90 XLPE, 90°C rated, 600 volt insulation

.6 For conductors of #14 AWG to #10 AWG furnish thermoplastic insulation material to CSA C22.2 No. 75-M as follows:

.1 TWH, 75°C rated, 600 volt insulation

.7 CSA type AC90 (BX) 600 volt armoured cables for dry locations 90°C rated to CSA C22.2 No. 51, complete with code gauge ground conductor.

.8 CSA type ACL90 600 volt armoured cables for wet locations 90° rated, complete with code gauge ground conductor.

.9 Conductor Colour Coding

.1 Furnish wiring with conductor colour coding as follows:

.1 600 V/208, 3 phase AC, power

.1 Phase A - Red

.2 Phase B - Black

.3 Phase C - Blue

.4 Neutral - White

.2 120/240 V, 1 phase AC (2 or 3 wire) or DC, power

.1 Hot (line) - Black

.2 Hot (line) - Red

.3 Neutral - White

.3 Control AC - Red

.4 Control, DC - Blue

.5 Ground - Green

.10 Wire and Cable Connectors

.1 Copper compression type wire and cable terminations for #8 AWG and larger conductors, sized to suit, T & B Series 5400.

.2 Wire terminations on items not provided with a mechanical clamp connector to be made with insulated (uninsulated) ring tongue tinned copper wire terminal, crimp type.

.3 Wire terminations at terminal, blocks with clamp connectors to be made by bare conductor.

.4 Not more than 2 lugs or conductors to be plated on each terminal connection.

.5 Conductors to be single continuous length from devices to terminal blocks; splices not permitted.

2.3 CONDUIT

.1 Conduit: Minimum size 19 mm

.2 Rigid thickwall galvanized steel threaded conduit to CSA C22.2 No. 45-M.

.3 EMT conduit to CSA C22.2 No. 83.

.4 Liquid-tight flexible steel conduit with PVC cover to CSA C22.2 No. 56.

.5 Conduit Fittings and Supports

.1 Galvanized cast steel fittings for rigid steel conduit to CSA C22.2 No. 18 steel fittings for EMT conduit T & B 5223, 5220 and 42421. Furnish connections and supports of material to prevent galvanic reaction. Furnish supports sized for loads imposed.

.2 Furnish factory "ells" for 90 degree bends in conduit 25 mm and larger. Furnish insulating grounding bushings to protect wires inside boxes, except where protective shoulder is furnished as part of conduit thread connection.

.3 Furnish watertight connectors with nylon insulated throat for liquid tight flexible steel conduit, T & B Series 531, Crouse-Hinds Series LT38, Sealing O-ring T & B series 5262, Crouse-Hinds Series SG1.

2.4 ENCLOSURES

.1 For electrical equipment furnish enclosures approved for environmental conditions, such as rain, dust, etc., in which this equipment will be installed and used, or furnish enclosures as stipulated in equipment Specification. Furnish enclosures prime and finish painted in manufacturer's standard colour.

.2 Furnish equipment enclosures complying with minimum requirements as follows:

.1	EEMAC Type 1A	In clean non production areas
.2	EEMAC Type 4	For indoor and outdoor use in non- hazardous dusty locations

.3 Furnish enclosures with paint finish to ANSI 49 or ANSI 61 baked grey enamel.

2.5 **SPLITTER BOXES**

.1 Code gauge galvanized sheet steel enclosure EEMAC Type 1A (gasketed), welded corners and formed hinged cover equipped for locking in closed position.

.2 Copper main and branch lugs to match required size and number of incoming and outgoing conductors.

.3 Furnish minimum 3 spare terminals on each set of lugs in splitters less than 400A.

2.6 **JUNCTION BOXES**

.1 Code gauge galvanized sheet steel EEMAC Type 1A (gasketed), sized as required by code for number and size of conduits, conductors and devices, complete with covers, corrosion resistant screws, terminals and mounting channels.

.2 Screw-on sheet steel covers to match enclosure for surface mounting boxes. Furnish covers with 25 mm minimum extension around for flush-mounted junction boxes.

2.7 **WIRING DEVICES - SWITCHES**

.1 Specification grade, general purpose AC switches, manual toggle operated, 15A, 20A, 120V, single pole, double pole.

.2 Acceptable Manufacturers

.1 Hubbell - 1201, 2: 1221, 2

.2 Smith and Stone - 4-4801, 4-4902

.3 P & S - 15AC1, 2: 20AC1, 2

2.8 **WIRING DEVICES – RECEPTACLES**

.1 Receptacles: Specification grade, white coloured, suitable for back and side wiring, complete with grounding terminal and as follows:

.1 Type 3 - 120V, 15A, 3 pin, U-ground duplex. Hubbell No. 5262, Smith & Stone No. 4-5262, P & S No. 5262.

2.9 **OPERATOR PILOT DEVICES**

.1 Furnish standard duty operator devices.

.2 Furnish operator devices complete with manufacturer's standard engraved legend plates.

.3 Contact blocks

.1 Quick make - quick brake, one (1) NO and one (1) NC minimum.

.2 Rating continuous 10A, 600V AC and DC.

.4 Operators

.1 Pushbuttons

.1 flush head

.2 Colour:

.1 green – start

.2 red – stop

.3 black - other

.3 Emergency stop: mushroom head, colour red, push/pull motion.

.4 Selector switches: standard operator knob lever, 2-position, 3-position.

.5 Pilot lights

.1 Push to test transformer type.

.2 Lens colour:

.1 Running - red

.2 Stopped - green

.3 alarm/malfunction - amber

.4 on - white

.6 Acceptable manufacturers: Allen Bradley type 800T, Square D Class 9001 type K.

2.10 **PILOT CONTROL DEVICES**

.1 Furnish industrial grade pilot control devices such as: limit switches, temperature switches, pressure switches proximity switches and solenoid valves as required by process.

2.11 **DISCONNECT SWITCHES**

.1 Except where noted otherwise, furnish non-fusible disconnect switches on electrically powered mechanical equipment to isolate equipment from power supply.

.2 Switches: quick-make quick-break heavy duty to CSA C22.2 No. 4-M with arc chutes, operating lever on outside of enclosure and provision for locking in off position with minimum 3 padlocks.

.3 Mechanism, buswork, and assembly braced for minimum 100,000 AIC symmetrical.

.4 Fuseholders to CSA C22.2 No. 39 to suit specified fuses.

.5 Enclosure EEMAC Type 1A code gauge galvanized steel for dry indoor, locations. For disconnect switches mounted outdoors and exposed to the elements furnish weatherproof EEMAC type 4 enclosure.

.6 Acceptable Manufacturers: FPE, Siemens, Westinghouse Canada, Square D.

2.12 **FUSES**

.1 H.R.C. fuses to CSA C22.2 No. 59-M, CSA C22.2. No. 106-M with interrupting capacity minimum 100,000 amps symmetrical.

.2 Except where noted otherwise furnish time delay fuses as follows:

.1 Rated 250V, up to 600A HRCI-R, Form I: Class R Bussman FRN-R250 volt, Gould Shawmut TRNR, Littelfuse FLNR.

.2 Fuses 600V, up to 600A HRCI-R, Form I: Class R Bussman FRS-R600 volt, Gould Shawmut TRSR, Littelfuse FLNR.

.3 Furnish spare fuses of each type and size in use as follows:

.1 600A and below: 6

.2 Above 600A: 3

.4 Submit a list of proposed spare fuses to DCC Representative.

2.13 **GROUNDING**

.1 Furnish grounding system conforming to Ontario "Electrical Safety Code" and Canadian Electrical Code, CSA C22.3 No. 2, CSA C22.2 No. 41 and meet approval of inspection department of authority having jurisdiction.

.2 Ground Conductors: ASTM Class B soft electrolytic copper stranded conductors code gauge, or larger where indicated.

.3 Furnish ground lugs sized in accordance with Canadian Electrical Code for control and equipment electrical panels.

2.14 **EQUIPMENT IDENTIFICATION**

.1 Furnish engraved lamicoid identification nameplates with black face on white core, for front-of-panel mounted devices.

.2 Furnish warning signs and labels as required by Canadian Electrical Code.

PART - 3 EXECUTION

3.1 **WIRING METHODS**

.1 Install equipment and field wiring in raceways unless noted otherwise.

.2 Tag each wire on both ends with sleeve wire marker, showing wire number. Hand lettering on sleeves is not permitted.

.3 Soldered connections to devices are not permitted. Connect wires to identified terminals. Install relay bases with terminal screws readily accessible for testing.

3.2 **CONDUIT SYSTEMS**

.1 Install wiring in rigid steel (EMT) conduit using conduit fittings and seals as required. Install cast feraloy fittings, except where suitable flexible conduit may be used for connections to equipment subject to vibration or adjustment. Install connections and supports for conduit of a material or construction to prevent galvanic reaction. Length of liquid tight flexible conduit not to exceed 750 mm.

.2 Run exposed conduit in a neat and organized manner, vertically, horizontally or parallel to equipment lines so as not to interference with access to the unit for normal maintenance or operation. Furnish conduit junction boxes independently supported.

.3 Support conduits as required by code. Install supports at bends, fittings and fixtures, and as required to make conduit system rigid and free from vibrations. Install supports sized for loads imposed.

.4 Install fittings with cover opening in vertical plane or downward in horizontal plane. Locate cover opening not to be blocked, which would require disassembly of pipe or other measures for access to interior of fittings for future wire replacement.

.5 Install insulating grounding bushings in conduit to protect wires inside boxes except where protective shoulder is furnished as part of conduit thread connection.

.6 Execute threaded conduit joints with a minimum of 5 full threads engaged. Execute conduit connections to boxes and equipment with factory hubs or Meyers type hubs. Execute conduit joint with suitable lubricant. Maintain grounding continuity of conduit system.

.7 Maintain uniform circular cross-section of conduit at bends. Do not execute single bend greater than 90 degrees.

3.3 **SPLITTER BOXES**

.1 Install splitters as required and mount plumb, true and square to equipment lines.

.2 Extend splitters full length of equipment arrangement.

3.4 **JUNCTION BOXES**

.1 Install junction boxes in accessible locations and secured to equipment.

.2 Install terminal blocks as required.

3.5 **PULL BOXES**

.1 Install pull boxes as may be required, in accessible locations, and secure to equipment.

3.6 **WIRING DEVICES - RECEPTACLES**

.1 Install receptacles vertically, use gang type outlet box where more than 1 receptacle is required in a location.

.2 Where split receptacle has 1 portion switched, mount vertically and switch upper portion.

3.7 **CONTROL PANELS**

.1 Panel Wiring: Install panel wiring conforming to applicable codes.

.2 Arrange internal components so not to interfere with service or maintenance of any equipment or components.

.3 Route wiring to permit future installation and easy access to equipment for maintenance and adjustment.

.4 Install wiring neatly arranged in properly supported bundles from front and rear of panel mounted equipment to conveniently located terminal blocks for each panel section.

3.8 **DISCONNECT SWITCHES**

.1 Install to equipment on suitable mounting surface.

.2 Locate flexible or rigid conduit to equipment, not to obstruct access to equipment or walking aisle.

3.9 **FUSES**

.1 Deliver fuses separately with equipment, labelled to identify their installation locations.

.2 Clearly mark manufacturer's labels on inside cover of each fusible unit, with ampere rating and catalogue symbol of replacement fuses to be used.

3.10 **GROUNDING**

.1 Install grounding system conforming requirements of Ontario "Electrical Safety Code" and Canadian Electrical Code, CSA C22.3 No. 2, CSA C22.2 No. 41 and meet approval of inspection department of authority having jurisdiction.

3.11 **EQUIPMENT IDENTIFICATION**

.1 Install engraved lamicoid identification nameplates on front-of-panel mounted devices.

.2 Install warning signs and labels as required by Canadian Electrical Code.

3.12 **TESTING**

.1 Except for low energy and electronic circuits, check wiring at expected operational voltage levels for insulation resistance. Submit documentation of insulation resistance testing after installation and prior to shipment.

.2 Check circuits for continuity.

.3 Perform functional test in addition to continuity check, before shipping. Functional test consists of simulating purchaser's devices with breadboard switches, relays, lights, or resistors, and/or exercising each circuit.

