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End of Section

DIVISION 00 PROCUREMENT AND CONTRACTING REQUIREMENTS

SECTION 00 43 22

UNIT PRICE FORM

PART 1 - UNIT PRICES

1.01 SUBMIT WITH BID FORM BEFORE TIME OF TENDER CLOSE:

- .1 Unit prices including all labour, materials, products, equipment, services, and respective overhead, profit, disbursements and any other related charges to represent the actual total cost (excluding applicable taxes) to the Owner for each item.
- .2 These prices shall remain in effect until **twelve (12) months from award of tender.**
- .3 Work completed on a case-by-case basis using the unit prices below shall be warrantied for a period of one (1) year from completion of the relevant associated work within additional scope (i.e. there may be several different warranty periods).
- .4 Quote prices for the following items: **Include information on submission form provided in RFQ front end.**

- .1 Provide all associated material and labour to demolish / install the indicated size and length of piping tabled below including removal / install of associated thermal insulation, pipe hangers, isolation, and testing of same to complete the installation (where applicable).

Scope of Work	Regular Working Hours		After Hours	
	Demolition of Existing	Provision of New	Demolition of Existing	Provision of New
10ft of 1/2"Ø Pipe	\$ _____	\$ _____	\$ _____	\$ _____
10ft of 3/4"Ø Pipe	\$ _____	\$ _____	\$ _____	\$ _____
10ft of 1"Ø Pipe	\$ _____	\$ _____	\$ _____	\$ _____
10ft of 1-1/4"Ø Pipe	\$ _____	\$ _____	\$ _____	\$ _____
10ft of 1-1/2"Ø Pipe	\$ _____	\$ _____	\$ _____	\$ _____
10ft of 2"Ø Pipe	\$ _____	\$ _____	\$ _____	\$ _____

DIVISION 00 PROCUREMENT AND CONTRACTING REQUIREMENTS
SECTION 00 43 22
UNIT PRICE FORM

Scope of Work	Regular Working Hours		After Hours	
	Demolition of Existing	Provision of New	Demolition of Existing	Provision of New
10ft of 2-1/2"Ø Pipe	\$_____	\$_____	\$_____	\$_____
10ft of 3"Ø Pipe	\$_____	\$_____	\$_____	\$_____
10ft of 4"Ø Pipe	\$_____	\$_____	\$_____	\$_____

END OF SECTION

The printed forms outlined below shall form the basis of communication between the Architect and the General Contractor. Copies of forms unrelated to the issuance of monies, shall be kept on the site; neatly filed and readily accessible to the parties concerned.

1. TRANSMITTAL RECORD

A record of material issued by the Architect or General Contractor.

2. GENERAL REVIEW REPORT

A progress report completed by the Architect or Consultant on a regular basis.

3. PROPOSED CHANGE

A description of contemplated changes to the Contract.

4. CASH ALLOWANCE CHANGE ORDER

Assignment of money for work executed under the Cash Allowance Section.

5. CHANGE ORDER

Assignment of money for work executed beyond the financial limits of the Contract.

6. CHANGE DIRECTIVE

A description of a change in the work when the Owner requires the Contractor to proceed with a change in the work prior to the Owner and the Contractor agreeing upon the adjustment in Contract Price and Contract Time.

7. CERTIFICATE FOR PAYMENT

For release of contract money based on monthly progress draws.

8. SUPPLEMENTAL INSTRUCTIONS

A description and/or clarification for the purpose of recording a clarification or interpretation of the contract documents or giving directions on problems resulting from field conditions.

END OF SECTION

1. NEWFORMA SOFTWARE SYSTEM

- 1.1 This project will be administered through the Architect using the NEWFORMA software system.
- 1.2 The Contractor is required to use this internet based software for ALL project communications, RFIs, quotations, project schedule, shop drawing log, change log, RFI log, etc., All shop drawings, interference drawings and as-built drawings shall be submitted electronically through the Newforma Info Exchange in PDF format and shall be numbered in the order which they are submitted. Numbering shall be in the following format; 001, 002, 003, etc. Submittals will not be deemed as received unless delivered through Newforma Info Exchange.
- 1.3 Utilization of this system does not require the purchase or download of the Newforma software. The Architect will send an email notification which will automatically provide online access to the Newforma Info Exchange specific to this project.

2. NEWFORMA INSTRUCTIONS

- 1. You will receive an email instructing you how to get into the system (click on link). The system is self-explanatory as to the "use" for Submittals (Shop Drawings) and RFIs. Refer to attached screen shots.
- 2. When issuing Submittals and RFIs, the following people are to always be COPIED (not addressed to):

Linda Butler lbutler@plusvg.com
- 3. Shop Drawings are to be issued as "Submittals". There is a place on the Submittal section to put in the Contractor's "expected response date" – please ensure that is filled in. Submittals are to be numbered in the sequence which they are submitted. Numbering to be as follows; 001, 002, 003, etc. (NOTE: as per the contract, the Architect has 10 working days to respond).
- 4. RFIs: There is a place on the RFI section to put in the Contractor's "expected response date" – please ensure that is filled in. RFI's are to be numbered in the sequence which they are submitted. Numbering to be as follows; 001, 002, 003, etc.. (NOTE: as per the contract, the Architect has 5 working days to respond)
- 5. RFCs: (all Contractor quotations to be submitted as an RFC) RFC's are to be numbered in the sequence which they are submitted. Numbering to be as follows; 001, 002, 003, etc.
- 6. Submittals and RFI's requiring consultant review other than the Architect shall be sent via Newforma directly to the respective consultant. The +VG Project Manager as well as the persons noted above shall be copied on all submittals and RFI's.

7. All shop drawings, interference drawings and as-built drawings shall be submitted electronically through the Newforma Info Exchange in PDF format. Submittals will not be deemed as received unless delivered through Newforma Info Exchange.

END OF SECTION

1. GENERAL

1.1. Conform to Sections of Division 1 as applicable.

1.2. REFERENCES

1.2.1. CSA S350 M80 (R2003) Code of Practice for Safety in Demolition of Structures

1.3. QUALITY ASSURANCE

1.3.1. Regulatory Requirements:

1.3.2. Conform to the latest Occupational Health and Safety Act, as currently amended.

1.3.3. Most recent Occupational Health and Safety Act, as currently amended, Designated Substance - Asbestos on Construction Projects and in Building and Repair Operations;

1.3.4. Conform to OBC, especially Article 2.3.2.3 as applicable.

1.3.5. Conform to Fire Code, Regulation under Fire Marshals Act especially Part 8.

1.3.6. Remove hazardous materials in accordance with applicable laws and regulations.

1.3.7. Qualifications:

Employ for this work demolition company having 5 years Canadian experience in this type of work satisfactory to Architect. If requested, submit proof of experience.

1.4. PROJECT CONDITIONS

1.4.1. Building is designated as historical. Protect existing building from damage due to demolition work for all historical elements.

2. PRODUCTS

2.1. All existing components being demolished shall become property of this Section. Remove from Site.

3. EXECUTION

3.1. PREPARATION

3.1.1. Protect **all** existing adjacent work (wainscoting, plaster walls, bases and trim, etc) against damages which might occur from falling debris, scrapes or other causes due to work of this Section.

- 3.1.2. Erect and maintain dustproof partitions as required to prevent spread of dust to other parts of building. On completion, remove partitions and make good surfaces to match adjacent surfaces of building. Ensure that all dust and debris is removed before finishing work commences.

3.2. PERFORMANCE

- 3.2.1. Contractor to remove existing plaster bulkheads, selective partial wall portions & selective wood moldings as noted on the drawings.
- 3.2.2. Contractor to carry out selective demolition of existing ceilings as noted on the drawings.
- 3.2.3. Contractor to carry out selective demolition (cutting out) of existing plasterwork as noted on the drawings, to repair cracks. Refer to Section 09200.
- 3.2.4. Materials and debris shall not be stacked in building but removed entirely from all circulation spaces at the end of each day.
- 3.2.5. At end of each day's work leave work in safe and clean condition.
- 3.2.6. Carry out demolition in accordance with requirements of CSA S350-M. Demolish and remove materials from Site.

3.3. DISPOSAL OF WASTE MATERIALS

- 3.3.1. Selling or burning of materials on Site is not permitted.
- 3.3.2. Provide bin for garbage on sidewalk in a location acceptable to the Owner.
- 3.3.3. Conform to requirements of municipality's Works Department regarding disposal of waste materials.
- 3.3.4. Materials prohibited from municipality waste management facilities shall be removed from Site and dispose of at recycling companies specializing in recyclable materials.

END OF SECTION

PART 1 GENERAL

1.1 General and Related Work

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of the General Conditions of the Contract.
- .2 Related work specified elsewhere:
 - Section 02 82 00.01 Asbestos Abatement – Type 1 Procedures
 - Section 02 82 00.02 Asbestos Abatement – Type 2 Procedures
 - Section 02 82 00.04 Asbestos Abatement – Type 2 Glove Bag Method
 - Section 02 83 11 Lead Abatement – Class 2 Procedures
- .3 Site Conditions identifies all known hazardous building materials within the Project Area. The information provided is for general reference only. Each Contractor must confirm existing conditions on site prior to tender close.
 - .1 The specification fulfils the requirements of Section 30 of the Ontario Occupational Health and Safety Act.
 - .2 The specification fulfils the requirements of the Section 10 of Ontario Regulation 278/05.
- .4 The Outline of Work identifies the location, condition and quantities of hazardous building materials to be removed as part of this project.
 - .1 It is the intent that work prescribed this Section will result in the removal of hazardous materials where impacted by the renovation scope of work as outlined by others and the decontamination of all surfaces or materials which may have been or become contaminated by hazardous materials either during or prior to work of this Contract.

1.2 Site Conditions

- .1 Refer to the report entitled ““*Hazardous Building Materials Assessment, Ventilation Upgrade – University Hall 1280 Main Street West*”, dated April 3, 2024, prepared by Pinchin Ltd., file number 336567.004 and the attached HMIS All Data for Locations 2, 33, 34, 46, 81, 82, 101, 129, and 172
 - .1 Lead is presumed present in all paints and coatings not sampled.
 - .2 Additionally, the following are site conditions in B111 (Location 2)
 - .1 Asbestos-containing parging cement is present on pipe fittings.
 - .3 Additionally, the following are site conditions in B180 (Location 44)
 - .1 Asbestos-containing texture coat is present on walls and ceilings.

- .2 Asbestos-containing parging cement is present on pipe fittings.
- .4 Additionally, the following are site conditions in B131 (Location 33), B182 (Location 38), B107 (Location 55), and 128 (Location 101):
 - .1 Vinyl floor tiles are presumed asbestos-containing.
- .5 Additionally, the following are site conditions in Corridor 381 (Location 172):
 - .1 Asbestos-containing texture coat is present on walls and ceilings.

1.3 Outline of Work

- .1 Coordinate the following items with the Owner's Project Manager and the Construction Manager, including but not limited to: electrical isolations, GFI connection, water connections, HVAC and exhaust ventilation system isolation, bin placement, schedule, disconnects, etc.
- .2 Refer to the Contract Drawings prepared by MCW Consultants Ltd. for the extent of construction work and the Work Areas.
- .3 Using procedures prescribed in the Sections identified in Related Work, complete the following, where required to accommodate the ventilation upgrade work:
 - .1 Remove asbestos-containing spray-applied texture coat as required to create new penetrations, at mounting points and or where it may be disturbed by the work.
 - .1 Seal exposed edges of texture with lagging.
 - .2 Perform drilling/cutting of asbestos-containing spray-applied texture coat or drywall finished with asbestos-containing joint compound using power tools equipped with a HEPA filtered dust collection device, as required to create new penetrations and or at mounting points.
 - .1 Seal exposed edges of texture with lagging.
 - .3 Remove and dispose of Transite bulkheads as required.
 - .4 Remove and dispose of asbestos-containing pipe insulation scheduled for demolition and or at tie in locations. All pipe insulation inside bulkheads and pipe chases is to be treated as asbestos-containing.
 - .1 If for reasons of pipe geometry or access, Glove Bag procedures cannot be used, remove and dispose of asbestos-containing insulations as per Section 02 82 11 for less than 1 square meter, or following Type 3 procedures in accordance with Ontario Regulation 278/05 for greater than 1 square meter.
 - .5 Remove and dispose of asbestos-containing lay-in ceiling tiles (24" x 48" with large and small pinhole pattern) from Room 203 and Room 203A (Location 114 and 115) as required to accommodate the ventilation upgrades.
 - .6 Remove and dispose of presumed asbestos-containing vinyl floor tiles and associated mastic as required to accommodate the ventilation upgrades.

- .7 Complete welding/cutting/modification of structural members with presumed lead-containing coatings. Alternatively, remove paint/coating from structural members where it will be affected/disturbed.
- .4 Refer to Specification Sections identified in the Related Work for specified personnel protective measures for the safe handling, removal, clean-up, enclosure, or repair of hazardous materials in each phase or work area.
- .5 Follow lead procedures prescribed in EACC Lead Guideline when disturbing lead-containing materials.
- .6 Follow silica procedures prescribed in MOL Silica guidelines when disturbing silica-containing materials.
- .7 Visit the site prior to tender close to confirm the location and extent of any hazardous building materials or materials contaminated by hazardous materials.
- .8 Protect surfaces, building fabrics and items remaining within the Abatement Work Area.
- .9 Without disturbing hazardous materials, perform removals where required, prior to abatement work.
- .1 Maximize waste diversion by use of resale of building materials, or recycling.
- .10 Isolate the Abatement Work Area from adjoining Occupied and Non-Occupied Areas whether present at an interior or exterior location.
- .11 Maintain emergency and fire exits from Abatement Work Area, or establish alternative exits satisfactory to Provincial Fire Marshall and local authorities having jurisdiction. Maintain extra routes from occupied areas. Place emergency exit signs at locations to clearly mark exit route. Seal emergency exit doors so as not to impede use of door during emergency evacuation.
- .12 Remove, clean, store and replace at completion of work, non-operating mechanical and electrical equipment, ducts, building components, materials or items removed to accommodate asbestos removal.
- .13 Perform selective demolition of mechanical and electrical equipment, building components, materials and items scheduled for demolition at locations required to facilitate asbestos removal. Refer to all Contract Documents for responsibility of demolition work and disposal.
- .14 Remove and dispose of as appropriate waste, building components, materials and items contaminated by hazardous materials that cannot be effectively cleaned.
- .15 Encapsulate remaining hazardous materials at locations where removal is deemed impractical by the Abatement Consultant.
- .16 Encapsulation will not be permitted where removal of building materials or structures scheduled for demolition will facilitate access to the asbestos materials in question.

- .17 Final clean work area to remove visible signs of asbestos and other hazardous materials, other debris or settled dust.
- .18 Apply lock-down agent to exposed surfaces throughout the work area and to surfaces from which any hazardous materials have been removed.
 - .1 Do not apply lock-down to materials which would be damaged by its application.
- .19 Unless otherwise specified, the handling, removal, clean-up or repair of hazardous materials or surfaces contaminated with hazardous materials is to be performed following wet removal techniques.

1.4 Schedule

- .1 Provide necessary manpower, supervision, equipment and materials to maintain and complete the project on schedule.
- .2 Work Hours:
 - .1 Coordinate all work, scheduling and phasing with the Owner.
 - .2 Duration for which HVAC systems may remain shutdown to accommodate quiet hours work will vary in accordance with outside weather conditions and internal demand. Duration of quiet hours work will have to be scheduled accordingly and in consultation with the Abatement Consultant and Owner.
- .3 Provide 48 hours written notice to the Abatement Consultant of any request to work outside normal working hours. Obtain written approval before proceeding.

1.5 Definitions

- .1 Abatement Consultant: Owner's Representative providing inspection and air monitoring.
- .2 Abatement Contractor: Contractor or sub-contractor performing work of this section.
- .3 Abatement Work Area: Area where work takes place which will, or may, disturb hazardous materials.
- .4 Amended Water: Water with wetting agent added for the purpose of reducing surface tension to allow thorough wetting of materials.
- .5 Asbestos: Any of the fibrous silicates defined in Regulation 278/05 including: actinolite, amosite, anthophyllite, chrysotile, crocidolite and tremolite.
- .6 Asbestos-Containing Material (ACM): Material identified under Site Conditions including any debris, overspray, fallen material and settled dust.
- .7 Authorized Visitors: Building Owner, Abatement Consultant, or designated representative, and persons representing regulatory agencies.

- .8 Competent Worker: A worker who is qualified because of knowledge, training and experience to perform the work, is familiar with Regulation 278/05 and the Occupational Health and Safety Act and has knowledge of the potential or actual danger to health and safety in the work.
- .9 Contaminated Waste: Material identified under Site Conditions, including fallen material, settled dust, other debris and materials or equipment deemed to be contaminated by the Abatement Consultant.
- .10 Curtained Doorway: Doorway consisting of two (2) overlapping flaps of rip-proof polyethylene arranged to permit ingress and egress from one room to another while permitting minimal air movement between rooms.
- .11 DOP Test: A testing method used to determine the integrity of the Negative Pressure unit or vacuum using a Dispersed Oil Particulate (DOP) or Poly Alpha Olefin (PAO) HEPA filter leak test. This test is to be conducted on site where units are to be installed. Refer to the Environmental Abatement Council of Canada (EACC) DOP/PAO Testing Guideline 2013 or ANSI/ASME N510-2007.
- .12 Fitting: Individual segments or pieces of a mechanical service line which may include but is not limited to the hangers, tees, elbows, joints, valves, unions, etc.
- .13 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.
- .14 HEPA: High Efficiency Particulate Aerosol filter that is at least 99.97 percent efficient in collecting a 0.3 micrometre aerosol.
- .15 Lead-Containing: The Ontario Ministry of Labour (MOL) has not established a lower limit for concentrations of lead in paint, below which precautions do not need to be considered during construction projects. Pinchin follows the recommendations of the Environmental Abatement Council of Canada (EACC) Lead Guideline for Construction, Renovation, Maintenance or Repair. The Guideline suggests that 0.1% (1,000 ppm) lead in paint represents a de minimis concentration of lead in paint for construction hygiene purposes, that is a concentration below which the lead content is not the limiting hazard in any disturbance of leaded paint for non-aggressive disturbance of painted finishes, (hand powered demolition, chipping, scraping, light sanding, etc.).
- .16 Lead Waste: Waste generated from removal of lead-containing materials, or the substrate and paint finish where left intact.
- .17 Mercury Waste: Equipment, materials or items containing mercury or contaminated with mercury.
- .18 Milestone Site Review: Review of the Abatement Work Area at a defined point in the abatement operation.
- .19 Negative Pressure: A reduced pressure within the Abatement Work Area (> 0.02 inches of water column) established by extracting air directly from Abatement Work Area and discharging it to exterior of building.

- .20 Non-Friable Material: Material that when dry cannot be crumbled, pulverized or powdered by hand pressure.
- .21 Occupied Area: Any area of the building or adjoining space outside the Abatement Work Area.
- .22 Personnel: All Contractor's employees, sub-contractors' employees, supervisors.
- .23 PCBs: Monochlorinated or Polychlorinated Biphenyls (or any mixture of both).
- .24 PCB Material: means solid material containing PCBs at a concentration of more than fifty milligrams per kilogram (mg/kg) or 50 parts per million (ppm), or liquid with greater than 2 mg/kg or ppm.
- .25 PCB Waste: PCB Equipment, PCB Material, PCB Liquids and materials or items contaminated with PCBs.
- .26 PCM: Phase Contrast Microscopy.
- .27 Remove: Remove means remove and dispose of (as applicable type of waste) unless followed by other instruction (e.g. remove and turn over to Owner).
- .28 Toxicity Characteristic Leachate Procedure (TCLP): Laboratory analysis to determine leachable parameters in lead waste.
- .29 TEM: Transmission Electron Microscopy.

1.6 Regulations and Guidelines

- .1 Comply with Federal, Provincial, and local requirements, provided that in any case of conflict among those requirements or with these Specifications, the more stringent requirements shall apply. Work shall be performed under regulations in effect at the time work is performed.
- .2 Where regulations are not present, follow accepted industry standards and applicable Guideline documents.
- .3 Regulations and Guidelines include but are not limited to the following:
 - .1 Ministry of Labour Occupational Health and Safety Act Regulations for Construction Projects including Revised Statutes of Ontario 1990, Chapter 0.1 and Ontario Regulation 278/05.
 - .2 Ministry of the Environment and Climate Change Regulation for the disposal of waste, including R.R.O. 1990, Reg. 347 as amended.
 - .3 PCB Regulations, SOR 2008-273 and R.R.O. 1990, Reg 362.
 - .4 Regulation 490/09 Designated Substances.

.5 Environmental Abatement Council of Ontario (EACO), Lead Guideline For Construction, Renovation, Maintenance or Repair, October 2014.

.6 Ministry of Labour, Guideline, Silica on Construction Projects, 2011.

1.7 Quality Assurance

- .1 Removal and handling of hazardous materials is to be performed by persons trained in the methods, procedures and industry practices for Abatement.
- .2 Ensure work proceeds to schedule, meeting all requirements of this Specification.
- .3 Complete work so that at no time airborne dust, visible debris, or water runoff contaminate areas outside the Abatement Work Area.
- .4 Any contamination of surrounding area (indicated by visual inspection or air monitoring) shall necessitate the clean-up of affected area, and in the same manner applicable to an Abatement Work Area at no cost to the Owner.
- .5 All work involving electrical, mechanical, carpentry, glazing, etc., shall be performed by licensed persons experienced and qualified for the work required.

1.8 Supervision

- .1 Provide on site for each work shift, a Shift Superintendent(s), who has authority regarding all aspects related to manpower, equipment and production.
- .2 At all times during work, the Overall or Shift Superintendent(s) must be on site. Failure to comply with this requirement will result in a stoppage of all work, at no cost to the Owner.
- .3 Replace supervisory personnel, with approved replacements, within three (3) working days of a written request from the Owner. Owner reserves the right to request replacement of supervisory personnel without explanation.
- .4 Do not replace supervisory personnel without written approval from the Owner.

1.9 Instruction and Training

- .1 Instruction and training must be provided by a competent person.
- .2 All workers completing Type 1, 2 or 3 asbestos abatement must be trained in compliance with Section 19 of O.Reg. 278/05.
 - .1 For Type 3 asbestos abatement, workers must be trained and certified per Section 20 of O.Reg. 278/05.

1.10 Notification

- .1 Before commencing work, notify orally and in writing, an inspector at the office of the Ontario Ministry of Labour nearest the project site, where required.

- .2 Inform all trades on site of the presence and location of hazardous materials identified in the Contract documents.
- .3 Notify the Owner or Owner's Representative, the Joint Occupational Health and Safety Committee and the Provincial Ministry of Labour, if suspected asbestos-containing materials not identified in the contract documents are discovered during the course of the work. Stop work in these areas immediately.
- .4 Notify Sanitary Landfill site as per O.Reg. 347/90 as amended.

1.11 Submittals

- .1 Submit prior to starting work:
 - .1 Provincial Workers' Compensation Board Clearance Certificate.
 - .2 Insurance certificates.
 - .3 Copy of Company Health and Safety Policy and applicable programs.
 - .4 Ministry of Labour Notice of Asbestos Removal Work form.
 - .5 Copy of Certificate of Approval for disposal of hazardous materials waste and location of landfill.
 - .6 Pre-removal damage survey of the Abatement Work Area(s), waste transport routes, and bin storage areas
- .2 Submit the following information regarding personnel prior to starting work:
 - .1 Written statement that personnel have had instruction on hazards of exposure to hazardous materials identified within this scope, the use of respirator, protective clothing, worker and waste decontamination procedures, and all aspects of work procedures and protective measures.
 - .2 WHMIS training certificates for all personnel.
 - .3 Certificate proving that each worker on site has been fit tested for the respirator appropriate for the work being performed.
- .3 Submit the following information regarding HEPA filtered devices prior to construction of enclosure or asbestos abatement:
 - .1 Performance data on HEPA filtered vacuums including DOP tests no more than 3 months old.
 - .2 Performance data on negative air units including DOP tests which must be no more than 3 months old if the unit is vented outdoors or which must be performed on site immediately prior to initial usage and when HEPA filters are changed if the unit is vented indoors.

- .3 DOP tests to be performed by an independent testing company.
 - .1 DOP testing company is required to submit a detailed technical report of testing protocol, including Introduction, Methodology, Results, Conclusions, and Recommendations, including results of the Air-Aerosol Mixing Uniformity test as per ASME N510-1989 (1995).
 - .2 DOP testing company must also provide calibration certificates from an independent calibration firm or from the manufacturer of the testing equipment for both the aerosol photometer and the pressure gauge on the aerosol generator dated within 1 calendar year from the on-site testing date.
 - .3 DOP testing company must also provide the National Sanitation Foundation (NSF) certification name and number of the on-site technician performing the testing.
- .4 Proof of calibration of DOP testing equipment.
- .4 Submit the following prior to isolating the work area:
 - .1 Safety Data Sheets for chemicals or material used in the course of the Abatement Project.
- .5 Submit the following upon completion of the work.
 - .1 Manifests, waybills, bills of lading etc. as applicable for each type of waste.

1.12 Insurance

- .1 Maintain a Commercial General Liability Policy with an insurance company acceptable to McMaster University and the Construction Manager. The intent of this policy is to hold McMaster University and the Construction Manager harmless as it relates to claims for Bodily Injury or Property Damage or both, relating to the contract. Commercial General Liability insurance shall be provided on an “occurrence” basis to cover injury or damage (whether detected or not during the policy period) which happens during the policy period.
- .2 Maintain an Automobile or Fleet Policy, and Non-owned Automobile Policy with an insurance company acceptable to McMaster University and the Construction Manager. The intent of these policies is to hold McMaster University and the Construction Manager harmless as it relates to claims for Bodily Injury or Property Damage or both, relating to the contract.

- .3 Maintain a Pollution Liability Policy (or asbestos/lead liability policy or specific coverage under the CGL for asbestos/lead abatement) with an insurance company acceptable to McMaster University and the Construction Manager. The intent of this policy is to hold McMaster University and the Construction Manager harmless as it relates to claims for Bodily Injury or Property Damage or both, relating to the contract. Pollution Liability shall be provided on an “occurrence” basis to cover injury or damage (whether detected or not during the policy period) which happens during the policy period. Without limiting the generality of the foregoing, the policy shall insure the operations of abatement and shall not contain any environmental and/or health hazard exclusions relating to remediation operations.
- .4 Forward all certificates to McMaster University and the Construction Manager before work is commenced, showing McMaster University and the Construction Manager as additional insured as their interest may appear.
- .5 McMaster University and the Construction Manager may request a certified true copy of the policies.
- .6 The limits will not be less than:
 - .1 Commercial General Liability \$5,000,000.00
 - .2 Automobile \$2,000,000.00
 - .3 Pollution Policy \$5,000,000.00

1.13 Site Review

- .1 From commencement of work until completion of clean-up operations, the Abatement Consultant is empowered by the Owner to review for compliance with the requirements of governing authorities, adherence to specified procedures and materials, and to review for final cleanliness and completion.
- .2 The Abatement Consultant is empowered by the Owner to order a shutdown of work when leakage of asbestos from the controlled work area has occurred or is likely to occur.
- .3 Any deviation from the requirements of the Specifications or governing authorities that is not approved in writing may result in a stoppage of work, at no cost to the Owner.
- .4 Additional labour or materials expended by the Contractor to rectify unsatisfactory conditions and to provide performance to the level specified shall be at no additional cost to the Owner.
- .5 Site review and air monitoring performed as a result of Contractor's failure to perform satisfactorily regarding quality, safety, or schedule, shall be back-charged to the Contractor.
- .6 Facilitate site review and provide access as necessary. Make good work disturbed by review and testing at no cost to the Owner.

- .7 Refer to the Sections identified in Related Work for specified milestone site reviews which are to take place at defined points throughout the abatement operation specific to each phase or work area.
- .8 Provide 24 hours written notice to the Abatement Consultant of any request for scheduling of milestone site reviews or transportation of waste through Occupied Areas.
- .9 The following Milestone Site Reviews may take place, at the Owner's cost, as outlined in each related specification section:
 - .1 Milestone Site Review - Clean Site Preparation
 - .1 Review of preparations and set-up prior to contaminated work in the Abatement Work Area.
 - .2 Milestone Site Review – Bulk Removal Site Review
 - .1 Review during asbestos removal, monitoring removal methods, site deficiencies, performing occupied air monitoring, etc.
 - .3 Milestone Site Review - Visual Clearance
 - .1 Review of Abatement Work Area after completion of all abatement, but prior to application of lock-down agents or dismantling of enclosure.
- .10 Refer to the Sections identified in Related Work for specified milestone inspections which are to take place at defined points throughout the abatement operation specific to each phase or work area.
- .11 Do not proceed with next phase of work until written approval of each milestone is received from the Abatement Consultant.

1.14 Air Monitoring - Asbestos

- .1 Air monitoring will be performed using Phase Contrast Microscopy (PCM) following the National Institute for Occupational Safety and Health Method 7400.
- .2 Co-operate in the collection of air samples, including providing workers to wear sample pumps for up to full-shift periods. Contractor will be responsible for the cost of testing equipment repairs or resampling resulting from the actions of the Contractor's forces.
- .3 Results of PCM samples at or exceeding 0.05 fibres per cubic centimeter of air (fibre/cc) or greater, outside an Abatement Work Area, or from within the Abatement Work Area during or following Glove Bag Work, will indicate asbestos contamination of these areas. Respond as follows:
 - .1 Suspend work within the adjoining Abatement Work Area until written authorization to resume work has been received from the Abatement Consultant.
 - .2 Isolate and clean area in the same manner applicable to the Abatement Work Area.

- .3 Maintain work area isolation, and repeat clean-up operations until visual inspection and air monitoring results are at a level equal to that specified.
- .4 At the discretion of the Abatement Consultant provide additional negative air units at locations specified in response to elevated fibre levels being detected in the Clean Change Room or Occupied Areas.
- .4 Results of PCM samples at or greater than 0.01 fibres per cubic centimeter of air (fibre/cc), collected within the Abatement Work Area enclosure after the site has passed a visual inspection, and an acceptable coat of lock-down agent has been applied, will indicate asbestos contamination of these areas. Respond as follows:
 - .1 Maintain work area isolation and re-clean entire work area. Then apply another acceptable coat of lock-down agent to exposed surfaces throughout the work area.
 - .2 Repeat above measures until visually inspected and air monitoring results are at a level equal to that specified
 - .3 Alternate to items above, the Asbestos Abatement Contractor can pay for analysis of PCM samples by Transmission Electron Microscopy (TEM) at NVLAP accredited laboratory.
 - .1 Enclosure to remain sealed, with negative pressure maintained, and subject to required daily inspections until TEM results are received.
- .5 Additional labour or materials expended by the Contractor to rectify unsatisfactory conditions and to provide performance to the level specified shall be at no additional cost to the Owner.
- .6 Cost of additional site review and sampling performed as a result of elevated fibre levels in areas outside the Abatement Work Area or from within the work area following completion of work, will be back-charged to the Contractor.

1.15 Worker Protection

- .1 Instruct workers before allowing entry to the Abatement Work Area. Instruction shall include training in use of respirators, dress, showering, entry and exiting from an Abatement Work Area, and all other aspects of work procedures and protective measures.
- .2 Workers shall not eat, drink, chew gum or tobacco, vape or smoke in the Abatement Work Area.
- .3 Workers shall be fully protected at all times when possibility of disturbance of hazardous materials exists.
- .4 Provide soap, towels and facilities for washing of hands and face, which shall be used by all personnel when leaving the Abatement Work Area.
- .5 Respiratory Protection

- .1 Refer to each particular Section of the Specification for specified type of respiratory equipment specific to each phase or work area.
- .2 Respirators shall be:
 - .1 Certified by the National Institute of Occupational Safety and Health (NIOSH) or other testing agency acceptable to the Ministry of Labour.
 - .2 Fitted so that there is an effective seal between the respirator and the worker's face. Ensure that no person required to enter an Abatement Work Area has facial hair which affects the seal between respirator and face.
 - .3 Assigned to a worker for their exclusive use.
 - .4 Maintained in accordance with manufacturer's specifications.
 - .5 Cleaned, disinfected and inspected by a competent person after use on each shift, or more often if required.
 - .6 Repaired or have damaged or deteriorated parts replaced.
 - .7 Stored in a clean and sanitary location.
 - .8 Provided with new filters as necessary, according to manufacturer's instructions.
 - .9 Worn by personnel who have been fit checked by qualitative or quantitative fit-testing.
 - .10 Instruction on proper use of respirators must be provided by a competent person as defined by the Occupational Health and Safety Act.
- .3 Provide protective clothing, to all personnel which:
 - .1 Is made of a material that does not readily retain nor permit penetration of asbestos fibres or lead/silica dust.
 - .2 Consists of head covering and full body covering that fits snugly at the ankles, wrists and neck.
 - .3 Once coveralls are worn, treat and dispose of as contaminated waste.
 - .4 Is replaced or repaired if torn or ripped.
- .4 Use hard hats, safety footwear and other protective equipment and apparel required by applicable construction safety regulations.

1.16 Visitor Protection

- .1 Provide clean protective clothing and equipment to Authorized Visitors.
- .2 Instruct Authorized Visitors in the use of protective clothing and Abatement Work Area entry and exit procedures.
- .3 Authorized visitors are required to be fit tested on respirators, prior to entering Abatement Work Area.
 - .1 Respirator worn must be compliant with Section 13 and Table 2 of O.Reg. 278/05.

1.17 Signage

- .1 Asbestos Abatement Signs: Post signs at access points to the Abatement Work Area, stating at minimum, the following:

- .1 There is an asbestos dust hazard.
- .2 Access to the work area is restricted to persons wearing protective clothing and equipment.
- .2 Lead Abatement Signs: Post signs at access points to the Abatement Work Area, stating at minimum, the following:
 - .1 There is a 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.
- .3 Silica Warning Signs: Post signs at access points to the Abatement Work Area, stating at minimum, the following:
 - .1 There is a silica dust hazard.
 - .2 Access to the work area is restricted to authorized persons.
 - .3 Respirators must be worn in the work area.
- .4 Vehicles, Bins and Asbestos Waste Containers: Post signs on both sides of every vehicle used for the transportation of asbestos waste and on every asbestos waste container. Signs must display thereon in large, easily legible letters that contrast in colour with the background the word “CAUTION” in letters not less than ten centimetres in height and the words:
 - .1 CONTAINS ASBESTOS FIBRES
 - .2 Avoid Creating Dust and Spillage
 - .3 Asbestos May be Harmful To Your Health
 - .4 Wear Approved Protective Equipment.
- .5 Place placards in accordance with Transportation of Dangerous Goods Act.

1.18 Differential Pressure Monitoring

- .1 Provide and install differential pressure monitors as specified in each section.
- .2 Replace damaged or non-functional equipment at the request of the Abatement Consultant.
- .3 Record at minimum twice daily, and when damage to the enclosure is identified and repaired, the following information:
 - .1 Name of inspector.
 - .2 Date and time.

- .3 Pressure reading.
- .4 Repairs completed, if applicable.
- .4 Maintain specified differential pressure.
- .5 Stop contaminated work and take corrective action if pressure differential drops below the specified level. Notify the Abatement Consultant immediately.

1.19 Waste and Material Handling

- .1 Waste bins must be placed on grade or in receiving.
- .2 All bins for hazardous materials must be covered and locked when waste transfer is not being performed.
- .3 Ensure redundant non-ACM, rubble, debris, etc. removed during contaminated work are treated, packaged, transported and disposed of as appropriate waste.
- .4 Clean, wash and apply Post Removal Sealant to metal waste prior to removal from Abatement Work Area. Recycle metals.
- .5 Clean, wash and apply Post Removal Sealant to non-porous materials prior to disposal as clean waste. Obtain prior written approval from the Abatement Consultant for each individual type of material.
- .6 Clean and wash equipment prior to removal from Abatement Work Area if removed prior to completion.
- .7 Place all equipment, tools and unused materials that cannot be cleaned in Abatement Waste Containers.
- .8 As work progresses, and at regular intervals, transport the sealed and labelled waste containers from the Abatement Work Area to waste bin.
- .9 Place items in bins according to waste classification. Place asbestos waste, lead waste, metals, non-asbestos waste, etc. in separate bins.
- .10 Removal of waste containers and decontaminated tools and materials from the Abatement Work Area shall be performed as follows:
 - .1 Remove any visible contamination from the surface of non-porous or cleanable waste being removed from the Abatement Work Area. If the item can be cleaned, remove it from the site as clean waste.
 - .2 Place waste or item in Waste Container and seal closed.
 - .3 Wet wipe outside of Waste Container.
 - .4 Within Decontamination Facility, Transfer Room or at the perimeter of the Abatement Work Area, place in second Waste Container. Seal closed.

- .5 Remove waste containers and transport to appropriate bin.
- .11 Transport waste and materials via the predetermined routes and exits. Arrange waste transfer route with Owner. Use a closed, covered cart to transport through Occupied Areas.
- .12 Provide workers transporting waste with means to access full personal protective equipment and all tools required to properly clean up spilled material in the case of a rupture of a Waste Container.
- .13 Pick-up and drop off of garbage bin shall be at pre-approved times and must not interfere with the Owners operations.
- .14 Transport hazardous waste to landfill or waste transfer station licensed by the provincial Ministry of the Environment.
- .15 Cooperate with the provincial Ministry of the Environment inspectors and immediately carry out instructions for remedial work at dump to maintain environment, at no additional cost to the Owner.

1.20 Re-establishment of Objects and Systems

- .1 Re-establish objects and items relocated by the Contractor's workforce to facilitate work.
- .2 Re-establish electrical, communication, HVAC and other services previously disconnected or otherwise isolated to accommodate work by this Section.
- .3 Make good at completion of work, all damage not identified in pre-removal survey.

PART 2 PRODUCTS AND FACILITIES

2.1 Materials and Equipment

- .1 Refer to the Sections identified in Related Work for specified materials, equipment or facilities specific to each phase or work area.
- .2 Materials and equipment must be in good condition and free of debris and fibrous materials. Disposable items must be of new materials only.
- .3 Airless Sprayer: AC powered pressure washer that allows wetting agent to mix with water, uses no air or compressed air, and has a nozzle to regulate power and pressure.
- .4 Amended Water: Water with wetting agent added for purpose of reducing surface tension to allow thorough wetting of materials.
- .5 Asbestos Waste Container: A container acceptable to disposal site, Ministry of the Environment, and Ministry of Labour, comprised of the following:
 - .1 Dust tight.
 - .2 Suitable for the type of waste.

- .3 Impervious to asbestos.
- .4 Identified as asbestos waste.
- .6 Differential Pressure Monitor: a high precision instrument for measuring and controlling pressure differences in the low range, between the Abatement Work Area and Occupied Area. Calibrate regularly to manufacturer's instructions.
- .7 Discharge Ducting: Polyethylene Tubing. Reinforced with wire. Diameter to equal negative pressure machine discharge. Not to be longer than required, or so long that negative pressure is compromised.
- .8 Ground Fault Panel: Electrical panel as follows:
 - .1 Ground fault circuit interrupters of sufficient capacity to power temporary electrical equipment and lights in Asbestos Work Area.
 - .2 Interrupters to have a 5 mA ground fault protection.
 - .3 Necessary accessories including main switch disconnect, ground fault interrupter lights, test switch to ensure unit is working, and reset switch.
 - .4 Openings sealed to prevent moisture or dust penetration.
 - .5 Inspected by the Electrical Safety Authority.
 - .6 Panel uses CSA approved parts and been constructed, inspected and installed by a licensed electrician.
 - .7 Provide one Ground Fault Panel for each 5,000 square feet (500 square metres) of Abatement Work Area.
- .9 HEPA Filtered Negative Pressure Machine: Portable air handling system which extracts air directly from the Abatement Work Area and discharges the air to the exterior of the building. Equipped as follows:
 - .1 Prefilter and HEPA filter. Air must pass HEPA filter before discharge.
 - .2 Pressure differential gauge to monitor filter loading.
 - .3 Auto shut off and warning system for HEPA filter failure.
 - .4 Separate hold down clamps to retain HEPA filter in place during change of prefilter.
- .10 HEPA Vacuum: Vacuum with necessary fittings, tools and attachments. Discharged air must pass through a HEPA filter.
- .11 Hose: Leak-proof, minimum bursting strength of 500 PSI or greater if required, abrasion resistant covering, reinforcing, and machined-brass couplings. Maintained and tested. Hose to be temperature resistant if it is to carry domestic hot water.

- .12 OSB: Oriented Strand Board.
- .13 Polyethylene Sheeting: 6 mil (0.15 mm) minimum thickness unless otherwise specified, in sheet size to minimize joints.: 6 mil (0.15 mm) minimum thickness unless otherwise specified, in sheet size to minimize joints.
- .14 Post Removal Sealant (or Lockdown): Sealant that when applied to surfaces serves the function of trapping residual asbestos fibres or other dust. Product must have flame spread and smoke development ratings both less than 50. Product shall leave no stain when dry. Post Removal Sealant shall be compatible with replacement insulation or fireproofing where required and capable of withstanding service temperature of substrate. Apply to manufacturer's instructions.
- .15 Protective Clothing: Disposable coveralls complete with head covering and full body covering that fits snugly at the ankles, wrists and neck.
- .16 Rip-Proof Polyethylene Sheeting: 8 mil (0.20 mm) fabric made up from 5 mil (0.13 mm) weave and two (2) layers of 1.5 mil (0.05 mm) poly laminate or approved equal. In sheet size to minimize on-site seams and overlaps.
- .17 Shower Hose: Water lines for supply of hot & cold water to shower facilities to be rated for use at 200 PSI (1380 kPa) or twice the working pressure whichever is greater. Supply lines to be continuous and free of fittings, joints or couplings.
- .18 Sprayer: Garden type portable manual sprayer or water hose with spray attachment if suitable.
- .19 Tape: Duct tape or tape suitable for sealing polyethylene to surfaces under both dry and wet conditions in the presence of Amended Water.
- .20 Wetting Agent: Non-sudsing surfactant added to water to reduce surface tension and increase wetting ability.

PART 3 EXECUTION

- .1 Refer to the Sections identified in Related Work for specified procedures for work area preparation, maintenance, site dismantlement, application of lock-down agent and all other procedures for the safe handling, removal and clean-up of hazardous materials specific to each phase or work area.