.4 Purchaser reserves the right to witness testing when deemed a requirement.

.5 Approval or release of equipment does not relieve Supplier of any responsibility or guarantee. Acceptance of shop tests does not constitute a waiver of field performance requirements under specific operating conditions, and shop inspection by Purchaser and/or Contractor representatives does not relieve Supplier of responsibilities in case of later discovery of defective design, material or workmanship.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

PART - 2 PRODUCTS

2.1 GROUND CONDUCTORS

.1 Copper conductors, soft drawn, ASTM Class B stranded.

.2 Insulated or bare conductors. Insulation colour green.

2.2 CONNECTIONS TO STRUCTURAL STEEL

.1 Exothermic connection or compression ground connector.

.2 Acceptable Manufacturers:

.1 Erico (exothermic)

.2 Burndy Groundlink type YGIB and cable connector

.3 Panduit StructuredGround

2.3 MISCELLANEOUS HARDWARE

.1 Galvanized steel ground studs, bolts, washers, nuts and accessories necessary for grounding system, including but not limited to:

.1 Grounding and bonding bushings

.2 Bolt type conductor connectors

.3 Bonding jumpers, straps

.4 Pressure type wire connectors

.2 Acceptable Manufacturers:

.1 Burndy

.2 T & B Blackburn

.3 Nesco

2.4 GROUND BUS

.1 Ground bus: copper, 50 mm x 6 mm thick complete with insulated supports, fastenings, connectors, length as indicated.

2.5 ALUMINUM STRUCTURES AND EQUIPMENT

.1 Use tin or silver plated connectors for grounding connections to aluminum structures and equipment.

.2 Acceptable Manufacturers:

.1 Burndy

.2 Thomas & Betts

.3 Techspan

PART - 3 EXECUTION

3.1 GENERAL

.1 Clean all paint, rust and dirt from all surfaces to which ground lugs are bolted.

.2 Protect exposed grounding conductors from mechanical damage.

.3 Ensure that molds, for exothermic type connections, are not used for more than 50 connections.

.4 At junction and terminal boxes, bond grounding conductors to ground stud.

3.2 BURIED GROUNDING

.1 For buried grounding use exothermic or compression or wedge pressure connection types.

3.3 CABLES

.1 Bond single conductor cable armour to equipment enclosure at supply end and load end.

.2 Bond multiconductor cable armour to equipment enclosures.

.3 Bond grounding conductor of multiconductor armoured and non-armoured cable to ground bus or lug in equipment enclosures.

3.4 STRUCTURAL STEEL AND BUILDING GROUNDING

.1 Ground building structural steel columns to buried perimeter grounding conductor. Ensure perimeter cable is slack to avoid stressing the connections.

.2 Install grounding jumpers across building expansion joints.

.3 Install ground rods close to column foundations and drive top of rod 150 mm below grade or finished floor level of slab on grade.

.4 Install inspection boxes.

3.5 RACEWAYS

.1 On raceways, lock-up tight all couplers and connections to boxes and enclosures. Install bonding jumpers at expansion joints, and where necessary. Maintain ground continuity throughout run of raceway.

.2 Install bonding jumpers on both ends of flexible conduit. Use grounding bushing, solderless lug, clamp or cup washer and screw connection. Install grounding conductor inside flexible conduit.

.3 EMT and non-metallic raceways: install insulated grounding conductor in raceway.

.4 Branch and feeder circuits in rigid conduit: use raceway as bonding conductor.

.5 Cable trays: provide a bare No. 2/0 AWG ground conductor along inside of tray run bonded to tray at 15 m intervals. Where multiple cable trays are supported on a common structure bond all trays to one common grounding conductor at 15 m intervals.

3.6 **TESTING**

.1 Engage an approved testing company to perform grounding tests.

.2 Acceptable Testing Companies:

.1 Cutler-Hammer Engineering Services

.2 K-Tek

.3 Siemens (Westinghouse)

.3 Test the resistance between the grounding triangle or small grid installed below the computer room and the building grounding system, before the connection is made to link them together.

.4 For resistance to ground measurements use a ground resistance test set with an accuracy of 10 milliohms.

.5 For measuring resistance to ground use the fall of potential method as outlined in IEEE Standard No. 81. After selecting the distance for the current probe take resistance measurements at a minimum of six voltage probe locations. Ensure that three of the voltage probe locations have resistance values such that the difference between any two is 0.5 ohm or less. If this is not the case repeat and retest with a larger distance for the current probe until this condition is satisfied.

.6 Perform testing under average weather conditions, allow three days after the last rain before conducting test. Do not test resistance to ground under frozen soil conditions unless specifically approved by DCC Representative.

.7 Test the integrity of the connections between the various components of the total grounding system. Test separately the continuity of the building perimeter loop (if used) and the connections between the main substation ground grid and the building grounding system, between the building grounding system and grounding triangles and between the computer room floor grid and the small grid below it.

.8 For continuity measurements use a bridge or similar type test meter designed for the purpose with an accuracy of 1 milliohm.

.9 Where readings are not acceptable to Electrical Inspection and DCC Representative provide additional ground conductors, ground rods, connections, as necessary to satisfy the requirements of both.

.10 Prepare and submit a Test Report, signed by the Test Engineer, and where witnessed, by DCC Representative. Include record of tests performed, methods of calculation, date and time of test, ambient conditions, names of testing company, test engineer, witnesses, also calibration record of all test instruments used together with manufacturers name, serial number and model number. Calibration record shall include percentage error, correction factors, if any. Submit 3 copies.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 APPROVALS

.1 Identification subject to prior approval of DCC Representative.

PART - 2 PRODUCTS

2.1 WIRE AND CABLE MARKERS

.1 Wire and Cable Diameter Less Than 13 mm

.1 Acceptable manufacturer

.1 Wieland Z type

.2 Brady Clip Sleeve type

.3 ABB SMC Series type

.2 Cable Diameter 13 mm and Larger

.1 Acceptable manufacturer

.1 Wieland K type

.2 Brady Clip Sleeve type

.3 3M Scotch Code type

.3 Non-Circular Wire

.1 Acceptable manufacturer

.1 Raychem Shrinkmark sleeves

.2 Phoenix Contact WMS Shrink Sleeves.

.3 Weidmüller SlimFix

2.2 CONDUIT AND ELECTRICAL METALLIC TUBING MARKERS

.1 Stick-On Marker

.1 Raceway Size Minimum Character Height

.1	¾" - 1¼ "	15 mm
.2	1½" - 2"	19 mm
.3	over 2"	32 mm

.2 Acceptable Manufacturers

.1 Brady, vinyl cloth, black on orange, type B-500

.2 Panduit, vinyl cloth, black on yellow, type PCL

.3 Wieland, mylar, black on yellow, type NL

2.3 **PANELBOARD IDENTIFICATION**

.1 Engraved laminated plastic, black lettering on white background, 6 mm character height.

.2 Typical 2-line identification for lighting panel:

"Lighting Panel C, 120/208V, 3 ph, 4W"

"Supplied from panel BB"

.3 Directories: Typewritten identification of breaker number, ampere rating and connected equipment.

2.4 **MOTOR STARTER, CONTACTOR AND DISCONNECT SWITCH IDENTIFICATION**

.1 Engraved laminated plastic, black lettering on white background, 6 mm character height.

.2 Typical Identification: "Pump S4, 208V, 3 ph".

2.5 **MAGLOCK/FIRE ALARM PULL STATIONS IDENTIFICATION**

.1 Engraved laminated plastic, red lettering on white background, 25 mm character height. To meet requirements of CSA B651.

.1 Provide tactile signs near the door.

.2 Identification:

.1 "PUSH UNTIL ALARM SOUNDS. DOOR CAN BE OPENED IN 15 SECONDS".

2.6 **WARNING SIGNS**

.1 Outdoor - metal, porcelain enamel finish. Indoor - rigid vinyl.

.2 Typical Identification: "Danger - High Voltage".

.3 Acceptable Manufacturers

.1 Outdoor: Safety Supply Canada, Almetek Industries, Brady

.2 Indoor: Safety Supply Canada, Almetek Industries, Brady

2.7 **MARKER TAPE, SERVICE AND PHASE IDENTIFICATION**

.1 Acceptable Manufacturer

.1 3M, Scotch Code Tape, type STD with SDR colour refills, Techspan Cut mark dispenser, or Ideal Wire Armour.

PART - 3 EXECUTION

3.1 **SYSTEMS IDENTIFICATION**

.1 Identify outlet boxes for various systems with distinctive paint colour. Apply a small area of paint to inside of outlet, junction and pull boxes and panels. In suspended ceiling areas, apply paint to inside and outside of junction boxes. System colours:

System	Normal
120/208 volt	black
347/600 volt	orange
Fire alarm	red
Intercom	brown
Low voltage control	black
PA and sound	light green

3.2 **POWER COMPANY SERVICE IDENTIFICATION**

.1 Identify service conductors with coloured marker tape as follows:

.1	Phase A	red
.2	Phase B	black
.3	Phase C	blue
.4	Neutral	white
.5	Ground	green

3.3 **WIRE AND CABLE IDENTIFICATION**

.1 Identify power, control, lighting and receptacle wires with continuous colouring as follows:

.1	Phase A	red
.2	Phase B	black
.3	Phase C	blue
.4	Neutral	white
.5	Ground	green
.6	Isolating ground	green and yellow
.7	Control	red
.8	Interlock	yellow
.9	D.C.	blue

.2 For larger wire sizes available only in black, install coloured wire marker tape in accordance with above coding.

.3 Cables Bearing Identification Numbers on the Drawings

.1 Install identification markers at each end of cable run.

.4 Lighting and Receptacle Branch Circuits

.1 Install conductor identification markers at panel, outlet box connections to lighting fixtures and device outlet boxes.

.2 Typical identification if fixture or device is connected to panel A, circuit 5: A-5.

.5 Low Voltage Lighting Control

.1 Install conductor identification marker at relay phase conductors. Typical identification if connected to panel A, circuit 5: A-5.

.2 Install conductor identification marker on conductors between control locations and relay panels. Identify in accordance with reviewed shop drawings.

.6 Data, Voice and Fibre Optic Cables

.1 Label horizontally distributed cabling at the following locations:

.1 Both ends of cable run

.2 Entrance and exit of cable pathway (i.e. cable trays, zone conduits, etc.)

.2 Label riser/backbone distribution cables at the following locations:

.1 Both ends of cable run

.2 Entrance and exit of cable pathway (ie. cable trays, zone conduits, etc.)

.3 1.5 m above finished floor in communication closets and equipment rooms

.4 At entrance and exit of a sleeve or slot in communication closets and equipment rooms

.3 Use the following colour codes for labels:

Function	Colour
Auxiliary and miscellaneous circuits	Yellow
Common equipment	Purple
Customer side of network interface	Green
First level backbone	White
Horizontal cabling to workstations	Blue
Interbuilding backbone	Brown
Key telephone systems	Red
Network side of network interface	Orange
Second level backbone	Gray

Note: Common equipment refers to PBX equipment, host computer, LANs and multiplexer. Miscellaneous refers to maintenance alarms, security, paging systems, and other system and circuits not an integral part of common equipment. Colour codes to ANSI/TIA/EIA-606.

.7 Fire Alarm and Miscellaneous Systems

.1 Install identification on conductors at panels, remote devices and system connections. Identify in accordance with reviewed shop drawings.

.2 Install maglock/fire alarm pull station identification adjacent to each door equipped with a maglock.

3.4 CONDUIT AND ELECTRICAL METALLIC TUBING (EMT) IDENTIFICATION

.1 Where Drawings indicate conduit and EMT identification numbers/letters, install identification markers at each end of run and at pull box locations.

3.5 PANELBOARD IDENTIFICATION

.1 Install identification plates, using adhesive, on outside of panel.

.2 Install directory.

.3 Identify main bus as follows:

.1	Phase A	red
.2	Phase B	black
.3	Phase C	blue
.4	Neutral	white
.5	Ground	green

3.6 SWITCHBOARD IDENTIFICATION

.1 Install identification plates for panel and branch feeders.

3.7 MOTOR STARTER, CONTACTOR AND DISCONNECT SWITCH IDENTIFICATION

.1 Install identification plates using self-tapping screws.

3.8 IDENTIFICATION AFTER FINISH PAINTING

.1 Behind access doors at shaft plenums: identify busways, feeder cables and feeder conduits.

3.9 EQUIPMENT WARNING SIGNS

.1 Install "Danger - High Voltage" signs.

.2 When equipment is supplied from more than one source install red warning signs to this effect.

3.10 PATCH PANEL AND FACEPLATE IDENTIFICATION

.1 Identify each jack at each wall or furniture outlet with a label supplied by the faceplate manufacturer. Each jack identification designation to match the respective cable identification designation.

.2 Identify each jack at each patch panel jack with labels, front and back, supplied by the patch panel manufacturer. Each jack identification designation to match the respective cable identification designation.

.3 In addition to an alphanumeric label use manufacturer's matching colour coded icons, which conform to ANSI/TIA/EIA-606, to identify individual jacks on faceplate and patch panels.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

.2 Integrated System Testing.

1.2 TESTING AND INSPECTION

.1 Arrange for site attendance by representatives of product manufacturer companies as requested by Testing and Inspection Company.

1.3 RELATED SECTIONS

.1 Related work includes but is not limited to the following sections:

.1 Section 26 08 03: Field testing and commissioning.

.2 Section 28 31 00 Fire Detection and Alarm Systems.

1.4 REFERENCES

.1 Conform to latest issues, amendments and supplements of following standards:

.1	ASTM	American Society for Testing and Materials
.2	CSA C22.2 No. 41-81	Grounding and Bonding Equipment
.3	NETA	International Electrical Testing Association Acceptance Testing Specifications for Electric Power Distribution Equipment and Systems, 1987
.4	ICEA	Insulated Power Cable Engineer's Association
.5	IEEE	Institute of Electrical and Electronic Engineers Guide for Making High Voltage Tests on Power Cable Systems the Field Std. 400
.6	CAN/ULC - S1001-11	Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.5 PROJECT SITE CONDITIONS

.1 Prior to testing, concrete and masonry work in vicinity of equipment and enclosures, walls, doors, gates and fences shall be completely installed, loose dirt and debris removed, and area cleaned. Interior areas shall be broom cleaned and washed down to remove dust.

1.6 SAFETY

.1 Conform to Federal, Provincial and Municipal safety requirements.

.2 Provide adequate protection for persons performing, assisting, or witnessing tests.

.3 Guard test areas from persons not involved in test procedures.

1.7 **QUALITY ASSURANCE**

.1 Perform testing of the following:

.1 Ground system

.2 Medium voltage cables

.3 Medium voltage starters

.4 Low voltage cables

.5 Panelboards

.6 Thermographic scanning

1.8 **SUBMITTALS**

.1 Submit an integrated testing plan to the requirements on CAN/ULC S1001. Integrated tests with the fire alarm system to include but not be limited to:

.1 Fire protection devices

.2 Electromagnetic door locks

.3 Smoke dampers

.4 Pressurization Fans

.5 Security Systems

.2 Submit testing plan c/w schedule a minimum of 4 weeks prior to commencing testing.

.3 Submit completed testing forms and documentation with Operations and Maintenance manuals.

PART - 2 PRODUCTS

2.1 **MATERIALS**

.1 Furnish materials, instruments, and equipment required to execute specified pre-test inspection, testing and cleaning.

.2 Furnish megger test instruments as follows:

	System Voltage	Megger Voltage
.1	less than 208V	500V
.2	277V to 1000V	1000V

PART - 3 EXECUTION

3.1 **GENERAL**

.1 Remove dust, debris, surplus material and tools from equipment.

.2 Check and tighten bus connections and terminations with a calibrated torque wrench. Refer to manufacturer's instruction for proper foot pound levels. Mark with adhesive tape or label when satisfactory.

.3 Insulation resistance values:

System Voltage	Megger Voltage	Minimum Acceptable Resistance in Megohms
less than 208V	500V	25
277 to 1000V	1000V	100

3.2 **LOW VOLTAGE CABLES (LESS THAN 1000V)**

.1 Install low voltage feeder cables to switchgear, panelboards, MCC's and distribution transformers but do not terminate to equipment.

.2 Take precautions necessary to ensure that installed cable runs which have not been terminated to their respective equipment and exposed terminals of equipment are protected from any damage.

.3 Visually inspect and megger cables to ensure they are ready for testing by Testing and Inspection Company.

.4 Terminate cable runs to equipment when instructed to do so by DCC Representative.

3.3 **PANELBOARDS**

.1 Inspect for physical, electrical, and mechanical condition.

.2 Compare equipment nameplate information with latest single line diagram and report discrepancies.

.3 Inspect for paint, dents, scratches, fit, and missing hardware.

.4 Verify that fuse and/or circuit breaker sizes and types correspond to drawings.

.5 Check tightness of bolted bus joints by calibrated torque wrench method. Refer to manufacturer's instructions for proper torque levels.

.6 Clean panelboard.

.7 Megger test.

3.4 **LOW VOLTAGE MOTOR CONTROL CENTRES, STARTERS, CONTACTORS UP TO 1000 VOLT SERVICE**

.1 Visually inspect components and the complete assembly, check drawout and plug connections.

.2 Clean equipment.

.3 Check each contactor and starter for rating, contactor size and operation, auxiliary contact operation.

.4 Check starter overloads and fuses with motor full load nameplate ratings.

.5 Check controls, starters and contactors operation on load.

.6 Check phasing.

.7 Check tightness of bolted bus joints by calibrated torque wrench method. Refer to manufacturer's instructions for proper torque levels.

3.5 **FUSIBLE AND NON FUSIBLE DISCONNECT SWITCHES**

.1 Clean equipment.

.2 Inspect for physical and mechanical condition.

.3 Verify that fuse sizes and types correspond to drawings.

3.6 **FIRE DETECTION AND ALARM SYSTEM**

.1 Engage manufacturer's qualified representative to make an inspection of fire alarm system. Inspection shall verify the following:

.1 The installation is that designated by the DCC Representative's specifications.

.2 The installation complies with standard CAN/ULC-S537-M.

.3 The equipment has been installed in accordance with manufacturer's recommendations, and that all signalling devices of whatever manufacture have been operated or tested to verify their operation.

.4 That supervisory wiring of those items of equipment connected to a supervised circuit is operating and that governmental regulations, if any, concerning such supervisory wiring, have been met.

.2 On completion of inspection and when all of above conditions have been complied with, manufacturer shall issue to DCC Representative:

.1 A copy of inspection report showing location of each device and certifying test results of each device.

.2 A certificate of verification confirming that inspection has been completed and showing conditions upon which such inspection and certification have been rendered.

3.7 **INTEGRATED TESTING**

.1 Perform and document integrated tests between the fire alarm system and all associated systems to the requirements of CAN/ULC S1001 and the Testing plan.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section, including but not limited to the following:

.1 Inspection, testing and commissioning each equipment, electrical system and installation as specified herein.

.2 Material, equipment, labour and technical supervision to perform work as specified herein.

.3 Determine and conclude, equipment and systems specified herein, are operational, within industrial and manufacturer's tolerance, installed in accordance with design specifications and manufacturer's requirements, comply with design specifications and Electrical Safety Authority (ESA). Certify that equipment and systems are suitable for energization.

.4 Obtain and utilize for inspection, testing and commissioning the following references.

.1 International Electrical Testing Association; Acceptance, Testing Specifications for Electrical Power Distribution Equipment and Systems, NETA ATS-2017

.2 Project Design Specifications

.3 Project Design Drawings

.4 Short Circuit Analysis and Protective Device Coordination Study Report

.5 Approved manufacturer's shop drawings

.5 Obtain and utilize information required for Short Circuit Analysis/Equipment Evaluation Study and Protective Device Coordination Study from:

.1 Project Design Specifications and Drawings

.2 Approved Manufacturer's Shop Drawings

.3 Project Site Visits

.4 Local Utility Authority

.6 Coordinate with installation Contractors, inspection, testing and commissioning schedules for equipment and electrical system. Work must be coordinate to expedite project scheduling and must not interfere with progress of installation work.

.7 Maintain a written record of each inspection, test and commissioning and provide a certified final project testing and commissioning report.

.8 Maintain a written record of each deficiency and provide a certified final project deficiency report.

.9 Inform DCC Representative, installation contractor and equipment manufacturer immediately when equipment, electrical system or

installation;

.1 Found defective on the basis of acceptance test

.2 Not in compliance with design specifications, design drawings and approved manufacturer's shop drawings

.3 Not in compliance with Electrical Safety Authority (ESA)

.4 Found in adverse conditions

.5 Requires adjustments

.10 Remove and re-terminate cables, bus bars, and wire terminations required to isolate equipment or electrical system under test.

.11 Retest equipment after deficiencies have been rectified.

1.2 **REFERENCES**

.1 ANSI/IEEE Std 241-1983 IEEE Recommended Practice for Electrical Power Systems in Commercial Building

.2 IEEE Std 242-1986 IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

.3 CSA C22.3 No. 0.3-M85 Test Methods for Electrical Wires and Cables

.4 CSA C22.2 No. 0.4-M82 Bonding and Grounding Equipment (protective grounding)

.5 CSA C22.2 No. 41-81 Grounding and Bonding Equipment

.6 NETA ATS-2017 International Electrical Testing Association Acceptance Testing Specifications for Electrical Power Distribution Equipment and System,

.7 IEEE 400-1980 Institute of Electrical and Electronic Engineers Guide for Making High Voltage Tests on Power Cable Systems the Field Std. 400-1980

.8 CEA Commissioning Guide for Electrical Apparatus

.9 ICEA Insulated Power Cable Engineers Association

.10 IEEE Institute of Electrical and Electronic Engineers Guide for Making High Voltage Tests on Power Cable Systems the Field Std. 400-1980

.11 ASTM American Society for Testing and Materials

1.3 **PROJECT SITE CONDITIONS**

.1 Prior to testing, concrete and masonry work in vicinity of equipment and enclosures, walls, doors, gates and fences shall be completely installed, loose dirt and debris removed and area cleaned. Interior areas shall be broom cleaned and washed down to remove dust.

1.4 **SAFETY**

.1 Conform with Federal, Provincial and Municipal safety requirements.

.2 Provide adequate protection for persons performing, assisting, or witnessing tests.

.3 Guard test areas from persons not involved in test procedures.

1.5 **QUALITY ASSURANCE**

.1 This Specification is intended to supplement the International Electrical Testing Association NETA ATS. Requirements of the NETA ATS apply unless superseded or modified by the specification.

.2 Perform inspection, testing and commissioning during warranty period of equipment and electrical installation.

.3 Certified Inspection, Testing and Commissioning Report, reviewed and stamped by a Professional Engineer currently licensed and registered with the Professional Engineers of Ontario.

.4 Utilize only full-time technicians who are regularly employed by the firm for inspection, testing and commissioning services. Electrically unskilled employees are not permitted to perform testing or assistance of any kind.

.5 Instruments used to evaluate electrical performance to comply in accordance with "Test Instrument Calibration" section as herein specified.

1.6 **TEST INSTRUMENT CALIBRATION**

.1 Instruments calibrated in accordance with the following frequency schedule:

.1 Field Instruments:

.1 Analog - 6 months maximum

.2 Digital - 12 month maximum

.2 Laboratory Instruments: 12 months

.3 Leased specialty equipment: 12 months

.2 Provide and have in place a calibration program which documents test instrumentation are maintained within rated accuracy.

.3 Accuracy of test instrumentation directly traceable to the National Bureau of Standards.

.4 Dated calibration labels visible on test equipment.

.5 Calibration records, maintained up-to-date, illustrating; date of last calibration test, results of instruments calibrated or tested, instruments manufacturer name, instrument model, and serial number, scales, percentage error, accuracy, correction factors if applicable, and name of calibration firm.

.6 Calibrating standard to have higher accuracy than that of instrument tested.