END OF SECTION

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PART 1 GENERAL

1.1 General and Related Work

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of the General Conditions of the Contract.
- .2 Requirements specified elsewhere:
 - .1 Section 02 81 00 Hazardous Materials – General Provisions

1.2 Outline of Work

- .1 Refer to Section 02 81 00 Hazardous Materials – General Provisions for the Outline of Work.
- .2 The intent of this Section is to provide safe work practices and procedures to govern the handling, removal, clean-up and disposal of asbestos-containing materials following Type 1 or Low Risk procedures, and Pinchin and Owner specific requirements.

1.3 Personal Protection

- .1 Protect all personnel at all times when possibility of disturbance of ACM exists.
 - .1 Provide non-powered half-face respirators with P100 high efficiency (HEPA) cartridge filters when requested by personnel.
 - .2 When requested by personnel, provide protective clothing.
- .2 Provide protective clothing, to all personnel entering the Abatement Work Area.
- .3 Wear hard hats, safety shoes and other personal protective equipment required by applicable construction safety regulations.

1.4 Site Reviews

- .1 Refer to Section 02 81 00 – General Provisions.
- .2 The following Milestone Site Reviews are to be scheduled:
 - .1 Milestone Site Review - Visual Clearance

PART 2 PRODUCTS AND FACILITIES

- .1 Refer to Section 02 81 00.

PART 3 EXECUTION

3.1 Site Preparation

- .1 Remove stored or non-fixed items from the Abatement Work Area including but not limited to equipment, furniture, waste etc. Store in area provided by Owner.
- .2 Remove visible dust and friable material from all surfaces in the work area including those to be worked on, using HEPA Vacuums or wet wiping.
- .3 Install polyethylene drop sheets below areas of work.
- .4 Install signage in clearly visible locations and in sufficient numbers to adequately warn of an asbestos dust hazard.
- .5 Provide power from ground fault interrupt circuits.
- .6 Shut down HVAC systems serving the Abatement Work Area.
 - .1 Install polyethylene sheeting over openings in ducts and diffusers and seal.

- .2 HVAC to remaining areas of building must not be disrupted during work of this section.
- .3 System shall remain inoperative until completion of work, unless ducts can be effectively capped.
- .4 Perform work at scheduled times after shutting down HVAC systems affecting the Abatement Work Area.
- .7 Provide amended water for wetting ACM, and adequate method of wetting (garden sprayers, airless sprayers, etc.).

3.2 Maintenance of Abatement Work Area

- .1 Inspect polyethylene sheeting and ensure it is effectively sealed and taped. Repair damage and remedy defects immediately.
- .2 Maintain Abatement Work Area in tidy condition.
- .3 Remove any standing water on polyethylene/floor at the end of every shift.
- .4 Turn off water supply to any hoses and reduce pressure in hose, prior to leaving the Abatement Work Area at end of shift.

3.3 Asbestos Removal - General

- .1 Do not use powered tools or non-hand held tools.
- .2 Do not use compressed air to clean or remove dust or debris.
- .3 Do not break, cut, drill, abrade, grind, sand or vibrate ACM if it cannot be wetted. Type 2 procedures would be required if the material cannot be wetted due to hazard or damage.
- .4 Wet ACM prior to work and keep ACM wet throughout the removal process.
- .5 Frequently and at regular intervals during the work, clean up dust and waste using HEPA vacuums and/or wet sweeping or mopping.
- .6 Frequently and at regular intervals, place all waste in asbestos waste containers.
- .7 Immediately upon completion of work, clean area with HEPA vacuum and/or wet sweeping or mopping.

3.4 Asbestos Removal - Vinyl Asbestos Tile

- .1 Wedge a heavy duty scraper in seam of two adjoining tiles and gradually force edge of one tile up and away from floor. Do not break off pieces of tile, but continue to force balance of tile up.
- .2 Place tile, without breaking into smaller pieces, into Asbestos Waste Container.
- .3 Force scraper through tightly adhered areas by striking scraper handle with a hammer.
- .4 Heat tile thoroughly with a hot air gun until heat penetrates through tile and softens adhesive in areas where scraper will not remove tile.
- .5 Scrape up adhesive remaining on floor with a hand scraper until only a thin smooth film remains.
- .6 Use a hot air gun where deposits are heavy or difficult to scrape.
- .7 Deposit scrapings into asbestos waste disposal bag.
- .8 HEPA vacuum floor on completion of work in area.

3.5 Asbestos Removal - Ceiling tiles (less than 7.5 square metres)

- .1 Slightly lift first tile, HEPA vacuum the ceiling grid the perimeter of tile.
- .2 Lift tile vertically, and while keeping level, slide tile over to adjacent tile.
- .3 HEPA vacuum back of all tiles within reach.
- .4 Mist surface of ceiling tiles with amended water.
- .5 Remove ceiling tiles intact. Do not break or pulverize.
- .6 Place directly into asbestos waste container.
- .7 HEPA vacuum grid and area below ceiling.

3.6 Asbestos Removal - Drywall with Asbestos Drywall Joint Compound (less than 1 square metre)

- .1 Protect drywall around area to be removed by covering with polyethylene and taping seams to wall.
- .2 Mist surface of drywall and drywall joint compound.
- .3 Cut drywall and remove using non-powered hand-held tools. Place directly into a 6 mil polyethylene bag.
- .4 HEPA vacuum floor and Abatement Work Area.

3.7 Asbestos Removal - Removal of Other Non-Friable Asbestos Materials (Transite)

- .1 Wet all material to be disturbed.
- .2 Undo fasteners if necessary to remove material.
- .3 Break material only if unavoidable, and wet material if broken during work.
- .4 Use only non-powered hand-held tools to remove ACM.
- .5 Scrape to remove material adhered to substrate.
- .6 Place removed ACM directly into an asbestos waste container.

3.8 Abatement Work Area Dismantling

- .1 Wash or HEPA vacuum equipment and tools used in contaminated Abatement Work Area to remove all asbestos contamination, or place in Asbestos Waste Containers prior to being removed from Abatement Work Area.
- .2 Place tools and equipment used in contaminated work site but not cleaned in polyethylene bags prior to removal from Abatement Work Area.
- .3 Clean polyethylene sheeting and drop sheets which with HEPA vacuum or wet cleaning methods at completion of work.
- .4 Wet drop sheets and polyethylene sheeting.
- .5 Carefully roll polyethylene sheeting and drop sheets toward the centre. As polyethylene is rolled away, immediately remove visible debris beneath with a HEPA vacuum.
- .6 Remove remaining polyethylene sheeting and tape.
- .7 Place polyethylene sheeting, drop sheets, tape, disposal clothing and other contaminated waste in asbestos waste containers, wet wipe and place in second asbestos waste container.

3.9 Waste and Material Handling

- .1 Refer to Section 02 81 00.

END OF SECTION

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PART 1 GENERAL

1.1 General and Related Work

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of the General Conditions of the Contract.
- .2 Requirements specified elsewhere:
 - .1 Section 02 81 00 Hazardous Materials – General Provisions

1.2 Outline of Work

- .1 Refer to Section 02 81 00 Hazardous Materials – General Provisions for the Outline of Work.
- .2 The intent of this Section is to provide safe work practices and procedures to govern the handling, removal, clean-up and disposal of asbestos-containing materials following Type 2 or Moderate Risk procedures, and Pinchin and Owner specific requirements.

1.3 Personal Protection

- .1 Protect all personnel at all times when possibility of disturbance of ACM exists.
- .2 Provide the following minimum respiratory protection to all personnel:
 - .1 Full face respirators with P100 high efficiency (HEPA) cartridge filters, for:
 - .1 Removal of all or part of a ceiling if asbestos is likely lying on the surface.
 - .2 Use of a HEPA filtered power tool on non-friable ACM if the material is not wetted.
 - .2 Non-powered half-face respirators with P100 high efficiency (HEPA) cartridge filters.
- .3 Provide protective clothing, to all personnel entering the Abatement Work Area.
- .4 Wear hard hats, safety shoes and other personal protective equipment required by applicable construction safety regulations.

1.4 Site Reviews

- .1 Refer to Section 02 81 00 – General Provisions.
- .2 The following Milestone Inspections are to be scheduled:
 - .1 Milestone Site Review - Clean Site Preparation
 - .2 Milestone Site Review - Visual Clearance

PART 2 PRODUCTS AND FACILITIES

- .1 Refer to Section 02 81 00.

2.2 Hoarding Walls

- .1 Type A Hoarding Wall: One layer of rip-proof polyethylene sheeting installed floor to ceiling, secured with telescopic poles, clips, or other suitable methods.
- .2 Windows: Install sufficient transparent windows area in hoarding walls to allow observation of entire work area from outside the enclosure where existing solid walls do not make up the perimeter.

2.3 Transfer Room

- .1 Transfer Room to be generally 2000 mm x 2000 mm x 2200 mm high. Increase size accordingly to accommodate number of workers.
- .2 Install walls as follows:
 - .1 Install 38 x 89 mm wood framing at 610 mm o/c with continuous top and sill plates.
 - .2 Install one layer rip-proof polyethylene sheeting on interior walls of Transfer Room.
- .3 Install one layer of rip-proof polyethylene sheeting over two layers of 6 mil polyethylene sheeting beneath entire Transfer Room.
- .4 Install one layer rip-proof polyethylene sheeting over roof.
- .5 Turn 600 mm of polyethylene down the sides over polyethylene on the perimeter walls.
- .6 Install a fire extinguisher, mount to wall.

2.4 Curtained Doorways

- .1 Construct as follows:
 - .1 Install two flap doors, full width and height of door opening at all doors to Abatement Work Area and both ends of Transfer Room.
 - .2 Construct each flap door of two layers of polyethylene sheeting with all edges reinforced with tape. Use wood strapping to securely fasten flap doors to head and alternate jambs.
 - .3 Install weights attached to bottom edge of each door flap.
 - .4 Provide direction arrows on flaps to indicate opening.

PART 3 EXECUTION

3.1 Site Preparation - General

- .1 Moving of equipment, tools, supplies, and stored materials that can be performed without disturbing ACM will be performed by others.
- .2 Remove visible dust and friable material from all surfaces in the work area including those to be worked on, using HEPA Vacuums or wet wiping.
- .3 Isolate, at panel, and disconnect existing power supply to Abatement Work Area. Power supply to remaining areas of building must not be disrupted during work of this section.
 - .1 Lock-out/tag-out power at electrical panels.
 - .2 Mark/tag any items within or passing through the Abatement Work Area that are to remain live including but not limited to cable, conduit, wire, fixtures, equipment panels, etc.
- .4 Provide power from ground fault interrupt circuits.
- .5 Shut down HVAC systems serving the Abatement Work Area.
 - .1 Install polyethylene sheeting over openings in ducts and diffusers and seal.
 - .2 HVAC to remaining areas of building must not be disrupted during work of this section.
 - .3 System shall remain inoperative until completion of work, unless ducts can be effectively capped.

- .4 Perform work at scheduled times after shutting down HVAC systems affecting the Abatement Work Area.

- .6 Provide amended water for wetting ACM, and adequate method of wetting (garden sprayers, airless sprayers, etc.).

3.2 Site Preparation – Enclosure Required

- .1 Install polyethylene enclosure complete with Windows at Abatement Work Areas for the following work:
 - .1 Removal of friable asbestos-containing materials (less than 1 square metre).
 - .2 Removal of a false ceiling (or part of) where asbestos-containing material is presumed or known to be present on the surface.
- .2 Install Transfer Room where duration of work is to last longer than one 8 hour shift.
- .3 Seal openings in floor using tape, caulking, polyethylene, etc. Floor openings are to be sealed independently prior to installation of floor polyethylene.
- .4 Install polyethylene sheeting on floors of Abatement Work Area. Use sufficient layers to provide adequate protection for carpeting and equipment.
 - .1 Minimum requirement over carpet is one layer of 6 mil polyethylene under one layer of rip-proof polyethylene.
 - .2 Cover floors first so that polyethylene on walls is overlapped by at least 305 mm.
- .5 Construct Hoarding Walls between Abatement Work Area perimeter and occupied areas.
- .6 Install polyethylene sheeting at openings in walls (as required) and seal.
- .7 Install 6 mil polyethylene sheeting on walls within the Abatement Work Area., including existing walls that make up, or are within, the Abatement Work Area.
- .8 Provide a completely sealed polyethylene top for free standing enclosures.
- .9 Extend to underside of ceiling system, enclosures for access into ceilings. Enclosure may be supported from the ceiling system if ceiling can support the polyethylene.
- .10 Install Curtained Doorways.
- .11 Install one layer of 6 mil polyethylene sheeting so as to protect all equipment and finishes in the Abatement Work Area that may be damaged. Items to remain include but are not limited to:
 - .1 Millwork.
 - .2 Doors.
 - .3 Bulkheads.
 - .4 Plumbing fixtures.
 - .5 Electrical Equipment.
 - .6 Mechanical Equipment.
- .12 Install temporary lighting in enclosure to a level that will provide for safe and efficient use of work area - minimum 550 LUX.
- .13 Establish negative pressure in Abatement Work Areas as follows:
 - .1 Provide sufficient HEPA filtered negative pressure machines to exchange a volume of air equivalent to that of the Abatement Work Area a minimum of every 20 minutes.

- .2 Provide additional HEPA filtered negative pressure machines as required to ensure air flow from Occupied Area into Abatement Work Area.
- .3 Arrange negative air units to maximize the distance between units and decontamination facilities.
- .4 Provide weighted flaps in perimeter Hoarding Walls as necessary to provide make-up air.
- .5 Operate HEPA filtered negative pressure machines continuously from first disturbance of ACM until completion of dismantling.
- .6 Replace prefilters to maintain specified flow rate.
- .7 Replace HEPA filter as required to maintain flow rate and integrity of unit.
- .8 Discharge HEPA filtered negative air machines as follows:
 - .1 To building exterior.
- .14 Place required tools to complete the abatement with the Abatement Work Area.
- .15 Install Signage in clearly visible locations and in sufficient numbers to adequately warn of an asbestos dust hazard.

3.3 Site Preparation – No Enclosure Required

- .1 Install caution tape around work area where existing walls are not present.
- .2 Cover walls, floors, finishes, millwork, equipment and furnishings remaining in the Abatement Work Area with polyethylene sheeting before disturbing ACM to control the spread of dust.
- .3 Install one layer of 6 mil polyethylene sheeting so as to protect all equipment and finishes in the Abatement Work Area that may be damaged. Items to remain include but are not limited to:
 - .1 Millwork.
 - .2 Doors.
 - .3 Bulkheads.
 - .4 Plumbing fixtures.
 - .5 Electrical Equipment.
 - .6 Mechanical Equipment.
- .4 Install Signage in clearly visible locations and in sufficient numbers to adequately warn of an asbestos dust hazard.
- .5 Install temporary lighting in enclosure to a level that will provide for safe and efficient use of work area - minimum 550 LUX.
- .6 Place HEPA vacuum in Abatement Work Area.
- .7 Place required tools to complete the abatement with the Abatement Work Area.

3.4 Maintenance of Abatement Work Area

- .1 Inspect polyethylene sheeting and ensure it is effectively sealed and taped. Repair damage and remedy defects immediately.
- .2 Inspect electrical panels and ensure locks and tags are on panels prior to entering the Abatement Work Area.
- .3 Inspect HEPA filtered negative pressure machines including discharge ducting at the beginning and end of each working period. Inspection must be performed by competent

person.

- .4 Maintain Abatement Work Area in tidy condition.
- .5 Remove standing water on polyethylene/floor at the end of every shift.
- .6 Turn off water supply to any hoses and reduce pressure in hose, prior to leaving the Abatement Work Area at end of shift.

3.5 Asbestos Removal - General

- .1 Do not use compressed air to clean or remove dust or debris.
- .2 Frequently and at regular intervals during the work, clean up dust and waste using HEPA vacuums and/or wet sweeping or mopping.
- .3 Frequently and at regular intervals, place all waste in asbestos waste containers.
- .4 Immediately upon completion of work, clean area with HEPA vacuum and/or wet sweeping or mopping.

3.6 Asbestos Removal – Thermal Systems Insulation (less than 1 Square Metre)

- .1 Construct an enclosure around Abatement Work Area and use the procedures described above under *Site Preparation – Enclosure Required*.
- .2 Adequately wet exterior of the ACM with amended water to suppress dust.
- .3 Remove asbestos-containing mechanical insulations in layers, maintaining all exposed surfaces of insulation in a wet condition.
- .4 Remove wetted ACM directly into waste containers. Do not allow ACM to fall to the floor of the Abatement Work Area.
- .5 Clean all surfaces from which ACM has been removed with scouring pads, vacuuming or wet-sponging to remove all visible material after completion of removal of ACM.
- .6 Remove visible dust and debris.
- .7 Seal exposed ends of asbestos-containing insulation to remain, with canvas and lagging.
- .8 HEPA vacuum or wet clean entire Abatement Work Area, including any surfaces not covered with polyethylene sheeting. Any materials removed to access ACM that are to be re-used, and any abatement equipment, must be wet cleaned or HEPA vacuumed prior to completion.
- .9 Apply Post Removal Sealant to all surfaces within the Abatement Work Area including those from which ACM has been removed.

3.7 Ceiling Entry where Asbestos-Containing Debris is Present

- .1 Construct an enclosure around Abatement Work Area and use the procedures described above under *Site Preparation – Enclosure Required*.
- .2 Slightly lift first tile, HEPA vacuum the ceiling grid the perimeter of tile.
- .3 Lift tile vertically, and while keeping level, slide tile over to adjacent tile.
- .4 HEPA vacuum back of all tiles within reach.
- .5 Mist surface of ceiling tiles with amended water.
- .6 Carefully remove HEPA vacuumed ceiling tiles from grid. Do not break tiles or allow to fall to floor.

- .7 Repeat Items .4 to .6 until all required ceiling tiles have been cleaned and removed.
- .8 Remove visible dust and debris including on grid, ceiling tiles and accessible items within reach.
- .9 Wet clean or HEPA vacuum Abatement Work Area, including any surfaces not covered with polyethylene sheeting. Any materials or equipment removed to access ACM that are to be reused, must be vacuumed prior to reinstatement.
- .10 Re-establish ceiling systems and reinstall tiles.

3.8 Asbestos Removal – More than 7.5 square metres of Ceiling Tiles

- .1 Use the procedures described above under *Site Preparation –No Enclosure Required*.
- .1 Slightly lift first tile, HEPA vacuum the ceiling grid the perimeter of tile.
- .2 Lift tile vertically, and while keeping level, slide tile over to adjacent tile.
- .3 HEPA vacuum back of all tiles within reach.
- .4 Mist surface of ceiling tiles with amended water.
- .5 Remove ceiling tiles intact. Do not break or pulverize.
- .6 Carefully remove laminated tiles by prying tile from substrate. Do not break tiles or allow to fall to floor.
- .7 Remove all glue from substrate.
- .8 Place directly into asbestos waste container.
- .9 Repeat items .3 to .6, until all required ceiling tiles are removed.
- .10 Place ACM directly into waste containers.
- .11 Remove visible dust and debris including at grid.
- .12 Do not damage or remove grid.
- .13 Remove ceiling grid and support system and dispose of as clean waste where specified to be removed.
- .14 Wet clean or HEPA vacuum the entire Abatement Work Area, including surfaces not covered with polyethylene sheeting (i.e. ceiling grid).
- .15 Any materials or equipment removed to access ACM that are to be reused, must be wet cleaned or vacuumed prior to reinstatement.

3.9 Asbestos Removal - Drywall with Asbestos Drywall Joint Compound (greater than 1 square metre)

- .1 Use the procedures described above under *Site Preparation –Enclosure Required*.
- .2 Protect drywall around area to be removed by covering with polyethylene and taping seams to wall.
- .3 Cut drywall and remove using non-powered hand-held tools. Place directly into polyethylene waste bag, or sealed container until at waste bin.
- .4 Remove all screws and fasteners in studs or strapping.
- .5 Remove studs and strapping where specified. Clean metal studs and remove from Abatement Work Area.
- .6 Wet clean or HEPA vacuum the entire Abatement Work Area, including surfaces not

covered with polyethylene sheeting. Any materials or equipment removed to access ACM that are to be reused, must be wet cleaned or vacuumed prior to reinstatement.

3.10 Asbestos Removal - Asbestos Materials with HEPA Filtered Power Tools (Texture Coat, Flooring Mastic and Drywall)

- .1 Use the procedures described above under *Site Preparation –No Enclosure Required*.
- .2 Wet all material to be disturbed.
- .3 Turn on HEPA vacuum. Vacuum to remain operation throughout work.
- .4 Place removed ACM directly into an asbestos waste container.
- .5 Apply lagging to any exposed edges created by removal.
- .6 If power tool can disconnect from HEPA vacuum, remove tool, and HEPA vacuum tool and bit, blade, etc., and shrouds.
- .7 Wet clean or HEPA vacuum the entire Abatement Work Area, including surfaces not covered with polyethylene sheeting. Any materials or equipment removed to access ACM that are to be reused, must be wet cleaned or vacuumed prior to reinstatement.

3.11 Asbestos Removal – Non-Friable Materials with a Machine (Flooring Mastic)

- .1 Use the procedures described above under *Site Preparation –Enclosure Required*.
- .2 Wet all materials to be disturbed.
- .3 Using only a self-propelled machine (i.e. excavator or similar) to complete the required removal work.
- .4 Maintain removed material wet, until packaged.
- .5 Place removed ACM into asbestos waste container.
- .6 Wet clean or HEPA vacuum the entire Abatement Work Area, including surfaces not covered with polyethylene sheeting and the machinery used during the work.

3.12 Asbestos Removal - Dust and Debris

- .1 Use the procedures described above under *Site Preparation –No Enclosure Required*.
- .2 Remove visible dust and debris from Abatement Work Area using HEPA vacuums or wet cleaning methods.

3.13 Application of Post Removal Sealant

- .1 Apply one coat of Post Removal Sealant with an airless sprayer, in accordance with Manufacturer's Instructions, to cover all surfaces on all items in the Abatement Work Area, including but not limited to polyethylene, ACM substrate, structural steel, and surfaces scheduled for demolition.
- .2 Do not apply post removal sealant to materials that will be damaged by its application.

3.14 Abatement Work Area Dismantling

- .1 Wash or HEPA vacuum equipment and tools used in contaminated Abatement Work Area to remove all asbestos contamination, or place in Asbestos Waste Containers prior to being removed from Abatement Work Area.
- .2 Place tools and equipment used in contaminated work site but not cleaned in polyethylene bags prior to removal from Abatement Work Area.
- .3 Clean polyethylene sheeting and drop sheets which with HEPA vacuum or wet cleaning

methods at completion of work.

- .4 Wet drop sheets and polyethylene sheeting.
- .5 Carefully roll polyethylene sheeting and drop sheets toward the centre of enclosure. As polyethylene is rolled away, immediately remove visible debris beneath with a HEPA vacuum.
- .6 Remove remaining polyethylene sheeting and tape, and dispose of as asbestos waste.
- .7 Place polyethylene sheeting, drop sheets, tape, disposal clothing and other contaminated waste in asbestos waste containers, wet wipe and place in second asbestos waste container.
- .8 Remove remaining site isolation, seals, tape, etc.
- .9 Remove Transfer Room.
- .10 Remove seals, tape, Signage etc.
- .11 Immediately upon shutting down negative air units, seal air inlet grill and exhaust vent with polyethylene and tape.
- .12 Seal openings in HEPA vacuums.
- .13 Remove and dispose of the pre-filters from HEPA filtered negative pressure machines as asbestos waste.
- .14 Remove HEPA filtered negative pressure machines and discharge ducting or HEPA vacuums.
- .15 Remove temporary lights.
- .16 Remove ground fault panels.
- .17 Place contaminated materials including polyethylene sheeting, drop sheets, seals, tape, disposable coveralls, and other contaminated waste in asbestos waste containers.

3.15 Waste and Material Handling

- .1 Refer to Section 02 81 00.

3.16 Re-Establishment of Items

- .1 Upon completion of work:
 - .1 Move items that were removed from Abatement Work Area prior to work, back into same location within Abatement Work Area.
 - .2 Remove and disconnect Ground fault Panel, tags and locks from electrical panels and re-energize equipment and items.
 - .3 Remove hose bibs installed and repair pipe.
 - .4 Reinstall ducts removed to perform cleaning of ducts or to access ACM.
 - .5 Clean, mop and vacuum Abatement Work Area and area beneath any tunnels, platform and Decontamination Facilities.
 - .6 Enable building air handling systems.

END OF SECTION

PART 1 GENERAL

1.1 General and Related Work

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of the General Conditions of the Contract.
- .2 Requirements specified elsewhere:
 - .1 Section 02 81 00 Hazardous Materials – General Provisions

1.2 Outline of Work

- .1 Refer to Section 02 81 00 Hazardous Materials – General Provisions for the Outline of Work.
- .2 The intent of this Section is to provide safe work practices and procedures to govern the handling, removal, clean-up and disposal of asbestos-containing materials following Glove Bag procedures, and Pinchin and Owner specific requirements.
- .3 If for reasons of pipe temperature, geometry or access, Glove Bag procedures cannot be used, remove and dispose of asbestos-containing insulations as per Section 02 82 11 for less than 1 square meter, or Section 02 82 13 for greater than 1 square meter.

1.3 Personal Protection

- .1 Protect all personnel at all times when possibility of disturbance of ACM exists.
- .2 Provide the following minimum respiratory protection to all personnel:
 - .1 Non-powered half-face respirators with P100 high efficiency (HEPA) cartridge filters.
- .3 Provide protective clothing, to all personnel entering the Abatement Work Area.
- .4 Wear hard hats, safety shoes and other personal protective equipment required by applicable construction safety regulations.

1.4 Site Reviews

- .1 Refer to Section 02 81 00 – General Provisions.
- .2 The following Milestone Site Reviews are to be scheduled:
 - .1 Milestone Site Review - Clean Site Preparation
 - .2 Milestone Site Review – Bulk Removal Inspection
 - .3 Milestone Site Review - Visual Clearance

PART 2 PRODUCTS AND FACILITIES

2.1 Materials and Equipment

- .1 Refer to Section 02 81 00.
- .2 Glove Bag: Prefabricated bag which provides a completely sealed envelope surrounding a given section of piping to permit the removal of asbestos-containing insulation from within the bag while maintaining the integrity of the bag and preventing the spread of airborne asbestos fibres. The glove bag shall be equipped with,
 - .1 sleeves and gloves that are permanently sealed to the body of the bag to allow the worker to access and deal with the insulation and maintain a sealed enclosure throughout the work period,

- .2 valves or openings to allow insertion of a vacuum hose and the nozzle of a water sprayer while maintaining the seal to the pipe, duct or similar structure,
 - .3 a tool pouch with a drain,
 - .4 a seamless bottom and a means of sealing off the lower portion of the bag, and
 - .5 a high strength double throw zipper and removable straps, if the bag is to be moved during the removal operation.
- .3 Securing Straps: For some types of Glove Bag, reusable nylon straps at least 25mm wide with metal tightening buckle for sealing ends of bags around pipe and/or insulation.

PART 3 EXECUTION

3.1 Site Preparation - General

- .1 Remove to the extent necessary to access piping, stored or non-fixed items from the Abatement Work Area including but not limited to equipment, furniture, waste etc. Store in area provided by Owner.
- .2 Shut down HVAC systems serving the Abatement Work Area.
 - .1 Install polyethylene sheeting over openings in ducts and at diffusers and seal.
 - .2 HVAC to remaining areas of building must not be disrupted during work of this section.
 - .3 System shall remain inoperative until completion of work, unless ducts can be effectively capped.
 - .4 Perform work at scheduled times after shutting down HVAC systems affecting the Abatement Work Area.
- .3 Install caution tape around work area where existing walls are not present.
- .4 Install Signage in clearly visible locations and in sufficient numbers to adequately warn of an asbestos dust hazard.
- .5 Remove visible dust and friable material from all surfaces in the work area including those to be worked on, using HEPA Vacuums or wet wiping.
- .6 Cover walls, floors, finishes, millwork, equipment and furnishings below the pipe to be worked on in the Abatement Work Area with polyethylene sheets before disturbing ACM. Drop sheets shall extend a minimum of 1,800 mm from pipe.
- .7 Use existing lighting or install temporary lighting to a level that will provide for safe and efficient use of work area - minimum 550 LUX.
- .8 Provide Amended Water for wetting ACM, in garden sprayers. Provide one garden sprayer for each worker.
- .9 Do not used compressed air to clean or remove and dust or debris when completing work of this section.
- .10 Place HEPA Vacuum in Abatement Work Area for each worker.
- .11 Place required tools to complete the abatement within the Abatement Work Area.
- .12 Post Notice of Asbestos Removal Work, where required by O.Reg. 278/05.

3.2 Maintenance of Abatement Work Area

- .1 Maintain Abatement Work Area in tidy condition.

3.3 Glove Bag Removal

- .1 Do not use Glove Bags on hot pipes that may damage Glove Bag. Refer to manufacturer's limitations.
- .2 Prior to use of Glove Bag on damaged orunjacketed insulation:
 - .1 Spray any areas of damaged insulation jacketing with mist of Amended Water.
 - .2 Tape over damaged insulation to provide temporary repair.
 - .3 Mist areas of insulation with no jacketing and wrap with polyethylene sheeting and seal with tape.
- .3 Place any tools necessary to remove insulation in tool pouch built into Glove Bag.
- .4 Inspect the Glove Bag for damage and defects immediately before it is attached to the pipe or duct.
 - .1 If damage or defects are observed, dispose of Glove Bag.
- .5 Install Glove Bag as per manufacturer's instructions.
- .6 Remove metal jacketing or banding carefully. Do not damage the Glove Bag.
- .7 Remove insulation from pipe as per manufacturer's directions.
 - .1 Volume and weight of insulation must not exceed capacity of the Glove Bag or supports.
 - .2 Arrange insulation in the Glove Bag to maximize use of the Glove Bag.
- .8 Only glove bags designed to be moved may be re-used on other sections of pipe or moved down same section of pipe (e.g. Safe-T-Strip).
- .9 At regular intervals during its use, if damage or defects are observed during the use of the Glove Bag, which cannot be readily repaired with tape and not affect the integrity or strength of the glove bag.
 - .1 Discontinue use of Glove Bag.
 - .2 Wash inner surface of Glove Bag.
 - .3 Wet insulation.
 - .4 Pull an Asbestos Waste Container over Glove Bag before removing from pipe.
 - .5 Remove Glove Bag and Asbestos Waste Container, seal with tape.
 - .6 Place in a second Asbestos Waste Container and seal with tape.
 - .7 Clean immediate area with a HEPA Vacuum prior to resuming work.
- .10 If bag is to be moved along pipe for use on adjacent section of insulation:
 - .1 Wash inner surface of Glove Bag.
 - .2 Wash tools and place tools in pouch.
 - .3 Wet surface of insulation in lower section of bag and any exposed end of asbestos insulation remaining on pipe with Amended Water.
 - .4 Insert nozzle of HEPA filtered vacuum cleaner into bag through valve and evacuate air from bag.
 - .5 Seal closure strip.
 - .6 Loosen securing straps to maintain a loose seal of Glove Bag to insulation or pipe.

- .7 Use double throw zipper as necessary to pass hangers.
- .8 Tighten straps once bag is in new position and continue insulation removal until Glove Bag is full, work is completed on the pipe or an obstruction prevents further movement of the bag.
- .11 If bag is to be removed from a pipe for use on a new section of pipe, perform the following:
 - .1 Wash inner surface of Glove Bag.
 - .2 Wash tools and place tools in pouch.
 - .3 Wet surface of insulation in lower section of bag and any exposed end of asbestos insulation remaining on pipe with Amended Water.
 - .4 Insert nozzle of HEPA filtered vacuum cleaner into bag through valve and evacuate air from bag.
 - .5 Seal valve cover on valve Glove Bags.
 - .6 Seal closure strip.
 - .7 Wash top section of Glove Bag and tool pouch thoroughly.
 - .8 Undo securing straps, unfasten zipper and carefully move bag to new section of pipe.
- .12 To remove bag after completion of insulation removal operation:
 - .1 Wash inner surface of Glove Bag.
 - .2 Wash and place all tools in one hand (glove), pull hand out inverted, twist to create a separate pouch, tape inverted hand at two separate locations 25 mm apart so as to seal pouch.
 - .1 Remove inverted hand and tools by cutting between the two tape seals.
 - .2 Place inverted hand pouch and tools into the next clean Glove Bag to be used or into a water bucket, open pouch underwater and clean tools.
 - .3 Wet surface of insulation in lower section of bag and any exposed end of asbestos insulation remaining on pipe with Amended Water.
 - .4 Insert nozzle of HEPA filtered vacuum cleaner into bag through valve and evacuate air from bag.
 - .5 Seal valve cover on valve Glove Bags.
 - .6 Seal closure strip if equipped with one. Twist bag at tapered point and secure with tape.
 - .7 Pull an Asbestos Waste Container over Glove Bag before removing from pipe.
 - .1 Undo straps and unzipper, or cut upper portion of single-use Glove Bag.
 - .2 Seal Asbestos Waste Container with tape.
 - .8 Ensure pipe is clean of all residue after removal of Glove Bag. If necessary, after removal of each section of asbestos, vacuum all surfaces of pipe, using HEPA vacuum or wipe with wet cloth.
- .13 Seal all surfaces of freshly-exposed pipe with Post Removal Sealer.
- .14 Cover exposed ends of any remaining asbestos insulation with canvas and lagging using Type 2 Procedures.

3.4 Clean-Up and Dismantling

- .1 Clean and remove from Abatement Work Area:

- .1 Equipment and tools.
- .2 Temporary lighting if used.
- .3 Polyethylene seals from HVAC systems.
- .2 Place polyethylene sheeting, drop sheets, seals, tape, clothing and other contaminated waste in asbestos waste containers, wet wipe and place in second asbestos waste container.
- .3 Clean Abatement Work Area with HEPA vacuums or wet wiping/mopping.
- .4 Seal openings in HEPA vacuums.
- .5 Proceed with the dismantlement of all barricades, etc. following receipt of authorization to proceed from the Asbestos Abatement Consultant.
- .6 Remove barricades, fencing, caution tape, signs, etc.

3.5 Waste and Material Handling

- .1 Refer to Section 02 81 00.

3.6 Re-Establishment of Items

- .1 Upon completion of work:
 - .1 Move all items that were removed from Abatement Work Area prior to work, back into same location within Abatement Work Area.
 - .2 Remove tags and locks from electrical panels and re-energize equipment and items.
 - .3 Enable building air handling systems.
 - .4 Clean and vacuum Abatement Work Area.

END OF SECTION

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PART 1 GENERAL

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of the General Conditions of the Contract.
- .2 Requirements specified elsewhere:
 - .1 Section 02 81 00 Hazardous Materials – General Provisions

1.2 Outline of Work

- .1 Refer to Section 02 81 00 Hazardous Materials – General Provisions for the Outline of Work.
- .2 The intent of this Section is to provide safe work practices and procedures to govern the handling, removal, clean-up and disposal of lead-containing materials following Class 2 or Moderate Risk procedures, and Pinchin and Owner specific requirements.
- .3 Comply with requirements of this Section when performing following Work:
 - .1 Removal of lead-containing paint using power tools with an effective dust collection system equipped with HEPA filter.
 - .2 Welding, torching or high temperature cutting of lead-containing surface coatings or materials indoors, with use of an effective fume collector or smoke eater.
 - .3 Welding, torching or high temperature cutting of lead-containing surface coatings materials outdoors.
 - .4 Removal of lead-containing surface coatings or materials by scraping or sanding (including wet sanding) using non-powered hand tools.
 - .5 Demolition of plaster or other building components that crumble, pulverize or powder and are covered with lead-containing surface coating.

1.3 Instruction and Training

- .1 Provide instruction and training to all workers including the following:
 - .1 Hazards of lead.
 - .2 Use, care and disposal of protective equipment (including but not limited to respirators and filters) and clothing that would be used and worn during abatement work, including:
 - .1 Limitations of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Proper fitting of equipment.
 - .4 Disinfecting and cleaning of equipment.
 - .3 Personal hygiene to be observed when performing the work.
 - .4 The measures and procedures prescribed by this section including decontamination of the worker.
 - .5 Instruction and training must be provided by a competent person.

1.4 Personal Protection

- .1 Provide the following respiratory protection to all personnel, at minimum:
 - .1 Non-powered half-face respirators with P100 high efficiency cartridge filters.

- .2 Provide protective clothing, to all personnel entering the Abatement Work Area, including:
 - .1 Dust impermeable gloves appropriate for the work being completed.
 - .2 Disposable protective clothing that does not readily retain or permit skin contamination, consisting of full body covering including head covering with snug fitting cuffs at wrists, ankles, and neck.
- .3 Provide protective clothing, to all personnel entering the Abatement Work Area.
- .4 Wear hard hats, safety shoes and other personal protective equipment required by applicable construction safety regulations.
- .5 Lead-specific soaps and hygiene indicators are recommended to be provided for hand-wash stations.

1.5 Site Reviews

- .1 Refer to Section 02 81 00 – General Provisions.
- .2 The following Milestone Site Reviews are to be scheduled:
 - .1 Milestone Site Review - Visual Clearance

PART 2 PRODUCTS AND FACILITIES

- .1 Refer to Section 02 81 00.

2.2 Hoarding Walls

- .1 Type A Hoarding Wall: One layer of rip-proof polyethylene sheeting installed floor to ceiling, secured with telescopic poles, clips, or other suitable methods.
- .2 Type B Hoarding Wall: 38 mm x 89 mm wood or metal studs at 400 mm o/c with continuous sill and top plate, covered with one layer of rip-proof polyethylene sheeting on each side of wall.
- .3 Windows: Install sufficient transparent windows area in hoarding walls to allow observation of entire work area from outside the enclosure where existing solid walls do not make up the perimeter.

2.3 Transfer Room

- .1 Transfer Room to be generally 2000 mm x 2000 mm x 2200 mm high. Increase size accordingly to accommodate number of workers.
- .2 Install walls as follows:
 - .1 Install 38 x 89 mm wood framing at 610 mm o/c with continuous top and sill plates.
 - .2 Install one layer rip-proof polyethylene sheeting on interior walls of Transfer Room.
- .3 Install one layer of rip-proof polyethylene sheeting over two layers of 6 mil polyethylene sheeting beneath entire Transfer Room.
- .4 Install one layer rip-proof polyethylene sheeting over roof.
- .5 Turn 600 mm of polyethylene down the sides over polyethylene on the perimeter walls.
- .6 Install a fire extinguisher, mount to wall.

2.4 Curtained Doorways

- .1 Construct as follows:
 - .1 Install two flap doors, full width and height of door opening at all doors to Abatement Work Area and both ends of Transfer Room.
 - .2 Construct each flap door of two layers of polyethylene sheeting with all edges reinforced with tape. Use wood strapping to securely fasten flap doors to head and alternate jambs.
 - .3 Install weights attached to bottom edge of each door flap.
 - .4 Provide direction arrows on flaps to indicate opening.

PART 3 EXECUTION

3.1 Site Preparation - General

- .1 Provide washing facilities consisting of a wash basin, clean water, soap and towels.
 - .1 Workers are to use washing facilities each time leaving the Abatement Work Area.
- .2 Stored or non-fixed items, including but not limited to equipment, furniture, waste etc., shall be removed from the Abatement Work Area prior to abatement work.
- .3 Isolate, at panel, and disconnect existing power supply to Abatement Work Area. Power supply to remaining areas of building must not be disrupted during work of this section.
 - .1 Lock-out/tag-out power at electrical panels.
 - .2 Mark/tag any items within or passing through the Abatement Work Area that are to remain live including but not limited to cable, conduit, wire, fixtures, equipment panels, etc.
- .4 Shut down HVAC systems serving the Abatement Work Area.
 - .1 Install polyethylene sheeting over openings in ducts and diffusers and seal.
 - .2 HVAC to remaining areas of building must not be disrupted during work of this section.
 - .3 System shall remain inoperative until completion of work, unless ducts can be effectively capped.
 - .4 Perform work at scheduled times after shutting down HVAC systems affecting the Abatement Work Area.
- .5 Remove visible dust from all surfaces in the work area including those to be worked on, using HEPA Vacuums or wet wiping.
- .6 Provide amended water for wetting materials, and adequate method of wetting (garden sprayers, airless sprayers, etc.).
- .7 Provide electrical power and shut off for operation of powered tools and equipment. Provide ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard.
 - .1 Ensure safe installation of electrical lines and equipment.

- .8 Do not use compressed air to clean or remove dust or debris.
- .9 Frequently and at regular intervals during the work, clean up dust and waste using HEPA vacuums and/or wet sweeping or mopping.
- .10 Frequently and at regular intervals, place all waste in waste containers.
- .11 Immediately upon completion of work, clean area with HEPA vacuum and/or wet sweeping or mopping.

3.2 Site Preparation – Enclosure Required

- .1 Install Transfer Room where duration of work is to last longer than one 8 hour shift.
- .2 Install Curtained Doorways.
- .3 Install polyethylene sheeting at openings in walls (as required) and seal.
- .4 Seal openings in floor using tape, caulking, polyethylene, etc. Floor openings are to be sealed independently prior to installation of floor polyethylene.
- .5 Install polyethylene sheeting on floors of Abatement Work Area. Use sufficient layers to provide adequate protection for carpeting and equipment.
 - .1 Cover floors first so that polyethylene on walls is overlapped by at least 305 mm.
- .6 Install 6 mil polyethylene sheeting on walls to remain, within the Abatement Work Area., including existing walls that make up, or are within, the Abatement Work Area.
- .7 Install one layer of 6 mil polyethylene sheeting so as to protect all equipment and finishes in the Abatement Work Area that may be damaged.
- .8 Place required tools to complete the abatement with the Abatement Work Area.
- .9 Install temporary lighting in enclosure to a level that will provide for safe and efficient use of work area - minimum 550 LUX.
- .10 Establish negative pressure in Abatement Work Areas as follows:
 - .1 Provide sufficient HEPA filtered negative pressure machines to exchange a volume of air equivalent to that of the Abatement Work Area a minimum of every 20 minutes.
 - .2 Provide additional HEPA filtered negative pressure machines as required to ensure air flow from Occupied Area into Abatement Work Area.
 - .3 Operate HEPA filtered negative pressure machines continuously from first disturbance of ACM until completion of dismantling.
 - .4 Replace prefilters to maintain specified flow rate.
 - .5 Replace HEPA filter as required to maintain flow rate and integrity of unit.
 - .6 Discharge HEPA filtered negative air machines to building exterior, where possible.
 - .1 Direct discharge away from building access points.
- .11 Install Signage in clearly visible locations and in sufficient numbers to adequately warn of lead hazard, and lead hazard where appropriate.