1.7 **INSPECTION, TESTING AND COMMISSIONING REPORT**

.1 Inspection, testing and commissioning report to include:

.1 Title page, Owners Name, Project Name, Project address, Project number, date, and complete name and address of testing firm

.2 Table of contents

.3 Summary of project inspection, testing and commissioning

.4 Description of test

.5 Itemized list of equipment and electrical system tested

.6 Inspection and test results

.7 Conclusions and recommendations

.8 Completed inspection and test forms for each equipment and system

.9 Itemized list of test instruments used with appropriate nameplate data

1.8 **DEFICIENCY REPORT**

.1 Deficiency report to include:

.1 Title page, owners name, project name, project addresses, project number, date and complete name and addresses of testing firm

.2 Summary of project deficiencies

.3 Itemized list of each deficiency

.4 Confirmation of corrected deficiencies

.2 Itemized list of deficiencies to in a table format and includes:

.1 Correct device name in accordance to project drawings

.2 Complete description of deficiencies

.3 Date the deficiency was noted

.4 Date the deficiency was corrected

1.9 **SUBMITTALS**

.1 Submit with tender the following documentation.

.1 Company user list of short circuit analysis, equipment evaluation study and protective device coordination study projects which are similar in scope of work, complete with project dates, references and telephone numbers.

.2 Company user list of inspection, testing and commissioning projects which are similar in scope of work, complete with project dates references and telephone numbers.

.3 Resume and record of fulltime employment of professional engineers and electrical technologist which will be assigned the project if awarded.

.4 Inspection and test forms sample for, each type of equipment appropriate to this project.

.5 Schedule indicating time to:

.1 Submit, short circuit analysis and equipment evaluation study report

.2 Submit, protective device coordination study report

.3 Commence on site inspection, testing and commission

.4 Submit, inspect, testing and commissioning report.

.2 Submit the following documentation within 2 weeks of contract award:

.1 Schedule of on site inspection, testing and commission as coordinated with installation contractors.

.2 Submit reports in electronic Microsoft "Word 6.0" format.

.3 Submit 6 copies of the complete short circuit analysis, equipment evaluation study and protective device coordination study report.

.4 Submit 6 copies of the complete inspection testing, and commissioning report no later than 2 weeks after completion of testing in the field.

.5 Submit 6 copies of complete deficiency report, no later than 2 weeks after completion of testing in the field. Resubmit revised deficiency report after correction in the field no later than 1 week after correction of deficiency.

.6 For each check and test performed, prepare and submit 4 copies of test reports, signed by Test Engineer. Where witnessed by DCC Representative include their signatures also.

.7 Include with each test report record of tests performed; method of calculations, date and times of test, ambient conditions, names of testing company, test engineer, witnesses, also calibration record of test instruments used.

.8 Final test reports shall certify that:

.1 Circuits are continuous and free from short circuits

.2 Circuits are free from unspecified ground

.3 Circuits are connected according to applicable diagrams and operate as intended

.4 Grounding systems conform in every respect with requirements of Electrical Safety Authority (ESA) Department.

.5 Equipment passed tests and inspection

.6 Equipment installation is as per manufacturer's recommendations

.7 Equipment and installation deficiencies have been corrected

1.10 **COORDINATION WITH COMMISSIONING AGENCY**

.1 The project will be subjected to a commissioning process by the DCC Representative. The DCC Representative will separately purchase from one or more agents, specific commissioning activities.

.2 Work of DCC Representative’s commissioning agent will be executed after the testing activities noted under this section.

.3 Cooperate in full the requirements of the commissioning agent.

1.11 **EQUIPMENT AND ELECTRICAL SYSTEM LIST**

.1 Inspect, Test and Commission following items of equipment and electrical installation as herein specified.

.1 Low Voltage Motor Starters

.2 Power Panelboards

.3 Low Voltage Power Feeders

.4 Thermographic Survey for all and 600V and 480V Terminations

PART - 2 PRODUCTS

2.1 MATERIALS

.1 Furnish all materials, instruments, equipment, required to execute the specified testing and commissioning.

.2 Furnish megger test instruments as follows:

Megger Voltage	System Voltage
500V	less than 208V
1000V	208V to 1000V

PART - 3 EXECUTION

3.1 PRE-TEST INSPECTION AND CLEANING

.1 Check that dust, debris, surplus materials and tools, have been removed from equipment.

.2 Inspect the power distribution systems at each voltage level for completeness.

.3 Check phase sequence throughout systems and application of colour codes to equipment and cables.

.4 Verify cable sizes, and equipment ratings, conform to specifications and coordination study.

.5 Verify arc flash labels are in place as per the arc flash study.

3.2 INSPECTION, TESTING AND VERIFICATION

.1 Verify by measurement correct phase sequence throughout systems and application of colour codes to equipment and cables.

.2 Verify cable sizes, and equipment ratings, conform to specifications and coordination study.

.3 Verify alarms, protection and control. Submit comprehensive written procedures (step-by-step) one week prior to test date.

.4 Overpotential testing to be ac Hi-Pot.

3.3 INSPECTION, TESTING AND COMMISSIONING REPORT DOCUMENTATION

.1 Provide separate inspection and test forms for each individual equipment and item as follows:

.1 Control Relay

.2 Low Voltage Breaker

.3 Panelboard Assembly

.4 Low Voltage Cables

.2 Document each qualitative inspection specified herein complete with description of Inspection and assessment (i.e. poor, satisfactory, good, excellent).

.3 Document each quantitative test specified herein, complete with appropriate calculation, acceptable maximum and minimum values, obtained test value and assessment.

.4 Inspection and Test forms to include as a minimum:

.1 Correct device name in accordance to project drawings

.2 Complete nameplate data

.3 Itemized list of inspection and assessment

.4 Complete test data for each test conducted

.5 Acceptable maximum and minimum test values

.6 Date and time of test

3.4 **TESTING GENERAL**

.1 Perform high potential tests before connecting equipment and cables.

.2 Perform megger tests before applying high potential tests.

.3 Perform such additional tests and re-tests as may be directed by the DCC Representative.

.4 Energize each voltage level of system immediately after testing is complete.

.5 In case this is not feasible verify fuse sizes and trip settings, and megger test each feeder and equipment with circuit breakers and switches open, immediately before energization.

.6 Medium Voltage Starters, Panelboards.

.1 Check bolted connections bus to bus, and bus to cable lug with torque wrench, to manufacturer's values. Mark with adhesive tape or label when satisfactory.

.2 Measure contact resistance on low voltage fusible and non-fusible switches, circuit breaker, contactors.

Acceptable Values:	Microhms
Low voltage - 208V to 1000V	100

.3 Measure resistance of fuse above 1000V or 600 amps and above.

.4 Megger test insulation resistance phase to phase and phase to ground of medium and low voltage switches, circuit breakers, contactors, buswork, control wiring. Acceptable values:

	Megohms
Low voltage, 208V to 1000 V	50

Duration of each test: one (1) minute

.5 Check ground bus and ground path for continuity, and connection to all non-current carrying metalwork. Maximum acceptable reading 0.1 ohms.

.6 Check for physical faults: damaged or dirty insulators, alignment of contacts, switchblades, operating mechanism, clearances, barriers, mounting.

.7 Operate circuit breakers, switches, contactors, 3 times.

.8 Operate equipment through design functions, including remote control operation, actuation of alarm and indication devices, mechanical and electrical operation and operation from protective relays.

.9 Simulate operating conditions and check operation of all alarm and control relays. Megger test ground insulation: potential transformer primaries, acceptable reading 50 megohms, potential transformer secondaries and current transformer acceptable reading 1 megohm.

.10 With current transformer secondaries shorted and grounded, potential transformer fuses removed and circuit open, apply ground insulation and phase to phase megger tests to the power bus work. Minimum acceptable reading 500 megohms.

.11 Check calibration and function of all meters, gauges and auxiliary devices forming part of equipment installed.

.12 Subsequent to energization, verify current flow using current injection test in all current transformer circuits.

.7 Prior to acceptance by the DCC Representative and after commissioning prepare a Final Test Report certifying that "based on tests the electrical installations tested are ready and fit for service". The report shall:

.1 List and include 1 copy of all test reports.

.2 Certify that grounding systems conform in every respect to the DCC Representative's requirements, and meet the requirements of the authority having jurisdiction.

.3 Include the phase to phase and phase to ground resistance of each feeder throughout the electrical systems, from high voltage system down to distribution panels, with connections made and all switches and circuit breakers open, as determined by megger test. Record these test results in schedule form, with three spare columns for warranty and subsequent tests.

3.5 LOW VOLTAGE CABLE, 600 V MAXIMUM SERVICE

.1 Megger test insulation resistance phase to phase and phase to ground.

.2 Test feeders cables prior to termination with cable ends separated 50 mm distance. Minimum acceptable reading, 100 megohms.

.3 Megger test feeders cables after termination. Minimum acceptable reading 100 megohms.

.4 Megger test each feeder cable with switch or breaker open.

.5 Inspect and test in accordance with NETA ATS, Section 7.3.1, Cables - Low Voltage 600 V Maximum.

3.6 LOW VOLTAGE MOULDED CASE BREAKERS

.1 Inspect and test in accordance with NETA ATS, Section 7.6.1.1, Circuit Breakers - Low Voltage Insulated Case.

.2 Perform secondary current injection test for moulded case breaker with solid state trip units.

3.7 LOW VOLTAGE FUSED OR UNFUSED SWITCH

.1 Inspect and test in accordance with the NETA ATS, Section 7.5.1.1, Air Switches - Low Voltage.

3.8 GROUNDING SYSTEM

.1 Inspect and test in accordance with NETA ATS, Section 7.13, Grounding System.

3.9 **THERMOGRAPHIC SURVEY**

.1 Perform thermographic surveys, 4 months and 10 months after process load is introduced on system in accordance with NETA ATS, Section 9, Thermographic Survey.

.2 Provide photographs and thermographs of problems only for the 4 month survey.

.3 Provide photographs and thermographs of each area as seen on the imaging system for 10 month survey.

.4 Inspect for physical, electrical and mechanical conditions.

.5 Remove all necessary covers prior to scanning.

.6 Equipment and items to be scanned;

.1 Panels

.2 Cables

.3 Switches

.4 Bus termination

.5 Cable termination

.7 Report to include and indicate photograph of the hot spots, colour photograph of the problem areas, indicate temperature rise between "hot spot" and normal or reference area, indicate cause of heat rise, indicate phase unbalance if present.

.8 Acceptable thermographic scanning equipment will be Thermovision 782 or Thermovision 870 CUV.

.9 The thermographic scan is to be performed upon completion of installation and one year after completion before the expiration of the warranty period.

.10 The thermographic scan is to be conducted when installation is under its maximum load condition.

.11 Correct all conditions which are found abnormal by the thermographic scan, immediately and at no extra cost.

.12 Perform a subsequent thermographic scan and submit a report to verify that all abnormal conditions have been corrected.

3.10 **COORDINATION WITH COMMISSIONING AGENT**

.1 The project will be subjected to a commissioning process by the DCC Representative. The DCC Representative will separately purchase from one or more agents, specific testing and commissioning activities.

.2 In addition, the DCC Representative's Commissioning Agent shall be allowed to witness any in contract testing, adjusting, start-up, and demonstration procedures.

.3 Co-operate with independent testing agencies and allow for all labour, equipment, and tools necessary to assist in completion of the commissioning process as defined herein.

.4 Prior to execution of any testing, start-up or demonstration, verify with the DCC Representative’s Commissioning Agent any tests required to be witnessed.

.5 Provide sufficient notice to DCC Representative's Commissioning Agent prior to commencement of procedures.

.6 For independent testing by DCC Representative's Commissioning Agent related to normal and emergency power equipment tests, receptacle testing, fire alarm verification, all communication equipment testing, etc., allow in tender price for availability of one journeyman electrician during testing process as needed to gain access to equipment an for removal and replacement of covers, wires, and cables.

.7 Co-operate with the commissioning agency as follows:

.1 Inform commissioning agency minimum 7 working days in advance of all testing.

.2 Provide copies of manufacturer's operating and maintenance brochures and product bulletins for all major equipment. This information t be made available immediately after approval of shop drawings, but no later than three weeks prior to testing.

.3 Allow DCC Representative's Commissioning Agent free access to site during construction phase.