3.3 Site Preparation – No Enclosure Required

- .1 Cover materials to remain in the Abatement Work Area with polyethylene sheeting before disturbing ACM to control the spread of dust.
- .2 Install caution tape around work area where existing walls are not present.
- .3 Install temporary lighting in enclosure to a level that will provide for safe and efficient use of work area - minimum 550 LUX.
- .4 Place HEPA vacuum in Abatement Work Area.
- .5 Place required tools to complete the abatement with the Abatement Work Area.
- .6 Install Signage in clearly visible locations and in sufficient numbers to adequately warn of a lead dust hazard.

3.4 Maintenance of Abatement Work Area

- .1 Inspect polyethylene sheeting and ensure it is effectively sealed and taped. Repair damage and remedy defects immediately.
- .2 Inspect electrical panels and ensure locks and tags are on panels prior to entering the Abatement Work Area.
- .3 Inspect HEPA filtered negative pressure machines including discharge ducting at the beginning and end of each working period. Inspection must be performed by competent person.
- .4 Maintain Abatement Work Area in tidy condition.
- .5 Remove standing water on polyethylene/floor at the end of every shift.
- .6 Turn off water supply to any hoses and reduce pressure in hose, prior to leaving the Abatement Work Area at end of shift.

3.5 Lead Abatement

- .1 Use the procedures described above under *Site Preparation – Enclosure Required*.
 - .1 Removal of lead-containing surface coatings or materials by scraping or sanding (including wet sanding) using non-powered hand tools.
 - .2 Demolition of plaster or other building components that crumble, pulverize or powder and are covered with lead-containing surface coating.
- .2 Use the procedures described above under *Site Preparation – No Enclosure Required*.
 - .1 Removal of lead-containing paint using power tools with an effective dust collection system equipped with HEPA filter.
 - .2 Welding, torching or high temperature cutting of lead-containing surface coatings or materials indoors, with use of an effective fume collector or smoke eater.
 - .3 Welding, torching or high temperature cutting of lead-containing surface coatings materials outdoors.
- .3 Provide washing facilities consisting of a wash basin, clean water, soap and towels.
 - .1 Workers are to use washing facilities each time leaving the Abatement Work Area.
- .4 Removal methods minimizing dust generation should be used wherever possible.

- .1 Wet methods are to be used to reduce dust generation.
 - .1 Wetting agents should be used where possible.
 - .2 Wet method not be used if it creates a hazard or cause damage to equipment or to project.
- .5 Provide drop sheets below all lead operations that may produce dust, chips or debris containing lead.
- .6 Waste water from cleaning or removal operations must be contained, for treatment or disposal.
- .7 Remove lead-containing paint in small sections and pack as it is being removed in sealable waste containers.
- .8 Waste generated should be maintained wet until cleaned and packaged.
- .9 After completion of stripping work, wire brush and wet sponge surface from which lead based paint has been removed to remove visible material. During this work keep surfaces wet.
- .10 After wire brushing and wet sponging to remove visible lead containing paint, wet clean entire work area, and equipment used in process.
 - .1 Compressed air or dry sweeping not be used to clean up lead-containing dust or waste.
 - .2 Ensure all waste is cleaned and packaged.
- .11 Seal filled containers. Clean external surfaces thoroughly by wet sponging. Remove from immediate working area to staging area. Clean external surfaces thoroughly again by wet sponging. Wash containers thoroughly pending removal to outside. Ensure containers are removed by workers who have entered from uncontaminated areas dressed in clean coveralls.

3.6 Waste Management and Disposal

- .1 Per Section 02 82 00.

3.7 Final Cleaning

- .1 Following specified cleaning procedures, and when visual site review is acceptable, proceed with final cleanup.
- .2 Remove polyethylene sheet by rolling it away from walls to centre of work area. Clean visible lead-containing particles observed during cleanup, immediately, using HEPA vacuum.
- .3 Place polyethylene sheets, tape, cleaning material, clothing, and contaminated waste in plastic bags and seal. Dispose of in accordance with waste materials generated.
- .4 Clean Work areas and Transfer Room, where present.
- .5 Remove sealed waste containers and equipment used in Work and remove from work areas at appropriate time in cleaning sequence.
- .6 Conduct final check to ensure no dust or debris remain on surfaces as result of dismantling operations.

END OF SECTION

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Precautions UH McMaster.docx

ALL DATA REPORT

Client: McMaster University
Location: #2 : STORAGE
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 111
Last Re-Assessment: 2024-11-19

Area (sqft): 90

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	N/a	Plaster	Not Applicable		C	Y		100			LF	V0013	None Detected	N.D.	None	
Duct		None Found														
Floor	N/a	Concrete (poured)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Mechanical Equipment		None Found														
Piping	Unidentified Pipe One	Fibreglass	Straight	Polyvinyl chloride (PVC)	A	Y					LF	V0000	Non-Asbestos		None	
Piping	Unidentified Pipe One	Parging Cement	Fitting	Canvas	A	Y		6(5)			EA	V0001	Chrysotile	50-75%	Confirmed Asbestos	F
Piping	Unidentified Pipe Two	Fibreglass	Fitting	Polyvinyl chloride (PVC)	A	Y					EA	V0000	Non-Asbestos		None	
Piping	Unidentified Pipe Two	Sweatwrap	Straight	Canvas	A	Y		20			LF	V0006	None Detected	N.D.	None	
Structure		Concrete (poured)										V0000	Non-Asbestos		None	
Wall		Plaster			B	Y		100			%	S0013	None Detected	N.D.	None	

Client: McMaster University
Location: #2 : STORAGE
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 111
Last Re-Assessment: 2024-11-19

Area (sqft): 90

PAINT								
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard
Wall	Plaster	100		%	V9500			Presumed Lead
Structure	Steel	100		%	V9500			Presumed Lead

Client: McMaster University
Location: #2 : STORAGE
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 111
Last Re-Assessment: 2024-11-19

Area (sqft): 90

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	100	%	V9500	Presumed

ALL DATA REPORT

Client: McMaster University
Location: #33 : OFFICE
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 131
Last Re-Assessment: 2024-11-19

Area (sqft): 100

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	N/a	Plaster	Not Applicable	N/A	C	Y		100			%	V0013	None Detected	N.D.	None	
Duct	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Floor	N/a	Vinyl Floor Tile and Mastic		Carpet	D	N		170(0)			SF	V9500	Presumed Asbestos		Presumed Asbestos	NF
Mechanical Equipment	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Piping	Chilled Water Return	Fibreglass	Fitting	Polyvinyl chloride (PVC)	A	Y										
Piping	Chilled Water Return	Styrofoam	Straight	Canvas	A	Y						V0000	Non-Asbestos		None	
Piping	Heating Water Return	Fibreglass	Straight	Canvas	A	Y						V0000	Non-Asbestos		None	
Piping	Heating Water Return	Fibreglass	Fitting	Polyvinyl chloride (PVC)	A	Y										
Structure	Beam, Deck	Concrete (poured)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Wall	N/a	Plaster	Not Applicable	N/A	A	Y		100			%	V0013	None Detected	N.D.	None	

Client: McMaster University
Location: #33 : OFFICE
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 131
Last Re-Assessment: 2024-11-19

Area (sqft): 100

PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard	
Structure	Steel	100		%	V9500			Presumed Lead	
Wall	Plaster	100		%	V9500			Presumed Lead	

Client: McMaster University
Location: #33 : OFFICE
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 131
Last Re-Assessment: 2024-11-19

Area (sqft): 100

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	100	%	V9500	Presumed

ALL DATA REPORT

Client: McMaster University
Location: #34 : JANITOR ROOM
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 132
Last Re-Assessment: 2024-11-19

Area (sqft): 150

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	N/a	Plaster	Not Applicable	N/A	C	Y		100			%	V0013	None Detected	N.D.	None	
Duct	N/a	Fibreglass	Not Applicable	N/A								V0000	Non-Asbestos		None	
Floor	N/a	Concrete (poured)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Mechanical Equipment	Fan Unit	Not Insulated	Not Applicable	N/A								V0000	Non-Asbestos		None	
Piping		Fibreglass	Elbow	Polyvinyl chloride (PVC)	B	Y						V0000	Non-Asbestos		None	
Piping	Chilled Water Return	Fibreglass	Elbow	Polyvinyl chloride (PVC)	B	Y										
Piping	Chilled Water Return	Styrofoam	Straight	Canvas	B	Y						V0000	Non-Asbestos		None	
Piping	Domestic Hot Water	Fibreglass	Straight	Canvas	B	Y						V0000	Non-Asbestos		None	
Piping	Domestic Hot Water	Fibreglass	Elbow	Polyvinyl chloride (PVC)	B	Y										
Piping	Unidentified Pipe One	Fibreglass	Straight	Canvas	B	Y						V0000	Non-Asbestos		None	
Piping	Unidentified Pipe One	Fibreglass	Elbow	Canvas	B	Y						V0000	Non-Asbestos		None	
Structure	Beam, Deck	Concrete (poured)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Wall	N/a	Plaster	Not Applicable	N/A	A	Y		100			%	V0013	None Detected	N.D.	None	

Client: McMaster University
Location: #34 : JANITOR ROOM
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 132
Last Re-Assessment: 2024-11-19

Area (sqft): 150

PAINT								
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard
Structure	Steel	100		%	V9500			Presumed Lead
Wall	Plaster	100		%	V9500			Presumed Lead

Client: McMaster University
Location: #34 : JANITOR ROOM
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 132
Last Re-Assessment: 2024-11-19

Area (sqft): 150

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	100	%	V9500	Presumed

ALL DATA REPORT

Client: McMaster University
Location: #46 : STORAGE
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 101
Last Re-Assessment: 2024-11-19

Area (sqft): 45

ASBESTOS															
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard
Ceiling	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None
Duct	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None
Floor	N/a	Concrete (poured)	Not Applicable	N/A								V0000	Non-Asbestos		None
Mechanical Equipment	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None
Piping	Domestic Hot Water	Fibreglass	Straight	Canvas	B	Y						V0000	Non-Asbestos		None
Piping	Domestic Hot Water	Fibreglass	Fitting	Polyvinyl chloride (PVC)	B	Y									
Structure	Beam, Deck	Concrete (poured)	Not Applicable	N/A								V0000	Non-Asbestos		None
Wall	N/a	Concrete (poured)	Not Applicable	N/A								V0000	Non-Asbestos		None

Client: McMaster University
Location: #46 : STORAGE
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 101
Last Re-Assessment: 2024-11-19

Area (sqft): 45

PAINT								
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard
Structure	Steel	100		%	V9500			Presumed Lead
Wall	Concrete (poured)	100		%	V9500			Presumed Lead

Client: McMaster University
Location: #46 : STORAGE
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 101
Last Re-Assessment: 2024-11-19

Area (sqft): 45

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	100	%	V9500	Presumed

ALL DATA REPORT

Client: McMaster University
Location: #81 : OFFICE
Survey Date: 2022-01-11

Site: McMaster
Floor: 1

Building Name: 1 : UNIVERSITY HALL
Room #: 113
Last Re-Assessment: 2024-11-19

Area (sqft): 140

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling		Ceiling tiles (glue-on)			C	N		20			SF	V0011	None Detected	N.D.	None	
Ceiling		Mastic, Black			C	N		20(7)			SF	V0015	Chrysotile	0.5-5%	Confirmed Asbestos	NF
Ceiling ¹	Acoustic Tile	Ceiling Tiles (lay-in), 24x24 pinhole and fleck			C	Y		140			SF	V0000	Non-Asbestos		None	
Ceiling	Bulkhead	Cement Product			C	Y		20(7)			SF	V9000	Confirmed Asbestos		Confirmed Asbestos	NF
Ceiling	N/a	Plaster	Not Applicable	N/A	C	Y		135	5		SF	V0013	None Detected	N.D.	None	
Duct	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Floor	N/a	Wood	Not Applicable	N/A								V0000	Non-Asbestos		None	
Mechanical Equipment	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Other		Ceiling tiles (glue-on)			C	N		100			SF	V0011	None Detected	N.D.	None	
Piping	N/a	N/A	Not Applicable	N/A	D	N						V0000	Non-Asbestos		None	
Structure	Beam, Deck	Concrete (precast)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Wall	N/a	Plaster	Not Applicable	N/A	C	Y		100			%	V0013	None Detected	N.D.	None	

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Client: McMaster University
Location: #81 : OFFICE
Survey Date: 2022-01-11

Site: McMaster
Floor: 1

Building Name: 1 : UNIVERSITY HALL
Room #: 113
Last Re-Assessment: 2024-11-19

Area (sqft): 140

PAINT								
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard
Structure	Steel	100		%	V9500			Presumed Lead
Wall	Plaster	100		%	V9500			Presumed Lead

Client: McMaster University
Location: #81 : OFFICE
Survey Date: 2022-01-11

Site: McMaster
Floor: 1

Building Name: 1 : UNIVERSITY HALL
Room #: 113
Last Re-Assessment: 2024-11-19

Area (sqft): 140

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	100	%	V9500	Presumed

ALL DATA REPORT

Client: McMaster University
Location: #82 : OFFICE
Survey Date: 2022-01-11

Site: McMaster
Floor: 1

Building Name: 1 : UNIVERSITY HALL
Room #: 114
Last Re-Assessment: 2024-11-19

Area (sqft): 200

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	Bulkhead	Cement Product			C	Y		60(7)			SF	V9000	Confirmed Asbestos		Confirmed Asbestos	NF
Ceiling	N/a	Plaster	Not Applicable	N/A	C	Y		100			%	V0013	None Detected	N.D.	None	
Duct	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Floor	N/a	Wood	Not Applicable	N/A								V0000	Non-Asbestos		None	
Mechanical Equipment	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Piping	N/a	N/A	Not Applicable	N/A	D	N						V0000	Non-Asbestos		None	
Structure	Beam, Deck	Concrete (precast)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Wall	N/a	Plaster	Not Applicable	N/A	C	Y		100			%	V0013	None Detected	N.D.	None	

Client: McMaster University
Location: #82 : OFFICE
Survey Date: 2022-01-11

Site: McMaster
Floor: 1

Building Name: 1 : UNIVERSITY HALL
Room #: 114
Last Re-Assessment: 2024-11-19

Area (sqft): 200

PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description			Hazard
Structure	Steel	100		%	V9500				Presumed Lead
Wall	Plaster	100		%	V9500				Presumed Lead

Client: McMaster University
Location: #82 : OFFICE
Survey Date: 2022-01-11

Site: McMaster
Floor: 1

Building Name: 1 : UNIVERSITY HALL
Room #: 114
Last Re-Assessment: 2024-11-19

Area (sqft): 200

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	100	%	V9500	Presumed

ALL DATA REPORT

Client: McMaster University
Location: #101 : JANITOR ROOM
Survey Date: 2022-01-11

Site: McMaster
Floor: 1

Building Name: 1 : UNIVERSITY HALL
Room #: 128
Last Re-Assessment: 2024-11-19

Area (sqft): 80

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	N/a	Plaster	Not Applicable	N/A	C	Y		100			%	V0013	None Detected	N.D.	None	
Duct	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Floor	N/a	Vinyl Floor Tile and Mastic	Not Applicable	N/A	A	Y		80(7)			SF	V9500	Presumed Asbestos		Presumed Asbestos	NF
Mechanical Equipment	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Piping	N/a	N/A	Not Applicable	N/A	D	N						V0000	Non-Asbestos		None	
Structure	Beam, Deck	Concrete (precast)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Wall	N/a	Plaster	Not Applicable	N/A	C	Y		100			%	V0013	None Detected	N.D.	None	

Client: McMaster University
Location: #101 : JANITOR ROOM
Survey Date: 2022-01-11

Site: McMaster
Floor: 1

Building Name: 1 : UNIVERSITY HALL
Room #: 128
Last Re-Assessment: 2024-11-19

Area (sqft): 80

PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard	
Structure	Steel	100		%	V9500			Presumed Lead	
Wall	Plaster	100		%	V9500			Presumed Lead	

Client: McMaster University
Location: #101 : JANITOR ROOM
Survey Date: 2022-01-11

Site: McMaster
Floor: 1

Building Name: 1 : UNIVERSITY HALL
Room #: 128
Last Re-Assessment: 2024-11-19

Area (sqft): 80

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	100	%	V9500	Presumed

ALL DATA REPORT

Client: McMaster University
Location: #129 : CORRIDOR
Survey Date: 2022-01-11

Site: McMaster
Floor: 2

Building Name: 1 : UNIVERSITY HALL
Room #: 281
Last Re-Assessment: 2024-11-19

Area (sqft): 1000

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	N/a	Fireproofing (Fibrous)	Not Applicable	N/A	C	Y		150			SF	V0007	None Detected	N.D.	None	
Ceiling	N/a	Texture Coat	Not Applicable		C	Y		850(7)			SF	V0005	Chrysotile	50-75%	Confirmed Asbestos	F
Duct	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Floor	N/a	Terrazzo	Not Applicable	N/A								V0000	Non-Asbestos		None	
Mechanical Equipment	N/a	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Piping	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Structure	Deck	Concrete (poured)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Wall	N/a	Fireproofing (Fibrous)	Not Applicable	N/A	C	Y		800	2		SF	V0007	None Detected	N.D.	None	
Wall	N/a	Texture Coat	Not Applicable		C	Y		2000(7)			SF	V0005	Chrysotile	50-75%	Confirmed Asbestos	F

Client: McMaster University
Location: #129 : CORRIDOR
Survey Date: 2022-01-11

Site: McMaster
Floor: 2

Building Name: 1 : UNIVERSITY HALL
Room #: 281
Last Re-Assessment: 2024-11-19

Area (sqft): 1000

PAINT								
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard
Structure	Steel	100		%	V9500			Presumed Lead
Wall	Texture Coat	100		%	V9500			Presumed Lead

Client: McMaster University
Location: #129 : CORRIDOR
Survey Date: 2022-01-11

Site: McMaster
Floor: 2

Building Name: 1 : UNIVERSITY HALL
Room #: 281
Last Re-Assessment: 2024-11-19

Area (sqft): 1000

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	100	%	V9500	Presumed

ALL DATA REPORT

Client: McMaster University
Location: #172 : CORRIDOR
Survey Date: 2022-01-11

Site: McMaster
Floor: 3

Building Name: 1 : UNIVERSITY HALL
Room #: 381
Last Re-Assessment: 2024-11-19

Area (sqft): 1000

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	N/a	Fireproofing (Fibrous)	Not Applicable	N/A	C	Y		150			SF	V0007	None Detected	N.D.	None	
Ceiling	N/a	Texture Coat	Not Applicable		C	Y		850(7)	4(6)		SF	V0005	Chrysotile	50-75%	Confirmed Asbestos	F
Duct	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Floor	N/a	Terrazzo	Not Applicable	N/A								V0000	Non-Asbestos		None	
Mechanical Equipment	N/a	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Piping	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Structure	Deck	Concrete (poured)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Wall	N/a	Fireproofing (Fibrous)	Not Applicable	N/A	C	Y		800			SF	V0007	None Detected	N.D.	None	
Wall	N/a	Texture Coat	Not Applicable		C	Y		2000(7)			SF	V0005	Chrysotile	50-75%	Confirmed Asbestos	F

Client: McMaster University
Location: #172 : CORRIDOR
Survey Date: 2022-01-11

Site: McMaster
Floor: 3

Building Name: 1 : UNIVERSITY HALL
Room #: 381
Last Re-Assessment: 2024-11-19

Area (sqft): 1000

PAINT								
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard
Structure	Steel	100		%	V9500			Presumed Lead
Wall	Texture Coat	100		%	V9500			Presumed Lead

Client: McMaster University
Location: #172 : CORRIDOR
Survey Date: 2022-01-11

Site: McMaster
Floor: 3

Building Name: 1 : UNIVERSITY HALL
Room #: 381
Last Re-Assessment: 2024-11-19

Area (sqft): 1000

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	100	%	V9500	Presumed

Legend:

Sample number	Units	Other
S#### Asbestos sample collected	SF Square feet	A Access
L#### Paint sample collected	LF Linear feet	V Visible
P#### PCB sample collected	EA Each	AP Air Plenum
M#### Mould sample collected	% Percentage	F Friable material
V#### Material is visually identified to be identical to S####	LF Linear feet	NF Non Friable material
V0000 Known non hazardous material		PF Potentially Friable material
V9000 Material visually identified as a Hazardous Material		Pb Lead
V9500 Material is presumed to be a hazardous material		Hg Mercury
		As Arsenic
		Cr Chromium

Access
A Accessible to all building occupants
B Accessible to maintenance and operations staff without a ladder
C Accessible to maintenance and operations staff with a ladder. Also rarely entered, locked areas
D Not normally accessible

Condition
Good No visible damage or deterioration
Fair Minor, repairable damage, cracking, delamination or deterioration
Poor Irreparable damage or deterioration with exposed and missing material

Visible
Y The material is visible when standing on the floor of the room, without the removal or opening of other building components (e.g. ceiling tiles or access panels).
N The material is not visible to view when standing on the floor of the room and requires the removal of a building component (e.g. ceilings tiles or access panels) to view and access. Includes rarely entered crawlspaces, attic spaces, etc. Observations will be limited to the extent visible from the access points.
L The material is partially visible to view when standing on the floor of the room and requires the removal of a building component (e.g. ceiling system or access panels) to view completely and access. Includes partially viewed access points to crawlspaces, attic spaces, etc. without entering. Observations are limited to the extent visible from the access points.

Air Plenum
Yes or No The material is in a return air plenum or in a direct airstream or there is evidence of air erosion (e.g. duct for heating or cooling blowing directly on or across an ACM). This field is only completed where Air Plenum consideration is required by regulation.

Colour Coding
The material is a hazardous material, either by analytical results or by visible identification.
The material is presumed to be a hazardous material, based on visual appearance, and was not sampled due to limited access or the non-destructive nature of sampling.

Action					
(1)	Clean up of ACM Debris	(2)	Precautions for Access Which may Disturb ACM Debris	(3)	ACM removal
(4)	Precautions for Work Which may Disturb ACM in Poor Condition	(5)	Proactive ACM removal (Minimum repair required for fair condition)	(6)	ACM repair

(7) Management program and surveillance

1. **GENERAL**

1. **GENERAL REQUIREMENTS**

1. Division One, General Requirements, is a part of this section and shall apply as if repeated here.

2. **SHOP DRAWINGS**

1. Submit shop drawings in accordance with Article G.C. 3.11 of CCDC Document 2-2020.
2. Submit shop drawings for review by the Architect prior to fabrication.
3. Design Criteria-Applicable Standards:
 1. All standards in accordance with latest issue.
 2. CSA Standard CAN3-S16.1-M, "Steel Structures for Buildings" Limit States Design.
 3. CSA Standard W59, "Welded Steel Construction" (Metal Arc Welding).
 4. CSA Standard W.55.2, "Resistance Welding Practice."
 5. CSA Standard W55.3, "Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings."
 6. CSA Standard W.47, "Certification of Companies for Fusion Welding of Steel Structures."
 7. CSA Standard S.136, "Cold Formed Steel Structural Members".
 8. Ontario Building Code.
4. Certificates:
 1. Provide a certificate signed and sealed by the licensed/registered professional engineer responsible for the stair designs and the detailed steel connections (including guards) stating that the stairs and connections have been designed, detailed and fabricated in accordance with the applicable standards.
 2. Certification must bear the original seal and signature of the engineer and be dated. Photocopies are not acceptable.
5. Clearly indicate construction details, sizes of steel sections, thickness or gauge of steel sheet, connections, joints, method of anchorage, number of anchors, supports, reinforcement and accessories. Confirm all

dimensions on site.

3. STANDARDS

1. Materials and workmanship shall conform to the requirements of the Latest Ontario Building Code, as currently amended.
2. Do welding work to CSA W59, unless specified otherwise. Welders to qualify under CSA W47, CSA 55.2 and CSA W55.3.
3. Design of steel fabrications, unit stresses and workmanship to conform to CSA CAN3-S16 1-M.

4. DESIGN CRITERIA

1. Design stair: landing construction; guards and railings and connections to conform to the Ontario Building Code.
2. Design detail and fabricate in general to CSA CAN3-S16 1-M.

5. QUALITY ASSURANCE

1. WELDING APPLICABLE STANDARDS:

1. CSA Standard W59, "Welded Steel Construction" (Metal Arc Welding).
2. CSA Standard W.55.2, "Resistance Welding Practice."
3. CSA Standard W55.3, "Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings."
4. CSA Standard W.47, "Certification of Companies for Fusion Welding of Steel Structures."

2. QUALITY ASSURANCE

1. Fabrication and erection of all components to be by companies holding current C.W.B. Certification as Division 1 or Division 2.1. All welding by welders holding current certification for the required welding position.

6. SCOPE

1. Supply and install interior steel attic and roof access ladders, support frames for interior mechanical units, attic level service platforms.
2. Supply and install, miscellaneous items, steel bracket supports and angles.

3. Provide all miscellaneous metals (incl. stainless steel and aluminum) items as detailed and noted under other sections.
4. Provide all additional miscellaneous steel items as required to complete the above work.

2. **PRODUCTS**

1. **MATERIALS**

1. **Ferrous Metals:**

1. Unless otherwise indicated, hot rolled mild steel in .15% to .25% carbon range.
2. Steel sections and plate: CSA G40.21-/M1987, minimum 260W grade.
3. Square steel tube: CSA G40.21-/M1987, Grade 350W.
4. Steel pipe: ASTM A53-76, Type E, Grade A.
5. Sheet Steel: hot dip galvanized, cold rolled, with stretcher level degree of flatness to ASTM A526; zinc coating designation Z275.
2. Aluminum: CSA HA Series - M1980 for aluminum and aluminum alloys, Alcan 50S Alloy.
3. Prime Paint: Oil alkyd type (shop coat) conforming to CGSB-1-GP-40M. Colour to be grey.
4. Expansion Joints: as specified.
5. Welding Materials: CSA W59-1984.
6. Bituminous Enamel: Alkali resistant asphaltic coating conforming to CGSB1-GP-108M.
7. Non-shrink Grout: Por-Rok by Hallemite Products Ltd., or SET 15 Minute Anchoring Cement by SET Products Ltd.
8. Galvanized Touch-Up Paint: Zinc rich, Galvafruid by W.R. Meddows of Canada Ltd. or approved equal.
9. Hot Dipped Galvanizing: conform to CSA G164-M1981.
10. Bolts and Anchor Bolts: to ASTM A307-82a.

11. Stainless Steel:

1. To have brushed finish, Type 304 finish to be ornamental grade AISI No.4.

2. FABRICATION - GENERAL

1. Fabricate components in the shop in largest size practicable to minimize field jointing.
2. Fabricate components square, straight, true, free from warpage and other defects. Accurately cut, machine file and fit joints, corners, copes and mitres.
3. Reinforce fabricated components to safely withstand expected loads.
4. Make joints in built-up sections with hairline joints in least conspicuous locations and manner.
5. Make allowance for thermal expansion and contraction when fabricating exterior work.
6. Joints shall be welded unless otherwise indicated and unless details of construction do not permit welding. Exposed welds shall be continuous and shall be ground smooth.
7. Close exposed open ends of tubular members with welded on steel plugs.
8. Where work of other Sections is to be attached to work of this section, prepare work by drilling and tapping holes, as required to facilitate installation of such other work.
9. Work of this Section, supplied for installation under other Sections, shall be prepared as required ready for installation by: drilling, countersinking and tapping holes, forming shapes and cutting to required sizes.
10. Grind off mill stampings and fill recessed markings on steel components left exposed to view.
11. Make workmanship of best grade of modern shop and field practice known to recognized manufacturers specializing in this work. Fit joints and intersecting members accurately. Make work in true plumb, true, square, straight, level and accurate to sizes and shapes detailed, free from distortion or defects detrimental to appearance or performance.
12. Insulate metals where necessary to prevent corrosion due to contact between dissimilar metals and between metals and masonry, concrete or plaster. Use bituminous paint, butyl tape, building paper or other approved means.

13. Supply all fastenings, anchors and accessories required for fabrication and erection of the work. Make exposed metal fastenings and accessories of same material, texture, colour and finish as base metal on which they occur unless otherwise shown or specified. Keep exposed fastenings to an absolute minimum and inconspicuous, spacing them evenly and setting them out neatly. Make fastenings of permanent type.
14. Draw mechanical joints to hairline tightness and seal countersunk screws and access holes for locking screws with metal filler where these occur on exposed surface.

3. FINISHES

1. Thoroughly clean steel of loose scale, rust, oil, dirt and other foreign matter. Suitably prepare steel surfaces by power tool cleaning to receive specified finishes.
2. Grind smooth sharp projections.
3. Remove oil and grease by solvent cleaning.
4. Apply coatings in the shop and before assembly. Where size permits, galvanize components after assembly.
5. Shop apply coat of primer to interior components after fabrication except where galvanized finish and stainless steel is required.
6. Hot dip galvanize exterior components and other components, where so indicated, after fabrication in accord with requirements of CSA Standard G164-M1981.
7. Apply coat of bituminous enamel to contact surfaces of metal components in contact with cementitious materials and dissimilar metals.
8. After erection and installation, thoroughly clean the work and apply field touch up of same formula as shop coat to all damaged or unpainted surfaces. Work all paint well into all joints, crevices and open spaces.

4. MISCELLANEOUS STEEL SECTIONS

1. Supply all miscellaneous steel angles, plates, lintels, etc., indicated on the architectural drawings & not indicated on the structural drawings or noted on the structural drawings by others. Size according to loads, set plumb and true and securely fix. Continuously weld and grind smooth exposed connections. Others may be welded or bolted.

3. EXECUTION

1. INSTALLATION

1. Install components plumb, square, straight and true to line. Drill, cut and fit as necessary to attach this work to adjoining work.
2. Provide temporary supports and bracing required to position components until they are permanently anchored in place.
3. Securely anchor components in place; unless otherwise indicated, anchor components as follows:
 1. To concrete and solid masonry with expansion shields and bolts.
 2. To hollow construction with toggle bolts.
 3. To thin metal with screws or bolts.
 4. To thick metal with bolts or by welding.
 5. Fill space between railing members and sleeves with non-shrink grout.
 6. To wood with bolts or lag screws.
4. Provide all components required for anchoring. Make anchoring in concealed manner wherever possible. Make exposed fastenings, where approved by Architect neatly and of same material, colour, texture and finish as base metal on which they occur. Keep exposed fastenings evenly spaced.
5. Dissimilar metals and metals in contact with cementitious elements shall have contact surfaces coated with bituminous paint or be isolated by other means as approved by Architect.
6. After installation, clean and refinish injured finishes, welds, bolt heads and nuts. Refinish with zinc rich paint or primer to match original finish.

2. MISCELLANEOUS ITEMS, STEEL BRACKETS SUPPORTS AND ANGLES

1. Supply for installation by respective trades, steel brackets, supports, and angles as indicated on drawings. Drill for countersunk screws and anchor bolts. Prime paint for interior, galvanize for exterior.
2. Provide support brackets for vanities and counters, cabinets and storage units as indicated. These items are part of the allowance of miscellaneous items supplied to the millwork contractor.

3. Provide hot-dipped galvanized Roof Top Unit support posts and beams as required by manufacturer.
 4. Provide 8" min. D. hoist steel beam as requested by Elevator manufacturer.
 5. Provide steel miscellaneous angles and hanger rods as indicated.
 6. Provide other metal fabrications which are not a part of a manufactured item or covered under another section in Division 5. Refer to drawings.
3. INTERIOR ROOF ACCESS LADDER, AND STAIRS
1. Provide roof access ladder and stairs as detailed on drawings.
4. CAVITY CLOSURES AND COMPARTMENT CONTROL JOINTS
1. Cavity Closures: 12 gauge 304 stainless steel with 2B finish cold rolled formed to suit continuous bent closure profile:
 - around all window and curtain wall openings;
 - around all door openings,
 - around all other misc. openings through exterior cavity wall
 - at expansion joints and control jointsClosure(s) to have minimum dimensions to meet or exceed cavity wall insulation thickness / depth on both flanges. Do not over exceed insulation and air space cavity dimensions as to block off drainage and air space, this is to remain free of infill to breathe and drain.
 2. Compartment Control Joint (CCJ): 12 gauge 304 stainless steel, 2B finish cold rolled formed, complete with ss reinforcing wire @ 400 o/c through slotted holes.
 1. Exterior wall locations. Install CCJ at:
 1. All exterior corners, 300mm from corner on both sides;
 2. All interior cornersMax. 20m horizontally on walls and wherever indicated on the drawings.

END OF SECTION

1. **GENERAL**

1. **GENERAL REQUIREMENTS**

1. Division One - General Requirements, is a part of this Section, and shall apply as if repeated here.

2. **REFERENCE STANDARDS**

1. Standard of finished carpentry, metal work and cabinet work in accordance with the "Architectural Millwork Standards" of the Architectural Woodwork Manufacturers Association of Canada (AWMAC).

3. **QUALIFICATIONS**

1. The work of this trade shall be executed by a company having a minimum of 5 years proven first class experience in this type of work and having adequate equipment and skilled personnel. Refer to Instructions to Bidders for list of Prequalified Trades.

4. **SHOP DRAWINGS**

1. Submit Shop Drawings in electronic PDF format in accordance with GC.3.10 of CCDC Document 2 - 2020.
2. Before Shop Drawings and fabrication are started, take critical measurements at the site to facilitate installation and fitting of work.
3. Design Criteria - Applicable Standards:
 1. All standards in accordance with latest issue.
 2. Ontario Building Code
4. Clearly indicate construction details, sizes and wood and steel sections, thickness or gauge of wood and steel sheet, connections, joints, method of anchorage, number or anchors, supports, reinforcement and accessories. Confirm all dimensions on site.

5. **DELIVERY AND STORAGE**

1. Give Painter sufficient notice so that untreated or unpainted carpentry items or materials can be primed immediately upon delivery to site.
2. No equipment shall be delivered to the site until a portion of the building in which it is to be installed is completely ready for equipment as approved by the Architect.

3. Store finished work properly and keep under cover both in transit and at site. Finish woodwork shall not be delivered to site until concrete and masonry work has dried out.
4. Cover all plastic laminate and melamine faces at shop with heavy Kraft Paper.
5. Check access clearance at site before assembling.
6. SAMPLES
 1. Submit duplicate 12" x 12" (300 mm x 300 mm) samples of each type of panelling and each type of solid wood or plywood to receive stain or natural finish.
 2. Submit duplicate 12" (300 mm) long samples of each type of moulding.
 3. Submit samples of construction methods and all hardware.
7. WARRANTY
 1. The warranty period stipulated in the General Conditions of the Contract shall be extended five (5) years in writing against defects.
8. MOISTURE CONTENT
 1. Finish material to be dried to a uniform maximum moisture content of 12% for exterior work and 6% to 8% for interior work.

2. PRODUCTS

1. MATERIALS
 1. Materials used for finish work shall be sound, free from defects that would mar finished appearance, well seasoned and air dried and of good quality for intended purposes. Wood laminates pressure bonded.
 2. Plywoods: shall be plain sliced Maple architectural grade "AA" No. 1 Face Grade and shall comply to C.S.A. 0115-M1982, with plywood core, laminated with waterproof adhesive. Plywood shall be good both sides.
 3. Hardwoods - Shall be solid selected Maple Architectural Grade 'AA'. Wood shall be selected for uniform colours and graining when at stained and varnished items. Finger jointed woods will not be accepted.
 4. Framing Lumber - No. 2 or better spruce, pine or fir best mercantile lumber.
 5. Penetrating Sealer - "Penetrim" by Tremco Mfg. Co. (Canada) Ltd., or

"1402" by MacNaughton Brooks Ltd.

6. Painted Hardwood: American Poplar ("White Wood") "C" select grade.
7. Adhesive: As recommended by manufacturer for required application and to conform to C.S.A. 0121-M1978.
8. Nails, Spikes and Staples: To C.S.A. B111-1974, plain finish nails. Use spiral thread nails and barbed staples.
9. Pressure Treated Wood: Conforming to Section 06100, sizes as indicated and detailed. **NOTE**: Warped, twisted, loose or missing knots in wood will not accepted.
10. Exposed fasteners: All exposed fasteners to be stainless steel. At exposed screw locations use stainless steel screws and cup washers.
11. Refer to drawings and details for complete list of materials to be installed.

3. **EXECUTION**

1. WORKMANSHIP

1. Work shall be executed by mechanics skilled in their respective trade, according to best practice, or specified herein and indicated on drawings.
2. Check job dimensions and conditions and notify the Architect in writing of unacceptable conditions. Do not proceed until remedial instructions are received. Commencement of work will imply acceptance of site conditions and re-working or modification of the work as deemed necessary by the Architect will be done at no extra cost to the Owner.
3. As far as practical, assemble work at the shop and deliver to the job ready for installation. Leave ample allowance for fitting and scribing on the job.
4. Fabricate work square and to the required lines.
5. Lay out work carefully as indicated and to accommodate work of other trades. Accurately cut and fit; erect in proper position true to dimensions. Align, level, square, plumb, adequately brace, and secure permanently in place.
6. Use treated lumber for studs, blocking nailers, furring and other wood permanently installed in building. Brush coat freshly cut ends with two coats of concentrated form of preservative.
7. Recess and conceal fasteners and anchor heads. Fill with matching

wood plugs. Set nail heads and fasteners occurring within exposed interior carpentry work.

8. Provide wood members free from bruises, blemishes, mineral marks, knots, shake and other defects and select for uniform colour grain and texture. Machine and hand sand surfaces exposed in the finished work to an even, smooth surface free from defects detrimental to appearance.
9. Provide running members in the maximum lengths obtainable. Provide thickness of members in maximum dressed size of standard lumber. Where thickness of width indicated is not available in hardwoods, use glue laminations to obtain sizes required. Provide unexposed backs of veneers having the same physical characteristics as the face veneer.
10. Give painter sufficient notice so that untreated or unprimed carpentry items or materials can be primed immediately upon delivery to site. No exposed end grain of plywood shall be permitted; edging shall be solid 3/8" (10 mm) wide by thickness of plywood and of same species of wood. Finger jointed edging will not be accepted.
11. Co-operate with others engaged in work on the building to the end that proper unity of action will assure the orderly progress of the work. Do necessary boxing and protecting of sills, jambs, corners and the like. Construct scaffold, ramps, and other temporary staging necessary.

2. TRIM

1. Work includes miscellaneous trim as required of Oak unless indicated otherwise.
2. Trim members shall be of sizes and profiles indicated. Trim members shall be slow-fed work, free from chatter and other machine marks.
3. Install trim after it has been backprimed.
4. Members shall be full length and secured with wire nails, set and holes filled.
5. Mitre all joints.

3. INSTALLATION

1. Deliver Finish Carpentry to the site. Provide units of such sizes as will not present difficulty of entry to the place of installation. Where units are shipped in knock-down forms, provide clear instructions for assembly.
2. Install Finish Carpentry items plumb, square, true, rigid and secure with concealed fastening at exposed areas.

END OF SECTION

1 GENERAL

1.1 Summary

1.1.1 This Section shall conform to sections of Division One - General Requirements.

1.1.2 This Section relates to the manufacturing, supply and installation of all wood trim components to match existing/original wood components.

Repair, re-furbishing and re-finishing of existing wood trims and mouldings, fascia, soffits, cornice mouldings and trim, etc. to remain as impacted by the new work.

1.2 Reference Standards

1.2.1 Standard of finished carpentry, metal work and cabinetry work in accordance with the "Millwork Standards" of the Architectural Woodwork Manufacturers Association of Canada (AWMAC).

1.3 Qualifications

1.3.1 The following information is required:

- i. The work of this trade shall be executed by a company having a minimum of 15 years proven first class experience in this type of restoration work and having adequate equipment and skilled personnel.
- ii Examples of related work undertaken with present staff and facilities within last 5 years.
- iii Detailed production schedule, from receipt of order, shop drawing submission and approval, shop fabrication and delivery to site that meets or exceeds the project schedule.
- iv The contractor submission will be subject to review and solely acceptance by the Architect.

1.4 Shop Drawings

1.4.1 Submit Shop Drawings in multiple copies of four (4) in accordance with GC.3.11 of CCDC Document 2 - 2020.

1.4.2 Before Shop Drawings and fabrication are started, take critical measurements at the site to facilitate installation and fitting of work.

1.5 Delivery and Storage

1.5.1 Give Painter sufficient notice so that untreated or unpainted carpentry items or materials can be primed immediately upon delivery to site.

1.5.2 No equipment shall be delivered to the site until a portion of the building in which it is to be installed is completely ready for equipment as approved by the

Architect.

- 1.5.3 Store finished work properly and keep under cover both in transit and at site. Finish woodwork shall not be delivered to site until concrete and masonry work has dried out.
- 1.5.4 Check access clearance at site before assembling.
- 1.5.5 If required, store millwork items in temperature and humidity controlled area until delivery.
- 1.6 **Related Work Specified Elsewhere**
 - 1. Section 06100 – Rough Carpentry
- 1.7 **Samples**
 - 1.7.1 Submit duplicate 12" x 12" (300 mm x 300 mm) samples of each type of paneling type of solid wood to match existing and to receive paint finish.
 - 1.7.2 Submit duplicate 12" (300 mm) long samples of each type of moulding, profile, trims, fascia, soffits, etc.
 - 1.7.3 Submit samples of construction methods and all hardware.
- 1.8 **Warranty**
 - 1.8.1 At no cost to the Owner, repair any defects in the work of this Section due to lamination or warping. Finish carpentry components for a period of two (2) years from date of Substantial Performance.
- 1.9 **Moisture Content**
 - 1.9.1 Finish material to be dried to a uniform maximum moisture content of 10% for exterior work.

2 PRODUCTS

- 2.1 **Materials**
 - 2.1.1 Materials used for finish work shall be sound, free from defects that would mar finished appearance, well seasoned and air dried and of good quality for intended purposes. Wood laminates pressure bonded.
 - 2.1.2 Framing Lumber: No.2 or better spruce, pine or fir best mercantile lumber to CSA 0141-91.
 - 2.1.3 Exposed Framing Lumber, T&G Boards, Trim, Mouldings, Brackets and Profiles: No. 1 clear fir with no knots, D Select or better, kiln dried to a moisture content no greater than 10% at time of fabrication.

- 2.1.4 Epoxy (for all end grains and skyward faces): Arbatron Inc. Epoxy or approved equal.
- 2.1.5 Adhesive: As recommended by manufacturer for required application and to conform to C.S.A. 0121.
- 2.1.6 Nails, Spikes and Staples: To C.S.A. B111, plain stainless steel nails. Use spiral thread stainless steel nails and barbed staples.

3 EXECUTION

3.1 Workmanship

- 3.1.1 Work shall be executed by mechanics skilled in their respective trade, according to best practice, or specified herein and indicated on drawings.
- 3.1.2 Check job dimensions and conditions and notify the Architect in writing of unacceptable conditions. Do not proceed until remedial instructions are received.
- 3.1.3 As far as practical, assemble work at the shop and deliver to the job ready for installation. Leave ample allowance for fitting and scribing on the job.
- 3.1.4 Fabricate work square and to the required lines.
- 3.1.5 Lay out work carefully as indicated and to accommodate work of other trades. Accurately cut and fit; erect in proper position true to dimensions. Align, level, square, plumb, adequately brace, and secure permanently in place.
- 3.1.6 Use lumber for studs, blocking nailers, furring and other wood permanently installed in building.
- 3.1.7 Recess and conceal fasteners and anchor heads. Fill with matching wood plugs. Set nail heads and fasteners occurring within exposed carpentry work.
- 3.1.8 Provide wood members free from bruises, blemishes, mineral marks, knots, shake and other defects and select for colour grain and texture. Machine and hand sand surfaces exposed in the finished work to an even, smooth surface free from defects detrimental to appearance.
- 3.1.9 Provide running members in the maximum lengths obtainable. Provide thickness of members in maximum dressed size of standard lumber. Where thickness of width indicated is not available, use glue laminations to obtain sizes required.
- 3.1.10 Give painter sufficient notice so that untreated or unprimed carpentry items or materials can be primed immediately upon delivery to site. No exposed end grain of plywood shall be permitted. Edge grain only exposed to weather. All skyward facing wood components such as sills to be coated with thinned epoxy prior to painting.
- 3.1.11 Co-operate with others engaged in work on the building to the end that proper unity of action will assure the orderly progress of the work. Do necessary boxing

and protecting of sills, jambs, corners and the like. Construct scaffold, ramps, and other temporary staging necessary.

- 3.1.12 Machine dressed work shall be slow fed using sharp cutter and finished members shall be free from drag, feathers, slivers or roughness of any kind. Remove machine marks by sanding.
- 3.1.13 Accurately scribe, cope and mitre members where required.
- 3.1.14 Glue, blind screw or nail all work unless otherwise specified. Set surface nails and plug surface screws with wood plugs of material to match surface. Conceal nailing of tongued and grooved work.
- 3.1.15 Joints made on Site shall be equal in quality and workmanship to joints made in shop.
- 3.1.16 Mortise and tenon joints shall be glued and pinned.
- 3.1.17 Conceal joints and connections wherever possible. Locate prominent joints where to match existing and as directed by Architect. Intermediate joints between supports not permitted.
- 3.1.18 Design construction methods for expansion and contraction of material.
- 3.1.19 Take care to prevent opening up of glue lines in finished work.
- 3.1.20 Be responsible for methods of fabrication and for ensuring that materials are rigidly and securely attached and will not be loosened by installation of items on Site or by work of other trades.
- 3.1.21 Provide all blocking coming in direct contact with millwork in accordance with applicable provision set forth herein.
- 3.1.22 Glues shall be waterproof and of type suitable for work to be joined.
- 3.1.23 Refer to glue manufacturer's recommendations for lumber moisture content, glue shelf life, pot life, working life, mixing, spreading, assembly time, time under pressure and ambient temperature.

3.2 **Wood Restoration Components, Trim, Profiles, Fascia, Soffits**

- 3.2.1 Work includes miscellaneous trim, base trim, with profiles as required of fir unless indicated otherwise, or solid wood to match existing/original.
- 3.2.2 All members shall be of sizes and profiles to match existing. Members shall be slow-fed work, free from chatter and other machine marks.
- 3.2.3 Install members after they have been back-primed or sealed.
- 3.2.4 Members shall be full length and secured with glue and stainless steel nails, set and holes filled.

3.2.5 Mitre all joints.

3.3 **Installation**

3.3.1 Deliver Restoration Finish Carpentry to the site.

3.3.2 Construct and install work as indicated on Drawings.

3.3.3 Install Restoration Finish Carpentry items plumb, square, true, rigid and secure.

3.3.4 Be responsible for methods of installation and for ensuring that items and materials are rigidly and securely attached and will not be loosened by work of other trades.

3.3.5 When installing items not shop assembled, distribute defects allowed in quality grade specified to best overall advantage.

3.3.6 Fasten all wood nailers, blocking, framing and strapping solidly to adjacent materials in true planes.

3.3.7 Joints made on site shall be equal in quality and workmanship to joints made in shop.

3.3.8 Strips and Blocking

.1 Provide and install wood strips required for attaching work of other Sections.

.2 Provide and install all wood blocking required.

3.4 **CLEANING**

3.4.1 On completion, remove manufacturer's identification markings, then sand and clean all surfaces.

End of Section

1. GENERAL

1. GENERAL REQUIREMENTS

1. Division One, General Requirements, is a part of this Section, and shall apply as if repeated here.

2. WORK INCLUDED

1. This section includes polyethylene vapour barrier for installation at warm side of insulation at stud wall construction, and at warm side of insulation at roof/wall transitions.

3. SPECIAL PROTECTION

1. Provide adequate protection of materials and work of this Section from damage by weather and other causes.
2. Protect the work of other Subcontractors from damage resulting from work of this Section. Make good such damage to the satisfaction of the Consultant.

2. PRODUCTS

1. MATERIALS

1. Polyethylene Film Vapour Barrier: equal to CAN/CGSB-51.34. (min. 6 mil thickness) for all areas (except for below concrete slabs on grade).

2. ACCESSORIES

1. Staples: ½" (12 mm) minimum leg.
2. Sealant: Tremco Acoustic Caulking.
3. Tape: 3M No. Y-8086 Contractor's Sheathing Tape or duct tape as recommended by vapour barrier manufacturer, 2" (50 mm) wide at all joints, etc.

3. EXECUTION

1. INSTALLATION

1. Place polyethylene on warm side of insulation and tight to insulation at exterior wall and ceiling assemblies prior to installation of gypsum board to form continuous barrier.
2. Use sheets of largest practical size to minimize joints.

3. Secure vapour barrier to framing members and use sealant at joints. Lap joints 16" (400 mm) minimum and caulk complete joint with sealant over solid backing at joint, then tape all joints. Ensure joints occur over framing members.
4. Caulk with sealant where screws or staples penetrate vapour barrier. Tape seal areas where nails or staples penetrate vapour barrier and at all points of penetration.
5. Seal vapour barrier at points of penetration.
6. Inspect sheets for continuity. Patch breaks and openings in vapour barriers. Tape seal.
7. Take extreme care to ensure continuity of vapour barriers. Patch breaks and openings in vapour barriers.
8. Cut sheet vapour barrier to form openings and ensure material is lapped and sealed at frames.
9. Seal perimeter of sheet vapour barrier as follows:
 1. Apply continuous bead of sealant to substrate at perimeter of sheets.
 2. Lap sheet over sealant and press into sealant bead.
 3. Install staples through perimeter of sheets at sealant bead into wood substrate. Use tape to hold in place at metal masonry and concrete substrate.
10. Seal lap joints of sheet vapour barrier as follows:
 1. Attach first sheet to substrate.
 2. Apply continuous bead of sealant over solid backing at joint.
 3. Lap adjoining sheet minimum 150 mm and press into sealant bead.
 4. Install staples through lapped sheets at sealant bead into wood substrate. Use tape to hold in place at metal substrate.
 5. Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.
11. Seal electrical switch and outlet device boxes that penetrate vapour barrier as follows:

1. For sheet-type vapour barriers, install moulded box vapour barrier wrap boxes with polyethylene film sheet providing minimum 300 mm perimeter lap flange.
2. Apply sealant to seal edges of flange to main vapour barrier and seal wiring penetrations through box cover.
12. Protect ceiling insulation with vapour barrier. Extend ceiling vapour barrier over all exterior and interior wallheads.
13. Attach warning labels to walls with vapour barrier.

END OF SECTION

1. GENERAL

1. GENERAL REQUIREMENTS

1. Division One, General Requirements is part of this Section and shall apply as if repeated here.

2. SCOPE OF WORK

1. Supply and install rigid insulation at top and side of roof parapets; roof curbs and foundation upturn, and high wall/low roof conditions below through wall flashing; below grade insulation at perimeter walls; below interior floor slabs at exterior entrance concrete slabs, and elsewhere where indicated on drawings.

3. SUBMITTALS

1. Submit shop drawings and samples in accordance with CCDC Document 2-2020 - Submittals for items 2 below.

2. PRODUCTS

1. INSULATION

1. Below Grade foundation Locations: To conform to CAN/ULC S701 Type 4, ship lapped / square edged – buttered with waterproofing membrane backup, extruded polystyrene rigid insulation to be "Styrofoam SM" with RSI 0.87 (R-5.0) minimum thermal resistance values per inch by DuPont de Nemours, Inc. or equal.
2. Below Grade Cavity Wall Locations: Shipped lapped / square edged – buttered with waterproofing / air/vapour barrier retarder backup, ultra extruded polystyrene rigid insulation to be "Styrofoam Cavitymate Ultra" (Grey) with RSI 0.97 (R-5.6) minimum thermal resistance value per inch by DuPont de Nemours, Inc. or equal.
3. Below Grade, Slab on Grade, Frost Slab, Door Threshold Locations: To conform to CAN/ULC S701 Type 4, square edge, extruded polystyrene rigid insulation to be "Styrofoam SM" with RSI 0.87 (R-5.0) minimum thermal resistance values per inch by DuPont de Nemours, Inc. or equal.
4. Above Grade Cavity Wall Locations (over masonry or concrete substrates where all the insulation is on the exterior side of the wall substrate) and parapets: Ship lapped / square edged – buttered or air retarder backup, ultra extruded polystyrene rigid insulation to be "Styrofoam Cavitymate Ultra" (Grey) with RSI 0.97 (R-5.6) or "Styrofoam SM" with RSI 0.87 (R-5.0) minimum thermal resistance values per inch by DuPont de Nemours, Inc. or equal – less than 1 permeance.
5. Above Grade Cavity Wall Locations (over exterior sheathing, on framed substrate systems where mineral wool insulation fills the framed substrate cavity void): Ship lapped / square edged – buttered, extruded polystyrene

rigid insulation to be "Styrofoam Cladmate" with RSI 0.88 (R-5.0) minimum thermal resistance values per inch by DuPont de Nemours, Inc. or equal – greater than 1 permeance - this insulation is to be breathable and only an air barrier on the exterior side of the wall substrate sheathing.

6. Foam Insulation: Sprayed polyurethane foam to flame spread rating of less than 500, min. RSI 1.05 (R 6/1") at density of 32.8 kg/cu.m (2lb/cu.ft). Spray foam at voids and broken areas in the rigid insulation. Spray foam is for repairs only.

2. ADHESIVE

1. Cavity wall insulation board perimeter buttered edges: "Air-Bloc 21" by Bakor (air/vapour retarder, both)

Note:

Over exterior sheathing, on framed substrate systems where there is mineral wool insulation filling the voids with a continuous air/vapour barrier sealed on the interior side of the framing members, the exterior rigid insulation is not to be sealed around perimeters when the contractor does not install Cladmate as specified for breathability.

2. Adhesive for perimeter insulation below grade: to be CGSB 71-GP-24m equal to Bakor 230-3J.

3. EXECUTION

1. WORKMANSHIP

1. Work shall include rigid insulation in cavity walls, clear storey walls; roof parapets, roof curbs, below grade foundation perimeter and below concrete entrance slabs.
2. Surfaces to receive rigid insulation shall be clean, free of grease and oil, and reasonably smooth with no mortar or concrete pin projections.
3. Install insulation after building substrate materials are dry.
4. Prime surfaces before using asphaltic type adhesives.
5. Install all materials using adhesive or fasteners in strict accordance with manufacturer's installation instructions unless otherwise specified herein.
6. Ensure a uniform, continuous thermal barrier effect. Where insulation is to be provided under other Sections, co-ordinate the work such that the thermal barrier continuity is achieved.
7. Install insulation to maintain continuity of thermal protection to building elements and spaces.
8. Fit insulation closely around electrical boxes, plumbing and heating pipes

and ducts, and other protrusions.

9. Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from damaged or broken edges. Use longest possible lengths to reduce number of joints. Keep insulation minimum 3" (75 mm) from heat emitting devices such as recessed light fixtures, and a minimum 2" (50 mm) from sidewalls of CAN4-S604 Type "A" chimneys and CAN1-B149.1 and CAN1-B149.2 Type "B" and "L" vents.
10. In multiple layer applications offset both vertical and horizontal joints.
11. Do not enclose insulation until it has been inspected.

2. BELOW GRADE FOUNDATION WALL LOCATIONS – WITH BELOW GRADE FLOOR LEVEL / BASEMENT

1. Install 75mm (3") minimum rigid insulation using below grade adhesive (fasteners not to be used as this will puncture the waterproofing membrane already adhered to the concrete foundation system) dabbed on as required to hold insulation in place prior to installing waterproofing drainage bubble board over. Backfill gently at below grade perimeter foundation locations.
2. Repair all open joints and damaged edges with foam spray insulation to fill voids.

3. BELOW GRADE CAVITY WALL LOCATIONS

1. Install 75mm (3") minimum rigid insulation using below grade adhesive (fasteners not to be used as this will puncture the waterproofing membrane already adhered to the concrete foundation system) dabbed on as required to hold insulation in place prior to installing solid masonry over.
2. This is typically two courses below floor level datum without a below grade floor level / basement, or 4 courses below floor level datum with below grade floor level / basement overlapping below grade exterior foundation wall insulation by two courses – 4x overlapping.
3. Repair all open joints and damaged edges with foam spray insulation to fill voids.

4. BELOW GRADE – EXTERIOR HARD SURFACE LOCATIONS

1. Install 100mm (4") for 1220mm (4') minimum rigid insulation out below / underside all hard surface materials from building perimeters.
2. Repair all open joints and damaged edges with foam spray insulation to fill voids.

5. BELOW SLAB ON GRADE – INTERIOR HEATED SLABS

1. Zone 5
Install 75mm (3") x 915mm (36") vertical (on inside of foundation) and 50mm (2") x continuous horizontal (underside slab on grade) minimum rigid insulation around building perimeters where more stringent insulation is not indicated / detailed on drawings – this is typically Zone 5.
 2. Zone 6
Install 75mm (3") x 915mm (36") vertical (on inside of foundation) and 50mm (2") x 610mm (24") (1220mm (4') at daycare locations) horizontal (underside slab on grade) minimum rigid insulation around building perimeters where more stringent insulation is not indicated / detailed on drawings – this is typically Zone 6.
 3. Zone 7
Install 100mm (4") x 915mm (36") vertical (on inside of foundation) and 50mm (2") x continuous horizontal (underside slab on grade) minimum rigid insulation around building perimeters where more stringent insulation is not indicated / detailed on drawings – this is typically Zone 6.
 4. Repair all open joints and damaged edges with foam spray insulation to fill voids.
6. BELOW SLAB ON GRADE – INTERIOR NON-HEATED SLABS
1. Zone 5
Install 50mm (2") x 610mm (24") vertical (on inside of foundation) and 50mm (2") x 610mm (24") (1220mm (4') at daycare locations) horizontal (underside slab on grade) minimum rigid insulation around building perimeters where more stringent insulation is not indicated / detailed on drawings – this is typically Zone 5.
 2. Zone 6
Install 75mm (3") x 610mm (24") vertical (on inside of foundation) and 50mm (2") x 610mm (24") (1220mm (4') at daycare locations) horizontal (underside slab on grade) minimum rigid insulation around building perimeters where more stringent insulation is not indicated / detailed on drawings – this is typically Zone 6.
 3. Zone 7
Install 75mm (3") x 610mm (24") vertical (on inside of foundation) and 50mm (2") x continuous horizontal (underside slab on grade) minimum rigid insulation around building perimeters where more stringent insulation is not indicated / detailed on drawings – this is typically Zone 6.
 4. Repair all open joints and damaged edges with foam spray insulation to fill voids.
7. BELOW GRADE FROST SLAB LOCATIONS
1. Install 100mm (4") thick for 1220mm (4') horizontal out from all exterior frost

slab foundation systems, then 50mm (2") for 1220mm (4') out from 4" thick insulation horizontal at all hard surface locations. Coordinate with typical frost slab plan detail.

2. Repair all open joints and damaged edges with foam spray insulation to fill voids.

8. BELOW GRADE INSULATION AT DOOR THRESHOLDS

1. Install 50mm (2") x 200mm (8") minimum vertical rigid insulation below door thresholds between interior slab on grade and exterior frost slabs at every door threshold location.
2. Repair all open joints and damaged edges with foam spray insulation to fill voids.

9. ABOVE GRADE CAVITY WALL LOCATIONS

1. Install 75mm (3") minimum rigid insulation using above grade adhesive dabbed on as required to hold insulation in place prior to installing fasteners with enlarged plastic washer heads for final anchorage / fastening (there is no air/vapour barrier membrane adhered / fastened to the wall substrate system to puncture, only an air barrier as the wall substrate cavity has more insulation to fill the void along with an air/vapour barrier on the interior side.
2. Repair all open joints and damaged edges with foam spray insulation to fill voids.

10. ABOVE GRADE ROOF PARAPETS AND CURBS

1. Cut and fit 75mm (3") minimum rigid insulation at tops and sides of roof parapets and curbs as detailed on drawings.
2. Repair all open joints and damaged edges with foam spray insulation to fill voids.

END OF SECTION

1. GENERAL

1. GENERAL REQUIREMENTS

1. Division One, General Requirements, is a part of this Section and shall apply as if repeated here.

2. WORK INCLUDED

1. Firestopping and smoke seal wall(s), floor(s) and roof assemblies at all vertical and horizontal fire separations, (including 0 hr. rated walls). Division 15 and 16 of firestopping and smoke seals shall be by Mechanical and Electrical Contractors where their equipment and materials penetrated rated walls. Coordinate with Life Safety Drawings, ceiling plans, and all other drawings for exact location of smoke/fire rated assemblies.

3. SAMPLES

1. Submit samples in accordance with Section 01300 - Shop Drawings, Product Data, Samples and Mock-ups.
2. Submit 1'-0" (300 mm) x 1'-0" (300 mm) sample of each actual firestop material proposed for project.

4. QUALITY ASSURANCE

1. Applicator shall be licensed by the manufacturer of fireproofing materials with minimum three years documented experience for installing firestopping and smoke seal systems.
2. Submit manufacturer's certification that materials meet or exceed specified requirements.
3. Product manufactured under ULC Follow-up Program. Each container or package shall bear ULC label or listing mark.

5. SHOP DRAWINGS

1. Submit shop drawings and product data in accordance with Section 01300 - Shop Drawings, Product Data, Samples and Mock-ups.
2. Submit shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation. Construction details should accurately reflect actual job conditions.
3. Submit manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site. Include manufacturer's printed instructions for installation.

6. SEQUENCING AND SCHEDULING

1. Sequence work to permit installation of firestopping and smoke seal materials to be installed after adjacent work is complete and before closure of spaces.

7. MUNICIPAL AUTHORITY APPROVAL

1. Discuss firestopping and smoke seal requirements with municipal building inspector to obtain their approval prior to installation. Determine which products and/or procedures will be required to obtain final approval.
2. Submit in writing, prior to commencing installation, full detailed descriptions of materials and methods to be employed for firestopping work to achieve full final approval of authorities having jurisdiction.

2. PRODUCTS

1. MATERIALS

1. Firestopping and smoke seal systems: A/D FIREBARRIER Firestop Systems by A/D Fire Protection Systems Inc., capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of CAN4-S115-M85, and not to exceed opening sizes for which they are intended. Other manufacturers shall not be used unless approved in writing (5) days prior to tender closing. Approved Alternate Manufacturer: Tremco Ltd., Fire Stopping Systems and Hilti Firestopping Systems.
2. Mineral Wool Backing Insulation: ULC Labelled, preformed non-combustible material A/D FIREBARRIER Mineral Wool by A/D Fire Protection Systems Inc.
3. Firestopping Sealant: ULC labelled, single component silicone based, A/D Silicone FIREBARRIER Sealant by A/D Fire Protection Systems Inc.
4. Firestopping Seal: ULC labelled, single component water-based seal, A/D FIREBARRIER Seal by A/D Fire Protection Systems Inc.
5. Spray-On Firestopping Sealant: ULC labelled, high performance single component, water-based, elastomeric acrylic firestop sealant, "TREMstop Acrylic SP" (sprayable grade) by Tremco Ltd.
6. Fire resistance rating of installed firestopping assembly not less than the fire resistance rating of surrounding floor and wall assembly as indicated on the drawings.
7. Firestopping system at openings around penetrations for pipes, ductwork, conduit and other mechanical and electrical items requiring sound and vibration control: elastomeric sealant type with mineral wool; do not use a cementitious or rigid seal at such location.

8. Primers: to manufacturer's recommendation for specific material, substrate, and end use.
9. Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
10. Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
11. Sealants for vertical joints: non-sagging.
12. Firestopping mortar is not acceptable.

3. EXECUTION

1. EXAMINATION

1. Examine existing conditions to receive this work prior to submitting shop drawings.
2. Examine surfaces to receive work of this Section and report any defects which may affect the Work of this Section.
3. Verify that openings are ready to receive the Work of this Section.
4. Confirm compatibility of surfaces to receive firestopping and smoke seal materials.
5. Beginning of installation means acceptance of existing surfaces and substrate.

2. PREPARATION

1. Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials. Ensure that substrates and surfaces are dry and frost free.
2. Prepare surfaces in contact with firestopping materials and smoke seals to manufacturer's instructions.
3. Maintain insulation around pipes and ducts penetrating fire separation.
4. Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3. INSTALLATION

1. Install firestopping and smoke seal material and components in accordance with ULC certification and manufacturer's instructions.

2. Seal holes or voids made through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained. For vertical sections, sealant is required only on the top side of the mineral wool. It is required on both sides for horizontal sections except only one side on '0' hour rated walls.
3. Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
4. Tool or trowel exposed surfaces to a neat finish.
5. Remove excess compound promptly as work progresses and upon completion.
6. Install firestopping with smoke seal sealant on both sides of all fire rated walls except for '0' hour rated walls where sealants is required continuously only one side of mineral wool backing insulation.

4. INSPECTION

1. Notify architect when ready for inspection and prior to concealing or enclosing firestopping and smoke seal materials and service penetration assemblies.
2. Arrange for final inspection of the work of this Section by firestopping manufacturer and municipal building inspector prior to concealing or enclosing work. Make corrections required.

5. SCHEDULE

1. Fire and smoke seal at all areas where work is indicated on drawings (corridors, mechanical rooms, ceilings, janitor's room, washrooms, changerooms, server, Library, gymnasium, etc. fire separations), and at locations as follows:
 1. Generally all locations required by code.
 2. Penetrations through fire resistance rated (including 0 hour rated fire separations) masonry and concrete walls (except mechanical and electrical penetrations which will be firestopped by the mechanical and electrical contractors).
 3. Top of fire resistance rated masonry and gypsum rated partitions and walls (Includes corridors noted as 0 hr. fire rating)

NOTE: Refer to Architectural drawings for locations of vertical fire separations.
 4. Intersection of fire resistance rated masonry.
 5. Control and sway joints in fire resistant rated masonry.

6. Penetrations through all floor slabs and fire rated ceilings (except mechanical and electrical penetrations which will be firestopped by the mechanical and electrical contractors).
7. Openings and sleeves installed for future use through fire resistant rated separations.

6. CLEAN-UP

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

7. CERTIFICATION

1. The manufacturer of the firestopping and smoke seal products shall inspect each application on site and certify in writing its fire rating.
2. Costs for manufacturer's site inspection of firestopping and smoke seals application and certification shall be included in this Contractor's Section 07270 base bid.

End of Section

1. GENERAL

1.1. GENERAL REQUIREMENTS

- 1.1.1. Division One, General Requirements, is a part of this section and shall apply as if repeated here.

1.2. INTENT

- 1.2.1. Provide for the proper and complete installation of all roofing and flashings as required to prevent entry of moisture into the insulation and structure below the roofing and flashing.

1.3. QUALIFICATIONS

- 1.3.1. Work shall be executed by an applicator who has adequate plant, equipment and skilled tradesmen to perform this work expeditiously, and is known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past five years. Likewise applicator must be a member of the C.R.C.A. and a member in good standing with the appropriate provincial roofing contractors association.
- 1.3.2. Applicator must be approved by the Consultant, Owner and the roofing material manufacturers.
- 1.3.3. Applicator shall provide a list of a least five (5) projects available for inspection employing same roofing system within 200km. radius of the project.
- 1.3.4. The intent is to have a complete roofing system provided by one manufacturer. The following manufacturers are considered to have equivalent systems/products suitable for use on this project; Siplast, Garland, Tremco, Soprema, IKO, Bakor.

1.4. REFERENCES

- 1.4.1. CSA - Canadian Standards Association
- 1.4.2. CGSB - Canadian General Standards Board
- 1.4.3. ULC - Underwriters Laboratories of Canada
- 1.4.4. FM - Factory Mutual Engineering Corporation
- 1.4.5. CRCA - Canadian Roofing Contractors Association
- 1.4.6. Canadian Construction Documents Committee (CCDC), CCDC 2-2008 Stipulated Price Contract.
- 1.4.7. ASTM – Standards Test Methods for Sampling and Testing Bitumen Saturated

Felts and Woven Fabrics for Roofing and Waterproofing.

1.5. ADMINISTRATIVE

- 1.5.1. Submit to the Consultant submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- 1.5.2. Work affected by submittal shall not proceed until review is complete.
- 1.5.3. Present shop drawings, product data, samples and mock-ups in SI Metric units.
- 1.5.4. Where items or information is not produced in SI Metric units converted values are acceptable.
- 1.5.5. Review submittals prior to submission to the Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and shall be considered rejected.
- 1.5.6. Notify the Consultant, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- 1.5.7. Contractor is responsible to verify field measurements and all site conditions including adjacent properties and roof areas.
- 1.5.8. Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.
- 1.5.9. Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by the Consultant's review.
- 1.5.10. Keep one reviewed copy of each submission on site.

1.6. SHOP DRAWINGS & PRODUCT DATA

- 1.6.1. The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by the Contractor to illustrate details of a portion of the Work.
- 1.6.2. Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items

have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

- 1.6.3. Allow 7 days for Consultant's review of each submission.
- 1.6.4. Adjustments made on shop drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to the Consultant prior to proceeding with Work.
- 1.6.5. Make changes in shop drawings as the Consultant may require, consistent with Contract Documents. When resubmitting, notify the Consultant in writing of any revisions other than those requested.
- 1.6.6. Accompany submissions within containing:
 1. Date.
 2. Project title and number.
 3. Contractor's name and address.
 4. Identification and quantity of each shop drawing, product data and sample.
 5. Other pertinent data.

Submissions shall include:

1. Date and revision dates.
 2. Project title and number.
 3. Name and address of:
 4. Subcontractor.
 5. Supplier.
 6. Manufacturer.
 7. Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 8. Details of appropriate portions of Work as applicable:
 9. Fabrication.
 10. Layout, showing dimensions, including identified field dimensions, and clearances.
 11. Setting or erection details.
 12. Capacities.
 13. Performance characteristics.
 14. Standards.
 15. Operating weight.
 16. Wiring diagrams.
 17. Single line and schematic diagrams.
 18. Relationship to adjacent work.
- 1.6.7. After Consultant's review, distribute copies.
 - 1.6.8. Submit 3 prints of shop drawings for each requirement requested in specification Sections and as Consultant may reasonably request.

- 1.6.9. Submit 3 copies of product data sheets or brochures for requirements requested in Specification. Sections and as requested by the Consultant where shop drawings will not be prepared due to standardized manufacture of product.
- 1.6.10. Delete information not applicable to project.
- 1.6.11. Supplement standard information to provide details applicable to project.
- 1.6.12. If, upon review by the Consultant no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- 1.6.13. The review of shop drawings by the Consultant is for sole purpose of ascertaining conformance with general concept. This review shall not mean that the Consultant approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting all requirements of construction and Contract Documents. Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of all sub-trades.

1.7. HANDLING & STORAGE OF MATERIALS

- 1.7.1. Handle and store materials carefully to prevent damage. Manufacturer's labels, seals and identification shall remain intact. Store containers upright and roll materials on end to prevent flattening. Protect materials from moisture at all times.
- 1.7.2. Deliver materials in sufficient quantities to allow for continuity of work.
- 1.7.3. Co-ordinate delivery with Owner.
- 1.7.4. Store materials marked "keep from freezing" in areas where temperatures will remain above 4°C (40°F).
- 1.7.5. Contractor shall assume responsibility for the protection and safekeeping of products stored on the job site.
- 1.7.6. Provide a continuous fence at grade level around all machinery, material and equipment 7'6" in height with welded mesh and welded tubing that includes a gate/door with locking gate to meet or exceed manufacturer's recommendations.

- 1.7.7. The Contractor's materials and equipment shall be kept orderly and shall not encumber operations of facilities. Job site shall be maintained free of marketing signage.

1.8. INSPECTION & TESTING

- 1.8.1. Roofing shall be completed in strict accordance with specifications, conforming to best trade practice and to the satisfaction of the Owner or his authorized representative. Afford facilities and access for inspecting the work as required and immediately act upon instructions given.
- 1.8.2. Notify inspection authority minimum two working days in advance of commencing work and provide further notification as required due to temporary postponement of work, etc.
- 1.8.3. Make and repair all cut tests for testing purposes at locations requested. Cut tests will be made during progress of work or on completion of work. Wherever possible, tests will be made before workmen have left the site, all at no additional cost to the contract.
- 1.8.4. Samples of roof membrane from cut tests and samples of material taken from containers may be kept by the Consultant. These samples may be submitted to an independent laboratory for testing purposes. Cut test locations should be reinstated with material and installation as specified immediately after cut tests have been provided.
- 1.8.5. Should test results prove that a material is not functionally equal to specified material:
Contractor shall pay for all testing. Roofing installed and found not to comply with the specifications shall be removed and replaced at no change in the contract price.
- 1.8.6. Membrane manufacturer to inspect installation to ensure compliance with product application requirements. It is the Contractor's responsibility to arrange with the manufacturer's representative to provide inspections. The manufacturer's representative shall visit the project during the course of roofing work often enough to ensure that the work is being undertaken in accordance with the manufacturer's written recommendations. The Consultant shall be notified of all such visits in writing.
- 1.8.7. When all work is substantially completed the Roofing Contractor shall arrange for an inspection. At this time the Roofing Contractor's superintendent and foreman should be present. The Roofing Contractor should also arrange for the manufacturer's representative of the roof membrane to be in attendance.
- 1.8.8. If work is deemed incomplete or discrepancies are found by the Consultant, complete the outstanding items and rearrange for a further inspection.

1.8.9. The Roofing Contractor shall correct all deficiencies before a date agreed upon by the Consultant and Owner.

1.8.10. The inspection and testing service does not relieve the Contractor's responsibility for quality control of production and for errors made the Contractor.

1.9. REJECTED WORK

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

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

1.9.3. If in opinion of Consultant it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner may deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by Consultant.

1.10. EXAMINATION

1.10.1. Prior to commencement of work, examine surfaces and ensure that defects of level or construction are corrected before proceeding with work. Commencement of work shall imply acceptance of surfaces.

1.11. WORK RESTRICTIONS

1.11.1. Do not load or permit any part of the structure to be loaded with a weight that will endanger its safety. Questions of structural loading as part of construction means and methods shall be addressed by a licensed Structural Engineer engaged by the Contractor.

1.12. CO-ORDINATION

1.12.1. Co-ordinate work with other trades and ensure all openings, drains pipes, sleepers, etc., are installed and flashed at the appropriate time.

1.12.2. Co-ordinate progress of the work, progress schedules, submittals, use of site temporary utilities and construction facilities.

1.12.3. The Contractor shall have a competent foreperson or superintendent on the job site at all times during the execution of the contract when work is in progress. This foreperson shall not be changed without permission unless the Consultant deems that this foreperson is unsatisfactory to carry out the

work, or if the foreperson's employment is terminated. This foreperson shall represent the Contractor for each specific phase and any minor direction given this foreperson will be held as being given to the Contractor.

- 1.12.4. It shall be the responsibility of the Contractor's foreperson to inform General Contractor which areas are to be worked upon and to determine what measures may be necessary to limit disruption of the building activities to a minimum.

1.13. PROTECTION

- 1.13.1. Protect the building and work of other trades from soiling and other damage. Damage to the building as a result of this work shall be repaired as instructed, all at no extra cost to the contract. Protect the interior of the building as required and directed.
- 1.13.2. Contractor shall be responsible for protection of property during course of work. Lawns, shrubbery, paved areas and building including interior shall be protected from damage. Repair damage at no extra cost to contract.
- 1.13.3. Roof installation shall be scheduled in such a manner that traffic over new roofing is eliminated. Wherever traffic cannot be avoided, adequately protect roof areas with plywood sheathing, etc. Damage to roofing shall be repaired as instructed by the Owner or authorized representative at no extra cost to the contract.
- 1.13.4. Arrange work sequence to avoid using newly constructed roofing for storage, walking surface or equipment movement.
- 1.13.5. Protect building surfaces at set-up areas with tarpaulin and secure tarpaulin. Spilled or scattered debris shall be cleaned-up immediately. Removed material to be disposed from roof as it accumulates.

1.14. PROJECT MEETINGS

- 1.14.1. The Consultant will call an initial project meeting. The Roofing Contractor must invite the superintendent and foreman to fully participate in this initial briefing meeting.
- 1.14.2. The agenda of the briefing meeting will include:
1. Introduction all key personnel participating in the project.
 2. Establishing limits on work hours, access, movements on site, etc.
 3. Reviewing the approved work schedule.
 4. Establishing all administrative and procedural matters.
 5. Providing all procedural forms and communication routing.
 6. Establishing regular periodic project meetings throughout the progress of work.
 7. Provide physical space and make arrangements for meetings.
 8. Chair the meeting and record the minutes. Include significant proceedings and decisions. Identify actions by parties.

9. Reproduce and distribute copies of minutes within three days after each meeting and transmit to meeting participant, affective parties not in attendance, the Consultant and Owner.

1.15. CONSTRUCTION SAFETY MEASURES

- 1.15.1. Observe construction safety measures of Provincial Government, Workers'/Workmen's Compensation Board and municipal authority provided that in any case of conflict or discrepancy more stringent requirements shall apply.
- 1.15.2. In event of conflict between any provisions of above authorities the most stringent provision will apply.
- 1.15.3. The Contractor shall comply with the safety regulations presently in effect in this Province and shall provide such supervision and apparatus necessary for the safety of all concerned.
- 1.15.4. All application, material handling, and associated equipment shall conform to and be operated in conformance with the guidelines as outlined by the "Workplace Hazardous Materials Information System" (WHMIS), the Ministry of Labour, the Occupational Health and Safety Act (OS) and the "Foreman's Safe Roofing Guidelines".
- 1.15.5. The Contractor must follow the Ministry of Labour's guidelines and recommendations. The Consultant is to receive a copy of this document.
- 1.15.6. Comply with federal, provincial, local and Owner's fire and safety requirements.
- 1.15.7. Maintain fire extinguisher equipment in sufficient quantity and size as per Provincial Health and Safety Regulations and within easy access whenever power tools, roofing kettles and torches are being used.
- 1.15.8. Ensure that no part of the building is subject to a load, which will endanger its safety or cause permanent deformation.
- 1.15.9. The Contractor will adequately train and instruct workers in accordance with WHMIS requirements and will provide the Owner with detailed information with respect to the training provided to workers, the language in which instructions are given and a copy of training manuals used.
- 1.15.10. The Contractor will consult with the Consultant and if required further consult with Ministry of Labour co-ordinator regarding the physical set up of the job site and comply with any orders of the co-ordinator in that regard.
- 1.15.11. The Contractor will supply the Consultant with a list of hazardous materials to be used and "Material Safety Data Sheets" for them to be kept, in a

readily accessible location for the duration of the project.

- 1.15.12. The Contractor will not bring any controlled products onto the Owner's property that are not labelled in accordance with WHMIS requirements.
- 1.15.13. The Ministry of Labour co-ordinator is permitted to inspect the work site at any time and to speak to workers to determine the adequacy of their safety knowledge if they consider it necessary. Any violation of Ministry of Labour requirements may result in work being stopped until they are rectified. Repeated or serious violations may result in cancellation of the contract.
- 1.15.14. The Contractor will indemnify the Owner for any costs the Owner incurs as a result of his failure to comply with Occupational Health and Safety Act.
- 1.15.15. Provide and maintain protection and warning signs at all areas, which may be dangerous to the occupants or the public.
- 1.15.16. Remove all ladders from the building at the end of each working day to prevent unauthorized access to the building and cause possible damage.
- 1.15.17. Disconnect propane burners from bottles at the end of each working day. Store propane bottles in protected area away from ignition source and building.
- 1.15.18. Contractor's workers shall be properly protected and use all required protective clothing including face masks, goggles and gloves, etc.
- 1.15.19. Assume complete responsibility for construction strength, packing, anchoring and operation of derricks, cranes, hoists and other mechanical contrivances used for work; and ensure that loads carried thereon can be safely supported and be free from accidents to all persons.
- 1.15.20. Have hoist capacities, with regard to anticipate loads, verified by a Professional Engineer registered in this province.

1.16. ENVIRONMENTAL

- 1.16.1. Apply only dry materials and apply only during weather that will not introduce moisture into roofing system. Do not apply material during inclement weather or over damp, frozen or unsuitable substrate.
- 1.16.2. Do not install materials marked "keep from freezing" when daily temperatures are scheduled to fall below 4°C (40°F).
- 1.16.3. Do not perform masonry work below 2°C (35°F). Make proper provisions to protect work from freezing forty-eight (48) hours after layer if work is performed between 2°C (35°F) and 7°C (45°F).

- 1.16.4. Store solvent-soaked cleaning rags in approved containers in a location to prevent a threat to fire safety or health of the building occupants or workmen. Dispose from site daily.

1.17. MATERIALS SOURCE SEPARATION PROGRAM

- 1.17.1. Separate building materials for recycling that are to be removed from site.
- 1.17.2. Provide containers to deposit reusable and/or recyclable materials.
- 1.17.3. Locate containers in locations, to facilitate deposit of materials without hindering daily operations.
- 1.17.4. Locate separated materials in areas which minimize material damage.
- 1.17.5. Collect, handle, and transport off-site, salvaged materials in separate condition. Transport to an appropriate recycling facility

1.18. WORKFORCE

- 1.18.1. Once roofing commences, work shall not be postponed for any reason other than weather. Roofing crew shall consist of qualified and experienced personnel and/or more if required due to size and/or schedule of completion. The workforce shall not be changed without written permission from the Consultant.

1.19. GUARANTEE / WARRANTY

- 1.19.1. The Contractor represents that the Contractor has the special qualifications for doing the Work and that the plans and specifications are, in the Contractor's opinion, appropriate and adequate for the construction and/or renovations set out therein.
- 1.19.2. The Contractor and Subcontractor hereby jointly and severally warrant the work of this section, including roof membrane, vapour retarder, insulation and sheet metal work against any actual leakage for a period of two [2] years from the date of substantial performance, and agree to make good promptly any defects which occur or become apparent within the warranty period, such defects to include but not be restricted to leaking, failure to stay in place, undue expansion, lifting, deformation, loosening or splitting of seams, joint declaration, failure to adhere, deterioration, blisters, etc.
- 1.19.3. The Contractor shall furnish the guarantee/warranty in writing, on a form satisfactory to the Owner or the authorized representative signed.
- 1.19.4. The guarantee/warranty period shall commence from the day of substantial performance.

- 1.19.5. The specified roofing membrane system shall carry a manufacturer's extended limited warranty. The length of the warranty period shall be for a period of ten [10] years from the date of substantial performance for materials, including labour, to repair leaking membrane and maintain the roofing membrane in a watertight condition.
- 1.19.6. The Contractor's guarantee and the manufacturer's extended warranty are to exclude: normal wear and tear, damage caused by neglect, carelessness of vandalism caused by the installation or removal of any equipment and or material built into or part of the roofing membrane system, damage caused by excessive traffic over the roofing membrane, or use of the roof area for the purpose that it was not intended, or damage structure building components and finishes or building contents.
- 1.19.7. The shipment of and arrival on the site of the manufacturer's materials will constitute the manufacturer's agreement to warrant the roof in accordance with the conditions as outlined above.
- 1.19.8. The Owner's representatives are to conduct an inspection of the project 60 days prior to the expiration of the two [2] year roofing guarantee. The Contractor will be contacted at the time if any deficiencies related to the guarantee and/or long-term warranty are evident and will require attention. The Contractor will correct the deficiencies before the expiration of the Contractor's guarantee or make arrangements for the correction.

1.20. COMPLETION

- 1.20.1. Clean-up and remove all debris, surplus materials, tools and equipment, etc., upon completion of work to the satisfaction of the Consultant.

1.21. WORKMANSHIP

- 1.21.1. Workmanship shall be of the highest quality. Use competent trades people and execute work in accordance with contract documents.
- 1.21.2. Regard manufacturer's printed recommendations and latest literature as the minimum requirement for materials, method and procedures.
- 1.21.3. Notify the Consultant should the specifications conflict with the manufacturer's recommendations, otherwise it will be assumed that the Contractor and manufacturer are in agreement with procedure outline.
- 1.21.4. Advise the Consultant of adjustments to specified roofing procedures recommended by manufacturers caused by weather and site conditions. Make adjustments to specified procedure only after review with the Consultant, and receive approval in writing.
- 1.21.5. When roofing operations require open torch operation advise Roofing Consultant of nature of work. In such cases higher safety and insurance limits may be imposed. Any additional cost to meet these requirements will

be at the Contractor's expense.

- 1.21.6. Unsuitable or damaged materials shall immediately be removed from the site.
- 1.21.7. Wherever two or more plies of membrane are applied, the second ply, etc., shall extend minimum 6" (150mm) beyond the termination of the previous ply of membrane.
- 1.21.8. Roof curb and sleeper heights shall be minimum 12" (300mm) measured from the surface of the completed roof system to the top. This applies to prefabricated curbs and sleepers as well as those provided by the carpenters.
- 1.21.9. Inspect the underside of the deck to ensure fasteners will not be visible or damage the structure, interior surfaces or affect electrical and mechanical services. Investigate the location of all hidden services which include mechanical, electrical, cable, security, fire alarms which may be installed under the deck.