3.11 **DOCUMENTATION**

.1 For tests and checks, provide completed detailed checklist of work performed. Checklists to be signed by individual performing the work and DCC Representative's Site Representative.

.2 For the required demonstrations, document successful completion to DCC Representative's Representative and note attendance.

3.12 **TESTING DURING WARRANTY PERIOD**

.1 Megger test as for Final Test Report and enter values on the Final Test Report schedule.

.2 Perform ground resistance tests during no load periods.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section, including but not limited to the following:

.1 Short circuit analysis and equipment evaluation study.

.2 Protective device coordination study.

.3 Arc Flash Hazard Analysis

.4 Determine and conclude, equipment and systems specified herein, are operational, within industrial and manufacturer's tolerance, installed in accordance with design specifications and manufacturer's requirements, comply with design specifications and Electrical Safety Authority (ESA). Certify that equipment and systems are suitable for energization.

.5 Obtain and utilize information required for Short Circuit Analysis/Equipment Evaluation Study and Protective Device Coordination Study from:

.1 Project Design Specifications and Drawings

.2 Approved Manufacturer's Shop Drawings

.3 Project Site Visits

.4 Local Utility Authority

.6 Coordinate with installation Contractors, inspection, testing and commissioning schedules for equipment and electrical system. Work must be coordinated to expedite project scheduling and must not interfere with progress of installation and testing work.

.7 Maintain a written record of each deficiency and provide a certified final project deficiency report.

.8 Inform DCC Representative, installation contractor and equipment manufacturer immediately when equipment, electrical system or installation;

.1 Found defective on the basis of acceptance test

.2 Not in compliance with design specifications, design drawings and approved manufacturer's shop drawings

.3 Not in compliance with Electrical Safety Authority (ESA)

.4 Requires adjustments

1.2 REFERENCES

.1 ANSI/IEEE Std 241-1983 IEEE Recommended Practice for Electrical Power Systems in Commercial Building

.2 IEEE Std 242-1986 IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems

.3 IEEE 3002.3-2018 IEEE Recommended Practice for Conducting Short-Circuit Studies and Analysis of Industrial and Commercial Power Systems

.4 IEEE 1584-2018 IEEE Guide for Performing Arc-Flash Hazard Calculations

.5 IEEE 519-2014 - IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems

.6 CSA C22.3 No. 0.3-M85 Test Methods for Electrical Wires and Cables

.7 CSA C22.2 No. 0.4-M82 Bonding and Grounding Equipment (protective grounding)

.8 CSA C22.2 No. 41-81 Grounding and Bonding Equipment

.9 NETA ATS-2017 International Electrical Testing Association Acceptance Testing Specifications for Electrical Power Distribution Equipment and System,

.10 CEA Commissioning Guide for Electrical Apparatus

.11 ICEA Insulated Power Cable Engineers Association

.12 ASTM American Society for Testing and Materials

1.3 **PROJECT SITE CONDITIONS**

.1 Prior to testing, concrete and masonry work in vicinity of equipment and enclosures, walls, doors, gates and fences shall be completely installed, loose dirt and debris removed and area cleaned. Interior areas shall be broom cleaned and washed down to remove dust.

1.4 **SAFETY**

.1 Conform with Federal, Provincial and Municipal safety requirements.

.2 Provide adequate protection for persons performing, assisting, or witnessing tests.

.3 Guard test areas from persons not involved in test procedures.

1.5 **QUALITY ASSURANCE**

.1 Short Circuit Analysis/Equipment Evaluation Study and Protective Device Coordination Study performed, reviewed and stamped by a Professional Engineer currently licensed and registered with the Professional Engineers of Ontario.

1.6 **SHORT CIRCUIT ANALYSIS/EQUIPMENT EVALUATION STUDY AND PROTECTIVE SERVICE COORDINATION STUDY REPORT**

.1 Report to include:

.1 Title page, Owner's Name, Project address, Project Number, date and complete name and address of firm

.2 Table of Contents

.3 Summary of project short circuit analysis study

.4 Summary of project equipment evaluation study

.5 Summary of project protective device coordination study

.6 Summary of project arc flash hazard study

.7 Tabulated System Input Data;

.1 Utility Short Circuit Capacity

.2 Cable Data

.8 Tabulated short circuit analysis results

.9 Tabulated equipment evaluation

.10 Tabulated arc flash analysis results

.11 Official Utility correspondence of supply feeders present and ultimate available short circuit capacity and supply feeder protective device settings

.12 Detailed review of protective device study procedure and proposed setting

.13 Comments on the coordination curves

.14 Coordination time-current graphs

.15 Tabulated protective device settings

.16 Single line diagram with appropriate source, branch and bus number nomenclature

1.7 **DEFICIENCY REPORT**

.1 Deficiency report to include:

.1 Title page, owners name, project name, project addresses, project number, date and complete name and addresses of testing firm

.2 Summary of project deficiencies

.3 Itemized list of each deficiency

.4 Confirmation of corrected deficiencies

.2 Itemized list of deficiencies to in a table format and includes:

.1 Correct device name in accordance to project drawings

.2 Complete description of deficiencies

.3 Date the deficiency was noted

.4 Date the deficiency was corrected

1.8 **SUBMITTALS**

.1 Submit during construction prior to testing and commissioning Short circuit, protective device coordination and arc flash reports and deficiency report.

1.9 **COORDINATION WITH COMMISSIONING AGENCY**

.1 The project will be subjected to a commissioning process by the DCC Representative. The DCC Representative will separately purchase from one or more agents, specific commissioning activities.

.2 Work of DCC Representative’s commissioning agent will be executed after the testing activities noted under this section.

PART - 2 PRODUCTS (NOT USED)

PART - 3 EXECUTION

3.1 SHORT-CIRCUIT ANALYSIS WITH PROTECTIVE DEVICE EVALUATION

.1 Systematically calculate fault currents based on the available fault current at the facility service entrance. Study preparer shall obtain the available fault current from the local utility.

.2 Short-circuit calculations shall be prepared by means of a digital computer utilizing a commercially available software package. Motor contribution shall be incorporated in determining fault levels. Results of short-circuit calculations shall be presented in tabular form and shall include momentary and interrupting fault values for three-phase and phase-to-ground faults. Calculate short-circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchboard, distribution panelboard, lighting and receptacle panelboards, and any other significant protective device locations throughout the system.

.3 Provide a ground fault current study for the same areas, including the associated zero sequence impedance data. Include in the tabulations fault impedance, X to R ratios, asymmetrical factors, short circuit kVA and symmetrical and asymmetrical fault currents.

.4 The studies shall include all operating mode at the equipment specified above in the scope.

.5 Provide harmonic analysis for baseline model predicting the system's level of harmonics distortion. This information is then to be used to evaluate conformance to IEEE 519.

.6 Analyze the short-circuit currents by preparing a tabulation comparing the fault levels to the device interrupting ratings. Indicate areas in which integrated/series ratings are utilized. The following information shall be included in the tabulation:

.1 Bus identification number.

.2 Location identification.

.3 Voltage

.4 Manufacturer and type of equipment.

.5 Device rating.

.6 Calculated short-circuit current.

3.2 PROTECTIVE DEVICE COORDINATION STUDY

.1 Prepare coordination time-current characteristic curves to determine the required settings/sizes of the protective devices to maximize selectivity. The utility upstream protective device feeding the facility shall be maintained as the upper limit for coordination. These settings shall be obtained by the preparer, along with any other protective device setting requirements. The coordination curves shall be prepared on log-log paper and illustrate adequate clearing times between series devices. The curves shall be created through the use of the study software package, but must reflect actual protective devices to be installed. Adequate time-current curves shall be generated to depict coordination. In addition, protective device characteristics shall be suitably determined to reflect calculated short-circuit levels at the location.

.2 A narrative analysis shall accompany each coordination curve sheet and describe the coordination and protection in explicit detail. All curve sheets shall be multi-color for improved clarity. Areas lacking complete coordination shall be highlighted and reasons provided for allowing condition to remain or provide solution to resolve situation. System

coordination, recommended ratings, and setting of protective devices shall be accomplished by a registered professional electrical engineer with a minimum of eight years of current experience in the coordination of electrical power systems.

.3 Include all adjustable settings for ground fault protective devices. Including manufacturing tolerance and damage bands in plotted fuse characteristic. Show transformer full load current, transformer magnetizing inrush, ANSI transformer withstand parameters and significant asymmetrical fault currents. Terminate device characteristics curves at a point reflecting the maximum symmetrical fault current to which the device is exposed.

.4 The following information shall be provided on all curve sheets.

.1 Device identification and associated settings/size.

.2 Voltage at which curves are plotted.

.3 Current multiplier.

.4 ANSI frequent fault damage curve.

.5 Cable insulation damage curves.

.6 Transformer inrush point.

.7 Single-line for the portion of the system.

.8 Motor starting profiles (where applicable).

3.3 ARC FLASH ANALYSIS

.1 Perform an arc flash analysis based on existing short circuit values provided by the customer or in conjunction with a short circuit study. Determine the arc energy levels at each equipment location in the facility for a specified working distance. Based on the arc energy at each point, determine the proper PPE required and if the arc energy level exceeds available PPE ratings.

.2 Determine the following:

.1 Flash Hazard Protection Boundary

.2 Limited Approach Boundary

.3 Restricted Boundary

.4 Prohibited Boundary

.5 Incident Energy Level

.6 Required Personal Protective Equipment Class

.7 Type of Fire Rated Clothing

.3 Supply and Install labels for each evaluated location that lists the hazard levels along with the required PPE while working in that area. Analysis will be provided to determine if any changes can be made in protection system to reduce arc energy levels. Study analysis shall be compliance to CSA-Z462 requirements.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 RELATED SECTIONS

.1 Section 26 05 01: Common Work Results for Electrical.

.2 Section 26 05 54: Electrical Identification for Electrical Systems.

1.3 REFERENCES

.1 Conform to latest issues, amendments and supplements of following standards:

.1	CSA C22.2 No. 5.1M	Moulded Case Circuit Breakers
.2	CSA C22.2 No. 39	Fuseholder Assemblies

PART - 2 PRODUCTS

2.1 CONTACTORS

.1 Enclosure: Steel, EEMAC 1.

.2 EEMAC type, electrically held, heavy duty, designed for the application, e.g. lighting contactors for lighting circuits.

.3 Auxiliary contacts, minimum 2 N.O. and 2 N.C.

.4 Control transformer, fused primary and secondary, 120 volt output.

.5 Hand/Off/Auto (HOA) control selector switch and red pilot light, "press to test" type.

.6 Acceptable Manufacturers:

.1 Electrically held:

.1 Cutler-Hammer, Type ECL-03

.2 Allen-Bradley 500L series

.3 GE Canada CR260L and CR360L series

.4 Schneider, Square D class 8903

2.2 CONTROL STATIONS

.1 Pushbutton and selector switches: heavy duty, oiltight.

2.3 FUSIBLE AND NON FUSIBLE DISCONNECT SWITCHES

.1 Enclosure: Steel, EEMAC 1.

.2 Switches: Quick-make, quick-break, heavy duty, short circuit rating 100,000A rms sym. Provision for locking in off position with up to 3 padlocks.

.3 Viewing Window: For viewing blades.

.4 Electrical Interlock: Mechanically operated from switch mechanism, rated 120 VAC, 15A, 1 NO and 1 NC contact.

.5 Acceptable Manufacturers:

.1 Schneider, Square D

.2 Cutler-Hammer

.3 GE Canada

.4 Siemens, I-T-E

2.4 **FUSES**

.1 HRC fuses to CSA C22.2 No. 106-M.

.2 Time delay fuses as follows:

.1 Fuses up to 600V, up to 600A HRCI-J, Form I: Class J Bussman JHC, Gould Shawmut AJT.

.2 Fuses above 600A HRC-L, Form I: Class L Bussman KLU, Gould Shawmut A4BT.

.3 Provide spare fuses of each type and size in use as follows:

.1 600A and below: 6

.2 Above 600A: 3

.4 Submit a list of spare fuses to DCC Representative for approval.