1.22. INSPECTION & DECLARATION

- 1.22.1. Contractor's Inspection: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents. Notify the Consultant in writing of satisfactory completion of Contractor's Inspection and that corrections have been made. Request Consultant's Inspection.
- 1.22.2. Consultant's Inspection: Consultant and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.
- 1.22.3. Completion: submit written certificate that following have been performed: Work has been completed and inspected for compliance with Contract Documents. Defects have been corrected and deficiencies have been completed. Equipment and systems have been tested, adjusted and balanced and are fully operational. Operation of systems have been demonstrated to Owner's personnel. Work is complete and ready for Final Inspection.
- 1.22.4. Final Inspection: when items noted above are completed, request final inspection of Work by Consultant, and Contractor. If Work is deemed incomplete by Consultant, complete outstanding items and request re-inspection.

1.23. SHEET METAL WORK

- 1.23.1. Sheet metal work shall be of the highest quality installed in accordance with best trade practice and to the following requirements.

- 1.23.2. Apply two coats of bituminous back paint to all surfaces of metal in contact with masonry, concrete or dissimilar metals.
- 1.23.3. Seams shall be of the "slip lock type" that permit adequate movement without resulting in deformation or loosening of metal flashings. Lapped joints or exposed raw edges will not be accepted. Exposed edges shall be "doubled back" at least 1/2" (12.5mm). At eaves, parapets, etc., metal shall be hooked over continuous starter strips minimum one gauge thicker than the metal used for flashing. Secure starter strips at 12" (300mm) on centre or closer as required.
- 1.23.4. Fabricate all possible work in shop in maximum 8' (2450mm) lengths by brake forming, bench cutting, drilling and shaping. On vertical sections or horizontal planes greater than 30" (750mm) install metal in 4' (1200mm) section unless otherwise specified or shown.
- 1.23.5. Space joints evenly where exposed. When flashing is being installed in more than one piece, offset joints in adjacent flashings by approximately 50%.
- 1.23.6. Form inside and outside corners by means of standing seams.
- 1.23.7. All flashings shall be installed in perfectly straight lines. Irregular or badly fitted work will not be accepted. Exposed fastenings will only be permitted where concealed fastening is impossible. Provide neoprene washers at exposed fastenings.
- 1.23.8. Where sheet metal counter-flashings are the only form of waterproofing, provide waterproofing underlayment prior to installing metal. Overlaps of underlayment shall be minimum 2" (50mm) and end laps minimum of 6" (150mm).
- 1.24. SAMPLES OF SHEET METAL FLASHINGS
 - 1.24.1. Install mockup samples of metal flashings indicating method of joints, fastening, seams, expansion joints and stiffeners for approval by Consultant or Owner prior to fabrication.
 - 1.24.2. Commencement of metal flashing installations implies that this Contractor has accepted the surfaces as satisfactory and accepted responsibility for appearance of completed work.
- 1.25. SCOPE OF WORK
 - 1.25.1. Unless specified otherwise supply and install sheet metal counter-flashings at perimeters, and curbs, etc., as required and directed.
 - 1.25.2. Unless specified otherwise supply and install "stack jacks" specified. Trim height of existing pipes as required and/or extend existing pipes as required and directed. Maintain a minimum height of 12" (300mm)

above the completed roof surface.

- 1.25.3. Unless specified otherwise supply and install spun aluminum chimney stack base flashing complete with aluminum collars, etc., minimum 12" (300mm) in height.
- 1.25.4. Install Torch Safe strips at junction of vertical surfaces.
- 1.25.5. All conduits, piping, etc., that pass through sleeves and curbs to roof openings, etc., shall be installed by using products specified.
- 1.25.6. Where ductwork passes through the top of roof curbs provide tapered wood blockings surfaced with 1/2" plywood covered with membrane flashings extending minimum 12" up the vertical surface of the ductwork.
- 1.25.7. Where ductwork passes through walls extend modified membrane onto ductwork approximately 12" and ensure tapered insulation of ductwork slopes away from wall.
- 1.25.8. Where several pipes pass through the top of a large roof curb provide metal base flashings including metal cover and provide tapered wood blockings surfaced with 1/2" plywood completely covered with membrane flashings.
- 1.25.9. Install all patio slabs for traffic surfaces as specified.
- 1.25.10. Unless specified otherwise where rigid electrical conduits pass through roof supply and install electrical outpost supplied by Lexcor; where flexible conduits pass through the roof provide wire outlet post supplied by Lexcor.
- 1.25.11. Configure roof curbs to suit cover of the exhaust fan units.
- 1.25.12. Provide high temp caulking sealant where hot pipes pass through top of curbs and base flashings and around collars.

2. PRODUCTS

- 2.1. Products shall conform to the requirements of jurisdictional authorities, to C.S.A and C.G.S.B. specification number named including all revisions to date.
- 2.2. Products substituted without prior written approval shall be removed from the site and areas disturbed shall receive specified products.
- 2.3. Compatibility of roof system components is essential and this shall be confirmed by the applicator.
- 2.4. Product data sheets and material data sheets shall be issued to the Consultant prior to ordering materials.

- 2.5. Submit sample of products prior to ordering and do not order products or start work before receiving Owner's written approval.
- 2.6. Asphalt primer – PA-917 LS primer conforming to C.G.S.B. specification #37-GP-9A.
- 2.7. Adhesive – Parafast or Millenium Adhesive supplied by Siplast.
- 2.8. Steel deck overlayment – 5/8" (16mm) prime glass-faced gypsum roof board (Dens-Deck prime), supplied by Georgia-Pacific Corporation.
- 2.9. Vapour retarder and reinforcement - applicable to steel deck overlayment – Paradiene 20 TG, 2.32mm modified membrane conforming to CGSB 37-G-56M supplied by Siplast.
- 2.10. Vapour retarder and reinforcement - applicable to cementitious deck - Paradiene 20 TG, 2.32mm modified membrane conforming to CGSB 37-G-56M supplied by Siplast.
- 2.11. Roof Board Insulation – R-35 (All Zones), three layers bi-directional (no joints to line up, to be staggered) Paratherm closed cell polyisocyanurate roof insulation integrally laminated to organic/inorganic facers in conformance with Environment Canada Ozone-Depleting Substance regulations and conforming to CAN/ULC S704/ S770 Type II, Class 1 Grade 2 with 1/4" Protectoboard supplied by Siplast.
There will be no extra monies allotted for the wrong insulation thickness carried / provided by the roof bidder / Contractor.
- 2.12. Roof membrane composition - modified bituminous base sheet membrane 2.32mm Paradiene 20 TG EG surfaced with a modified cap sheet membrane 3.94mm Paradiene 30 TG Bright White (BW) with published SRI 90 granular cap supplied by Siplast.
- 2.13. Membrane Flashings - modified bituminous base sheet membrane 2.32mm Paradiene 20 SA surfaced with a modified cap sheet membrane 4.14mm Parafor 30 TG (BW) with published SRI 90 granular cap supplied by Siplast. Colour to be selected by Owner and Consultant from manufacturer's full range of colours.
- 2.14. Waterproofing Underlayment – Paradiene 20 SA 98mls (2.55mm) thickness 3.28ft (1.00m) 33.5ft (10.21m) length self-adhesive modified bitumen membrane consisting of light weight random fibrous glass mat impregnated and coated with high quality styrene butadiene-styrene (SBS) modified bitumen with TA 325 self adhesive primer. Supplied by Siplast.
- 2.15. Cant strips - 3" x 3" (75mm x 75mm) torch safe cant strips supplied by Siplast.
- 2.16. Stack Jacks (pipe flashing) - SJ-41A 12" in height pre-insulated aluminum "stack jacks" supplied by Thaler Metal Industries Inc.
- 2.17. Miscellaneous Flashings (for protrusions through roof) – Provide ChemLink . Para Pro 123 Flashing System as supplied by Siplast

- 2.18. Sheet Metal for Flashing - 26 ga. pre-painted galvanized steel series 8000 supplied by Stelco - colour to be selected by Owner and Consultant prior to prefabrication from manufacturer's full range of colours.
- 2.19. Miscellaneous Metal for Flashing - for "hook-on" strips, fastening strips, metal bellows, etc., same metal as specified for sheet metal flashing but thickness shall be 1 ga. thicker.
- 2.20. Back paint for metal - asphalt primer (two coats) conforming to C.G.S.B. specification #37-GP-9.
- 2.21. Nails, bolts, screws and other fastenings - compatible with metal specified. Size of fasteners and type shall suit applicable conditions and must be approved by Owner or his authorized representative prior to use.
- 2.22. Plastic cement - PA-1021 plastic conforming to ASTM D 4586 Type II forasbestos free, asphalt base roof cement supplied by Siplast.
- 2.23. Caulking Sealant - PS 209 elastomeric sealant colour gray meeting CAN-19-13M82. Supplied by Siplast.

3. **EXECUTION**

3.1. PREPARATION

- 3.1.1. Remove all dust, dirt and debris from substrate and ensure same is smooth and free of all foreign matter. Perform only as much roof that can be completed each day or before showers commence. Take whatever action is necessary to prevent moisture from entering during roofing installations. Vacuum roof deck surfaces if necessary.
- 3.1.2. Inspect roof deck to determine if additional work is required before proceeding.
- 3.1.3. Any sharp projections, that in the opinion of the Consultant may penetrate the vapour retarder, shall be grounded smooth and flush.

3.2. ASPHALT PRIMING

- 3.2.1. Apply primer at the rate of 1 gal. (4.5L) per 100 sq. ft. (9m²) by brush or spray method. Work primer into surface by brooming and allow sufficient time for primer to penetrate and ensure same does not run into the building or stain aesthetic surfaces. Limit quantity of primer at deck openings and at points of termination to prevent damage to the building's interior.
- 3.2.2. Apply primer to vertical surfaces commencing at the top of cant strips and terminate primer 1" (25mm) below reglets and/or highest possible point.
- 3.2.3. Apply asphalt primer over all cementitious decks.

3.3. STEEL DECK OVERLAYMENT

- 3.3.1. Apply adhesive to the steel deck in ribbon form by mechanical means at the recommend rate parallel to flutes and centred on high sections of deck. On 8" (200mm) modular decks apply 2 ribbons of adhesive. Immediately place dens-deck with the long sides at right angles to the run of the deck. All joints must be staggered and no pieces less than 1/3 of the full size sheet will be accepted. Apply vapour retarder over the surface of the dens-deck. Conform to "rated system" requirements.

3.4. VAPOUR RETARDER

- 3.4.1. Apply vapour retarder in straight lines, smooth, free from air pockets, wrinkles, fishmouths, open laps or tears, etc. Reinforce and extend vapour retarder minimum 12" (300mm) at perimeter, vertical walls, pipes and other abutments. Continuously secure and laminate reinforcement to vapour retarder. Envelope insulation with vapour retarder and reinforcement by minimum 6" (150mm), all continuously secured to insulation.
- 3.4.2. Applicable to steel deck overlayment and cementitious deck – install Paradiene 20 TG membrane torch installed over dens-deck. Overlaps shall be minimum 4" (100mm) on side laps and all end laps shall be minimum 3" (75mm).

3.5. ROOF BOARD INSULATION

- 3.5.1. Place Paratherm polyisocyanurate roof insulation with all joints staggered over the vapour retarder membrane with the longest side parallel to the perimeter where work is commencing. Where cutting and fitting is required, minimum width of insulation must be 12" (300mm). Do not force insulation into place. Cut neatly at protrusions and points of termination. Replace all broken, damaged or misfit boards as work progresses. Protect insulation from moisture during all phases of the application progresses. Paratherm is to be set in Parafast by Siplast a highly elastomeric, two components, one step, all purpose, foamable adhesive that contains no solvents and sets in minutes. Apply adhesive to vapour retarder with specified adhesive applied in 2 cm. wide bands every 33 cm using the manufacturer's recommended applicator. Protect insulation from moisture during all phase of application process. Remove any temporary waterproof cut off prior to continuing with further work.
- 3.5.2. Subsequent layers of Paratherm polyisocyanurate insulation shall be applied with specified adhesives at the same application rate and bead spacing as the previous layer. Ensure all layers of Paratherm polyisocyanurate roof insulation are offset at joints of each layer by minimum 12" (300mm). Tapered polyisocyanurate insulation is to be positioned on top of the flat stock polyisocyanurate and below the cover board.

3.5.3. Tapered insulation shall be installed on top of the polyisocyanurate insulation prior to installing the insulation cover board. Tapered insulation to be set Parafast adhesive and at the same bead spacing and application rate as previous layer.

3.5.4. Reduce insulation thickness by 1/2" (12.5mm) at all drainage locations for a distance of 36" (900mm) from the centre of the drain opening and an additional 1/2" (12.5mm) for a distance of 12" (300mm) from the centre of the roof drain opening. Totally fill flutes of steel decks with insulation at drain openings to provide continuous support for drain.

3.6. INSULATION COVER BOARD

3.6.1. Cover board shall be installed with specified adhesives at the same application rate and bead spacing as the previous layer(s) of insulation. Ensure cover board is offset at joints by minimum 12" (300mm). Walk cover-board into place to ensure good contact.

3.7. INSTALLATION OF TORCH SAFE CANT STRIPS

3.7.1. Apply a single continuous and uniform bead OF Parafast adhesive in 2 cm. wide bands every 33 cm using the manufacturer's recommended applicator to the surface of the cover board and embed the cant strips in place.

3.8. ROOF MEMBRANE BASE SHEET

3.8.1. Initially apply base sheet over cover board terminating 2" (50mm) above top of cant strips. Membrane shall be torched into place. Side laps shall be minimum 3" (75mm) and end laps minimum 6" (150mm) all continuously torched into place.

3.8.2. Starting at low points of each roof area apply modified bituminous membrane base sheet torched into place.

3.8.3. Rolls must first be unrolled to align each course then rerolled before torching commences.

3.8.4. Base sheet membrane not to be left exposed longer than ten days before cap sheet is applied. It is recommended the cap sheet application be completed immediately after base sheet has been installed.

3.8.5. At the end of each working day all insulation and cover board must be covered with a minimum of base sheet membrane.

3.9. ROOF MEMBRANE BASE SHEET FLASHING

3.9.1. Extend base sheet from a point 4" (100mm) on the flat roof surface terminating at the highest possible points and at eaves, parapets, copings the flashing membrane shall extend across the top and down the fascia to

a point 1/2" (12.5mm) above the lowest terminating point of metal flashing at fascia.

- 3.9.2. Width of base sheet 1m wide, with lengths to fit, are to be cut from across the width of the rolls and torched or self adhere into place with no voids and with all laps sealed and mitres neatly cut and well sealed.
- 3.9.3. At sloping roofs base sheet membrane is to terminate 3ft up the sloping roof.

3.10. ROOF MEMBRANE CAP SHEET

- 3.10.1. Over the surface of the base sheet place the 4mm cap sheet into place and simultaneously heat the surface of the base sheet and underside of cap sheet to a point where the bitumen flows at a sufficient temperature to form homogeneous mass consisting of the base and cap sheet. Slowly roll membrane into the continuous bead of hot melted bitumen overlaps of the cap sheet shall not coincide with the base membrane but be offset by minimum 12" (300mm). Side laps shall be 3" (75mm) (follow selvage edge lines and end laps shall be 6" (150mm). The cap sheet shall terminate at the base of all cant strips.
- 3.10.2. The rolls must first be unrolled to align each course and then rerolled prior to torching the membrane into place.
- 3.10.3. All end laps of adjacent sheets are to be degranulated before the cap sheet membrane sheets are bonded together.
- 3.10.4. Liquid modified bitumen must flow in front of the cap sheet as it is being rolled onto the base sheet to ensure proper and complete adhesion. A bead of bitumen must flow out at the side lap onto the adjacent surface to seal the side laps.
- 3.10.5. Bleed outs of bitumen onto adjacent surfaces must be covered with additional loose granules the same colour as the cap sheet.
- 3.10.6. All end laps are to be neatly cut, the underlying selvage edge corners mitred and the cap sheet is to be neatly cut and fitted around all openings, sleeves, drains and curbing.
- 3.10.7. Care is to be taken not to walk on the freshly applied cap sheet and any marring or damaging of the cap sheet surface must be repaired either with additional granules broadcast into melted bitumen or with an additional ply of cap sheet. Contractors shall have a wet sponge on site at all time when applying the cap sheet membrane.
- 3.10.8. If a piece of cap sheet for repair is needed then this piece is to be at least 18" long and is to extend from the side lap of the repaired sheet over to butt against the side lap of the adjacent cap sheet course (The selvage strip is to be removed from the piece of repair material).

3.11. ROOF CAP SHEET FLASHING MEMBRANE

- 3.11.1. Apply one ply 4mm granular cap sheet as previously specified extending from a point 6" (150mm) on the flat roof surface terminating at highest possible point and at eaves, parapets and copings the flashing membrane shall extend across the top and down the fascia to a point 1/2" (12.5mm) above the lowest terminating point of metal flashing at fascia.
- 3.11.2. Width of the cap sheet 1m wide with lengths to fit, are to be cut from across the width of the rolls and torched into place with no voids and with all laps sealed and mitres neatly cut and well sealed.
- 3.11.3. All laps at mitres at adjacent sheets and the underlying cap sheet membrane surfaces are to be degranulated before the cap sheet membrane is torched into place
- 3.11.4. At parapets with a metal upstand to terminate membrane flashings a bead of sealant is to be applied and covered with granular
- 3.11.5. Mechanical fastening at curbs shall consist of nailing at the top at 6" (150mm) oc. Wherever reglets occur and at vertical surfaces apply a bead of Parafast(PS-304 Sealant) where membrane terminates and secure 1" (25mm) below with a continuous metal fastening strip at 12" (300mm) oc.
- 3.11.6. "Strip-in" flanges of "stack jacks" and other flashing flanges with the flashing membrane basically as previously specified. Ensure flanges are primed and set into (PA-828 Flashing Cement) a bed of hot asphalt set in over the base sheet. The prime membrane shall be torched to the flange all as specified and directed. Around the base of the stack jack provide Parafast adhesive (PS-304 Sealant) and granular to match the colour of the membrane.

3.12. CAULKING

- 3.12.1. Apply caulking sealant into all reglets and at points deemed necessary by the Owner or his authorized representative following installation of metal flashing. Caulking sealant shall be applied in strict accordance with the manufacturer's literature. Ensure caulking is tooled to provide and even finish. Colour of caulking shall match sheet metal counter-flashings or other adjacent material confirmed by the Consultant.
- 3.12.2. Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.
- 3.12.3. Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair work.
- 3.12.4. 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.

- 3.12.5. Ensure joint surfaces are dry.
- 3.12.6. Prepare surfaces in accordance with manufacturer's directions.
- 3.12.7. Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- 3.12.8. Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.
- 3.12.9. Apply bond breaker tape where required to manufacturer's instructions.
- 3.12.10. Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.
- 3.12.11. Apply sealant in accordance with manufacturer's written instructions.
- 3.12.12. Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
- 3.12.13. Apply sealant in continuous beads.
- 3.12.14. Apply sealant using gun with proper size nozzle.
- 3.12.15. Use sufficient pressure to fill voids and joints solid.
- 3.12.16. Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
- 3.12.17. Tool exposed surfaces before skinning begins to give slightly concave shape.
- 3.12.18. Remove excess compound promptly as work progresses and upon completion.
- 3.12.19. Cure sealants in accordance with sealant manufacturer's instructions.
- 3.12.20. Do not cover up sealants until proper curing has taken place.

3.13. CLEANUP

- 3.13.1. Clean adjacent surfaces immediately and leave work neat and clean.
- 3.13.2. Remove excess and droppings, using recommended cleaners as work progresses.
- 3.13.3. Remove masking tape after initial set of sealant.

3.14. VENT AND OTHER PIPES PROTRUDING THROUGH DECK

- 3.14.1. Install stack jacks, etc., including all accessories, specified and supplied by Division 15 and / or Division 16. Ensure flanges are primed and set in a continuous bed of asphalt. "Strip-in" flanges with 3-ply flashing membrane. Extend first ply 6" (150mm), second ply 9" (225m) and the third ply 12" (300mm) beyond the flange.

END OF SECTION

1. GENERAL

1. GENERAL REQUIREMENTS

1. Division One, General Requirements, is a part of this section and shall apply as if repeated here.

2. SYSTEM DESCRIPTION

1. Supply all labour, materials and equipment necessary for the complete work of this Section as indicated on the drawings, specified herein, or as required by job conditions and normally considered as work covered by this Section.
2. The term "sealant" to be synonymous with the term "caulking" where used on the drawings and/or specifications.

2. REFERENCES

CAN/CGSB-19.13-M87 Sealing Compound, One-Component, Elastomeric, Chemical Curing
CAN/CGSB-19.17-M90 One-Component Acrylic Emulsion Base Sealing Compound
CAN/CGSB-19.24-M90 Multicomponent, Chemical-Curing Sealing Compound

3. SUBMISSIONS

1. Submit complete colour samples for Architect's approval.
2. Supply a sample container of each type of caulking or sealant.
3. Sample joints of each type and colour of caulking shall be prepared at the site in a location directed by the Architect and be approved by the Architect before work commences. Approved joints will represent minimum acceptable for the work.
4. Cure samples and under conditions anticipated at job site during construction.

4. ENVIRONMENTAL CONDITIONS

1. Sealant and substrata materials to be minimum 5 C (41 deg. F.).
2. If necessary to apply sealants below 5 C., consult sealant manufacturer and follow their recommendations.

5. DELIVERY AND STORAGE

1. Deliver and store materials in manufacturer's original wrappings and containers.

6. PROTECTION

1. Mask adjacent surfaces as necessary to prevent contamination.
2. Protect all sealant against puncture or damage until sealant has attained its final set.
3. Be responsible for any damage to adjacent surfaces caused by the work of this Section. Provide extra protection as required when sandblasting.
4. Provide temporary covers over joints where joints have been cleaned out, but not yet caulked.

7. WARRANTY

1. Provide a written warranty, signed and issued in the name of the Owner stating that caulking work of this section is guaranteed against leakage, cracking, crumbling, melting, shrinkage, running, loss of adhesion, or staining adjacent surfaces, for a period of five years from the date of Substantial Certificate of Completion and that any defective caulking will be replaced.
2. At completion of the work, provide a written statement from the manufacturer or authorized manufacturer's representative that material used in the various applications is the recommended one and that the final application is as recommended by the manufacturer for the construction conditions detailed and for the performance required. These requirements are applicable to every material included in the work of this Section.

8. QUALIFICATIONS

1. Applicator for the work of this section shall:
 1. Be approved by the materials manufacturer and Architects.
 2. Have at least five years proven satisfactory experience in this type of work.
 3. Have adequate equipment and skilled personnel to expediently complete the work of this section in an efficient and very best workmanlike manner.
 4. Be completely familiar with the published recommendations of the manufacturer of the caulking material being used.
2. Indication of lack of skill or defective work to be sufficient grounds for the Consultant to reject the installed caulking and to require its immediate removal and complete recaulking at no additional cost to the Owner during the guaranty period.

3. Co-operate with the Consultant and/or any inspection and testing agency he may appoint.
4. Materials to be utilized shall be inspected and tested as required.
5. Provide cut tests of 6 inches in length in order to ensure correct thickness, hardness, mixing and surface finish. Provide these cut test samples at times and from locations as directed by the Consultant, and make good the areas from which the samples are taken.
6. All tests of the sealant installation shall be inspected by the sealant manufacturer's representative.

2. PRODUCTS

1. MATERIALS

1. Primers: type recommended by sealant manufacturer.
2. Joint Fillers:
 1. General: compatible with primers and sealants, outsized 30 to 50%.
 2. Polyethylene: extruded closed cell foam, Shore A hardness 20, tensile strength 140 to 200 kPa.
3. Bond Breaker: pressure sensitive plastic tape, which will not bond to sealants.
4. Sealant Type A: Equal three part polyurethane 'Tremco Dymeric 240' conforming to C.G.S.B. CAN2-19-24-M80. Colours to be tinted to specifically match wall colours. Maximum of five colours.
5. Sealant Type C: Equal to Sikaflex - 15 LM. Colours to be tinted to specifically match wall colours. Maximum of six colours.
6. Colour of Sealants: to be selected by the Architect. Colours of sealant to change where wall colours change (i.e. banding).
7. Joint Cleaner: xylol, methylethyleketon or non-corrosive type recommended by sealant manufacturer and compatible with joint forming materials.
8. Deliver materials to job site in sealed containers with manufacturer's original labels attached, and accompanied by certification of compliance with the specifications.

3. EXECUTION

1. EXAMINATION

1. Examine all surfaces prior to application and notify the Architect of any conditions detrimental to satisfactory application.
2. Commencement of work shall imply acceptance of surfaces.

2. PREPARATION

1. Use a dry, clean, oil free compressed air stream to remove dust and other contaminants. Masonry surfaces shall be cleaned with wire brush and then blown clean. Any waterproofing treatments contaminating the joint must be completely removed.
2. Remove oil, grease and other coatings from non-ferrous metals with joint cleaner.
3. Prepare surfaces to sealant manufacturer's instructions.
4. Examine joint sizes and correct to achieve depth ratio $\frac{1}{2}$ of joint width with minimum width and depth of 6 mm ($\frac{1}{4}$ "), maximum width 25 mm (1").
5. Before caulking, fill spaces deeper than 13 mm ($\frac{1}{2}$ ") with bedding material, packed tightly in place and set below finished surfaces to suit specified sealant depth. Provide joints less than 13 mm ($\frac{1}{2}$ ") deep with an approved joint breaker.
6. Where necessary to prevent staining, mask adjacent surfaces with tape prior to priming and caulking.
7. Apply bond breaker tape where required to manufacturer's directions.
8. Prime sides of joints to sealant manufacturer's instructions immediately prior to caulking.
9. Remove all existing caulking and prepare for replacement.

3. APPLICATION

1. Before application of any sealants, confirm that sealant material is compatible with the materials and finishes of the surfaces to which the material is applied or is in contact with.
2. Apply sealants, primers, joint fillers, bond breakers, to manufacturer's instructions. Apply sealant using a gun with proper size nozzle. Use sufficient pressure to fill voids and joints solid. Superficial pointing with skin bead is not acceptable.
3. Thoroughly mix caulking materials with a mechanical mixer capable of mixing at 80-100 rpm without mixing air into the material. Mix material in accordance with the manufacturer's directions and instructions.
4. Install caulking to the joints using manually operated or power operated

guns. Use nozzles of the correct size and shape and provide sufficient pressure to completely fill the joints and make adhesive contact with the backs and sides of the joints. Caulk solidly around entire perimeter of openings.

5. Finish the surface of the caulking with a smooth, full bead, free from ridges, wrinkles, sags, air pockets and embedded impurities. Tool the finish bead with a water wet or dry tool as recommended by the manufacturer, to a slightly concave joint.
6. Clean adjacent surfaces immediately and leave work neat and clean. Remove excess sealant and droppings using recommended cleaners as work progresses. Remove masking after tooling of joints. Finish work damaged due to this work shall be replaced at this contractor's expense to satisfaction of the Architect.
7. Use of sealants specified in the following locations:
 1. Type A: Use at interior control joints and expansion joints. NOTE: this sealant **must not be** painted over.
 2. Type C: At all remaining interior locations.

4. LOCATIONS

1. Do all caulking required (except where specified under other sections).
2. Caulk exposed control joints occurring in walls. (See item 3.6)
3. Caulk joints between window or door frames to adjacent building components around perimeter of every external window or door opening at interior sides.
4. Caulk around louvres.
5. Interior frames where it abuts interior finishes.
6. Caulk where shown on drawings and not specified in other sections.
7. Caulk joints at junction of different materials and junction of surfaces in different planes as required or directed (i.e. wood to drywall/ plaster).
8. Caulk areas on interior walls to stop air infiltration.
9. Caulk control joints in drywall.
10. Caulk joints between wood window and wall surfaces and wood door frames and wall surfaces, etc.

END OF SECTION

PART 1 - GENERAL

1. GENERAL REQUIREMENTS

1. Division One - General Requirements are part of this section and shall apply as if repeated here.

2. QUALIFICATIONS

1. Conform to CSA A82.30-M1980 including appendices.

3. SHOP DRAWINGS

1. Submit shop drawings in reproducible vellum form in accordance with Article G.C. 3.11 of General Conditions of CCDC 2 - 2020.
2. Clearly indicate construction details, sizes, thickness or gauge of steel studs, connections, joints, method of anchorage, number of anchors, supports, reinforcement and accessories. Confirm all dimensions on site.
3. Indicate control joint and expansion joint locations and framing details.

PART 2 - PRODUCTS

1. MATERIALS

1. Non-load-bearing channel stud framing less than 4800 mm long: to ASTM C645-83 size as noted on drawings, roll formed from 25 gauge (0.53 mm) thickness electro galvanized steel sheet; for screw attachment of gypsum board. Knock-out service holes at 1'-6" (460 mm) centres.
2. Extra strength channel stud framing (4800mm long and greater): to CAN 3-S146-M84 for design and ASTM A446 for steel, 3 5/8" (92 mm) or 6" (152 mm) stud size, roll formed from 20 ga. (0.91 mm) thickness hot dipped galvanized steel sheet; for screw attachment of gypsum board. Knock-out service hole a 1'-6" (460mm) centres. Use this type at all exterior framing locations. Note interior extra strength stud partitions with drywall on both sides can be electro galvanized finish.
3. Floor and ceiling tracks: to ASTM C645-83; in widths to suit stud sizes, 1 1/4" (32 mm) flange height. Use hot dipped galvanized units at exterior wall and exterior canopy locations.
4. Metal channel stiffener: size to suit studs, 2 mm thick cold rolled steel, coated with rust inhibitive coating. Use hot dipped galvanized units at exterior wall and exterior canopy locations.
5. Bridging channels and diagonal tension straps (load bearing stud systems): material and gauge to match studs, let into or surface fastened

to studs for diagonal/lateral bracing and reinforcement.

6. Screws: CGC Branch Screws (or approved equal) of type recommended in the selector guide on Page 5 of Canadian Gypsum Brochure 09250 - 1E. Use hot dipped galvanized or epoxy coated fasteners at exterior walls and canopies.
7. Furring Channels: 7/8" (22 mm) x 2 3/4" (70 mm), 25 Ga. (18 mils), cold rolled galvanized after fabrication, types manufactured by Bailey Metal Products Limited, D-1001, Donn Products, Universal Sections or Canadian Gypsum Co. to meet CSA A82.30-M1980. Use hot dipped galvanized units at exterior walls and canopies.
8. Resilient Channels: 1/2" (13mm) x 2 1/4" (57mm), Bailey RC Plus, manufactured by Bailey Metal Products Limited, Model No. D-1007, to meet ASTM A653/A653-11. Use G40 galvanizing to ASTM C754-11.
9. Carrying Channels: 1 1/2" (38 mm) x 6 lbs./10 ft. (892 g/m) cold rolled steel after fabrication to meet CSA A82.30-M1980. Use hot dipped galvanized units at exterior walls and canopies.
10. Hangers: 1/4" (6.3 mm) dia. galvanized pencil rods at 4'-0" (1220 mm) o.c. maximum on main tees to meet CSA A82.30-M1980.
11. Tie Wire: No. 16 (1.5 mm) Imperial Wire gauge galvanized soft annealed to meet CSA A82.30 - M1980.
12. Anchors: to meet CSA A82.30-M1980 standard.
13. Heavy Duty Studs: 4" (100 mm) and 6" (150 mm) 16 gauge (1.5 mm) as supplied by Bailey Metal Products Ltd., Toronto, Ontario.
14. Batt Insulation (exterior stud walls): Coordinate with Specification Section 07213, Mineral Fibre Insulation, thickness to suit stud cavity.
15. Vapour Barrier: at exterior stud walls install 6 mil poly to CGSB 51.34 complete with sealants.
16. Acoustical Sealant: Acoustical sealant to CGSB 19-GP-21M by Tremco or approved equal.
17. Insulating Strip: Rubberized, moisture resistant 1/8" (3mm) thick foamstrip, 1/2" (12mm) wide with self-sticking adhesive on one face, lengths as required.
18. Blocking: Bailey Backer Bar, interior partition use

PART 3 - EXECUTION

1. GENERAL

1. Installation shall be by mechanics skilled in this trade and done in accordance with best standard practice and material manufacturer's printed directions.
 2. Do not cover piping, conduit, duct and the like until inspected and approved by the Architect.
 3. Furring indicated shall not be regarded as exact or complete.
 4. Method of framing and furring left to Contractor's option but shall result in a rigid, secure, plumb framing and forming, erected to maintain overall sizes as indicated and of adequate strength to support without distortion of the facing indicated. Wall furring and suspended and furred ceilings must be installed to meet CSA A82.31-M1980 except where specified otherwise.
 5. Do not make fastenings to ducts, pipes, conduit, door frames, backers or inserts of other trades not specifically intended for fastening metal furring.
 6. The completed installation of framing and furring must allow drywall to be installed free of waves, depressions, other defects that would mar the finished appearance.
2. RESILIENT CHANNELLING ON PARTITIONS AND WALLS
1. Work includes as below
 2. Installation on Substrate: new and existing (on wood stud framing, metal stud framing, concrete block masonry, brick masonry, poured in place concrete, bulkheads, and all other substrates not noted, that is exposed and seen by line of sight)
 - .1 ***Walls are to be flat and an even / level & plumb plane, install resilient channelling, blocking, shims as required to achieve this. A wavy wall will not be accepted – wall types do not have to state this in order for it to be installed.***
 - .2 Install resilient channelling (13mm – ½" min.) at 400mm o/c maximum horizontally on substrate framing as to manufacturer's installation instructions (it is important which direction the fastened side is orientated). Ensure substrate framing is adequate to support loading of wall finish and resilient channelling loadings as per manufacturer's installation instructions / recommendations.
 - .3 Resilient channelling should not be required on new framed wall systems (unless noted otherwise on wall types) as these should be an even / level and plumb plane when installed – if not the framing is to be rectified.

- .4 Also consult manufacturer's installation instructions for other requirements that are to be met.
- .5 Erect resilient channelling to tolerance of 1:1200.

3. BULKHEADS

- 1. Work includes fire separations in ceiling space, drywall surfaces above windows and bulkheads to suspended ceilings.
- 2. Install steel studs and furring of sizes shown at 16" (400 mm) o.c. or as shown.
- 3. Furring indicated shall not be regarded as exact or complete. Provide adequate bracing at bulkheads to structure to ensure a rigid installation and to meet CSA A82.31-M1980.
- 4. Locate bulkhead furring no more than 2" (50 mm) from corners abutting partitions or other construction.

4. CEILINGS

- 1. Supply and install suspension and furring system and resilient channelling for exposed gypsum board ceiling.
- 2. Do not regard suspension system indicated on drawings as exact or complete. The specification for metal framing contained in Canadian Gypsum Co. Ltd. Brochure 09260 - 1E and CSA-A82.31-M80 shall govern installation conditions not covered by this specification. The more stringent being the acceptable.
- 3. Install hangers for suspended bulkhead or ceiling to support the grillage independent of the walls, columns, pipes, ducts and the like. Erect plumb and securely anchor to the structure. submit details of the proposed method to the consultant for approval. If so requested by the Architect, test hangers to provide that anchorage is adequate to support the proposed loading.
- 4. Supply hangers to support the grid in time to be installed in slabs.
- 5. Space hangers at maximum 3'-0" (910 mm) centres in the direction of the carrying channels and at 4'-0" (1200 mm) centres at right angles to the carrying channels, within 6" (150 mm) of ends and where normally required in good standard practice.
- 6. Space furring channels at maximum 16" (400 mm) o.c.
- 7. Erect the grillage for suspended ceilings and beams of required elevation to provide rigid, secure, framing independent of walls.

8. Frame all openings on all sides with suitable channels. Check clearances with respective trades. Co-operate with others to accommodate diffusers, grilles, light fixtures and access panels in drywall ceilings. Provide additional hangers and supports for fixtures as required.
 9. Level drywall screw channels to a maximum tolerance of 1/8" (3.2 mm) over 12'-0" (3650 mm).
 10. Erect ceiling furring system in strict accordance with system manufacturer's printed directions to allow drywall board installation to be free of waves or loose boards.
 11. Frame exterior soffits and walls using hot dipped galvanized framing materials and rustproof fasteners.
5. HEAVY DUTY STUDS
1. Use heavy duty studs where shown on drawings and as required in other locations to give firmness to bulkheads.
 2. Secure studs at ends with solid bearing at bulkheads.
6. CONSTRUCTION OF SOUND ATTENUATED PARTITIONS AND AROUND STEEL JOIST AT TOP OF MASONRY CLASSROOM & FIRE RATED WALLS
1. Install insulating strips under studs and tracks around perimeter of sound control partitions. Install acoustical sealant at joints at each side of studs and tracks, against insulating strips between studs and tracks and floor, wall or underside of floor or roof deck above.

END OF SECTION

1. **GENERAL REQUIREMENTS**

- 1.1 The General Conditions, the Supplementary General Conditions, the Instructions to Bidders, and Division 1 – General Requirements, shall be read in accordance with this Section.
- 1.2 The Specification shall be read as a whole by all parties concerned. Sectioning of the Specification is for convenience. Each Section may contain more or less than the complete work of any Trade. The Contractor is solely responsible to make clear to the Subcontractors the extent of their work.
- 1.3 Provide all labour, materials and equipment required to furnish and/or repair plaster finish forming the existing interior walls and ceilings. Coordinate and finish with all new work.

2. **QUALITY ASSURANCE**

- 2.1 Qualifications: Contractor executing work of this Section shall have a minimum of ten (10) years continuous experience in successful restoration & installation of work of type and quality shown and specified.
- 2.2 Prior to plaster restoration work, prepare sample wall panels using materials, joints, bond, and finishes for final work; and provide special features to provide repairs to existing plaster.
- 2.3 Obtain Consultant acceptance of visual qualities before start of work. Retain approved sample areas for comparative reference. Do not alter or destroy mock-ups.
- 2.4 Defective materials or workmanship whenever found at any time prior to acceptance of the work shall be rejected regardless of previous inspection. Inspection will not relieve responsibility, but is a precaution against oversight and error.
- 2.5 Remove and replace defective materials and work of other trades affected by this replacement, at no additional cost to the Owner.
- 2.6 Mock-ups: provide mock-up of existing plaster crack, and plaster molding /cornice profile repair to demonstrate typical installation conditions.

3. **SITE CONDITIONS**

- 3.1 Environmental Requirements

3.1.1 Ensure continuous temporary heat and ventilation is provided to maintain the required environmental requirements.

3.1.2 Maintain work area within 12 deg. C. (55 deg. F.) to 21 deg. C. (70 deg. F). Maintain this temperature for a minimum of one week prior to plastering operations and six weeks thereafter.

3.2 Existing Conditions

3.2.1 Should materials, systems, or conditions be encountered that differ from those indicated, immediately notify Consultant and do not proceed without instructions.

4. **PRODUCTS**

4.1 Manufactured Units

4.1.1 General

4.1.2 Products named are to establish general preferences and quality required and are not intended to restrict submission by other manufacturers or match existing plaster material to.

4.1.3 Acceptance of products by other manufacturers will be subject to review by the Consultant to determine conformity with the specifications.

4.1.4 Where not otherwise specified, materials shall conform to the highest standards of trade involved, and be in accordance with approved industry standards.

4.2 Wood lath and Anchors

4.2.1 Wood Lath: To match existing where required to be repaired or replaced laced.

4.2.2 Species: To match existing.

4.3 Lathing Nails

4.3.1 Lathing Nails:

4.3.2 Electroplated zinc galvanized.

4.4 Masonry Anchors for Lath

4.4.1 Zamac Nailin by Rawlplug, or Nylon Nailin by Rawlplug.

4.5 Base-coat Plaster to Match Existing Materials

4.5.1 Conforming to CSA Standard A82-22.

4.5.2 Acceptable Products: 'RED TOP Mason's Hydrated Lime',
manufactured by Canadian Gypsum Co.

4.6 Finish Plaster to Match Existing Materials

4.6.1 Dolomitic lime, conforming to SA A82-44.

4.6.2 Acceptable Product: 'IVORY' Hydrated Finishing Lime,
manufactured by CGC.

4.6.3 Conforming to CSA A82.22.

4.6.4 Acceptable Product: Slow-set RED TOP gauging plaster.

4.7 Bonding Agent

4.7.1 A poly-vinyl-acetate (PVA) bonding agent.

4.7.2 Acceptable Product: 'THOROBOND' manufactured by Thoro
Systems Ltd.

4.8 Sand and Aggregate to Match Existing

4.8.1 Conforming to CSA Standard A82-57.

4.9 Water

4.9.1 Clean, potable and free of alkali or impurities, direct from water
mains.

5. **EXECUTION**

5.1 Examination

5.2 Verification of Conditions

5.2.1 Be responsible for the cost of cutting deteriorated plaster and
cracks.

6. **PREPARATION**

6.1 Protection

6.1.1 Protect the work of this Trade and others from damage or disfigurement. Be responsible for, and make good all damage caused by this Trade.

6.1.2 Protect the existing building finishes from staining or soaking.

6.2 Surface Preparation (previously rendered masonry and wood lathe areas)

6.2.1 Hack-off deteriorated rendering back to sound plaster.

6.2.2 Thoroughly brush down surfaces with stiff bristle or phosphor-bronze wire brushes to remove all loose and friable material, efflorescence, dirt and dust. Rake out joints to a depth of 15mm to provide a key for new render where there is no lath.

6.2.3 Provide adequate controlled ventilation during application and drying of plaster. Take precaution to prevent too rapid or uneven drying. Close all openings in dry or windy weather. After plaster has set, provide air circulation and dehumidifiers if necessary, to remove excess moisture from plaster. Do not permit plaster to dry or freeze before it sets.

7. ERECTION, INSTALLATION AND APPLICATION

7.1 Restoring Existing Finishes

7.1.1 Restore finishes cracked or deteriorated and loose. Where work exposes damaged or unfinished materials, provide new or salvaged, acceptable, matching materials, to make continuous areas and surfaces uniform.

7.2 Wood Lathing

7.2.1 Cover surfaces to receive plaster with wood lath to match existing.

7.2.2 Fix lath to existing masonry or wood framing with anchors at 150mm centres.

7.3 Repair of Existing Lathing

7.3.1 Repair in-situ areas of existing plaster and lath that have been damaged during mechanical and electrical installations by replastering over the original lathing.

- 7.3.2 Carefully remove loose and deteriorated plaster off the lathing and vacuum clean the area to be repaired of dust and debris.
- 7.3.3 Undercut edges of original plaster to form a key using a router. Provide a clean keying surface for the new plaster by punching through the lath.
- 7.3.4 Repair the cleaned lath with matching material. Wire lath securely.
- 7.3.5 Provide two spray applications of PVA Bonding agent to lath and edge plaster.
- 7.3.6 Cover all lath and edges of plaster with bonding agent. Allow each coat to dry to a tacky stage before re-application or plastering.

7.4 Plastering Type

- 7.4.1 Three-coat plaster:
 - 7.4.1.1 Plaster all new repaired walls, cornices, cove and ceiling profiles.
 - 7.4.1.2 Provide a minimum thickness of 16mm (5/8") at repair areas.
 - 7.4.1.3 Provide steel trowel finish.

7.5 Plastering

- 7.5.1 Mix material for scratch-coat in watertight mixing box to match existing in the proportion of 2 cubic feet of sand to 100 pounds of gypsum plaster, to give a minimum dry compressive strength of 750 psi. Continue dry mixing until the mass is of uniform colour before adding water. Add sufficient water only to provide a plastic mix. Excess water reduces strength. Apply plaster within one hour of mixing. Do not retemper mixes, or all setting material to a new batch.
- 7.5.2 Apply scratch coat by hand with sufficient material and pressure to form good fully keys on metal and wood lath, and then heavily cross-rake and allow to set hard.
- 7.5.3 Thickness of scratch coat shall be not less than 1/4" heavily cross-scratched to form a good key for succeeding coats. Moist-cure for 48 hours before following with brown coat.
- 7.5.4 Mix material for brown coat in the proportion of 3 cubic feet of sand to 100 pounds of gypsum plaster in the same manner as the

scratch coat.

7.5.5 Apply brown coat after base has set hard. Bring out to grounds with a strong pressure brought to a true, even level finish and leave rough for finishing. Level ceilings to 3mm in 3600mm. Rod to a smooth, even, flush surface keeping it back sufficiently to allow for a thin finish coat. Cross scratch lightly for key and moist cure for 72 hours minimum.

7.5.6 Mix material for finish coat plaster in the proportions of 1-part dry gauging plaster to 2-parts dry lime. Box-soak hydrated finishing lime using 5 gallons of water per 50 pound bag. Allow to soak for a minimum of 16 hours before use. Mix only enough material that can be used in one hour with gauging plaster.

7.5.7 Scratch plaster in thoroughly and immediately double-back to fill-out to a smooth, dense surface, free of surface blemishes and irregularities. Apply finish-coat as thinly as possible, between 1mm and 3mm thickness, and form a hard steel-trowel finish.

7.6 Tolerances

7.6.1 Finished work shall be free of cracks, waves, crevices and all other irregularities detrimental to the appearance and performance of the work.

END OF SECTION

1. **GENERAL REQUIREMENTS**

- 1.1 The General Conditions, the Supplementary General Conditions, the Instructions to Bidders, and Division 1 – General Requirements, shall be read in accordance with this Section.
- 1.2 The Specification shall be read as a whole by all parties concerned. Sectioning of the Specification is for convenience. Each Section may contain more or less than the complete work of any Trade. The Contractor is solely responsible to make clear to the Subcontractors the extent of their work.
- 1.3 Provide all labour, materials and equipment required to furnish and/or repair plaster finish forming the existing interior walls and ceilings. Coordinate and finish with all new work.

2.0 **SCOPE OF WORK**

- .1 Selective repair of plaster on solid substrate adjacent to new ventilation work.
- .2 Heritage intent
The intent of this Section is to retain as much of the existing wall and plaster as is feasible and to repair it selectively, to return the walls to their original appearance, as far as possible, using a traditional lime-based plaster mix.

3.0 **MATERIALS**

- .1 White Portland cement: non-staining Portland cement
- .2 Lime putty: fully slaked mature dolomitic lime (Magnesium carbonate)
- .3 Finishing lime: double hydrated finishing lime such as CGC "Snowdrift"
- .4 Sand Aggregate: well-graded, sharp, washed masonry sand.
1. Reinforcement: cut fibreglass filaments

4.0 **DESIGN AND PERFORMANCE REQUIREMENTS**

- .1 Qualification
The company undertaking the Work of this Section and its personnel shall be of recognized standing in the industry, specializing in the area of heritage work and known to have been responsible for satisfactory installations equal to that specified for a period of at least the immediate past 5 years.
- .2 Plaster formula .
1 Scratch (first) coat: 1 cement: 1 lime: 6 sand
2 Brown coat: 1 cement: 2 lime: 8-9 sand
3 Finish coat: pure lime mixed in accordance with the manufacturer's

recommendations.

- .3 Where the existing plaster is spalled to expose the masonry wall, rake out horizontal brick joints to provide a key for new plaster.
- .4 Where the plaster is spalled but the remaining plaster is well bonded to wall, remove approximately half depth for area approximately 75 mm around spall back to edge of well-bonded plaster.
- .5 Where only the finish coat is spalled, brush surface with bristle brush until well-bonded plaster is exposed.
- .6 Cut edge of patch to sharp line and consistent depth so that new plaster is not applied to a feather edge.
- .7 Hand apply plaster with wood float for scratch and brown coats, and metal float for finishing coat. Spray application is not acceptable.
- .8 Score each plaster coat to provide a bond for the next.
- .9 In large areas, make surface even and true after every application with a leveling board.
- .10 Apply and finish the finishing coat without using the leveling board.
- .11 Match the thickness of the existing plaster and in more extensive areas of replacement ensure of minimum finished thickness of 12 mm.
- .12 Allow a minimum of four days between coats to allow plaster to cure and shrink. Protect against premature curing.
- .13 Apply plaster up against wall and window trim in traditional manner. Minor cracking at junctions is acceptable.

END OF SECTION

PART 1 - GENERAL

1. GENERAL REQUIREMENTS

1. Division One, General Requirements, is a part of this section and shall apply as if repeated here.

2. DESCRIPTION

1. Work of this Section includes:
 - .1 Gypsum wallboard to partitions, ceilings, bulkheads furring and wall facings at all areas.

3. QUALIFICATIONS

1. Contractor for this work to have a minimum of five years' experience in installation of wallboard.
2. Install work to CSA A82.31-M1980, C.G.C., Drywall Construction Handbook and the Manual of Gypsum Wallboard Construction by Gypsum Drywall Contractor's International except where specified otherwise.

4. DELIVERY, STORAGE

1. Store materials in a dry weatherproof enclosure. Store wallboard flat, in piles without overhanging boards.
2. Do not install damaged or deteriorated material but remove from site.
3. Materials as delivered shall bear the manufacturer's name branch name of material and where applicable, CAN/CSA classification.

5. JOB CONDITIONS

1. Air and surface temperature: Minimum 54 F (12 C) and maximum 77 F (25 C) for 24 hours before, during and until entire installation is complete.
2. Ensure proper ventilation, during and following joint treatment, to eliminate excessive moisture.
3. Examine surfaces in which wallboard is to be attached and check environmental conditions and do not commence work until surfaces and conditions are satisfactory.
4. Commencement of work will denote acceptance of conditions.

6. PROTECTION

1. Protect work of other sections against damage resulting from work of this section. Repair and make good to approval, damage to other sections caused by this work.

7. SUBMITTALS

1. Submit shop drawings showing control joints for Architect's approval.
2. Submit sample of each type of casing bead, corner bead, control joints, reveal moulding, etc.

PART 2 - PRODUCTS

1. MATERIALS

1. Gypsum Wallboard:

- .1 Manufacturer: Specification is generally based on Canadian Gypsum Co. Ltd. material but equivalent materials by other manufacturers are acceptable.
- .2 Backing Board and Gypsum Coreboard: CSA A82.27-M1977.
- .3 Gypsum Wallboard: CSA A82.27-M1977. Use Type 'X' (special fire retardant) board such as CGC Firecode 'C' when fire rating is required, 16 mm, (5/8") thick. Use board with round or tapered edges.
- .4 Exterior Sheathing: 5/8" (16mm) thick Dens-Glass Gold Fiberglass - Faced Sheathing by Georgia Pacific Corporation.

2. Accessories:

- .1 Casing beads, corner beads, fill type: 24 ga. (0.5 mm) base thickness commercial grade sheet steel with G90 zinc finish to ASTM A525-80A; perforated flanges; one piece length per location.

NOTE: Use Beadex U Trim (thickness as required) where "J" mould is indicated on drawings as manufactured by BeadeX Manufacturing Company Inc.

- .2 Screws: C.G.S. Brand Screws Type S. 1" (25 mm) and 1 ½" (38 mm) as required to C.S.A. A82.31-M1980. For exterior Sheathing and tile backer board use 1 1/4" Bugle head fine thread rust resistant drillpoint drywall screw (type S-12).

- .3 Joint Treatment Material: CGC MC "All-Purpose" and CGC MC "Joint Topping" compounds - to ASTM 0474 and 0475. Use materials recommended by board manufacturer for the proposed use. Material shall be pre-mixed, ready to use, in sealed cans.
- .4 Tile Backer Board Joint Treatment Materials: thin set mortar mixed with acrylic latex. Tape shall be 2" (50 mm) wide alkali resistant fibreglass tape. Screws to be self-taping rust resistant screws.
- .5 Reinforcing Tape: Perf-a-Tape by CGC or equal.
- .6 Adhesive: CGC "Durabond" 90 pre-mixed, ready to use in sealed cans.
- .7 Acoustic Materials:
 - 1. Acoustical Caulking: Acoustical sealant by Tremco or approved equal to CGSB 19-GP-21M.
 - 2. Sound Attenuation Batts: Section 07213 Mineral Fibre Insulation
- .8 Control Joint: equal to C.G.C. control joint No. 093.
- .9 Thermal Break: Permanent adhesive faced rubberized cork, 1/8" (3 mm) thick by width required.
- .10 Stud adhesive: to C.G.S.B. 71 GP-25M.

PART 3 - EXECUTION

- 1. EXAMINATION
 - 1. Examine surfaces and other conditions on which work of this Section depends and do not proceed until conditions are suitable.
 - 2. Commencement of work will denote acceptance of conditions.
- 2. GYPSUM BOARD INSTALLATION
 - 1. General:
 - .1 Do not install gypsum board until work of other Trades which will be covered by the board has been installed and approved.
 - .2 Use board of maximum practical length to reduce number of end

joints. Install control joints in long runs of board.

- .3 Fit ends and edges closely, but do not force together.
- .4 Attach board to framing using screws, not nails.

2. Installation on Stud Framing:

- .1 Install board vertically or horizontally whichever results in fewer end joints, use longest possible lengths. Cut and fit boards around openings, beams, joists, ducts, light fixtures and similar items. Install board up to underside of slab or metal deck above to provide sound insulated walls and fire separations.
- .2 Minimize gypsum board joints over openings. Use one piece application to span over opening width where board lengths allow. There is to be no board joint directly over / above edge condition of opening.
- .3 Position edges over supports for vertical or horizontal application.
- .4 For single layer vertical application space screws 12" (300 mm) o.c. for field of panel and 6" (150 mm) o.c. staggered, along vertical abutting edges. For horizontal application space screws 12" (300 mm) o.c. in field and 8" (200 mm) and along abutting end joints. For double layer application, stagger joints in second layer of boards, a minimum of one-stud spacing in both directions and fasten with screws as before.

3. Installation on Ceiling:

- .1 Install board with long dimension at right angles to furring channels.
- .2 Position end joints over channel flange and stagger in adjacent rows.
- .3 Fasten board to channels with 1" (25 mm) type S screws spaced 12" (300 mm) o.c. in field of panels and 8" (200 mm) along abutting edges.

3. FIRE RATING

- 1. Conform with following for fire rated partitions, ceilings and bulkheads:
 - .1 Fire resistant ratings called for on drawings and schedules.
 - .2 Appropriate codes and regulations.

.3 Use "Firecode C" or approved equivalent gypsum board.

4. FINISHING

1. Mix joint compound (powder) in accordance with manufacturer's printed instructions.
2. Prefill "V" grooves of rounded edges with Durabond 90 compound. Finish flush with tapered surface ready for reinforcing tape application. Allow pre-fill material to dry thoroughly before application of embedding compound and tape.
3. Apply "All-Purpose" compound in thin uniform layer; embed reinforcing tape accurately centred on joint, securely pressed in, leaving sufficient compound under tape to provide proper bond. Immediately apply skim coat over tape application. Allow to dry thoroughly before application of filler coat.
4. Apply filler coat of "Topping" compound such that taper depression is flush with board surfaces. Allow to dry thoroughly before application of finish coat.
5. Apply finish coat of "Topping" compound extending slightly beyond the filler coat and feathered out onto the board surface.
6. Sand between coats and following the finish coat, where necessary, and leave surface smooth and ready for painting.
7. Finish screw depressions with filler material and finish coat as specified in 4. and 5. above.
8. Joint and depression finish shall in no case protrude beyond the plane of the board surface.
9. Finish corner beads and metal trim flush with board surface using filler and finishing coats feathered out approximately 2" (50 mm) and 4" (100 mm) respectively onto the board surface to ensure that metal visible only at arris.
10. Fill and tape joints and internal corners and fill screw depressions in board face and smooth out along corner beads and metal trim with joint compound.
11. Provide specified metal trim and control joints at exposed edges, at junctions of drywall with dissimilar material, at control joints and at junction with columns. Fasten with screws at 12" (300 mm) o.c. along entire length.

12. Cut out a 'V' at all butt joints and install Durabond 90 then complete with filler and topping coats.

13. Avoid sanding adjacent paper surface of boards.

5. CLEANING

1. Clean thoroughly and remove all excess materials from other surfaces.

2. Remove all excess materials as job proceeds and at completion.

6. ACCESSORIES

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 6" (160 mm) o.c. for full length.

2. Install "J" molds around perimeter of suspended ceilings.

3. Install "J" molds where gypsum board butts against surfaces having no trim concealing junction and where indicated.

7. ACCESS PANELS

1. Ceiling access panels to be 18" x 18" (460 mm x 460 mm) drywall to match adjacent ceiling finishes except at fire rated ceilings, and as noted on drawings.

2. Provide "J" molds at exposed drywall edges of panel and at ceiling opening.

3. Reinforce panel with 3/4" (19 mm) fire retardant plywood backer as required.

4. Install access panels at wall locations provided by Divisions 15 and 16.

5. Rigidly secure frames to furring or framing systems.

8. THERMAL BREAK

1. Provide a continuous moisture resistant insulating material at edges of wallboard in contact with aluminum windows and exterior door frames to provide a thermal break.

9. CERTIFICATION

1. Provide at completion of work a written certification that all drywall work

where applicable conforms to the required ULC fire rated assemblies.

10. ACOUSTICAL MATERIALS

1. Install a continuous double row of caulking beads around perimeter of partitions which are indicated as containing sound attenuation batts.
2. Install sound attenuation batts in partitions where shown, with air space consistently on one side. Continue batts behind electrical boxes and conduits and all other services and items installed in partitions.
3. Provide caulking around all ducts, pipes, conduits and other items passing through partitions
4. Caulk all openings in wall and through base and ceiling plates for plumbing.
5. Electrical Outlets: cut holes neatly to reduce leaks. Caulk it tight around outlets before plate is installed. Do same for wall mounted fixture outlets before fixtures installed.
6. Bring early to General Contractor's attention that no electrical outlets are to be back to back in sound control walls. Consult Electrical Engineer.
7. Caulk edge of drywall to studs at perimeter of wall with 2 beads of caulking.
8. Installation of acoustical walls shall be from floor to bottom of floor above (not ceiling height) and sealed at all perimeters (including voids in metal deck).

11. FIRE STOPPING

1. Provide gypsum wallboard and furring as required to box in around steel joists at top of masonry and gypsum wallboard partitions including cross walls parallel to steel joists as per drawings.
2. All firestop sealants and backup mineral wool by Section 07270 - Firestopping and Smoke Seals.

END OF SECTION

1. **GENERAL**

1. **SUMMARY**

1. This procedure includes guidance on repairing small localized damage to wood floorboards by cutting out a geometric piece of the board slightly larger than the damaged area and replacing it with a piece of wood cut and fit to match. This method of repair - called a dutchman - enables as much of the original material to be retained as possible.
2. This procedure may also be used for making small repairs to wood trim and may include filling holes left from heating or plumbing pipes.
3. These guidelines cover the following sections:
 1. Safety Precautions
 2. Submittals
 3. Quality Assurance
 4. Delivery, Storage and Handling
 5. Project/Site Conditions
 6. Sequencing and Scheduling
 7. General Protection (Surface and Surrounding)
4. These guidelines should be reviewed prior to performing this procedure and should be followed.

2. **DEFINITIONS**

1. A wood floor surface can be either a series of connected planks or parquet (small wood pieces arranged in decorative patterns). The wood used is either plain sawn or quarter sawn. Plank flooring, the more common type, is assembled by joining: butt joint, tongue and groove, shiplap, doweled or spline. Wood floors are usually secured to the under structure by countersinking nails, blind-nailing, or screwing and plugging.

2. **PRODUCTS**

1. **MATERIALS**

1. Wood for Dutchman (match existing material to be repaired including species, saw/grain).
2. Wood glue such as Elmer's or equivalent.
3. Sandpaper

2. EQUIPMENT

1. Hammer
2. Chisel
3. Plane

3. EXECUTION

1. ERECTION, INSTALLATION, APPLICATION

1. Remove damaged portion with hammer and chisel
 1. Cut an irregular geometrically-shaped cavity in the wood that is slightly larger than the damaged area. Select a geometric shape that is easy to reproduce such as a diamond or trapezoid, but is not obvious to the eye (a plug in the shape of a circle or square is more apparent).
 2. Bevel the edges of the cavity
 3. Fabricate a plug to match the surface cavity bevel from matching wood stock. Make sure that the grain direction also matches. Glue the plug into the cavity.
2. Fabricate a plug to match the surface cavity bevel from matching wood stock. Make sure that the grain direction also matches. Glue the plug into the cavity.
3. Allow the glue to dry, then plane or sand if necessary and refinish to match surrounding floor.

END OF SECTION

PART 1 - GENERAL

1. GENERAL REQUIREMENTS

1. Division One, General Requirements, is a part of this Section and shall apply as if repeated here.

2. SUBMITTALS

1. Samples

- .1 Prepare samples of various finishes for Architect's approval either on site or by submitting samples as directed, at least thirty days before materials are required. Identify each sample as to job, finish, formula, colour name, number, sheen name and gloss units, date and name of Subcontractor.

3. PRODUCT HANDLING

1. Delivery and Storage

- .1 Deliver materials to site in their original containers with label intact and store in spaces directed by Architect. Keep stored materials covered at all times and take all necessary precaution against fire.
- .2 Provide CO2 fire extinguisher of minimum 20 lbs. (9 kg.) capacity in storage area.

4. ENVIRONMENTAL CONDITIONS

1. Do not paint or finish in unclean or improperly ventilated areas. Do not paint in temperatures lower than 50 degrees F. (10 degrees C.) or varnish in temperatures lower than 65 degrees F. (18 degrees C.) for 24 hours before, during and 48 hours after application.
2. Do not undertake exterior painting at temperatures under 50 degrees F. (10 degrees C.) for 24 hours before, during and 48 hours after application or immediately following rain, frost or dew. Safe levels shall be determined by use of an electronic metre.
3. Test for moisture content in each location immediately before commencing application of paint. Do not apply paint on surfaces where moisture content exceeds 14%. Promptly notify Consultant if such conditions are encountered.
4. Provide approved equipment for testing moisture content of surfaces to receive paint finishes and have available on Site at all times during Work of this Section.
5. Do not apply paint finish in areas where dust is being generated.

5. PROTECTION

1. Provide metal pans or adequate tarpaulin to protect floors in areas assigned for the storage and mixing of paints.
2. Use sufficient drop cloths and protective coverings for the full protection of floors, furnishings and work not being painted.
3. Leave above areas clean and free from evidence of occupancy upon completion of painting.
4. Protect paint materials from fire and freezing.
5. Keep waste rags in metal drums containing water and remove from building at end of each working shift.

6. RELATED WORK SPECIFIED ELSEWHERE

1. Read carefully all other Sections of the specifications to determine the extent of prime and finish coats applied by others.
2. Wood preservative for Rough Carpentry - Section 06100.
3. See Division 20 - Mechanical and 26 - Electrical, for extent of finish on equipment.

7. SCOPE OF WORK

1. With exceptions for work specifically called for in other Sections of the Specification, all paintwork is included in the scope of this Section
2. NOTE: In locations where Drawings do not call for paint or similar finish on walls and/or ceilings, the intent of this Specification is that all exposed unpainted metal surfaces shall be painted.
3. Paint exposed drywall and the like in locations where finish is not otherwise specified or noted. Do not paint such surfaces in mechanical shafts, unless specifically noted.
4. In locations where Drawings do not call for paint or similar finish on walls and/or ceilings, the intent of this Specification is that items such as new work, including miscellaneous metal work, shall be painted.
5. Paint pipes, conduit, ducts and related thermal insulation and all prime painted mechanical and electrical equipment and supports located in mechanical and electrical storage and maintenance rooms in allocations where Drawings call for paint or similar finish on walls and/or ceilings.
6. Do not paint pipe, conduit, ducts, insulation and the like where concealed

above ceilings (except louvred type ceilings) or in service shafts.

7. Make good paint finish on shop coated work where damaged.
8. Paint visible portions of steel shelf angles, lintels and structural steel.
9. Paint all edges and all faces of doors where primed for paint supplied.
10. Stain all top, bottom and side edges of all plastic laminate doors.
11. Interior of ducts and diffusers visible from exterior on room side.
12. Paint all roof top equipment, stairs, pipes, conduit, vents, ducts, pipe insulation, etc. exposed on roofs (including primed and prefinished items).
13. Allow for five (5) different paint colours to be used in the building - including field, accent walls and bulkheads.

8. QUALITY ASSURANCE AND REFERENCES

1. Paint work shall meet or exceed standards set out in C.G.S.B. Specification No.'s 85-GP-1M to 85-GP-33A and C.P.C.A. Canadian Painting Contractors Association - Painting Manual.
2. Employ fully trained workers who are regularly employed in this field.
3. Manufacturer's sales representative shall perform inspections on the Owner's behalf in order to ensure compliance with product specifications.

9. RETOUCHING

1. Do all retouching, etc. to ensure that the building may be handed over to the Owner in perfect condition, free of spatter, finger prints, rust, watermarks, scratches, blemishes or other disfiguration.

10. TEST AREA

1. A room or area in the building will be designated by the Architect as a test area to establish standard of workmanship, texture, gloss and coverage.
2. Prior to any painting being started, request a meeting on Site between Architect, Contractor, Subcontractor and Material Manufacturer's Representative to review conditions, surfaces, anticipated problems and to clarify quality of workmanship acceptable to Architect.
3. Apply finishes to each type of surface within room with correct material, coats, colour, texture and degree of gloss in sample area and have same approved prior to providing Work of this Section.

4. Retain test area until after completion of Work. Test area to be minimum standard for the Work.
5. Failure to comply with the above will be cause for Architect to request all Work previously painted to be repainted.

PART 2 - PRODUCTS

1. MATERIALS

1. "Top Line" products only are acceptable. Use only products of manufacturers whose best quality lines meet or exceed CGSB Specifications for the particular type of material required. Approved manufacture and product unless specifically indicated otherwise in specification:

- .1 Paints, stains and varnish:

1. General Paint
 2. Benjamin Moore
 3. Sherwin Williams
 4. Zinsser
 5. Glidden/Devoe Coatings

- .2 Latex Water Based Epoxy

1. Sherwin Williams B70W00211 - Waterbased catalyzed epoxy extra white/
Tint base A/B60V00025 - Waterbased Catalyzed epoxy Semi Gloss Hardner Part B
 2. Glidden - 4420 - True Glaze Waterborn epoxy / 4426 True Glaze semi gloss converter

- .3 Latex Supper Adherent Primer,

1. General Paint 51-050 Premium Latex Plastic Primer
 2. Benjamin Moore #23-00 Freshstart Acrylic Primer Sealer
 3. Zinsser 1-2-3 Acrylic Primer Sealer
 4. Sherwin-Williams - B51WQ8850 - Adhesion Prm White
 5. Glidden Latex super undercoat 94280

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- .4 Interior Latex Block Filler, C.G.S.B. Standard #-GP-188M
1. General Paint 70-224 Premium Latex Block Filler
 2. Benjamin Moore #595-01 Latex Block Filler
 3. Glidden #362650 Concrete Block Filler
 4. Sherwin-Williams B42W00046 Heavy Duty Block Filler
- .5 Stain Suppressant Sealer/Primer Hi-Hide, C.G.S.B. #1-GP-119M (where required)
1. General Paint 60-200 X-Terminator 2 Latex Sealer
 2. Zinsser BIN Primer, hi-hide (spot prime only)
 3. Zinsser Bullseye Odourless
 4. Sherwin-Williams - B49WQ8820 Multipur LTX Pr Wh
 5. Glidden/Jammer 200
- .6 Clear Wood Trim and Panel Finish
1. General Paint 25-011 Urethane Semi-Gloss
 2. Benjamin Moore & Co. Ltd. #435 Low Lustre Alkyd Urethane.
 3. Glidden #90333 Urethane Varnish.
- Note: Colours will be selected from Sherwin-Williams colour system. Sherwin-Williams colour formulas must be matched if one of the other approved manufacturer's are being used.
- .7 Fire Retardant Clear Coat at all exposed wood panels: Quantum Safe Coat Clear Fire Retardant Coating or equal by Ocean Products.
- .8 Typical Furniture Finish of all Wood Millwork, wood trim, panels, etc. (by Sections 06200 and 06400): shall be polymerizing two component catalytic varnish system equal to "Duravar Plus" manufactured by M. L. Campbell. The individual components of the system used must be chemically compatible to assure perfect adhesion and a top quality, durable final finish.
- .9 Thinners, cleaners: Type and brand recommended by the paint manufacturer.

- .10 Materials to be new and first line of manufacturer.
- .11 Deliver materials to site in original unbroken containers bearing brand and manufacturer's name.

PART 3 - EXECUTION

1. CONDITION OF SURFACES

- 1. Check all surfaces with electric moisture metre and do not proceed if reading is higher than 12-15 without written permission from Architect.
- 2. Proceed with work only when surfaces and conditions are satisfactory for production of a first class job.
- 3. Clean and remove dust, grease, rust and extraneous matter from all surfaces (except that rust occurring on items specified to be primed under other sections shall be removed and worked reprimed under these sections).
- 4. The commencing of work in a specific area shall be construed as acceptance of the surfaces, and thereafter the contractor shall be fully responsible for satisfactory work as required herein.
- 5. All surfaces shall be prepared in accordance with Chapter 2 for Interior Work of the Master Painters and Decorators Association Painting Manual latest edition.
- 6. Prepare surfaces in accordance with paint covering manufacturer's instructions.

2. PREPARATION

1. Concrete and Masonry

- .1 Test surfaces for alkalinity with pink litmus paper or other recognized method.
- .2 Where extreme alkalinity occurs, wash surface with 4% solution tetrapotassium pyrophosphate (5 oz. per gallon (31 ml./l.) of water) where latex base paint is to be used and with zinc sulphate solution (3 lbs. per gallon (300 g./l.) of water where other paint bases are to be used.)
- .3 Etch normal concrete surfaces to receive alkyd paint with muriatic acid solution (1 part commercial) 31.45% to 3 parts water. Neutralize and allow to dry before painting.
- .4 Prepare masonry concrete surfaces to CGSB 85-GP-31M.

2. Metal

- .1 All metal surfaces to receive coatings shall be cleaned to SSPC-SP1 (solvent washing) prior to painting as specified herein.
- .2 Touch-up shop primed metal after first removing loose primer, rust, oil, grease and other contaminants.
- .3 All metal surfaces exposed and/or exhibiting rust shall be cleaned to SSPC-SP2 or SSPC-SP3 standards and primed with an approved rust inhibitive primer prior to recoating as specified.
- .4 Feather edges to make touch-up inconspicuous when applying new primer.
- .5 Conform to CGSB 1-GP40d.M to CGSB 85-GP-14M.

3. Galvanized Surfaces

- .1 For Primer Application Type C Corrosive ensure that all surfaces to be painted are clean, dry, and free of all contaminants.
- .2 Cleaning of existing surfaces to be conducted according to SSPC-SP-4 Flame Cleaning procedure. Pass high temperature, high velocity, oxyacetylene flames over entire surface and then wire brushing. Primer is to be applied before surface is cool.
- .3 Phosphatize galvanized metal surfaces using CGSB 31-GP-105M pretreatment or prime with galvanized metal primer.

4. Woodwork

- .1 Inspect millwork, trim and panels to assure surfaces are smooth, free from machine marks and that nailheads have been countersunk. Seal all knots and sapwood in surfaces to receive paint, with a vinyl sealer compatible with finish specified conforming to CGSB 1-GP-125b.
- .2 Sand smooth all woodwork which is to be finished and clean surfaces free of dust before applying first coat. Fill nail holes, splits and scratches with non-shrinking filler conforming to CGSB 1-GP-103b after first coat is dry. When these occur on a transparent surface, filler shall be stained to match the finish as approved by Architect. Between coats, sand lightly with No. 00 sandpaper and remove dust.
- .3 Prime all wood noted for paint finish immediately on delivery to site.

.4 Back paint all wood noted for stain, varnish or Intumescent fire retardant clear coating or natural finish.

.5 Prepare all wood surfaces to CGSB-85-GP-1M.

5. Hardware

.1 Remove finishing hardware, electric cover plates and accessories, mask any that are not removable. Replace these when paint is dry and clean them. Do not clean hardware with solvent that will remove permanent lacquer finish.

6. Gypsum Wallboard

.1 For small holes, scratches or other surface marks fill with patching compound and sand smooth.

.2 For larger holes or damaged areas do not proceed until trade for original work has filled or repaired surfaces to acceptable levels.

.3 Prepare wallboard surfaces to CGSB-85-GP-33M.

7. Copper

.1 Prepare copper piping and accessories to CGSB 85-GP-20M.

8. General

.1 Mask specification plates occurring on equipment, switch boxes, and similar items requiring painting.

.2 Protect, remove and replace hardware, accessories, lighting fixtures and similar items as required.

.3 Conform with Architect's colour schedules and exactly match approved samples.

3. APPLICATION

1. Finishes and number of coats specified in the schedule are intended to cover surfaces perfectly. If they do not, apply further coats until perfect coverage and colour are achieved as required.

2. Any areas exhibiting incomplete or unsatisfactory coverage shall have the entire plane painted. Patching will not be acceptable.

3. Walls needing repainting, entire wall (plane) shall be painted to the satisfaction of the Architect. See drawings for extent of work.

4. Spray painting will not be permitted (except at metal deck and joist areas) unless specifically approved in writing by the Architect in each instance. Architect may withdraw approval at any time and prohibit spray painting for reasons such as carelessness, poor masking or protection measures drifting paint fog, disturbance to other Trades or failure to obtain a dense, even, opaque finish. Spray painting shall be full double coat, i.e. at least two passes for each coat. Do not use spray or roller on wood or metal surfaces, brush only unless approved in writing by Architect. Spray painting and backroll may be permitted on concrete blocks.
5. Arrange to have traffic barred from completed areas wherever possible.
6. Apply materials in strict accordance with manufacturer's directions and specifications and be familiar with these directions and specifications.
7. Prime woodwork as soon as possible after woodwork is delivered to site. Prime all surfaces, whether exposed or not, before installation. In case of woodwork which is to be stained, apply one coat of penetrating sealer to all finish surfaces of wood having uneven absorption, such as birch. Woods of uniform density such as oak shall be left unsealed. Back prime stained and varnished woodwork with one coat of gloss varnish reduced 25%. Fill open grain woods with filler tinted to match wood when transparent finish is required, and work well into grain. Before filler sets, wipe excess from surface.
8. Apply primer-sealer coats by brush or roller method. All primers and undercoats to be tinted to no more than 25% of intensity of the finish colour.
9. Permit paint to dry before applying succeeding coats, touch up suction spots and sand between coats with No. 00 sandpaper.
10. Where two coats of the same paint are to be applied, the first coat shall be the same colour as the finish coat and be inspected by the Architect before application of final coat, to allow the Architect to make reasonable modification of colour if necessary. Furnish Architect with a schedule showing expected completion of the respective coats of paint for the various areas and surfaces. Keep this schedule current as the job progresses.
11. Exterior paints and deep/intense interior and exterior colours shall be from the nearest factory premixed colour selection and shall be alterable to match required colours.
12. Flat and semi-gloss finishes on gypsum wall board, block and other surfaces of large areas shall be applied by roller and to all other surfaces applied by brush.

13. Paint shall be uniform in sheen, colour and texture, free from brush or roller marks, sags, runs or other defects.
14. Finish edges of doors (top, bottom, sides and cutouts) with paint or stain treatment as required to match face of door. Stain top and bottom edges a different colour and seal with one coat of shellac and one coat gloss varnish or two coats paint. Refinish tops and edges of wood doors after fitting.
15. Even up stained woodwork in colour as required by nature of wood and as directed by Architect. Apply same finish on trim, fitments, cupboards and other protecting ledges as on surrounding work, disregard sight lines.
16. Carefully hand smooth and sandpaper wood between coats (including priming). Apply one coat sealer before applying first coat paint filler to knots or sap blemishes on wood surfaces to receive paint or stain finish.
17. Remove rust, oil, grease and loose shop paint from metal work by brushing or with wire brushes and make good shop coat before proceeding with final finish. Feather out edges to make touch up patches inconspicuous.
18. After first coat, fill nail holes, splits, and scratches, using putty coloured to match finish.
19. Clean castings with wire brush before application of first paint coat.
20. Do not etch galvanized metal. Prepare prime and paint elsewhere in this section. This includes metal door frames and the like with wiped zinc coating.
21. Remove form oil or parting compounds from concrete surfaces. Use Xylol or approved compound.
22. Paint interior of pipe spaces, ducts, etc. visible through grilles or through metal ceilings in black matt finish.
23. Conform with Architect's colour schedule and exactly match approved samples.
24. Mechanical and Electrical Materials
 - .1 Refer to Mechanical and Electrical Sections of the Specifications and note the instructions regarding painting and finishing of materials and equipment supplied and installed by those trades.
 - .2 Remove grilles, covers, access panels for mechanical and electrical systems from location and paint separately, if these items are not factory finished.
 - .3 Paint work to match adjacent walls and ceilings unless directed

otherwise. Note: This includes trim on fixtures exposed, speaker covers, emergency lights, grilles, diffusers, louvres, vents, fire extinguisher cabinets, electrical panels, etc.

- .4 Paint interior surfaces that are visible through grilles and louvres with one coat of flat black metal paint to limit of sight line.
- .5 Where walls and ceilings are not scheduled to be painted, the work described above shall be painted a colour selected by Architect.
- .6 Unless factory painted, all exposed piping, conduits, ductwork hangers, insulation and mechanical equipment shall be painted.

- 25. Rooms without finished ceilings will have decks, joists, beams, ducts, etc., painted.
- 26. Paint graphics as shown on drawings. All graphics to be semi-gloss minimum two coat application.

4. ADJUST AND CLEAN

- 1. Cracks occurring in walls or ceilings requiring patching during "warranty period" shall be repainted in such a way that the patch is not visible at a distance of 5'-0" (1500 mm).
- 2. If patch painting not acceptable repaint entire wall or ceiling surface.
- 3. At completion clean entire area of surplus materials and equipment.

5. FIELD QUALITY CONTROL

- 1. Locate testing area in building to establish standard of workmanship, texture, gloss and coverage where designated.
- 2. Apply samples of all finishes on each type of surface to be coated with correct material, number of coats, colour, texture and degree of gloss required.
- 3. Retain test area until completion of work. Use approved work in test areas as standard for corresponding work throughout building. Correct and refinish work which does not compare with approved finishes.

6. FINISH SCHEDULE

1. General

- .1 Finish the listed exposed surfaces, wherever they occur unless such surfaces are specifically noted to be left unfinished.

- .2 Exposed means visible in the completed work and includes the interior of closets, cabinets and drawers.
- .3 The Architect shall have the option of having wood painted or with transparent finish and of which finish shall be used.
- .4 In instances where materials specified are not suitable for a particular job application, or are contrary to manufacturer's recommendations for use on a particular surface, such condition shall immediately be brought to the attention of the Architect for clarification and instructions.
- .5 Finishes shall match approved samples but Architect reserves the right to make reasonable changes to finish specifications to obtain desired results without additional cost or obligation of Owner.
- .6 A colour chart giving colour schemes for various areas will be prepared after tendering, by the Architect. The final selection of colours and surface textures of all finishes throughout and whether finishes are transparent (natural) or opaque (paint) shall rest solely with the Architect.
- .7 Where surfaces have been disturbed the entire plane shall be painted.

2. Exterior Schedule

- .1 Metal (Ferrous): One coat rust inhibitive primer (metal surfaces already primed need not receive a field prime coat except for touch up). Two coats exterior Aura paint by Benjamin Moore.

Note: All roof top equipment, pipes, conduit, vents, ducts, grilles, pipe insulation, etc. to be painted.

- .2 Galvanized Steel: One coat galvanized primer. Use a Polyamide converted epoxy primer by Devoe Coatings, "4170-1000 with 4170-999 - catalyst". Two coats of galvanized Finish Coat. Use a single package tough, durable alkyd modified urethane coating with water, chemical and solvent resistance by Devoe Coatings "Devoe" Glid Shield Urethane Gloss Enamel No. 4328-0100 Series (installation within 72 hours of installing primer).

Note: All exterior areas are to be painted including stairs, masonry lintels, etc.

- .3 Painted Wood Surfaces: One coat wood primer. Two coats exterior Aura paint by Benjamin Moore.
- .4 Stained Pressure Treated Wood or Cedar: Two coats solid hide

Aborite stain and one Clear Top Coat both by Benjamin Moore.

3. Interior Schedule

- .1 Metal (Ferrous): One coat latex super adherent primer (metal surfaces already primed need not receive a field prime coat except for touch up). Apply two coats latex water based epoxy 2 coats.
- .2 Hot Ferrous Metal - (Valve bodies, strainers, etc., on high temperature lines.) - One coat primer, latex super adherent heat resistant - Two coats latex water based epoxy.
- .3 Galvanized Steel: One coat galvanized primer. Use a Polyamide converted epoxy by Devoe Coatings "4170-1000 with 4170-9999-catalyst". Two coats of galvanized Finish Coat. Use a single package tough, durable alkyd modified urethane coating with water, chemical and solvent resistance by Devoe Coatings "Devoe Glid Shield Urethane Gloss Enamel No. 4328-0100 Series (install within 72 hours of installing primer).
- .4 Hollow Metal Doors, Metal Ducts, etc.: One coat super adherent primer. Two coats latex water based epoxy.
- .5 Metal Roof Decks and Joists: One of the approved primer finish combinations as follows:
 1. General Paint 10900 Alkyd Dryfall Primer. Apply one coat: spread rate, 250 square feet per 3.78 litre container on smooth surfaces and 75 square feet on corrugated steel. Each coat wet thickness: 4.6 mils. Each coat dry thickness: 2.0 mils.
 2. General Paint 6000-Line or 33-Line. Apply two coats: spread rate 400 square feet per 3.78 litre container. Each coat wet thickness: 4.0 mils. Each coat dry thickness: 2.0 mils.

OR

 3. Benjamin Moore and Co. Ltd. #597-01 Sweep-Up Spray Latex Flat primer. Apply one coat: spread rate, 255 square feet per 3.79 litre container. Each coat wet thickness: 6.3 mils. Each coat dry thickness: 2.5 mils.
 4. Benjamin Moore & Co. Ltd. T-7688 Impervo or T-7721 Satin Impervo. Apply two coats: spread rate, 500 square feet per 3.79 litre container. Each coat wet thickness: 3.0 mils. Each coat dry thickness: 1.3 mils.

OR

5. Glidden #10120 Spraymaster Latex Eggshell primer. Apply one coat: spread rate, 264 square feet per 3.78 litre container. Each coat wet thickness: 6.0 mils. Each coat dry thickness: 2.0 mils.
6. Glidden #4308 Devguard. Apply two coats: spread rate, 320 square feet per 3.78 litre container. Each coat wet thickness: 5.0 mils. Each coat dry thickness: 2.25 mils.
- .6 Woodwork Painted: One coat super adherent primer. Two coats latex Ultra "94800" by Glidden.
- .7 Natural or Stained Close Grain Wood: One coat non-bleeding alkyd stain. One coat sanding sealer.
Approved Finish Clear Coats are as follows:
 1. General Paint 25-011 Urethane Semi-Gloss. Apply two coats: spread rate, 350 square feet per 3.78 litre container. Each coat wet film thickness: 4.0 mils. Each coat dry thickness: 1.5 mils.

OR

2. Benjamin Moore & Co. Ltd. #435 Low Lustre Alkyd Urethane. Apply two coats: spread rate, 575 square feet per 3.79 litre container. Each coat wet thickness: 2.8 mils. Each coat dry thickness: 1.1 mils.

OR

3. Glidden #90333 Urethane Varnish. Apply two coats: spread rate, 638 square feet per 3.78 litre container. Each coat wet thickness: 2.5 mils. Each coat dry thickness: 1.0 mils.
- .8 Natural or Stained Open Grain Wood: One coat stain filler. One coat sanding sealer.
Approved Finish Clear Coats are as follows:
 1. General Paint 25-011 Urethane Semi-Gloss. Apply two coats: spread rate, 350 square feet per 3.78 litre container. Each coat wet film thickness: 4.0 mils. Each coat dry thickness: 1.5 mils.

OR

2. Benjamin Moore & Co. Ltd. #435 Low Lustre Alkyd Urethane. Apply two coats: spread rate, 575 square feet per 3.79 litre container. Each coat wet thickness: 2.8 mils. Each coat dry thickness: 1.1 mils.