2.5 **RELAYS**

.1 Totally enclosed plug-in type relay with 4 form-C contacts, operating coil to suit required voltage. Complete with mounting socket.

.2 Acceptable Manufacturers

.1 Allen-Bradley

.2 Schneider Square D

.3 Cutler-Hammer

PART - 3 EXECUTION

3.1 **GENERAL**

.1 Protect equipment from dust, debris, moisture, and physical damage, with sealed envelope of plastic or other impervious material until building is enclosed and cleaned and equipment is energized.

.2 Protect from condensation by maintaining at suitable temperature above 0°C.

.3 Finish equipment enclosures to ANSI 49 or ANSI 61, baked grey enamel.

3.2 **CONTACTORS**

.1 Install contactors local to panelboard where practical.

.2 Check operation of contactors.

.3 Provide plastic covers to exclude dust and dirt until contactors are energized.

3.3 **DISCONNECT SWITCHES**

.1 Install local to equipment on adjacent wall, column, or other suitable mounting surface. Where necessary provide free standing rigid continuous slotted channel strut frame.

.2 Where mounted on masonry walls, allow minimum of 6 mm clear space between enclosure and masonry wall.

3.4 **FUSES**

.1 Store fuses in a moisture free location until ready to energize.

.2 Install fuses immediately prior to energization.

.3 Prior to acceptance of the Work, clearly mark manufacturer's labels on inside cover of each fusible unit, with ampere rating and catalogue symbol of replacement fuses to be used.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 RELATED SECTIONS

.1 Section 26 05 01: Common Work Results for Electrical.

.2 Section 26 05 54: Electrical Identification for Electrical Systems.

1.3 REFERENCES

.1 Conform to latest issues, amendments and supplements of following standards:

.1	CSA C22.2 No. 4-M	Enclosed Switches
.2	CSA C22.2 No. 39	Fuseholder Assemblies

PART - 2 PRODUCTS

2.1 FUSIBLE AND NON FUSIBLE DISCONNECT SWITCHES

.1 Enclosure: Steel, EEMAC 1.

.2 Switches: Quick-make, quick-break, heavy duty, short circuit rating 100,000A rms sym. Provision for locking in off position with up to 3 padlocks.

.3 Viewing Window: For viewing blades.

.4 Electrical Interlock: Mechanically operated from switch mechanism, rated 120 VAC, 15A, 1 NO and 1 NC contact.

.5 Acceptable Manufacturers:

.1 Schneider, Square D

.2 Cutler-Hammer

.3 GE Canada

.4 Siemens, I-T-E

2.2 FUSES

.1 HRC fuses to CSA C22.2 No. 106-M.

.2 Time delay fuses as follows:

.1 Fuses up to 600V, up to 600A HRCI-J, Form I: Class J Bussman JHC, Gould Shawmut AJT.

.2 Fuses above 600A HRC-L, Form I: Class L Bussman KLU, Gould Shawmut A4BT.

PART - 3 EXECUTION

3.1 GENERAL

.1 Protect equipment from dust, debris, moisture, and physical damage, with sealed envelope of plastic or other impervious material until building is enclosed and cleaned and equipment is energized.

.2 Protect from condensation by maintaining at suitable temperature above 0°C.

.3 Finish equipment enclosures to ANSI 49 or ANSI 61, baked grey enamel.

3.2 DISCONNECT SWITCHES

.1 Install local to equipment on adjacent wall, column, or other suitable mounting surface. Where necessary provide free standing rigid continuous slotted channel strut frame.

.2 Where mounted on masonry walls, allow minimum of 6 mm clear space between enclosure and masonry wall.

3.3 FUSES

.1 Store fuses in a moisture free location until ready to energize.

.2 Install fuses immediately prior to energization.

.3 Prior to acceptance of the Work, clearly mark manufacturer's labels on inside cover of each fusible unit, with ampere rating and catalogue symbol of replacement fuses to be used.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section including, but not limited to, the following:

.1 Lighting equipment as per the luminaire schedule and as specified herein.

.2 Refer to Architectural reflected ceiling plans for exact location of luminaires.

.3 Check latest ceiling finish schedule in areas where recessed luminaires are specified to ensure that luminaires have suitable ceiling trim for particular ceiling finish.

1.2 SUBMITTALS

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

.2 Submit the following Product Data:

.1 Provide manufacturer's printed product literature, specifications and datasheet and include all product characteristics, performance criteria, BUG ratings, physical size, finish and limitations.

.2 Provide complete photometric test data prepared by independent testing laboratory in accordance with IESNA test procedures for all luminaires for approval by DCC Representative.

.3 Provide complete “useful lifetime” TM-21 report data, including L70/L80/L90 (as applicable) ratings for all luminaires for approval by DCC Representative.

.4 Provide photometric calculations for all site and interior lighting as required per plans.

.3 Each luminaire catalogue cut sheet to be provided with individually tagged luminaire number and all selected options to be highlighted.

.4 Submit battery sizing calculations for unit equipment.

1.3 REFERENCES

.1 Canadian Standards Association (CSA):

.1 C22.2 NO. 9.0-96 (R2016), General Requirements for Luminaires.

.2 CSA C22.2 No. 66-1988 (R2001), Specialty Transformers.

.3 C22.2 NO. 141-15, Emergency lighting equipment

.4 CAN/CSA-C866-17, Performance of LED Luminaires.

.2 IEEE (Institute of Electrical and Electronics Engineers)

.1 ANSI/IEEE C62.41, IEEE Recommended Practice on Surge Voltages in Low Voltage AC Power Circuits.

1.4 CODES AND STANDARDS

.1 All wiring to be in accordance with the Ontario Electrical Safety Code.

.2 Luminaires and all associated components, including but not limited to remote drivers, quick connects, control devices, etc. must be CSA certified or field evaluated and approved by ESAFE (ESA Field Evaluation) at the expense of this contractor. NOTE: where luminaires utilize remote components, each individual component must be CSA certified complete with CSA mark or label, in addition to the complete luminaire assembly/system's CSA certification.

PART - 2 PRODUCTS

2.1 LUMINAIRES

.1 General

.1 Furnish luminaires in accordance with CSA C22.2 No. 9.

.2 Luminaire finishes shall resist chipping, crazing, discolouration.

.3 Luminaires to contain no asbestos.

.4 Furnish luminaires with flanges and gaskets to eliminate light leaks.

.2 Exit Light Luminaires

.1 Cast aluminum housing, stencil face, knock-out directional arrows.

.2 Green Running Man pictogram.

.3 Universal ceiling, end-to-wall, surface back-to-wall mounting or recessed mounting if indicated.

.4 Connection for emergency 12V source where indicated.

.5 LED type with diffusing lens.

2.2 LED LUMINAIRES

.1 LED drivers shall be electronic-type, labelled as compliant with radio frequency interference (RFI) requirements of FCC Title 47 Part 15.

.1 NEMA SSL 1 "Electronic Drivers for LED Devices, Arrays, or Systems".

.2 LED drivers shall have a sound rating of "A", have a minimum efficiency of 85%, and be rated for a THD of less than 20 percent at all input voltages.

.2 Dimmable LED drivers shall be 0-10V type. Dimmable LED drivers shall be capable of dimming without LED strobing or flicker from 100%-1% of rated light output, unless noted otherwise.

.3 Luminaires must be tested in accordance with IESNA LM-63 by an independent LM-63 accredited laboratory. LM-63 test data in the form of IES-format electronic files must be available for all luminaires. Software generated/calculated IES files will **not** be accepted.

.4 LED fixtures are to be provided by manufacturers with a minimum (8) years' experience and provide minimum (5) years warranty on all electrical parts.

.5 All LED sources to be tested in accordance with IESNA LM-80. Test data must be available for all luminaires.

.6 LED lighting systems with unmatched drivers and power supplies will not be considered.

.7 Driver mA rating should be indicated when reporting initial delivered lumens of a specified fixture. Unless otherwise stated, no driver current shall exceed 750 mA.

.8 Maximum Efficacy (lm/W) of luminaries must be greater than 60 lm/W for downlights (pot lights) and greater than 90 lm/W for linear/volumetric luminaries, unless noted otherwise.

.9 'Useful Lifetime' projections for luminaire's to be calculated in accordance with IESNA TM-21-11. Unless otherwise noted, all luminaires to have minimum useful lifetimes to 70% of their original output (L70 ratings) of 50,000 hours.

.10 Luminaires shall have a CRI ≥ 80, source LEDs shall be binned per ANSI within a 3-step MacAdam Ellipse.

.11 Lumen values stated for luminaires in contract documentation or plans are stated as delivered lumens.

2.3 **EMERGENCY BATTERY UNITS**

.1 Supply voltage 120 V dc.

.2 Output voltage 12 V dc.

.3 Batteries: sealed lead acid calcium alloy grid type sized to operate the lamp load to 91% of initial voltage for 30 minutes.

.4 Battery charger: solid state, multi-rate, voltage/current regulated, sized to restore battery to full charge in 12 hours.

.5 Low voltage disconnect: solid state, modular, operates at 80% battery voltage.

.6 EEMAC 1 code gauge steel housing.

.7 Auxiliary equipment:

.1 "AC Power ON"

.2 "Fast charge" pilot light

.3 Voltmeter

.4 Test switch

.5 5 minute time delay relay

.8 Lamp heads: mounted as indicated, 360° horizontal and 180° vertical adjustment, LED lamps.

PART - 3 EXECUTION

3.1 **INSTALLATION - GENERAL**

.1 Provide supports for luminaires. Support single units from luminaire studs in outlet boxes. For continuous row fluorescent type, provide support for each end plus at least one for each channel section, or additional as required. Swivel mount stems. Provide concrete inserts at points of luminaire support in unfinished areas where a concrete slab serves as ceiling. Provide support from concrete floor and roof steel above ceiling as applicable.

.2 Align luminaires in rows, maintain required heights, and install luminaires clear of other work.

.3 Clean and relamp existing luminaires being removed and installed in new locations.

.4 Keep luminaires covered and protected from construction dust and debris until building is broom clean and free of suspended dust clouds.

.5 Do not lamp luminaires until ready for testing and use. Obtain DCC Representative's approval before lamping. Install lamps in lampholders.

.6 When installation is complete, demonstrate operation to satisfaction of DCC Representative.

.7 Standard octagonal boxes may be supplied where conduits feeding luminaires in finished areas are exposed on ceiling if hanger canopies entirely cover outlet boxes and are neatly notched for conduit. Otherwise, provide cast condulet outlet boxes with a diameter larger than canopies.

.8 Do not mount luminaires above pipes, ducts or equipment. In event of unavoidable tight locations, provide hangers to clear obstructions. Check layouts of other trades on job and plan cooperatively. Luminaires in any room shall hang at one height. Obtain approval before any changes are made to layouts shown.

.9 Provide continuous 12 mm x 38 mm channel above ceiling, where luminaires are suspended or mounted on furred ceilings. Fasten luminaires to channel with two 6 mm minimum diameter studs with minimum 1220 mm on centre.

.10 Where two 4'-0" surface or suspended fluorescent luminaires occur in tandem, an 8'-0" body may be used. Where two single lamp luminaires occur in tandem, a common lamp ballast may be used.

.11 Verify catalogue number of luminaires with description prior to ordering, and check for final ceiling finish in areas where recessed luminaires are called for in order to provide ceiling trim, flanges and mounting brackets to suit particular construction used where luminaires are installed.

.12 Support luminaires in an approved manner to comply with the Ontario Electrical Safety Code and the Ontario Building Code.

.13 Provide steel luminaire studs, brackets and hangers. Where luminaires are hung on chain hangers, provide chain of closed link type capable of supporting ten times luminaire weight. Use U-bolts for chain ends; S-hooks are not acceptable.

3.2 **INSTALLATION – LED**

.1 Verify LED drivers are compatible with selected dimming system where applicable.

.2 Locate and install remote drivers in concealed location. Provide access hatch when installed above hard ceilings.

3.3 **INSTALLATION - EMERGENCY AND EXIT LIGHTS**

.1 Exit sign installation shall meet all requirements of the authorities having jurisdiction.

.2 Install exit signs flush on suspended acoustic tile and drywall ceilings.

.3 Install exit sign with housing on wall mounted applications.

.4 For applications where there is no suspend ceiling exit signs to be supported from slab. Provide stems of sufficient length such that top of exit sign is 25 mm lower than bottom of general luminaires in the space.

.5 Where double arrows are shown, install 2 running man exit signs.

.6 Install emergency battery units where shown. Support on brackets supplied by manufacturer.

.7 Aim emergency heads to properly illuminate exit path.

.8 Connect exit signs to emergency battery units.

3.4 **INSTALLATION - CEILINGS**

.1 Suspend luminaires mounted from or in a suspended T-bar ceiling directly from building structure, independent of the T-bar system, to ULC, Local Fire Marshal's Office, Ontario Building Code, Electrical Safety Authority (ESA) and DCC Representative's approval.

.2 Provide additional safety chain secured to luminaire in 2 locations such that luminaire cannot swing below ceiling in the event of support failure.

.3 In non-accessible ceilings wire with not more than 1200 mm of AC90 or RW90 XLPE wire in flexible conduit to adjacent outlet boxes placed above finished ceiling within reach of the luminaire openings.

.4 In accessible ceilings wire with not more than 1800 mm of AC90 or RW90 XLPE wire in flexible conduit to adjacent outlet boxes, locations as shown on the Drawings.

.5 Provide suitable trim for all luminaires installed in drywall ceilings or within lay-in or snap-in tiles.

3.5 **FIELD QUALITY CONTROL**

.1 Perform a visual inspection to verify cleanliness and alignment of the fixtures. Misalignment and light leaks shall be corrected, and rattles due to ventilation system vibration shall be eliminated.

.2 Perform an operational test to verify that all fixtures illuminate properly, dimming systems dim properly (i.e. no flicker), and lighting zones are switched according to the drawings.

.3 Record at night normal light levels achieved with all luminaires at full brightness. Readings to be taken at workplane height in the centre of each room and at 5 metre intervals in larger rooms and corridors.

.4 Record at night emergency light levels achieved with luminaires connected to life safety systems at full brightness. Readings to be taken at tread level along all exit paths at 3 metre intervals.

.5 Assist with commissioning activities once field quality control is complete and documented.

END OF SECTION

PART - 1 GENERAL

1.1 SUMMARY

.1 Section includes:

.1 Labour, products, equipment and services necessary to complete the work of this Section.

1.2 RELATED SECTIONS

.1 Section 26 05 01 – Common Work Results for Electrical

1.3 REFERENCES

.1 CAN/ULC-S524-14 - Standard for the Installation of Fire Alarm Systems

.2 CAN/ULC-S536-19 - Standard for the Inspection and Testing of Fire Alarm Systems

.3 CAN/ULC-S537-13 - Standard for the Verification of Fire Alarm Systems

.4 CAN/ULC-S529-16, Smoke Detectors for Fire Alarm Systems.

.5 CAN/ULC-S1001-11 - Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.4 MANUFACTURER'S ATTENDANCE

.1 Provide services of manufacturer's representative in accordance with Section 26 05 01.

1.5 SUBMITTALS

.1 Shop Drawings

.1 Submit shop drawings in accordance with Division 01 for following and prior to commencing installation. Do work in accordance with reviewed shop drawings.

.2 Manufacturers' brochures on devices.

.3 Project specific detailed sequence of operation.

1.6 SYSTEM DESCRIPTION

.1 Contractor to verify the fire alarm system exist at site if it is Single Stage Fire Alarm System Two Stage Fire Alarm System and accordingly all devices provided shall comply with existing systems

PART - 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

.1 Notifier

2.2 **MATERIALS**

.1 Alarm Initiating Devices

.1 Smoke Detectors:

.1 Ionization smoke detector shall be self-compensating dual chamber type activated by products of combustion. The unit shall be plug-in, mounted to a twist/lock base complete with solid-state amplifier-switching circuit and status LED for visual supervision. Detector shall be addressable.

.2 Thermal Detectors.

.1 Thermal detectors operating on rate-of-rise and fixed temperature principles shall be sensitive to a temperature rise greater than or equal to 8°C per minute or rate fixed temperature of 57°C with status LED for visual supervision. Detector shall be addressable

.2 End-of-line Resistors

.1 End-of-line resistors shall be mounted on a stainless steel plate and bear a ULC label.

PART - 3 EXECUTION

3.1 **CONNECTIONS TO OTHER SYSTEMS**

.1 Existing System

.1 Arrange with Owner and tenant a timed disruption schedule for installation of the new system.

.2 Motor Control Connections

.1 The central fire alarm panel shall be provided with shutdown relays to stop all motors of fans, upon fire alarm activation.

.2 Provide all wiring and connections from the central fire alarm panel to designated new fan motor and starters. All other starter controls wiring shall be under Division 23 Mechanical.

.3 Elevator System Connection

.1 Provide all wiring, relays and connections from the central fire alarm panel to the elevator controller required for fire mode operation.

3.2 **INSTALLATION**

.1 Install to CAN/ULC S524.

.2 Install wiring for standard type initiating circuits in separate raceway system from alarm signal circuits, unless wiring is individually shielded and single point ground connected and acceptable to equipment manufacturer.

.3 Wire alarm signals in accordance with requirements by manufacturer and operation. Install end-of-line device for signal circuit in suitable box adjacent to last signal of signal circuit or mounted on suitable terminal strips in control panel.

.4 Clear wiring of shorts, opens and grounds on completion of work.

.5 Mount detectors on ceiling as per CAN/ULC-S524 Standard unless otherwise specified herein with minimum and maximum distances as required for respective type of detector, at highest point where variations in ceiling height exist. Do not mount detectors on sides, undersides, or less than 600 mm from walls, beams, joints, ducts, open web steel joists or any structure projecting below actual ceiling height and especially from lighting fixtures and air exhaust handling or heating outlets, but 900 mm from air supply handling or heating outlet.

.6 Should interference from obstruction, lamp positions, air outlets or heat radiating surfaces be encountered in locating any detector where indicated, locate detector as near as possible to indicated position, clear of obstacles, to satisfaction of Owner's Designee, but maintain clear space of 600 mm on ceiling, below and around.

.7 Identify signal circuit, alarm initiating circuit, auxiliary circuit and other wiring at fire alarm control panel, annunciator, terminal boxes or elsewhere on completion of work with appropriate marking labels. Mark single conductors with suitable self adhesive type, indelible numbered markers, identify cables with clear polyester tag, attached with self-locking TY-RAP.

.8 Provide, install and connect wiring and interconnecting wires and cables as specified herein, as required by control panel manufacturer and as indicated on Drawings.

.9 Wire magnetic fire door holder and closing units, electro-magnetic locking devices, air conditioning fans and any other ancillary device in accordance with manufacturer instruction and their operational requirements.

.10 Conductors shall be solid copper. The minimum size of conductor shall be:

.1 16 AWG for individual conductors

.2 18 AWG for integral assembly of two or more conductor cables

.3 14 AWG for control and audible signal circuits. In no case shall the voltage drop exceed 10%.

.11 Class A wiring shall be used for all alarm initiating devices.

.12 Provide EMT rigid conduits with steel set screw fittings with nylon insulated thread rigid coupling as manufactured by T & B or approved equal. Size conduits to Code requirements or larger sizes where indicated.

3.3 FIELD QUALITY CONTROL

.1 Inspection and Verification

.1 Only directly prior to verification, remove smoke detector protectors and clean smoke detectors thoroughly.

.2 Inspect and verify each individual device in entire system for proper connection, supervision and function in accordance with CAN/ULC-S537. Identify detectors, manual pull stations and signal appliances not installed within requirements of CAN/ULC-S524 in remarks column of verification report and bring to DCC Representative attention prior to acceptance test.

.3 Obtain verification certificate and verification report from manufacturer showing each device checked, and that this work has been carried out. Utilize standard verification forms similar to Canadian Fire Alarm Association (C.F.A.A.) forms.

.4 Inspection and checking shall include smoke testing of each ionization or photoelectric smoke detector when installed with similar material found in area protected or as directed otherwise by DCC Representative. Submit smoke detectors sensitivity calibration reading, as read on place of installation as part of verification report.

.5 Fire alarm manufacturer shall supply to electrical contractor reasonable amounts of technical assistance with respect to any changes necessary to execute work during period of inspection by manufacturer, electrical contractor shall make available, to manufacturer, electricians as designated by manufacturer.

.6 Verify only when entire system is fully operational and no subsequent work will be performed, unless project is designated for phased occupancy.

.7 For phased occupancy construction provide interim testing and verification service and retest entire system at the end of the project.

.8 Issue certificate of verification only after completion of deficiencies noted during verification have been corrected and re-verified.

3.4 **FINAL COMMISSIONING**

.1 After completion of above inspection and verification, make arrangement with DCC Representative, manufacturer of control equipment and other installers of related and connected equipment (extinguishing systems, fans, doors, elevators and other equipment) to perform functional acceptance tests, giving ample notice to parties concerned to be present.

.2 Tests to include:

.1 Spot check of devices to ensure proper connections and supervision.

.2 Testing of signal devices for correct operation and function.

.3 Testing of smoke detectors with similar material found in area to be protected.

.4 Record sound pressure levels in each room during an alarm condition and at ambient levels.

.3 Perform and document intergrated tests between the fire alarm system and fire protection system to the requirements of CAN/ULC S1001 and as per section 26 08 01. Testing to include, but not limited to, integration between fire alarm system and:

.1 Elevator recall.

.2 Stair pressurization system.

.3 Electromagnetic door locks

END OF SECTION

PART - 1 GENERAL

1.1 REFERENCES

.1 ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort 600 kN-m/m^3.

.2 CAN/CSA-A23.1/A23.2 - Concrete Materials and Methods of Concrete Construction / Methods of Test and Standard Practices for Concrete.

.3 OPSS 1010 - Material Specification for Aggregates - Granular A, B, M and Select Subgrade Material.

1.2 QUALITY ASSURANCE

.1 Standard Proctor Density shall comply with ASTM D698.

1.3 PROTECTION

.1 Document existing site conditions by taking photographs of the work area for the purpose of having a pre-construction site condition reference.

.2 Provide digital copies of photographs to DCC Representative.

.3 Protect existing buildings, landscaping, fencing, service poles, wires, underground services and paving located on this and adjoining properties from damage. Make good damage resulting hereto to the acceptance of DCC Representative and at no cost to the Contract.

.4 Underground Services: Notify Public Utilities in advance of planned excavations adjacent to their services. Take care not to damage or displace encountered services. When such services are encountered notify DCC Representative immediately and protect, brace and support them. Advise DCC Representative which services require adjustment, relocation or abandonment. Where work on these services become necessary use following procedure:

.1 Essential Services: Make necessary repairs only to maintain essential services satisfactory to DCC Representative and authorities having jurisdiction.

.2 Known Services: Repair promptly at no expense to DCC Representative.

.3 Unknown Services: Repair promptly on DCC Representative's instructions. Submit complete breakdown of cost of such work. Amount approved will be added to Contract Sum.

.4 Record location of maintained, re-routed and abandoned underground services.

.5 Carefully maintain bench marks and other reference points. If disturbed or destroyed, replace bench marks and reference points as directed by a registered land surveyor at no cost to DCC Representative.

.6 Provide protection and heating as required to prevent bearing surfaces from freezing.

.7 Protect excavated material approved for backfilling from freezing.

.8 Shoring and Bracing:

.1 Engage a professional engineer licensed in the Province of Ontario and fully qualified in this line of work to design, approve, and assume responsibility for lagging, sheeting, shoring, and bracing

.2 Design and detail shoring for excavation in accordance with the Contract Documents, the applicable Building Code, the Geotechnical Report, the Canadian Foundation Engineering Manual

.3 Submit engineered shop drawings, design data bearing stamp and signature of professional engineer, responsible for shoring, for DCC Representative's review.

.4 Submit detailed shop drawings of shoring and bracing to authorities having jurisdiction. Submit shop drawings to DCC Representative for review before commencing Work. Shop drawings to bear the seal and signature of a professional engineer licensed in the Province of Place of Work.