OR
 3. Glidden #90333 Urethane Varnish. Apply two coats: spread rate, 638 square feet per 3.78 litre container. Each coat wet thickness: 2.5 mils. Each coat dry thickness: 1.0 mils.
- .9 Concrete Block (Base Price): One coat latex block filler, applied at the minimum rate of 80 sq. ft per gallon (1.63 m2 per litre), or as required by block texture to completely fill block. **Pinholes will not be accepted.** Apply more block filler if necessary to completely fill the block before applying finish coats. Note that lightweight block requires more block filler to fill than standard weight block does and adjust application rate as required. Two coats interior Latex Semi-Gloss "Ultra 94800" by Glidden.
- .10 Exposed Insulated Pipes and Ductwork: One coat size. One coat super adherent primer undercoat. Two coats Ultra "94800" by Glidden eggshell.
- .11 Gypsum Wallboard (Base Price): One coat of Latex super adherent primer.. Two coats semi gloss Ultra "94800" by Glidden. Velvet or eggshell at walls and Low gloss at ceilings.
- .12 Surfaces Behind Grilles and Duct Work Where visible Within 12' (300 mm) of Grille:
1. Two coats vinyl latex matt black.
- .13 Painted Light Trims, Emergency Lights, Louvres, Diffusers, Vents, Concealed Sprinkler Covers, Fire Extinguisher Cabinets, and Electrical Panels, Etc.
1. One coat super adherent primer. Two coats Ultra "94800" by Glidden to match surrounding wall and ceiling colours or as specified by Architect.
- .14 General Notes
1. See drawings for locations of areas where more than one colour occurs on one wall and one ceiling plane.
 2. Each ceiling bulkhead section or level may be a different

colour.

3. Wall planes may be designated a different colour from surrounding walls such as stairwells, entrances to classrooms, corridor intersections, gym (area below band one colour area above another) and Library. Classrooms to have one wall an accent colour.
4. At stairwells and metal railings, allow for flatbars, pickets and stringers at stairs to be each painted a different colour. Maximum three colours to be chosen by Architect. Clarification detail will be issued with colour schedule after tender.
5. Gymnasium walls acoustic sound block to be painted a different colour from surrounding wall. Allow for three colours to be chosen by Architect.
6. Door frames may be one colour and door another colour.

7. MAINTENANCE MATERIAL

1. Provided one sealed can of four litre capacity, of each product in each colour used in the Work for Owner's use in maintenance work.
2. Container to be new fully labelled with manufacturer's name, type of paint, and colour.
3. Provide Owner 3 copies of paint formula for each colour and type of paint for Owner's maintenance manual.

END OF SECTION

PART 1 - GENERAL

1. GENERAL REQUIREMENTS

1. Division One, General Requirements, is a part of this Section and shall apply as if repeated here.

2. SUBMITTALS

1. Samples

- .1 Prepare samples of various finishes for Architect's approval either on site or by submitting samples as directed, at least thirty days before materials are required. Identify each sample as to job, finish, formula, colour name, number, sheen name and gloss units, date and name of Subcontractor.

3. PRODUCT HANDLING

1. Delivery and Storage

- .1 Deliver materials to site in their original containers with label intact and store in spaces directed by Architect. Keep stored materials covered at all times and take all necessary precaution against fire.
- .2 Provide CO2 fire extinguisher of minimum 20 lbs. (9 kg.) capacity in storage area.

4. ENVIRONMENTAL CONDITIONS

1. Do not paint or finish in unclean or improperly ventilated areas. Do not paint in temperatures lower than 50 degrees F. (10 degrees C.) or varnish in temperatures lower than 65 degrees F. (18 degrees C.) for 24 hours before, during and 48 hours after application.
2. Do not undertake exterior painting at temperatures under 50 degrees F. (10 degrees C.) for 24 hours before, during and 48 hours after application or immediately following rain, frost or dew. Safe levels shall be determined by use of an electronic metre.
3. Test for moisture content in each location immediately before commencing application of paint. Do not apply paint on surfaces where moisture content exceeds 14%. Promptly notify Consultant if such conditions are encountered.
4. Provide approved equipment for testing moisture content of surfaces to receive paint finishes and have available on Site at all times during Work of this Section.
5. Do not apply paint finish in areas where dust is being generated.

5. PROTECTION

1. Provide metal pans or adequate tarpaulin to protect floors in areas assigned for the storage and mixing of paints.
2. Use sufficient drop cloths and protective coverings for the full protection of floors, furnishings and work not being painted.
3. Leave above areas clean and free from evidence of occupancy upon completion of painting.
4. Protect paint materials from fire and freezing.
5. Keep waste rags in metal drums containing water and remove from building at end of each working shift.

6. RELATED WORK SPECIFIED ELSEWHERE

1. Read carefully all other Sections of the specifications to determine the extent of prime and finish coats applied by others.
2. Wood preservative for Rough Carpentry - Section 06100.
3. See Division 20 - Mechanical and 26 - Electrical, for extent of finish on equipment.

7. SCOPE OF WORK

1. With exceptions for work specifically called for in other Sections of the Specification, all paintwork is included in the scope of this Section
2. NOTE: In locations where Drawings do not call for paint or similar finish on walls and/or ceilings, the intent of this Specification is that all exposed unpainted metal surfaces shall be painted.
3. Paint exposed drywall and the like in locations where finish is not otherwise specified or noted. Do not paint such surfaces in mechanical shafts, unless specifically noted.
4. In locations where Drawings do not call for paint or similar finish on walls and/or ceilings, the intent of this Specification is that items such as new work, including miscellaneous metal work, shall be painted.
5. Paint pipes, conduit, ducts and related thermal insulation and all prime painted mechanical and electrical equipment and supports located in mechanical and electrical storage and maintenance rooms in allocations where Drawings call for paint or similar finish on walls and/or ceilings.
6. Do not paint pipe, conduit, ducts, insulation and the like where concealed

above ceilings (except louvred type ceilings) or in service shafts.

7. Make good paint finish on shop coated work where damaged.
8. Paint visible portions of steel shelf angles, lintels and structural steel.
9. Paint all edges and all faces of doors where primed for paint supplied.
10. Stain all top, bottom and side edges of all plastic laminate doors.
11. Interior of ducts and diffusers visible from exterior on room side.
12. Paint all roof top equipment, stairs, pipes, conduit, vents, ducts, pipe insulation, etc. exposed on roofs (including primed and prefinished items).
13. Allow for five (5) different paint colours to be used in the building - including field, accent walls and bulkheads.

8. QUALITY ASSURANCE AND REFERENCES

1. Paint work shall meet or exceed standards set out in C.G.S.B. Specification No.'s 85-GP-1M to 85-GP-33A and C.P.C.A. Canadian Painting Contractors Association - Painting Manual.
2. Employ fully trained workers who are regularly employed in this field.
3. Manufacturer's sales representative shall perform inspections on the Owner's behalf in order to ensure compliance with product specifications.

9. RETOUCHING

1. Do all retouching, etc. to ensure that the building may be handed over to the Owner in perfect condition, free of spatter, finger prints, rust, watermarks, scratches, blemishes or other disfiguration.

10. TEST AREA

1. A room or area in the building will be designated by the Architect as a test area to establish standard of workmanship, texture, gloss and coverage.
2. Prior to any painting being started, request a meeting on Site between Architect, Contractor, Subcontractor and Material Manufacturer's Representative to review conditions, surfaces, anticipated problems and to clarify quality of workmanship acceptable to Architect.
3. Apply finishes to each type of surface within room with correct material, coats, colour, texture and degree of gloss in sample area and have same approved prior to providing Work of this Section.

4. Retain test area until after completion of Work. Test area to be minimum standard for the Work.
5. Failure to comply with the above will be cause for Architect to request all Work previously painted to be repainted.

PART 2 - PRODUCTS

1. MATERIALS

1. "Top Line" products only are acceptable. Use only products of manufacturers whose best quality lines meet or exceed CGSB Specifications for the particular type of material required. Approved manufacture and product unless specifically indicated otherwise in specification:

.1 Paints, stains and varnish:

1. General Paint
2. Benjamin Moore
3. Sherwin Williams
4. Zinsser
5. Glidden/Devoe Coatings

.2 Latex Water Based Epoxy

1. Sherwin Williams B70W00211 - Waterbased catalyzed epoxy extra white/
Tint base A/B60V00025 - Waterbased Catalyzed epoxy
Semi Gloss Hardner Part B
2. Glidden - 4420 - True Glaze Waterborn epoxy / 4426 True Glaze semi gloss converter

.3 Latex Supper Adherent Primer,

1. General Paint 51-050 Premium Latex Plastic Primer
2. Benjamin Moore #23-00 Freshstart Acrylic Primer Sealer
3. Zinsser 1-2-3 Acrylic Primer Sealer
4. Sherwin-Williams - B51WQ8850 - Adhesion Prm White
5. Glidden Latex super undercoat 94280

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- .4 Interior Latex Block Filler, C.G.S.B. Standard #-GP-188M
1. General Paint 70-224 Premium Latex Block Filler
 2. Benjamin Moore #595-01 Latex Block Filler
 3. Glidden #362650 Concrete Block Filler
 4. Sherwin-Williams B42W00046 Heavy Duty Block Filler
- .5 Stain Suppressant Sealer/Primer Hi-Hide, C.G.S.B. #1-GP-119M (where required)
1. General Paint 60-200 X-Terminator 2 Latex Sealer
 2. Zinsser BIN Primer, hi-hide (spot prime only)
 3. Zinsser Bullseye Odourless
 4. Sherwin-Williams - B49WQ8820 Multipur LTX Pr Wh
 5. Glidden/Jammer 200
- .6 Clear Wood Trim and Panel Finish
1. General Paint 25-011 Urethane Semi-Gloss
 2. Benjamin Moore & Co. Ltd. #435 Low Lustre Alkyd Urethane.
 3. Glidden #90333 Urethane Varnish.
- Note: Colours will be selected from Sherwin-Williams colour system. Sherwin-Williams colour formulas must be matched if one of the other approved manufacturer's are being used.
- .7 Fire Retardant Clear Coat at all exposed wood panels: Quantum Safe Coat Clear Fire Retardant Coating or equal by Ocean Products.
- .8 Typical Furniture Finish of all Wood Millwork, wood trim, panels, etc. (by Sections 06200 and 06400): shall be polymerizing two component catalytic varnish system equal to "Duravar Plus" manufactured by M. L. Campbell. The individual components of the system used must be chemically compatible to assure perfect adhesion and a top quality, durable final finish.
- .9 Thinners, cleaners: Type and brand recommended by the paint manufacturer.

- .10 Materials to be new and first line of manufacturer.
- .11 Deliver materials to site in original unbroken containers bearing brand and manufacturer's name.

PART 3 - EXECUTION

1. CONDITION OF SURFACES

- 1. Check all surfaces with electric moisture metre and do not proceed if reading is higher than 12-15 without written permission from Architect.
- 2. Proceed with work only when surfaces and conditions are satisfactory for production of a first class job.
- 3. Clean and remove dust, grease, rust and extraneous matter from all surfaces (except that rust occurring on items specified to be primed under other sections shall be removed and worked reprimed under these sections).
- 4. The commencing of work in a specific area shall be construed as acceptance of the surfaces, and thereafter the contractor shall be fully responsible for satisfactory work as required herein.
- 5. All surfaces shall be prepared in accordance with Chapter 2 for Interior Work of the Master Painters and Decorators Association Painting Manual latest edition.
- 6. Prepare surfaces in accordance with paint covering manufacturer's instructions.

2. PREPARATION

1. Concrete and Masonry

- .1 Test surfaces for alkalinity with pink litmus paper or other recognized method.
- .2 Where extreme alkalinity occurs, wash surface with 4% solution tetrapotassium pyrophosphate (5 oz. per gallon (31 ml./l.) of water) where latex base paint is to be used and with zinc sulphate solution (3 lbs. per gallon (300 g./l.) of water where other paint bases are to be used.)
- .3 Etch normal concrete surfaces to receive alkyd paint with muriatic acid solution (1 part commercial) 31.45% to 3 parts water. Neutralize and allow to dry before painting.
- .4 Prepare masonry concrete surfaces to CGSB 85-GP-31M.

2. Metal

- .1 All metal surfaces to receive coatings shall be cleaned to SSPC-SP1 (solvent washing) prior to painting as specified herein.
- .2 Touch-up shop primed metal after first removing loose primer, rust, oil, grease and other contaminants.
- .3 All metal surfaces exposed and/or exhibiting rust shall be cleaned to SSPC-SP2 or SSPC-SP3 standards and primed with an approved rust inhibitive primer prior to recoating as specified.
- .4 Feather edges to make touch-up inconspicuous when applying new primer.
- .5 Conform to CGSB 1-GP40d.M to CGSB 85-GP-14M.

3. Galvanized Surfaces

- .1 For Primer Application Type C Corrosive ensure that all surfaces to be painted are clean, dry, and free of all contaminants.
- .2 Cleaning of existing surfaces to be conducted according to SSPC-SP-4 Flame Cleaning procedure. Pass high temperature, high velocity, oxyacetylene flames over entire surface and then wire brushing. Primer is to be applied before surface is cool.
- .3 Phosphatize galvanized metal surfaces using CGSB 31-GP-105M pretreatment or prime with galvanized metal primer.

4. Woodwork

- .1 Inspect millwork, trim and panels to assure surfaces are smooth, free from machine marks and that nailheads have been countersunk. Seal all knots and sapwood in surfaces to receive paint, with a vinyl sealer compatible with finish specified conforming to CGSB 1-GP-125b.
- .2 Sand smooth all woodwork which is to be finished and clean surfaces free of dust before applying first coat. Fill nail holes, splits and scratches with non-shrinking filler conforming to CGSB 1-GP-103b after first coat is dry. When these occur on a transparent surface, filler shall be stained to match the finish as approved by Architect. Between coats, sand lightly with No. 00 sandpaper and remove dust.
- .3 Prime all wood noted for paint finish immediately on delivery to site.

.4 Back paint all wood noted for stain, varnish or Intumescent fire retardant clear coating or natural finish.

.5 Prepare all wood surfaces to CGSB-85-GP-1M.

5. Hardware

.1 Remove finishing hardware, electric cover plates and accessories, mask any that are not removable. Replace these when paint is dry and clean them. Do not clean hardware with solvent that will remove permanent lacquer finish.

6. Gypsum Wallboard

.1 For small holes, scratches or other surface marks fill with patching compound and sand smooth.

.2 For larger holes or damaged areas do not proceed until trade for original work has filled or repaired surfaces to acceptable levels.

.3 Prepare wallboard surfaces to CGSB-85-GP-33M.

7. Copper

.1 Prepare copper piping and accessories to CGSB 85-GP-20M.

8. General

.1 Mask specification plates occurring on equipment, switch boxes, and similar items requiring painting.

.2 Protect, remove and replace hardware, accessories, lighting fixtures and similar items as required.

.3 Conform with Architect's colour schedules and exactly match approved samples.

3. APPLICATION

1. Finishes and number of coats specified in the schedule are intended to cover surfaces perfectly. If they do not, apply further coats until perfect coverage and colour are achieved as required.

2. Any areas exhibiting incomplete or unsatisfactory coverage shall have the entire plane painted. Patching will not be acceptable.

3. Walls needing repainting, entire wall (plane) shall be painted to the satisfaction of the Architect. See drawings for extent of work.

4. Spray painting will not be permitted (except at metal deck and joist areas) unless specifically approved in writing by the Architect in each instance. Architect may withdraw approval at any time and prohibit spray painting for reasons such as carelessness, poor masking or protection measures drifting paint fog, disturbance to other Trades or failure to obtain a dense, even, opaque finish. Spray painting shall be full double coat, i.e. at least two passes for each coat. Do not use spray or roller on wood or metal surfaces, brush only unless approved in writing by Architect. Spray painting and backroll may be permitted on concrete blocks.
5. Arrange to have traffic barred from completed areas wherever possible.
6. Apply materials in strict accordance with manufacturer's directions and specifications and be familiar with these directions and specifications.
7. Prime woodwork as soon as possible after woodwork is delivered to site. Prime all surfaces, whether exposed or not, before installation. In case of woodwork which is to be stained, apply one coat of penetrating sealer to all finish surfaces of wood having uneven absorption, such as birch. Woods of uniform density such as oak shall be left unsealed. Back prime stained and varnished woodwork with one coat of gloss varnish reduced 25%. Fill open grain woods with filler tinted to match wood when transparent finish is required, and work well into grain. Before filler sets, wipe excess from surface.
8. Apply primer-sealer coats by brush or roller method. All primers and undercoats to be tinted to no more than 25% of intensity of the finish colour.
9. Permit paint to dry before applying succeeding coats, touch up suction spots and sand between coats with No. 00 sandpaper.
10. Where two coats of the same paint are to be applied, the first coat shall be the same colour as the finish coat and be inspected by the Architect before application of final coat, to allow the Architect to make reasonable modification of colour if necessary. Furnish Architect with a schedule showing expected completion of the respective coats of paint for the various areas and surfaces. Keep this schedule current as the job progresses.
11. Exterior paints and deep/intense interior and exterior colours shall be from the nearest factory premixed colour selection and shall be alterable to match required colours.
12. Flat and semi-gloss finishes on gypsum wall board, block and other surfaces of large areas shall be applied by roller and to all other surfaces applied by brush.

13. Paint shall be uniform in sheen, colour and texture, free from brush or roller marks, sags, runs or other defects.
14. Finish edges of doors (top, bottom, sides and cutouts) with paint or stain treatment as required to match face of door. Stain top and bottom edges a different colour and seal with one coat of shellac and one coat gloss varnish or two coats paint. Refinish tops and edges of wood doors after fitting.
15. Even up stained woodwork in colour as required by nature of wood and as directed by Architect. Apply same finish on trim, fitments, cupboards and other protecting ledges as on surrounding work, disregard sight lines.
16. Carefully hand smooth and sandpaper wood between coats (including priming). Apply one coat sealer before applying first coat paint filler to knots or sap blemishes on wood surfaces to receive paint or stain finish.
17. Remove rust, oil, grease and loose shop paint from metal work by brushing or with wire brushes and make good shop coat before proceeding with final finish. Feather out edges to make touch up patches inconspicuous.
18. After first coat, fill nail holes, splits, and scratches, using putty coloured to match finish.
19. Clean castings with wire brush before application of first paint coat.
20. Do not etch galvanized metal. Prepare prime and paint elsewhere in this section. This includes metal door frames and the like with wiped zinc coating.
21. Remove form oil or parting compounds from concrete surfaces. Use Xylol or approved compound.
22. Paint interior of pipe spaces, ducts, etc. visible through grilles or through metal ceilings in black matt finish.
23. Conform with Architect's colour schedule and exactly match approved samples.
24. Mechanical and Electrical Materials
 - .1 Refer to Mechanical and Electrical Sections of the Specifications and note the instructions regarding painting and finishing of materials and equipment supplied and installed by those trades.
 - .2 Remove grilles, covers, access panels for mechanical and electrical systems from location and paint separately, if these items are not factory finished.
 - .3 Paint work to match adjacent walls and ceilings unless directed

otherwise. Note: This includes trim on fixtures exposed, speaker covers, emergency lights, grilles, diffusers, louvres, vents, fire extinguisher cabinets, electrical panels, etc.

- .4 Paint interior surfaces that are visible through grilles and louvres with one coat of flat black metal paint to limit of sight line.
- .5 Where walls and ceilings are not scheduled to be painted, the work described above shall be painted a colour selected by Architect.
- .6 Unless factory painted, all exposed piping, conduits, ductwork hangers, insulation and mechanical equipment shall be painted.

- 25. Rooms without finished ceilings will have decks, joists, beams, ducts, etc., painted.
- 26. Paint graphics as shown on drawings. All graphics to be semi-gloss minimum two coat application.

4. ADJUST AND CLEAN

- 1. Cracks occurring in walls or ceilings requiring patching during "warranty period" shall be repainted in such a way that the patch is not visible at a distance of 5'-0" (1500 mm).
- 2. If patch painting not acceptable repaint entire wall or ceiling surface.
- 3. At completion clean entire area of surplus materials and equipment.

5. FIELD QUALITY CONTROL

- 1. Locate testing area in building to establish standard of workmanship, texture, gloss and coverage where designated.
- 2. Apply samples of all finishes on each type of surface to be coated with correct material, number of coats, colour, texture and degree of gloss required.
- 3. Retain test area until completion of work. Use approved work in test areas as standard for corresponding work throughout building. Correct and refinish work which does not compare with approved finishes.

6. FINISH SCHEDULE

1. General

- .1 Finish the listed exposed surfaces, wherever they occur unless such surfaces are specifically noted to be left unfinished.

- .2 Exposed means visible in the completed work and includes the interior of closets, cabinets and drawers.
- .3 The Architect shall have the option of having wood painted or with transparent finish and of which finish shall be used.
- .4 In instances where materials specified are not suitable for a particular job application, or are contrary to manufacturer's recommendations for use on a particular surface, such condition shall immediately be brought to the attention of the Architect for clarification and instructions.
- .5 Finishes shall match approved samples but Architect reserves the right to make reasonable changes to finish specifications to obtain desired results without additional cost or obligation of Owner.
- .6 A colour chart giving colour schemes for various areas will be prepared after tendering, by the Architect. The final selection of colours and surface textures of all finishes throughout and whether finishes are transparent (natural) or opaque (paint) shall rest solely with the Architect.
- .7 Where surfaces have been disturbed the entire plane shall be painted.

2. Exterior Schedule

- .1 Metal (Ferrous): One coat rust inhibitive primer (metal surfaces already primed need not receive a field prime coat except for touch up). Two coats exterior Aura paint by Benjamin Moore.

Note: All roof top equipment, pipes, conduit, vents, ducts, grilles, pipe insulation, etc. to be painted.

- .2 Galvanized Steel: One coat galvanized primer. Use a Polyamide converted epoxy primer by Devoe Coatings, "4170-1000 with 4170-999 - catalyst". Two coats of galvanized Finish Coat. Use a single package tough, durable alkyd modified urethane coating with water, chemical and solvent resistance by Devoe Coatings "Devoe" Glid Shield Urethane Gloss Enamel No. 4328-0100 Series (installation within 72 hours of installing primer).

Note: All exterior areas are to be painted including stairs, masonry lintels, etc.

- .3 Painted Wood Surfaces: One coat wood primer. Two coats exterior Aura paint by Benjamin Moore.
- .4 Stained Pressure Treated Wood or Cedar: Two coats solid hide

Aborite stain and one Clear Top Coat both by Benjamin Moore.

3. Interior Schedule

- .1 Metal (Ferrous): One coat latex super adherent primer (metal surfaces already primed need not receive a field prime coat except for touch up). Apply two coats latex water based epoxy 2 coats.
- .2 Hot Ferrous Metal - (Valve bodies, strainers, etc., on high temperature lines.) - One coat primer, latex super adherent heat resistant - Two coats latex water based epoxy.
- .3 Galvanized Steel: One coat galvanized primer. Use a Polyamide converted epoxy by Devoe Coatings "4170-1000 with 4170-9999-catalyst". Two coats of galvanized Finish Coat. Use a single package tough, durable alkyd modified urethane coating with water, chemical and solvent resistance by Devoe Coatings "Devoe Glid Shield Urethane Gloss Enamel No. 4328-0100 Series (install within 72 hours of installing primer).
- .4 Hollow Metal Doors, Metal Ducts, etc.: One coat super adherent primer. Two coats latex water based epoxy.
- .5 Metal Roof Decks and Joists: One of the approved primer finish combinations as follows:
 1. General Paint 10900 Alkyd Dryfall Primer. Apply one coat: spread rate, 250 square feet per 3.78 litre container on smooth surfaces and 75 square feet on corrugated steel. Each coat wet thickness: 4.6 mils. Each coat dry thickness: 2.0 mils.
 2. General Paint 6000-Line or 33-Line. Apply two coats: spread rate 400 square feet per 3.78 litre container. Each coat wet thickness: 4.0 mils. Each coat dry thickness: 2.0 mils.

OR

 3. Benjamin Moore and Co. Ltd. #597-01 Sweep-Up Spray Latex Flat primer. Apply one coat: spread rate, 255 square feet per 3.79 litre container. Each coat wet thickness: 6.3 mils. Each coat dry thickness: 2.5 mils.
 4. Benjamin Moore & Co. Ltd. T-7688 Impervo or T-7721 Satin Impervo. Apply two coats: spread rate, 500 square feet per 3.79 litre container. Each coat wet thickness: 3.0 mils. Each coat dry thickness: 1.3 mils.

OR

5. Glidden #10120 Spraymaster Latex Eggshell primer. Apply one coat: spread rate, 264 square feet per 3.78 litre container. Each coat wet thickness: 6.0 mils. Each coat dry thickness: 2.0 mils.
6. Glidden #4308 Devguard. Apply two coats: spread rate, 320 square feet per 3.78 litre container. Each coat wet thickness: 5.0 mils. Each coat dry thickness: 2.25 mils.
- .6 Woodwork Painted: One coat super adherent primer. Two coats latex Ultra "94800" by Glidden.
- .7 Natural or Stained Close Grain Wood: One coat non-bleeding alkyd stain. One coat sanding sealer.
Approved Finish Clear Coats are as follows:
 1. General Paint 25-011 Urethane Semi-Gloss. Apply two coats: spread rate, 350 square feet per 3.78 litre container. Each coat wet film thickness: 4.0 mils. Each coat dry thickness: 1.5 mils.

OR

2. Benjamin Moore & Co. Ltd. #435 Low Lustre Alkyd Urethane. Apply two coats: spread rate, 575 square feet per 3.79 litre container. Each coat wet thickness: 2.8 mils. Each coat dry thickness: 1.1 mils.

OR

3. Glidden #90333 Urethane Varnish. Apply two coats: spread rate, 638 square feet per 3.78 litre container. Each coat wet thickness: 2.5 mils. Each coat dry thickness: 1.0 mils.
- .8 Natural or Stained Open Grain Wood: One coat stain filler. One coat sanding sealer.
Approved Finish Clear Coats are as follows:
 1. General Paint 25-011 Urethane Semi-Gloss. Apply two coats: spread rate, 350 square feet per 3.78 litre container. Each coat wet film thickness: 4.0 mils. Each coat dry thickness: 1.5 mils.

OR

2. Benjamin Moore & Co. Ltd. #435 Low Lustre Alkyd Urethane. Apply two coats: spread rate, 575 square feet per 3.79 litre container. Each coat wet thickness: 2.8 mils. Each coat dry thickness: 1.1 mils.

OR
 3. Glidden #90333 Urethane Varnish. Apply two coats: spread rate, 638 square feet per 3.78 litre container. Each coat wet thickness: 2.5 mils. Each coat dry thickness: 1.0 mils.
- .9 Concrete Block (Base Price): One coat latex block filler, applied at the minimum rate of 80 sq. ft per gallon (1.63 m2 per litre), or as required by block texture to completely fill block. **Pinholes will not be accepted.** Apply more block filler if necessary to completely fill the block before applying finish coats. Note that lightweight block requires more block filler to fill than standard weight block does and adjust application rate as required. Two coats interior Latex Semi-Gloss "Ultra 94800" by Glidden.
- .10 Exposed Insulated Pipes and Ductwork: One coat size. One coat super adherent primer undercoat. Two coats Ultra "94800" by Glidden eggshell.
- .11 Gypsum Wallboard (Base Price): One coat of Latex super adherent primer.. Two coats semi gloss Ultra "94800" by Glidden. Velvet or eggshell at walls and Low gloss at ceilings.
- .12 Surfaces Behind Grilles and Duct Work Where visible Within 12' (300 mm) of Grille:
1. Two coats vinyl latex matt black.
- .13 Painted Light Trims, Emergency Lights, Louvres, Diffusers, Vents, Concealed Sprinkler Covers, Fire Extinguisher Cabinets, and Electrical Panels, Etc.
1. One coat super adherent primer. Two coats Ultra "94800" by Glidden to match surrounding wall and ceiling colours or as specified by Architect.
- .14 General Notes
1. See drawings for locations of areas where more than one colour occurs on one wall and one ceiling plane.
 2. Each ceiling bulkhead section or level may be a different

colour.

3. Wall planes may be designated a different colour from surrounding walls such as stairwells, entrances to classrooms, corridor intersections, gym (area below band one colour area above another) and Library. Classrooms to have one wall an accent colour.
4. At stairwells and metal railings, allow for flatbars, pickets and stringers at stairs to be each painted a different colour. Maximum three colours to be chosen by Architect. Clarification detail will be issued with colour schedule after tender.
5. Gymnasium walls acoustic sound block to be painted a different colour from surrounding wall. Allow for three colours to be chosen by Architect.
6. Door frames may be one colour and door another colour.

7. MAINTENANCE MATERIAL

1. Provided one sealed can of four litre capacity, of each product in each colour used in the Work for Owner's use in maintenance work.
2. Container to be new fully labelled with manufacturer's name, type of paint, and colour.
3. Provide Owner 3 copies of paint formula for each colour and type of paint for Owner's maintenance manual.

END OF SECTION

1 GENERAL

1.2 Description

- 1.2.1 The work in this section describes priming and painting for the wood moldings, trim and baseboards.

1.3 Workmanship

- 1.3.1 Work of this section shall be completed by individuals with a minimum of five (5) years experience at this type of work.

1.4 Mock Ups

- 1.4.1 Contractor shall complete the work described in this section for one 500mm length of wood baseboard identified beforehand by the Consultant. Acceptance of the completed sample by the Consultant shall be necessary before additional surface preparation work proceeds.
- 1.4.2 Provide Consultant five (5) days notice prior to undertaking work on this sample.

1.5 Product Storage and Handling

- 1.5.1 Observe good housekeeping practices when executing work in this section.
- 1.5.2 Follow safety precautions for contact, removal, containment and removal of old paint contaminated with lead as defined by local, Provincial and Federal regulations.
- 1.5.3 Provide fire extinguisher (carbon dioxide type) minimum 9 kg. capacity, at immediate work area.

1.6 Project Conditions

- 1.6.1 Surface preparation work shall be performed in favorable weather conditions as defined herein. The temperature range within the work area shall be between 50 to 90 degrees F.
- 1.6.2 Wood being prepared must be dry and have a moisture content below 12% by weight. Protect area from moisture until Painting is complete and cured.

- 1.6.3 Use of a heated enclosure around the work area is acceptable.
- 1.6.4 Mask or otherwise protect surrounding or adjacent historic fabric and occupants from all activities associated with this work. No fastenings associated with hoarding or other protects shall be installed in historic material without prior approval of Consultant.
- 1.6.5 Prevent dust associated with these activities from spreading beyond the immediate work area and into the building interior.

1.7 Daily Clean Up

- 1.7.1 Remove from building any oil soaked rags and/or brushes at the end of each work day or earlier in the day if use of oil is finished, whichever occurs first. This is to avoid any danger of linseed oil soaked rags spontaneously combusting.
- 1.7.2 Clean up work area at the end of each work day. Remove from building and discard unused materials, containers, tools, towels and paint dust in accordance with any local, Provincial and Federal regulations.

2 PRODUCTS

2.1 Materials

- 2.1.1 Heat Guns: Purpose made for paint removal.
- 2.1.2 Chemical paint strippers shall not be used.
- 2.1.3 Non-ionic detergent.

3 EXECUTION

3.1 Scope of Paint Removal

- 3.1.1 Where re-painting is to be undertaken surfaces shall be scraped and sanded to sound substrate & smooth surface, which may or may not be bare wood.
- 3.1.2 Where epoxy repairs are required removal all paint to bare wood from the affected area.

3.2 Surface Preparation for Wood Work

- 3.2.1 Heat guns and careful scraping and sanding are the permissible means of removing paint.
- 3.2.2 Open flame devices for paint removal are not permitted because of the fire hazard they pose.
- 3.2.3 Use heat guns in such a way that wood is not scorched.
- 3.2.4 Scraping and sanding shall be done carefully so as not to gouge or otherwise alter the profiles of moldings. Orbital sanders are not permitted because of the tendency to tear across the grain.
- 3.2.5 Customize blades for scrapers to match the shape of the original profiles.
- 3.2.6 Carefully sand to achieve smooth surface without altering profiles and feather edges.

3.3 Interior Cleaning

- 3.3.1 Interior and hidden surfaces of all wood work associated with the baseboards.
- 3.3.2 Carefully vacuum all surfaces inside and out using a soft nozzle tip that will not scratch surfaces.
- 3.3.3 Agitate stubborn areas with a nylon brush.
- 3.3.4 Wash all surfaces with a small amount of non-ionic detergent in potable water using nylon brushes and/or lint free cloths.
- 3.3.5 Rinse all surfaces with potable water and dry with lint free cloths.

END OF SECTION

1 GENERAL

1.1 Description

- 1.2.1 The work in this section describes priming and painting for the wood baseboards.

1.2 Warranty

- 1.2.2 The work and materials of this section shall be under warranty in accordance with GC12.3 of CCDC-2 2020, but for the period of two years from the date of Architect's Certificate of Substantial completion.
- 1.2.3 Cracking, blistering, fading, bond failure and softening shall be taken as defects.

1.4 Delivery and Storage

- 1.4.1 Deliver packaged materials in original, unopened, labeled and sealed containers.
- 1.4.2 Keep stored materials at a temperature between 50-90 degrees F., and protect from direct sun or inclement weather.

1.5 Job Conditions

- 1.5.1 No painting shall be undertaken if the temperature is expected to fall below 50 degrees F. within the next 48 hours unless a heated enclosure is provided.
- 1.5.2 Finishes shall not be applied in direct sunlight.
- 1.5.3 Finishes shall be protected from moisture for 48 hours after application.
- 1.5.4 Surfaces must be dry, clean, free from dust, grease, oil or other contaminants that will affect the work of this Section.

1.6 Protection

- 1.6.1 Use sufficient drop cloths and protective coverings to protect furnishings, work of others and adjacent historic fabric not being painted.
- 1.6.2 Remove waste rags from site at the end of each working shift.

- 1.6.3 All exterior surfaces shall be protected by the use of polyethylene tents to protect from moisture from the time that surface preparation begins and until painting is about to commence. Once painting begins use breathable tarps through to final painting.

1.7 Colour

- 1.7.1 Prior to start of work collect & record min. 2 - 6" x 6" colour samples of each painted surface of all surfaces that are included in the scope of work. Samples shall clearly represent the colour, texture & gloss of the existing finish. File one set of colour samples securely on site & submit one set of colour samples to the Architect. Collected samples shall be used to select matching new finishes selection. Final paint colours to be selected by the Consultant.
- 1.7.2 "Top Line" products only are acceptable. Use only products of manufacturers whose best quality lines meet or exceed CGSB Specifications for the particular type of material required. Approved manufacturer unless specifically indicated otherwise in specification:
 - 1.7.2.1 Benjamin Moore
 - 1.7.2.2 ICI Glidden Co. Ltd.
 - 1.7.2.3 Para Paints
 - 1.7.2.4 Pittsburgh Paints
 - 1.7.2.5 Pratt and Lambert Incorporated
 - 1.7.2.6 Sherwin Williams Co. of Canada Ltd.
- 1.7.3 Note: Colours may be selected from one colour system above and their colour formulas must be matched if one of the other approved manufacturer's are being used.
- 1.7.4 Contractor shall provide three sample panels of the different paint colour(s) and finish(es) for review by Consultant and Owner. Colours other than white may be custom tints different than those available in standard colour wheels.

2 PRODUCTS

2.1 Primer

- 2.1.1 Latex Primer, manufacturer to be later selected by the Consultant.

2.2 Top Coats

- 2.2.1 To match existing type, texture & sheen, manufacturer to be later selected by the Consultant.

2.4 Other

- 2.4.1 Thinners, cleaners, primers, and sealers recommended by the coating manufacturer.
- 2.4.2 All materials to be new and top line of manufacturer.
- 2.4.3 Non-ionic detergent.
- 2.4.4 Potable water.

3 EXECUTION

3.1 General

- 3.1.1 Preparation: see "Section 09993: Surface Preparation".
- 3.1.2 Ensure all epoxy work is complete, cured and tooled.
- 3.1.3 Follow all manufacturers' printed instructions.
- 3.1.4 Seal knots.
- 3.1.5 Back prime all new material before installation.
- 3.1.6 Conform with approved samples.
- 3.1.7 Thoroughly clean all interior and hidden surfaces by first thoroughly vacuuming and then by washing with detergent in potable water. Rinse with potable water and allow to dry.

3.2 Application

- 3.2.1 Typically (1) coat primer, two (2) finish coats. Finish and number of coats specified are intended to cover surfaces completely. If they do not, apply further coats until complete coverage is achieved to Consultant's approval.
- 3.2.2 Apply materials in strict accordance with manufacturer's directions and specifications.
- 3.2.3 All primer and finish paint shall be applied by brush.

- 3.2.4 After application of first coat, Consultant must give approval of colour before second coat application. Contractor shall allow for changes in tint at this stage.
- 3.2.5 Finishes shall be uniform in sheen, colour and texture, and free from sags, runs or other defects.
- 3.2.6 On interior apply tinted varnish to new material spliced in as repairs to interior stops. Techniques for applying tinted varnish shall be developed in on-site tests and approved with samples.

3.3 Clean Up

- 3.3.1 On completion of work, remove surplus material, tools, equipment, and debris from work area to satisfaction of owner.
- 3.3.2 Remove excess paint from adjacent surfaces.

END OF SECTION

1. **GENERAL**

1. **GENERAL REQUIREMENTS**

1. Division One - General Requirements are part of this section and shall apply as if repeated here.

2. **SUBMITTALS**

1. Submit shop drawings in reproducible vellum form in accordance with GC 3.10 of CCDC Document 2-2020.
2. Submit maintenance manuals for Item 2.

3. **SPECIAL PROTECTION**

1. Provide adequate protection of materials and work of this Section from damage by weather and other causes.
2. Protect the work of other Subcontractors from damage resulting from work of this Section. Make good such damage to the satisfaction of the Consultant.

4. **WARRANTY**

1. Extend the warranty for work of this section to a period of two years, covering material and workmanship but not to include damage due to vandalism.

2. **PRODUCTS**

1. **ROOF TOP GUARDRAILS:**

1. Exterior (anodized for aluminum material).

Roof Hatch Barrier Guard

SG394 Hatch Guard; aluminum, modular, non-penetrating.

By SKYLINE Group, 2000 Rogers Rd., Perth, Ontario, Canada, K7H 1P9,

1.877.417.6336, www.skylinegroupintl.com

Colour(s) to be selected by Architect from full range of colours available, including custom colours.

Approved alternate manufacturers: Delta Prevention.

2. FIRE RATED CEILING ATTIC ACCESS HATCH:

1. Install manufacturer Attic Hatch at (1) location shown on Architectural drawings. Attic Access Hatch; min. 1hr fire rated fabrication, insulated, lockable, ceiling flange, upward swinging, 22"x36". ADC-FW-5050-UP rated hatch assembly by Acudor or approved equal.

3. **EXECUTION**

1. INSTALLATION

1. Delivery to the job site shall be coordinated by General Contractor.
2. Coordinate with mechanical and electrical for final connection
3. Install at locations indicated on drawings all in accordance with manufacturer's directions.

END OF SECTION

1. **GENERAL**

1.1 **GENERAL REQUIREMENTS**

- .1 Division One - General Requirements is a part of this section and shall apply as if repeated here.

1.2 **DESCRIPTION**

- .1 Work included: Provide manually operated rolling shade systems as indicated on Architectural drawings for Room 122. Provide all components as needed for a complete and proper installation.

1.3 **QUALITY ASSURANCE**

- .1 Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this Section.

1.4 **SUBMITTALS**

- .1 **Product Data:** Within 60 calendar days after the General Contractor has received the Owner's Notice to Proceed, submit:
- .1 Materials list of items proposed to be provided under this Section.
 - .2 Manufacturer's specifications and other data needed to prove compliance with the specified requirements.
 - .3 Shop Drawings in sufficient detail to show fabrication, installation, anchorage and interface of the work of this Section with the work of adjacent trades.
 - .4 Manufacturer's recommended installation procedures which, when approved by the Architect, will become the basis for accepting or rejecting actual installation procedures used on the work.

- .2 Construct one complete light proof window shade with attachments and accessories for approval by the Architect.

1.5 **WARRANTY**

- .1 Three (3) year written warranty against mechanical and fabric failure (including fabric fading) under normal conditions.

1.6 **ACCEPTANCE**

- .1 All manual and motorized shades remain the property of the supplier until accepted in place by the Architect.

2. **PRODUCTS**

1. Manually Operated Shade Locations: All exterior windows unless noted otherwise on Architectural Drawings.

.1 Manually Operated Rolling Shade System: SunProject, Moduline 105 Lite Lift. Commercial chain-driven, manually operated roller-screen shading system complete with aluminum fascia and stainless steel drive chain. Sunshade fabric to be 3% open weave flame retardant Thermoveil Shadecloth on South and West sides of building and 5% open weave flame retardant Thermoveil Shadecloth on North and East sides of building. Seams, if required, shall be equally spaced vertically to form material in equal widths. Drawings are based on Sun Project Canada Inc., (905-660-3117). Approved equal product/manufacturer is Solarfective Products Ltd., MechoShade or Silent Gliss.

2. Sunshade Fabric: 5% open weave flame retardant. Architect to choose colour when shop drawings are submitted. Seams, if required, shall be equally spaced vertically to form material in equal widths.

.1 Hardware and Accessories Required for a Total Integrated System

- .1 Shade Roller: Extruded aluminum tube, 6063-ST6 alloy, 2.55 in. OD with internal keyway to receive tubular motor. The tube is extruded with two fabric-mounting channels designed so that the shade cloth does not disengage from the tube itself.
- .2 Mounting Spline: Extruded vinyl with asymmetrical locking channels and embossed fabric guide for use with 2.55 in. OD tube. Spline has sufficient capacity to hold shade and additional weight without disengaging from the tube.
- .3 End Brackets: Consist of 1/8" in. thick sheet steel. Wall, jamb or ceiling mounted as required and permanently installed.
- .4 Centre Support Brackets: supplied to meet span or weight requirements. Ceiling or wall mounted.
- .5 Weights: Mill-finished aluminum, flat bars, single lengths for each shade panel.
- .6 Fascia: Extruded aluminum 6063T5 with clear anodized finish. Used for surface mounted applications. Snap on with concealed fastenings that hide the bracket assembly and appears to be a continuous unit when mounted side to side.