.5 Provide lagging, sheeting, shoring, bracing necessary to support sides of excavations. Maintain shoring and bracing in position until footings, walls and other foundations are in place and are strong enough to withstand the backfilling pressures

.6 Report any movement of shoring to DCC Representative immediately.

.7 Position lagging, sheeting, shoring, and bracing to minimize interference with the building Work.

.8 Comply with additional requirements of authorities having jurisdiction.

.9 Retain shoring and bracing until other work affected thereby is carried out.

.10 Remove and dispose of shoring remaining within 600 mm of finished grade or greater distance as required by authorities having jurisdiction.

1.4 **SOIL CONDITIONS**

.1 Geotechnical report, dated December 09, 2024, has been prepared for the Project by WSP. Copy of the Report is appended at the end of the Specifications.

.2 The Report was prepared and furnished in good faith for the information of the Contractor. It provides geotechnical considerations and recommendations related to construction but does not cover all subsurface conditions of the site or other localized conditions.

.3 DCC Representative does not guarantee the accuracy or completeness of the Report. DCC Representative assume no responsibility for any interpretation or deduction that the Contractor may make from the Report.

PART - 2 PRODUCTS

2.1 **MATERIALS**

.1 Type 1 fill: OPSS 1010, Granular A, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.

.2 Type 2 fill: OPSS 1010, Granular B, free from clay lumps, cementation, organic material, frozen material and other deleterious materials.

.3 Type 3 fill: Clean, approved, imported soil material, free from organic matter, foreign and building debris and graded within the following limits:

Sieve Size (Tyler)	Percent Passing

63 mm	100
4.75 mm	80 maximum
75 um	10 maximum

.4 Remaining Backfill and Fill: Clean excavated materials free from waste materials, debris, rubbish, frozen portions, muskeg, organic or cohesive matter and rocks larger than 100 mm in diameter. If sufficient quantity of material is not available from excavation, use imported fill having same, or better, characteristics.

PART - 3 EXECUTION

3.1 PREPARATION

.1 Carefully examine the Site including access to the Site.

.2 Establish the extent and nature of the materials to be removed and the amount of fill necessary to provide the required grades.

.3 Check dimensions at the Site before commencing excavation Work. Report discrepancies to DCC Representative.

3.2 TEMPORARY DRAINAGE - DEWATERING

.1 Perform dewatering Work to comply with Authority Having Jurisdiction

.2 Provide trenches for drainage and to lower the water table where required. If temporary drainage trenches are required, install pumps, and maintain pumping continuously until permanent drainage facilities are installed.

.3 Provide pumps and equipment necessary to intercept and direct water away from excavations. Keep excavations free of water. Provide necessary dams and culverts. Do not allow discharge from pumps to damage the Site or to flow to adjoining properties.

.4 Maintain in efficient operation, all pumping equipment, piping, and hose.

.5 Provide a dewatering system as required to keep excavations free of water.

.6 Ensure that soil in suspension is not removed by dewatering sufficient to cause settlement of adjacent soil.

3.3 EXCAVATION – GENERAL

.1 Excavate to extent, elevations and depths required for completion of work, leaving sufficient space for removal of formwork.

.2 Keep excavation free of water by bailing, pumping or system of drainage as required and provide pumps, suction and discharge lines or well points of sufficient capacity and maintain until such time as permanent drainage system is installed or until DCC Representative agrees to its removal. Take necessary measures to prevent flow of water into excavation.

.3 Protect bottom and sides of excavations and trenches from freezing and from exposure to wet weather to prevent cave-ins and softening of bed upon which concrete or drains rest.

.4 Keep bottoms of excavations clean and clear of loose materials, levelled and stepped at changes of levels with exception of excavations made for drainage purposes and those to slope as required.

.5 Excavate areas under concrete slabs on grade and where permanent roads, ramps, and walks will occur to depth required and sufficient to expose firm undisturbed subsoil, free of organic matter and to DCC Representative's satisfaction.

.6 If removal of earth causes displacement of adjacent earth, remove disturbed earth at no additional cost to DCC Representative.

.7 Remove from the Site and dispose of rock and boulders found within the excavated areas

.8 Remove soft unconsolidated soils, muskeg and organic material encountered in excavations and fill void and any wells, slumps, cesspools or similar pits with well compacted clean dry fill of quality as herein specified. Where these conditions occur under or near footings obtain direction before proceeding.

.9 After completion of excavation and prior to placing any concrete on bearing strata or placing of fill, notify DCC Representative to inspect exposed bearing surfaces. Do not proceed without authorization.

.10 Should nature of subsoil at depths indicated prove to be unsatisfactory to DCC Representative for placing of structural work thereon, then upon DCC Representative's written order, excavate to greater depth until satisfactory bottom is reached. Payment for such additional excavation and backfill will be in accordance with the Contract.

.11 Keep surfaces against which concrete or fill is placed free of frost.

.12 Thaw out frozen surfaces beneath concrete slabs, paving or structure requiring firm foundation to unfrozen depth. Remove thawed softened material to firm base and fill void with well compacted clean dry fill of quality as herein specified.

.13 If excavations reveal seepage zones, springs or other unexpected subsurface conditions which may necessitate revisions or additions to the Contract Documents, inform DCC Representative and obtain written instructions.

3.4 **ROCK EXCAVATION AND CUTTING.**

.1 General

.1 Remove rock encountered within limits of excavation as required to achieve the lines, grades, and elevations indicated on the Drawings.

.2 Controlled Rock Cutting

.1 Where excavation is required adjacent to existing structures, foundations, or where vertical rock faces are indicated on the Drawings, perform rock excavation using controlled cutting methods to avoid overbreak and disturbance of the remaining rock mass.

.3 Wire Saw Cutting

.1 Where indicated on the Drawings, cut rock using diamond wire saw cutting equipment to produce clean, vertical faces and to minimize vibration and disturbance of adjacent rock and existing structures.

.4 Restrictions

.1 Blasting is not permitted unless specifically approved in writing by the Consultant and Authorities Having Jurisdiction.

.2 Mechanical breaking methods that cause excessive fracturing or disturbance of remaining rock are not permitted where controlled cutting is specified.

.5 Extent of Cutting

.1 Cut rock to the limits indicated on the Drawings and to provide stable vertical faces suitable for placement of waterproofing, drainage layers, or structural concrete.

.6 Protection of Rock Mass

.1 Prevent damage, loosening, or fracturing of the remaining rock beyond the limits of excavation. Any rock disturbed beyond the intended excavation limits shall be removed and replaced with concrete or compacted granular fill as directed, at no additional cost to the Contract.

.7 Submittals

.1 Prior to commencing rock cutting operations, submit to the Consultant a description of the proposed cutting equipment, procedures, and sequencing.

3.5 FOUNDATION BEARING VALUE

.1 Carry excavation of foundations to undisturbed rock (soil) having bearing capacity and to depths identified in the Geotechnical Report, and as required to safely support the structure within acceptable limits of settlement.

.2 Excavate for footings down to rock (soil) having the appropriate quality and safe bearing value. The inspection company will probe the drilled check hole to verify the suitability of the bearing stratum.

.3 If upon excavating to the elevations shown it is found that required foundation bearing values are not achieved, or that they are achieved at higher elevations, the footings shall be lowered or raised accordingly, but only with the written permission of the DCC Representative. In no case shall footing excavations be raised such that less than the minimum frost protection is provided to footings.

.4 Keep a record of founding elevations of footings. Obtain approval of these records before claims for extras will be considered.

.5 If any soft or spongy areas are encountered, notify the DCC Representative at once. Do not proceed with extra Work until written authorization has been obtained from the DCC Representative.

.6 If the ground is frozen at or below the bearing surface elevations, excavate the frozen material to provide a frost-free base and report in writing the location and elevation of such areas. Extend foundations to new levels as directed.

.7 Correct unauthorized over-excavation at no extra cost to the Owner.

3.6 BACKFILLING

.1 Proceed promptly with backfilling as work progresses, after obtaining DCC Representative's review.

.2 Do not backfill over frozen ground. Do not backfill until the sub-grade, footings, and foundation walls have been inspected.

.3 Do not backfill at ambient temperatures below freezing. Temporary backfilling not permitted. Be responsible for damage to buried services, due to backfilling.

.4 Backfill evenly on both sides of foundation walls and pits to avoid unequal fill pressures on walls whenever backfilling on both sides is possible, in locations where backfilling is only on one side of structure ensure that structure is properly shored and braced

.5 Where walls are to be backfilled on one side only, commence backfilling only when the ground and basement floors structural members are in place or adequate bracing is provided for top and bottom of foundation walls.

.6 Ensure that areas behind permanent shoring to be left in place are properly backfilled.

.7 Properly roll, tamp, or otherwise consolidate each layer of backfill in place. Maintain fill within 2% of its optimum moisture content. Dampen dry fill with water and aerate wet fill to obtain the water content required.

.8 Areas adjoining vulnerable building components which cannot be thoroughly compacted by drawn equipment, shall receive equivalent compaction with mechanical tampers.

.9 Spread fill in layers not exceeding 150 mm uncompacted depth. Compact each layer before placing next. Carry out fill operations systematically. Prevent segregation of particle sizes.

.10 Fill shall be free of snow and ice and in no instance shall fill be placed on frozen snow-, or ice-covered ground

3.7 **FILL LOCATIONS AND COMPACTION DENSITY**

.1 Type 1 fill:

.1 Under interior concrete slabs on grade or skim slabs on grade and directly over bedrock to a minimum compacted depth of 200 mm.

.2 Under exterior concrete slabs on grade, ramp, walks and steps to a minimum compacted depth of 150 mm.

.3 Compact Type 1 fill to refusal to achieve 100% Standard Proctor density.

.2 Type 2 fill:

.1 Interior walls, trenches, pits and for fill for over-excavated areas to underside of Type 1 fill.

.2 Compact Type 2 fill to minimum 100% Standard Proctor density.

.3 Type 3 fill:

.1 Backfill under soft landscaped areas, and to make good disturbed existing grade levels.

.2 Compact Type 3 fill to minimum 90% Standard Proctor density.

.4 Compact fill until the required density is achieved. Do not compact material containing frost.

.5 Fill hollows and depressions which develop under compaction with matching backfill material. If the base becomes rutted or displaced due to any cause, regrade the surface.

.6 Compact backfill by means of vibratory type equipment capable of achieving the desired degree of compaction. Use hand operated vibrating tampers within 1200 mm of foundations and in areas not readily accessible to roller equipment.

.7 Make good damage caused by uncompacted backfill or inadequate compaction and settlement of fill, at no cost to the Contract. Immediately report damage resulting therefrom. Obtain acceptance of remedial procedures from DCC Representative.

3.8 **GRADING**

.1 Cut, shape, fill and grade as necessary to furnish the required elevations. Grade to smooth contours between variations in elevations.

.2 Make good levels existing at the commencement of the work which have been disturbed due to construction operations or by any other cause, as required and directed. Restore the correct grade levels. Place and compact materials as previously specified.

.3 Slope ground surface away from the building.

.4 Remove coarse material and stones greater than 75 mm diameter.

.5 Areas to be sodded shall have subgrades 125 mm below finished grade level, areas to be seeded shall have subgrades 100 mm below finished grade level.

.6 Grade under paved areas, parallel to finished pavement levels.

3.9 **FIELD QUALITY CONTROL**

.1 Water on Prepared Surfaces

.1 On surfaces to receive paving or concrete slabs, immediately remove any ponding water by approved methods.

.2 Where prepared subgrade soil under structural work, and any compacted fill under concrete slabs or paving, is softened or disturbed by water, remove unsatisfactory material and replace with compacted fill as specified for respective work and locations.

.2 Inspection and Testing

.1 Testing of materials and compaction may be carried out by testing laboratories designated by DCC Representative.

.3 Surplus Soil Disposal

.1 Remove from Site rock, spoil and any excavated material not required or not approved by DCC Representative for purpose of fill or backfill on Site. Obtain DCC Representative's permission before removing such surplus and conform to local municipal requirements for disposal of such materials.

.2 Reinstate existing work, such as asphalt paving, concrete sidewalk, sodding and similar items, disturbed to original condition and elevation. Clean and reinstate areas affected by work as directed.

END OF SECTION