- .7 Recessed Housing: is specifically designed for acoustical or plaster ceilings with removable closure plate for access to the recessed and concealed roller system.
 - .8 Finishes: All exposed aluminum parts have a clear anodized finish. Steel parts are either cadmium plated, satin finished or have been bonderized prior to painting with a baked enamel finish.
 - .9 Exterior hembar shall be rectangular 6 mm x 37 mm, with internal grooves to accommodate a fabric guide carrier at each end.
 - .10 Fabric shall be hot laser cut and reinforced at the edges with a high frequency thermoweld seal. Fabric is reinforced with heat sealed spring tempered stainless steel batten stiffeners positioned approximately every 900 mm insuring that fabric not escape or be pulled out of the side channel.
- .2 Blackout Shade Fabric: To be located at Room 122. Lightproof shades to be 100% opaque blackout flame retardant. Architect to choose colour when shop drawings are submitted. Seams, if required, shall be equally spaced vertically to form material in equal widths.

3. **EXECUTION**

3.1 SURFACE CONDITIONS

- .1 Examine the areas and conditions under which work of this section will be performed. Correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 INSTALLATION

- .1 Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interfaced with the work of this Section.
- .2 Install the work of this section in strict accordance with the original design, the approved Shop Drawings, pertinent requirements of government agencies having jurisdiction, and the manufacturer's recommended installation procedures as approved by the Architect, anchoring all components firmly into position for long life under hard use.
- .3 Install the work plumb, level, and in proper operating condition.
- .4 Install units within the following tolerances:
1. Maximum variation of gap at window opening perimeter: ¼ inch per 8 feet (+/- 1/8 inch) of shade height.
2. Maximum offset from level: 1/16 inch per 5 feet of shade width.
- .5 Upon completion of the installation, put each operating component through at least five complete cycles, adjusting as required to achieve optimum operation and complete

blackout at all edges (at blackout locations).

- .6 Touchup scratches and blemishes to be completely invisible to the unaided eye from a distance of five feet (1500 mm), or replace item.

3.3 CLEANING

- .1 Touch up damaged finishes and repair minor damage in order to eliminate evidence of repair. Remove and replace work that cannot be satisfactorily repaired.
- .2 Clean exposed surfaces, including metal and shade fabric, using non-abrasive materials and methods recommended by the Shadecloth Manufacturer. Remove and replace work which cannot be satisfactorily cleaned.

END OF SECTION



A member of the MCW Group of Companies
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Toronto, Ontario
M5J 1A7

MECHANICAL SPECIFICATIONS

FOR

**MCMASTER UNIVERSITY HALL –
VENTILATION UPGRADE**

DATED

AUGUST 5, 2024

ISSUED FOR TENDER

Contact Person: Tareq Nassar
Phone: 416-598-2920 Ext. 494
Email: tnassar@mcw.com

MCW Project No. 22227B

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PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Submit Shop Drawings, Product Data and Samples as specified herein.
- .2 Designate in the Construction Schedule, or in a separate coordination schedule, dates for submission and dates that reviewed Shop Drawings, Product Data and Sample will be required. Give due consideration for review time required by the Consultant, with a minimum of fifteen (15) working days required. The submission of Appendix 'B' will be considered an acceptable submittal schedule.
- .3 All shop drawings will be submitted directly to our office, at TOR.ShopDrawings@mcw.com, with a copy of the transmittal sent to the Architect. All shop drawings will be returned through the Architect's office. In order to expedite the process, MCW requests that all shop drawings be submitted electronically in pdf format. Upon MCW's review stamped shop drawings will be returned electronically in pdf format.
- .4 Prepare a schedule of shop drawings, not later than four weeks after the award of the Contract, indicating drawing submission and equipment delivery dates. Refer to specification and to the attached Shop Drawing Submittal Schedule for equipment requiring shop drawing submission.
- .5 All data and dimensions on shop drawings, product data and sample information to be based on units (Imperial or Metric) as shown on the contract documents.
- .6 Shop Drawings with errors or omissions and deviations will be returned "Not Reviewed".
- .7 The Contractor's responsibility for deviations in submission from the requirements of Contract Documents is not relieved by the Consultant's review of submittals, unless a deviation on the submittal is noted as such in writing and has been accepted by the Consultant.
- .8 Keep one (1) reviewed copy of each submission on site.
- .9 Make all submittals in accordance with Division 01, to suit submittal procedures.
- .10 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) material Safety Data sheets (MSDS) in accordance with Division 01.

1.02 SHOP DRAWINGS

- .1 Review and stamp Shop Drawings, Product Data and Samples prior to submission to the Consultant. Confirm that necessary requirements have been determined and verified and that each submittal has been checked and co-ordinated with requirements of the Work and the Contract Documents. Submittals not stamped, signed, dated and identified as to the specific project, will be returned without being examined and shall be re-submitted when completed.
- .2 Shop Drawings being submitted where the size, capacity or voltage are different from the specified piece of equipment, the specified data and alternate data must be highlighted (e.g. spec. pump P-4 20 HP, 1500 GPM, 575V, the alternate is 15 HP, 1470 GPM, 575V, 3PH) on the front cover sheet.
- .3 Submit drawings in a clear and thorough manner:
 - .1 Identify details by reference to drawing No. and detail, schedule or room numbers as shown on Contract Documents.
 - .2 Include manufacturer installation instructions and details.

- .3 Minimum sheet size and larger sheets to be multiples of 8½" x 11".
 - .4 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated. Indicate cross references to design drawings and specification.
 - .5 Adjustments to shop drawings by the Consultant do not change the cost of the work. If adjustments affect the cost of Work, advise through normal channels in writing prior to proceeding with the Work.
 - .6 Make changes in shop drawings as directed by the Consultant. Resubmit and note any revisions other than those requested.
 - .7 If only minor adjustments are made, shop drawings to be returned and fabrication and installation of work to proceed.
- .4 Determine and verify:
- .1 Field measurements.
 - .2 Field construction criteria.
 - .3 Catalogue numbers and similar data.
 - .4 Conformance with Specifications.
- .5 Co-ordinate each submittal with requirements of the Contract documents.
- .6 Each Shop Drawing will be stamped by the Consultant in the following format:
- | | |
|--|---|
| <input type="checkbox"/> NOT REVIEWED | <input type="checkbox"/> REVIEWED |
| <input type="checkbox"/> RESUBMIT | <input type="checkbox"/> REVIEWED AS MODIFIED |
| <input type="checkbox"/> NOT SPECIFIED BY MCW, REVIEWED FOR MEP ONLY | |
- .7 This review by the Consultant is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the Consultant approved the detail design inherent in the shop drawings, responsibility for which shall remain with this Subcontractor submitting same, and such review shall not relieve this Subcontractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the contract documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication.
- .8 Products not specified by MCW are reviewed to confirm compliance with services provided only. Any changes required between provided services and shop drawing requirements will be identified for coordination between trades.
- .9 Shop drawings shall be accompanied by a complete copy of the attached "Shop Drawing Submittal Sheet" Section 20 05 01, Appendix 'A'.
- .10 "Resubmit" Shop Drawings or Shop Drawings requiring additional information will have to be forwarded or returned to our office, at TOR.ShopDrawings@mcw.com in a timely fashion to allow time for review again, along with revised scheduling or delivery date changes as a result of having to provide additional information or resubmission.

- .11 Shop drawings must bear the stamp and signature of the submitting sub-contractor as well as the general contractor to indicate that the shop drawings or catalogue cuts are in conformance with all requirements of the drawings, that they have co-ordinated this equipment with other equipment which is related and/or connected and that they have verified all dimensions to ensure the proper installation of equipment including recommended service space and without interference with the work of other trades. Ensure that mechanical and electrical co-ordination is complete before submitting drawings for review. Incomplete or improperly submitted shop drawings will be returned as "Resubmit".
- .12 Begin no fabrication or work which requires submittals until return of submittals reviewed by Consultant.
- .13 Quality assurance Submittals:
 - .1 Make all submittals in accordance with Section 20 05 05 and Division 01, to suit submittal procedures.
 - .2 Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .14 Submit manufacturer installation instructions.
- .15 All submittals MUST be submitted using the same units (IP/SI) as shown on equipment schedules and drawings.

1.03 PRODUCT DATA

- .1 Where specified, Manufacturer's standard schematic drawings, catalogue sheets, diagrams, schedules, performance charts, illustrations and other standard descriptive data is acceptable provided there is conformance with the following:
 - .1 Clearly identify pertinent products or models.
 - .2 Show performance characteristics and capacities.
 - .3 Show dimensions and clearances required.
 - .4 Show wiring or piping diagrams and controls.
- .2 Manufacturer's standard schematic drawings and diagrams may require modifications to drawings and diagrams to provide information applicable to the Work.
- .3 Provide information specifically applicable to the Work.

1.04 SAMPLES

- .1 Samples are to be provided in accordance with Division 01.
- .2 Samples to be labelled, of sufficient size and quantity to clearly illustrate:
 - .1 Functional characteristics integrally related parts and attachment devices.
 - .2 Full range of colour, texture and pattern.
- .3 Field Samples and mock-ups:
 - .1 Erect, at the project site and in location acceptable to the Consultant.
 - .2 Fabricate each sample and mock-up complete and finished.
 - .3 Remove mock-ups at conclusion of Work or as specified by the Consultant.

1.05 CLOSE-OUT SUBMITTALS

- .1 Make all submittals in accordance with Section 20 05 05 and Division 01, to suit submittal procedures.

1.06 CO-ORDINATION/INSTALLATION DRAWINGS

- .1 Follow the requirements of section 20 05 05.

1.07 SUBMISSION REQUIREMENTS

- .1 Submit promptly to approved schedule and in sequence to prevent submission delay in the Work.
- .2 Submission requirements:
 - .1 Shop Drawings: Acceptable submissions are: Submit shop drawings electronically as agreed to during the kick off meeting with the Consultant.
 - .2 Product Data: Submit a copy for each O & M Manual.
 - .3 Samples: Submit as specified, or as requested during the shop drawing review period.

1.08 RESUBMISSION REQUIREMENTS

- .1 Make corrections or changes to the submittals noted by the Consultant and resubmit.
- .2 Shop Drawings and Product Data:
 - .1 Revise drawings or data, and resubmit as noted on the initial submittal.
 - .2 Indicate any changes which have been made other than those noted by the Consultant.
- .3 Samples: Submit new samples as required for initial submittal as soon as possible after notification of the rejection of the original submission and mark "resubmitted samples".

1.09 DISTRIBUTION

- .1 Distribute reproductions of Shop Drawings and copies of Product Data which carry the Consultant's stamp to all parties as specified by Division 01 General Requirements.
 - .1 Job site file
 - .2 Project record document file
 - .3 Other affected contractors
 - .4 Subcontractors
 - .5 Supplier or fabricator (as applicable)
 - .6 Operations Manual

PART 2 - PRODUCTS

2.01 NIL

PART 3 - EXECUTION

3.01 NIL

END OF SECTION 20 05 01

SHOP DRAWING SUBMITTAL SHEET

Project: _____ Date: _____

Project No. _____ Submittal No. _____

Section: _____

Equipment
Description _____

Contractor: _____

Sub-Contractor: _____

Suppliers Name: _____

Manufacturer: _____

Catalogue No.: _____

Variations From
Tender Documents _____

Engineer: MCW Consultants Ltd.
207 Queen's Quay West, Suite 615
Toronto, Ontario
M5J 1A7

MECHANICAL GENERAL REQUIREMENTS SECTION 20 05 01 – APPENDIX 'B' PROJECT: _____ PROJECT No: _____		SHOP DRAWING SUBMITTAL SCHEDULE DIVISION 20, 21 22, 23 & 25						Date: _____	
SECTION	DESCRIPTION	MANUFACTURER	SHOP DRAWING				DELIVERY		COMMENTS
			SUBMITTED		RETURNED		SCHED	ACTUAL	
			SCHED	ACTUAL	SCHED	ACTUAL			
20 05 10	Valves Strainers Thermometers and Gauges								
20 05 25	Insulation								
20 05 30	Variable Frequency Drives								
23 21 23	Pumps								
23 22 10	Condensate Receivers								
23 31 13	Ductwork								
23 33 10	Dampers								
23 34 00	HVAC Fans								
23 44 00	Filters								
23 57 00	Heat Exchangers								
23 73 11	Air Handling Units (Packaged)								
23 73 13	Grilles and Diffusers								
23 73 14	Makeup Air Units								
23 75 10	Semi-Custom Air Handling Units								
23 84 13	Humidifiers								
25 01 01	Controls: Written Sequences of Operation and Control Schematic Drawings, Wiring Diagrams, Components Description, Thermostats, Control Components.								

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PART 2 - PRODUCTS

- 2.01 NIL

PART 3 - EXECUTION

- 3.01 NIL

PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Comply with requirements of Division 01, General Requirements and all documents referred to therein.

1.02 APPLICATION

- .1 This Section applies to and is part of all Sections of Division 20, 21, 22, 23 and 25.
- .2 Perform All Work specified herein by experienced and licensed personnel.

1.03 DEFINITIONS

- .1 Wherever the term The Consultant is used in the Division 20, 21, 22, 23 and 25 Drawings and Specifications it means MCW Consultants Limited, Queen's Quay Terminal, 207 Queen's Quay West, Suite 615, Toronto Ontario, Canada M5J 1A7 (Phone 416-598-2920).
- .2 Wherever the term "install" (and tenses of "install") is used in the Division 20, 21, 22, 23 and 25 Drawings and Specifications it means install and connect complete.
- .3 Wherever the term "supply" is used in the Division 20, 21, 22, 23 and 25 Drawings and Specifications it means supply only for installation by other subtrades or under separate contract.
- .4 Wherever the terms "Provide" or "Provision of" are used in relationship to equipment, piping, other materials and systems specified for the Work of Divisions 20, 21, 22, 23 and 25, it means "Supply, Install and Connect and make operable to specified performance". Wherever the terms "Provide" or "Provision of" are used in connection with services such as testing, balancing, start-up, preparation of Drawings and commissioning for any part of the Work of Divisions 20, 21, 22, 23 and 25, it means procure, prepare, supervise, take responsibility and pay for these services.
- .5 Wherever "Drawings and Specifications" are referred to, it means "the Contract Documents".
- .6 Wherever the terms "Authorities" or "Authorities having jurisdiction" are used in the Division 20, 21, 22, 23 and 25 Drawings and Specifications it means any and all agencies that enforce the applicable laws, ordinances, rules, regulations or codes of the Place of the Work. Refer to Division One.
- .7 Wherever the term "Work" is used in the Divisions 20, 21, 22, 23 and 25 Drawings and Specifications it means all equipment, permits, materials, labour and Services to provide a complete Mechanical installation as described and detailed on the Drawings and in the Specifications.
- .8 Wherever the term "Performance" is used in the Divisions 20, 21, 22, 23 and 25 Drawings and Specifications in relation to specified equipment, it means the specified capacity of that equipment as it applies to provide air, steam or water flow, heating and/or cooling within the specified conditions of operation including air, steam and water pressures, physical space limitations and noise levels.
- .9 Wherever the term "Acceptable" is used in the Divisions 20, 21, 22, 23 and 25 Drawings and Specifications it means acceptable to the Consultant.

- .10 "Basis of Design" refers the mechanical design inherent in the Contract Documents to establish a specific performance requirement and may refer to specific Equipment or Products that have been used to establish an energy performance benchmark, space constraint, or structural load, or may refer to a specific duct or piping arrangement, or may refer to a particular operating sequence, or other similar consideration specific to the design. Basis of Design Equipment or Products are detailed in the Equipment Schedules and drawings.
- .11 "Acceptable Manufacturer", "Standard of Acceptance", "Alternative Manufacturer", "Acceptable Alternative" and similar language that describes manufacturers other than the manufacturer used as the Basis of Design shall all have the same meaning throughout the Contract Documents. Acceptable Manufacturers may be used in the Work in lieu of the Basis of Design manufacturers subject to conditions stipulated elsewhere in the Mechanical Division Contract Documents. Refer to section 20 05 05 – 1.14.

1.04 WORK INCLUDED

- .1 Sections of Divisions 20, 21, 22, 23 and 25 are not intended to delegate functions nor to delegate Work and supply to any specific trade. The Work of Divisions 20, 21, 22, 23 and 25 includes all labour, materials, equipment, permits and tools required for a complete and working installation as described in the Divisions 20, 21, 22, 23 and 25 Specifications and Drawings and is not necessarily limited to items in the following Sections:

20 05 01	Shop Drawings, Product Data and Samples
20 05 05	Mechanical Work General Instructions
20 05 10	Basic Mechanical Materials and Methods
20 05 20	Mechanical Vibration Control
20 05 25	Mechanical Insulation
20 05 30	Variable Frequency Drives
20 05 40	Demolition and Revision Work

HEATING, VENTILATION AND AIR CONDITIONING

23 05 00	Common Work Results for HVAC
23 21 23	Hydronic Pumps
23 31 13	Ductwork
23 33 00	Air Duct Accessories
23 33 10	Dampers
23 37 13	Diffusers, Registers & Grilles
23 37 20	Louvres, Intakes & Vents
23 44 00	HVAC Air Filtration
23 57 00	Heat Exchangers for HVAC
23 73 10	Air Handling
23 73 11	Air Handling Units Packaged
23 75 10	Semi-Custom Air Handling Units
23 82 39	Heat Transfer Equipment
23 84 13	Humidifiers

BUILDING AUTOMATION SYSTEM

25 01 01	Building Automation System (BACNET)
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1.05 REGULATORY REQUIREMENTS

- .1 Comply with requirements of all Municipal, Provincial and Federal Bylaws and Ordinances as well as requirements of Utilities such as Ontario Gas Utilization Code and The Ontario Electrical Safety Code.

.2 Do not reduce quality of any part of the Work specified and/or shown on the Drawings by following regulatory requirements.

.3 In general and as applicable, perform all Work of Divisions 20, 21, 22, 23 and 25 to comply with physical and chemical properties, characteristics and performance requirements of recognized associations and agencies as listed herein and in the following:

ACCGH	-	American Conference of Governmental Industrial Hygienists
AMCA	-	Air Moving & Conditioning Association
ADC	-	Air Diffusion Council
ANSI	-	American National Standards Institute
ARI	-	Air Conditioning & Refrigeration Institute
ASCII	-	American Standard Communication Information Interchange
ASHRAE	-	American Society of Heating, Refrigeration and Air Conditioning Engineers
ASME	-	American Society of Mechanical Engineers
ASTM	-	American Society for Testing and Materials
AWWA	-	American Water Works Association
CGA	-	Canadian Gas Association
CGSB	-	Canadian General Standards Board
CIRI	-	Canadian Industrial Risk Insurers
CSA	-	Canadian Standards Association
CTI	-	Cooling Tower Institute
EIA	-	Electronic Industry Association
FCC	-	Fire Commissioner of Canada
FM	-	Factory Mutual
ISA	-	Instrument Society of America
IAO	-	Insurers Advisory Organization
MMC	-	Marsh McLennan Insurance Protection Consultants
MTC	-	Ministry of Transportation and Communication
NBCC	-	National Building Code of Canada
NFPA	-	National Fire Protection Association
OBC	-	Provincial Ontario Building Code
OFM	-	Local Fire Codes or Standards Ontario Fire Marshall
MOEE	-	Ontario Ministry of Environment And Energy
OML	-	Ministry of Labour and Workmen's Compensation Requirements
OWRA	-	Ontario Plumbing Code
TSSA	-	Technical Standards & Safety Authority
UL	-	Underwriter's Laboratories Inc.
ULC	-	Underwriter's Laboratories of Canada

.4 Where any code, regulation, bylaw, standard, contract form, manual, printed instruction, and installation and application instruction is quoted it means, unless otherwise specifically noted, latest published edition at time of **[Permit or submission of Bids]** adopted by and enforced by local governing authorities having jurisdiction. Include for compliance with revisions, bulletins, supplementary standards or amendments issued by local governing authorities.

1.06 STANDARDS

.1 Provide new materials and equipment of proven design and quality. Provide current models of specified equipment manufactured in Canada or the United States of America, unless specified otherwise with published ratings certified by recognized North American testing and standards agencies.

.2 Provide Canadian made materials and equipment to maximize Canadian content in the Work

.3 Comply with ASHRAE/IES 90.1 Standards in the supply and installation of all parts of the Work.

- .4 Comply with Regulations Amending the Energy Efficiency Regulations P.C. 2004-965, 1 September 2004 for the following equipment:
 - .1 Water Chiller - To meet the requirements of CSA C743.
 - .2 Electric Water Heater - To meet the requirements of CAN/CSA C191-00.
 - .3 Gas Fired Water Heater - To meet the requirements of CSA – P.3-04.
 - .4 Large Air Conditioner, Heat Pumps and Condensing Units - To meet the requirements of CAN/CSA –C746 (current edition).
- .5 Conform to the best modern practices of workmanship and installation methods and employ only skilled tradesmen working under the direction of fully qualified personnel.
- .6 Materials and products provided and used must be in accordance with Division 01, to suit sustainable requirements.

1.07 PERMITS, FEES & INSPECTIONS

- .1 Apply for, obtain, and pay for all permits, licenses, inspections, examinations and fees required for Work of Divisions 20, 21, 22, 23 and 25. Also submit, if required by the Authorities, information such as heat loss calculations, and other data that may be obtained from the Consultant. Should the Authorities require the information on specific forms, fill in these forms by transcribing thereto the information as provided by the Consultant.
- .2 If the municipality is structured as a "single permit jurisdiction", the Contractor will apply, pay for and obtain the municipal building permit. In this case, the Divisions 20, 21, 22, 23 and 25 Subcontractor has no financial obligation for permit application except for permits not covered in the "single permit".
- .3 Arrange for inspection of all Work by the Authorities having jurisdiction over the Work. On completion of the Work, present to the Consultant the final unconditional certificate of acceptance of the inspecting Authorities.
- .4 Arrange and pay for inspection of all Work by TSSA for Gas Piping Systems including pressure testing of existing gas piping system where applicable. On completion of the Work, present to the Consultant the final unconditional certificate of acceptance of the inspecting Authorities.
- .5 In case of conflict, codes and regulations take precedence over the Contract Documents. In no instance reduce the standard or scope of work or intent established by the Drawings and Specifications by applying any of the codes referred to herein.
- .6 Before starting any work, submit the required number of copies of Drawings and Specifications to the Authorities for their approval and comments. Comply with any changes requested as part of the contract, but notify the Consultant immediately of such changes. Prepare and submit any additional drawings, details or information as may be required.

1.08 CONTRACT DRAWINGS

- .1 The Drawings for Mechanical Work are performance drawings, diagrammatic, intended to convey the scope of work and indicate general arrangement and approximate location of apparatus, fixtures and pipe runs. The Drawings do not intend to show Architectural and Structural details.
- .2 Do not scale Drawings. Obtain information involving accurate dimensions from dimensions shown on Architectural and Structural Drawings, and by site measurement.
- .3 Make, at no additional cost, any changes or additions to materials, and/or equipment necessary to accommodate structural conditions (pipes or ducts around beams and columns and other structural elements).

- .4 Alter, at no additional cost, the locations of materials and/or equipment as directed that do not necessitate additional material.
- .5 Install ceiling mounted or exposed components (e.g. diffusers, sprinkler heads, grilles) in accordance with reflected ceiling drawings or floor plans.
- .6 Confirm on the site the exact location and mounting elevation of outlets and fixtures as related to existing Mechanical and Electrical components and Architectural and Structural details.

1.09 EXAMINATION OF THE PLACE OF THE WORK AND DOCUMENTATION

- .1 Prior to submitting tender, carefully examine conditions at the place of the work which could affect the Work of this Division. Refer to and examine all Contract Documents.
- .2 Verify that materials and equipment can be delivered to the Place of the Work and that sufficient space and access is available to permit installation thereof in locations shown on the Drawings.
- .3 Verify location and elevation of existing services (water, electrical, sanitary, storm sewers, equipment, ductwork and piping) which may affect the Tender and Work of this Division. Repair any damage to existing underground services caused by neglect to determine and mark out the location of such services prior to excavation work commencing.

1.10 SHOP DRAWINGS

- .1 Conform to requirements of Section 20 05 01.

1.11 ACCEPTABLE MANUFACTURERS AND ALTERNATES

- .1 The manufacturers as listed in the equipment schedules and drawings are listed as the Basis of Design.
- .2 All manufacturers differing from the Basis of Design who are listed as "Acceptable Manufacturer", "Standard of Acceptance", "Alternative Manufacturer", "Acceptable Alternative" and similar language are considered as alternates.
- .3 Whenever the contractor intends to provide a product different than the Basis of Design it will be considered an alternate, regardless of it being listed as an "Acceptable Manufacturer", "Standard of Acceptance", "Alternative Manufacturer", "Acceptable Alternative". It is the contractor's responsibility to verify that the equipment performance, weight, connection, wiring, power requirements and dimensions are in line with the characteristics of the product listed as the Basis of Design. If different than the Basis of Design, the contractor shall coordinate with other trades and cover all costs associated with any modifications required to accommodate the proposed equipment/product.

1.12 RECORD DRAWINGS

- .1 Meet the requirements of Division 01 and the following.
- .2 Suitably store and protect Record "As-Constructed" or "As-built" Drawings on site and make available at all times for inspection.
- .3 Record inverts of underground piping at building entry/exit and below floor slab at each branch, riser base, change in direction as well as at least three points on straight runs.
- .4 Show locations of access doors and panels and identify the equipment and components that they serve.

- .5 Transfer all Record Drawings information to the Mechanical Trade Contractor's CAD model prior to submission to Consultant for review.
- .6 Submit Record "As-Constructed" or "As-built" Drawings for review in PDF format and hard copy for review. Submit reviewed Record "As-Constructed" or "As-built" Drawings in an editable CAD format with the O&M Manuals.

1.13 PRODUCT STANDARDS AND ALTERNATIVES

- .1 Provide new material and equipment as specified and to acceptance of the Consultant. Manufacturers' names are listed to set a standard of quality, performance, capacity, appearance and serviceability. Acceptable alternative Manufacturers are also listed, and their products may be used in the Work subject to conditions stipulated in paragraph .3 of this Article.
- .2 Where no other acceptable Manufacturers are indicated, provide only as specified. Requests for acceptance of manufacturers not listed must be submitted not less than seven working days prior to closing date of the tender. Submissions must bear proof of acceptance by the Consultant.
- .3 Assume full responsibility for ensuring that when providing acceptable alternative Manufacturers, all performance, space, weight, connections (mechanical and electrical), power and wiring requirements, are within the scope of the item specified, and costs for any variances therefore are included in the tender. Equipment requiring greater than specified energy requirements and greater installation and service space requirements will not be accepted.
- .4 All electrically operated equipment and electrical materials to bear the label of approval of CSA or be so stamped or have special approval of the Authorities. All material, wiring and devices to conform to the Canadian Electrical Code for the purpose for which they are to be used. All electrical equipment to be designed and manufactured in accordance with applicable EEMAC and ANSI specifications.
- .5 All gas fired equipment to bear the label of the CGA or be so stamped.
- .6 All plumbing products such as fixtures, faucets, flush valves and shower heads to bear the label of approval of the CSA or be so stamped.

1.14 TEMPORARY SERVICE

- .1 Do not use any of the permanent Mechanical Systems during construction except as may be specified in Division 01 or unless specific written acceptance is obtained from the Consultant.
- .2 The use of permanent facilities for temporary construction service such as for testing, commissioning and demonstration of operation will not affect in any way the commencement day of the warranty period. Refer to Division 01.
- .3 Refer to Division 01 for additional information regarding temporary services, contractor's shop, storage and other such facilities.

1.15 PATENTS

- .1 Pay all royalties and license fees, and defend all suits or claims for infringement of any patent rights, and save the Owner and Consultant harmless of loss or annoyance on account of suit, or claims of any kind for violation or infringement of any letters patent or patent rights, by this Subcontractor or anyone directly or indirectly employed by him or by reason of the use by him or them of any part, machine, manufacture or composition of matter on the work, in violation or infringement or such letters patent or rights.

1.16 RIGHTS RESERVED

- .1 Rights are reserved to issue any additional Detail Drawings, which in the judgement of the Consultant may be necessary to clarify the Work, and such Drawings shall form a part of the Contract.

1.17 EXPEDITING AND DELIVERIES

- .1 Comply with requirements of Division 01. For equipment and materials purchased directly by the Owner, comply with requirements of Division 01.
- .2 Continuously check and expedite delivery of equipment and materials. If necessary, inspect at the source of manufacture.
- .3 Ensure that materials and equipment are delivered to the site at the proper time and in such assemblies and sizes so as to enter into the building and to be moved into the spaces where they are to be located without difficulty. Perform any cutting and patching involved in getting assemblies into place.
- .4 Continuously check and expedite the flow of necessary information to and from all parties involved.
- .5 Immediately inform the Consultant of any difficulties in delivery of equipment.
- .6 Provide delivery records updated monthly.

1.18 WORK IN EXISTING BUILDING AREAS

- .1 Perform work in existing areas to best suit available space and not interfere with or obstruct use of existing facilities.
- .2 Cut, modify and extend, as shown in the Contract Documents or as directed by the Consultant, existing materials and equipment to be reused or relocated to suit the Work. Use new materials to match existing systems that are modified or extended.
- .3 Scan and/or x-ray all concrete slabs to identify the appropriate location to cut, trench and/or core prior to commencing any work. Submit the results of the scan and/or x-ray in a report format to the structural engineer for review prior to cutting, trenching and/or coring. This contractor shall ensure that there are no interferences with other existing services prior to commencing any work.
- .4 Refer to Section 20 05 40.

1.19 TRIAL USAGE, TESTS AND COMMISSIONING

- .1 Include, as part of the Work, trial usage of Mechanical Systems and equipment for the purpose of testing and commissioning and assisting Owner's staff in learning operational and maintenance procedures.
- .2 Assist in trial usage over a length of time sufficient to confirm specified equipment capacities and operating characteristics. Maintain full responsibility for all mechanical equipment and systems required to temporarily operate during trial usage. Warranty period commencement for any equipment operated during trial usage will not occur until all Mechanical Work is substantially complete. Warranty period commencement is to be applied only to equipment that is put into full continuous service prior to Substantial Completion of the Mechanical Work.
- .3 Provide all testing required on Mechanical System components and equipment where, in the opinion of the Consultant, specified performance is not being achieved.

1.20 COMPLETION

- .1 After successful completion of tests and adjustments, remove temporary covers, and strainers, and obstructions to flow. Drain, flush and refill piping systems as often as required until all piping is clear of all debris.
- .2 Provide a clean set of filters on each air handling system.
- .3 Provide new filter elements in pump seal filters.
- .4 Leave Mechanical work in specified working order.
- .5 Provide spare components as specified in Section 21 13 00 and Section 25 01 01.

1.21 WARRANTIES

- .1 Comply with requirements of Division 01.
- .2 Provide all required labour, parts and components required to service all installed items for a warranty period of at least one (1) year unless otherwise stated longer in individual specification sections.
- .3 Include for all costs for cutting and patching, removal of equipment and restoration materials and work and repairs to other equipment affected in performance of warranty work.
- .4 All warranties commence from the date of Substantial Performance of the Work, unless stated differently in individual specification sections.
- .5 Provide warranty certificates showing the name of the firm giving the warranty, dated and acknowledged. Where a specific piece of equipment has an extended warranty or one differing from the base warranty requirements, provide a separate warranty certificate.
- .6 Refer to individual specification sections in Divisions 20, 21, 22, 23, 25 for further warranty requirements.

1.22 INSTRUCTIONS TO OWNER'S STAFF

- .1 Instruct the Owner's designated staff on all aspects of the operation of systems and equipment. Advise the Consultant at least one week in advance of the schedules of all instruction sessions.
- .2 Obtain the services of Subtrade and Manufacturers' representatives to provide information and instructions on each part of the Mechanical Work and on items of equipment.
- .3 Submit documentation of training to the Consultant immediately following final inspections, stating for each system or item of equipment:
 - .1 Date and time instructions commenced for each system.
 - .2 Duration (hours) instructions were given for each system.
 - .3 Names of Owner's staff receiving instructions.
 - .4 Other parties present (Manufacturer's representative, consultants, etc.).
 - .5 Signatures of each of the Owner's staff in attendance.

1.23 OPERATING AND MAINTENANCE MANUALS AND CLOSE-OUT DOCUMENTS

- .1 Refer to Division 01 Close-Out Submittals and Close-Out Procedures.
- .2 Secure and assemble all necessary literature describing the operation and maintenance of all equipment provided. Complete and submit documentation for review to Consultant eight (8) weeks prior to substantial completion.

- .3 Provide 3 copies of Operating and Maintenance Manuals in hardcopy and Electronic PDF format copies on Optical media or USB storage device. Mount or connect digital copy to hard copy binders.
- .4 Provide the following on substantial performance of the work:
 - .1 One set of valve charts set in glazed frames mounted on the project as directed by the Consultant.
 - .2 Air and water balancing report.
 - .3 As constructed drawings including building automation system shop drawings.
- .5 Three manuals assembled in three ring binders with index tabs, each containing:
 - .1 This Subcontractor's name, address and telephone/fax numbers.
 - .2 Suppliers and Subtrades names and telephone numbers.
 - .3 Equipment data sheets (dimensions, capacities, electrical characteristics, wiring diagrams) along with equipment manufacturer's recommended spare parts lists.
 - .4 Maintenance, operating and lubricating instructions and schedules for each item of equipment.
 - .5 As-built Wiring diagrams for each item of equipment.
 - .6 Copies of valve charts for the project.
 - .7 Shop Drawings and Product Data: provide final copies of complete sets of "Reviewed" or "Reviewed as Modified" Shop Drawings and other Submittals including Interference/Coordination Model, Embedded Mechanical System's Drawings, and Sleeving Drawings.
 - .8 Warranties: include one copy each of the Contractor's warranty, Manufacturers' warranties longer than one year, the bond, and any service contract provided by the contractor. Provide section index.
 - .9 Certifications by Inspection Agency: collect and include copies of the following inspection certification reports:
 - .1 Plumbing and Gas Standards
 - .2 Building Standards and Fire Prevention
 - .3 Boilers and Pressure vessel
 - .4 Utility Companies
 - .5 Other Reports Required by Authorities
 - .10 Certificates for:
 - .1 Boiler start up and commissioning
 - .2 Chiller and refrigeration system start up and commissioning
 - .3 Water treatment
 - .4 Rooftop HVAC Equipment start-up and commissioning
 - .5 Rooftop Heating and Ventilation Equipment start-up and commissioning
 - .6 Control and Building Automation Systems commissioning
 - .7 Fuel oil pumping systems commissioning
 - .8 Variable speed electric drives commissioning
 - .9 Piping pressure tests (domestic water, non-potable, fire protection heating/cooling piping) certifying system tested, pressure held, time of test and date and certification by the Consultant or commissioning agent.
 - .10 Extended warranties.

1.24 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Division 01 to suit Common Product Requirements.
- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .3 Protect on site stored or installed absorptive material from moisture damage.

- .4 Packing, shipping, handling and unloading:
 - .1 Deliver materials to site in original factory packaging or unopened packages clearly labeled with, manufacturer's name, address, product identification, equipment tag identification/s and ULC markings.
 - .2 Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.
- .5 Storage and Protection:
 - .1 Store and protect all equipment and materials from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer in enclosed shelter.
 - .2 Repair any damage to the satisfaction of the manufacturer and the Consultant.
- .6 Waste Management and Disposal:
 - .1 Separate waste materials for re-use and/or recycling in accordance with Division 01, to suit Construction/Demolition Waste Management and Disposal
 - .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
 - .3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, & packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan (WMP).
 - .4 Separate for re-use and/or recycling and place in designated containers Steel, Metal and Plastic waste in accordance with Waste Management Plan (WMP).
 - .5 Divert unused metal materials from landfill to metal recycling facility as approved by the Consultant.
 - .6 Place materials defined as hazardous or toxic in designated containers.
 - .7 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, and Regional and Municipal regulations.
 - .8 Ensure emptied containers are sealed and stored safely.
 - .9 Fold up metal and plastic banding, flatten and place in designated area for recycling.

1.25 CLEANING

- .1 General
 - .1 Comply with General Conditions of the Contract, Supplementary Conditions and other Sections of Division 01.
 - .2 Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.
 - .3 Store volatile and toxic wastes in covered metal containers and remove from premises daily.
 - .4 Prevent accumulation of wastes which create hazardous conditions.
 - .5 Provide adequate ventilation during use of volatile or noxious substances.
 - .6 Use only cleaning materials and methods recommended by manufacturer of surface to be cleaned.
- .2 Construction Cleaning
 - .1 Perform cleaning operations as specified in Division 01 and in accordance with manufacturer's recommendations.
 - .2 At all times, maintain the premises free from accumulation of waste material and waste caused by the Contractor's work.
 - .3 In cases of disagreement or non-removal of waste material, the Owner may have waste removed from site at the Contractor's own expense.

- .4 Dumping of waste, debris, surplus materials, etc. on Owner's property is strictly prohibited. Obtain permit and provide on-site dump containers for collection of waste materials and debris.
- .5 Broom clean and keep dust free, daily, all rooms, surfaces and areas.
- .6 Maintain roads and walks clean and free of dirt and mud due to work of this Contract. Provide ice and snow removal for walks which will be used exclusively by Contractor and/or Subcontractor's forces.
- .3 Final Cleaning
 - .1 In preparation for Total Performance or occupancy, conduct final inspection of sight exposed surfaces and of accessible concealed spaces.
 - .2 Upon completion and verification of performance installation, remove all waste, equipment, tools, scaffolding, surplus materials, temporary protection, etc. and leave work in a clean and orderly condition.
 - .3 Remove grease, dust, dirt, stains, labels, fingerprints and other foreign materials from sight exposed interior and exterior finished surfaces.
 - .4 Upon completion of project or as required, remove all temporary buildings erected, all temporary construction aids, barriers and enclosures, all temporary utilities, hoists, access road sand walks, etc., leaving site in clear, tidy and satisfactory condition pending acceptance from the Owner.
 - .5 Brush clean all surfaces and areas of the Work.
 - .6 Vacuum clean and remove debris from the inside of air handling systems, fans, ducts, coils and terminal units.
 - .7 Clean exposed surfaces of Mechanical equipment, ductwork and piping. Polish plated work.
 - .8 Comb all bent fins to proper configuration on all coils in air handling units, fan coil units, entrance heaters and on finned radiation elements.
 - .9 Replace all temporary air filters with specified filters on all heating, cooling and ventilating equipment.
 - .10 Upon completion of work of each trade, thoroughly clean work and leave in a condition acceptable to Consultant and Owner.

PART 2 - PRODUCTS

2.01 NIL

PART 3 - EXECUTION

3.01 NIL

END OF SECTION 20 05 05

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PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.
- .2 Comply with requirements of Section 20 05 05 Mechanical Work General Instructions.

1.02 SUBMITTALS

- .1 Submit shop drawings on access doors, valves, strainers, expansion tanks, thermometers and gauges, expansion compensators, piping restraints, grooved end components, motor starters and motor control centers in accordance with Section 20 01 05.

PART 2 - PRODUCTS

2.01 PIPE AND FITTINGS

- .1 Corrosion Prevention
 - .1 Provide V line insulating couplings as supplied by H & G Specialties Limited, or accepted alternative dielectric couplings, for prevention of galvanic corrosion at specific points where connections are required between copper, brass or bronze and black or galvanized steel piping.
 - .2 Other acceptable manufacturers EPCO, Watts.
- .2 All fittings 50mm (2") and below connecting to equipment: Use unions, extra heavy duty pattern, having ground joints, brass seats and diagonal screws.
- .3 Connections to equipment 65mm (2½") and above: Flanged, standard weight provided with ring gaskets.
- .4 Cooling coil condensate: drainage grade copper tubing with copper drainage fittings with 50/50 solder.
- .5 Chilled water, Dual Temperature and Heating:
 - .1 Piping:
 - .1 Working Pressure up to and including 1035 kPa (150 psi): Schedule 40 ASTM specification A53 Grade A or B wrought steel black pipe with heavy cast iron threaded fittings rated at 1380 kPa (200 psi WOG) for pipe sizes up to and including 50mm (2").
 - .2 Working Pressure up to and including 1035 kPa (150 psi): Schedule 40 ASTM specification A53 wrought steel black pipe with schedule 40 black steel welding fittings rated at 1380 kPa (200 psi WOG) for pipe sizes 65mm (2½") and over.
 - .3 Type L copper to ASTM B88 with 95/5 soldered wrought copper pressure fittings to ANSI B16.22 for piping system rated at 1035 kPa (150 psi WOG) for pipe sizes up to and including 50mm (2").
 - .2 Fittings:
 - .1 For pipe fittings up to and including 50mm (2"):
 - .1 Up to 862 kPa (125 psi WSP) Soldered: Wrought bronze or cast copper, ASTM B32, solder joint fittings, ANSI/ASME B16.18 or B16.22.

- .2 Up to 862 kPa (125 psi WSP) Threaded: Banded black cast iron, ASTM A126, threaded, ANSI/ASME B16.4, Class 125, ASTM A126
- .3 1035 kPa (150 psi WSP) Threaded: Galvanized malleable iron, threaded, ANSI/ASME B16.3, Class 150.
- .4 1725 kPa (250 psi WSP) Threaded: Banded black cast iron, ASTM A126, threaded, ANSI/ASME B16.4, Class 250, and ANSI/ASME B1.20.1
- .5 [2070 kPa (300 psi WSP) Threaded: Galvanized malleable iron, threaded, ANSI/ASME B16.3, Class 300.]
- .2 For pipe fittings 65mm (2½") and up to 600mm (24"):
 - .1 Welded: Black steel, butted welded, ASTM A234/A234M, ANSI/ASME B16.9, each stamped by manufacturer for conformance and working pressure.
 - .2 Up to 862 kPa (125 psi WSP) Flanged: Cast iron flanged fittings, ANSI/ASME B16.1, Class 125.
 - .3 [2070 kPa (300 psi WSP) Welded: Black steel, butt-welded, ASTM A234/A234M, ANSI/ASME B16.9, Class 300.]
- .3 Victaulic couplings to CSA Standard B242 for fire protection, heating, chilled water and condenser water is acceptable provided that this application meets the approval of the Municipal Authorities who have jurisdiction at the place of the Work.
 - .1 Rigid Couplings: Ductile iron to specification A536. In mechanical rooms use grooved couplings to be designed with angle bolt pads to provide a rigid joint. Victaulic style 107N or 07. In mechanical rooms use grooved couplings to be designed with angle bolt pads to provide a rigid joint. Victaulic style 107 and 07.
 - .2 Flexible Couplings – Ductile iron to specification A536. Flexible grooved couplings shall be used where system flexibility is desired. Noise and vibration reduction at mechanical equipment connections is achieved by installing three flexible couplings near the vibrations source in lieu of braided flex connectors. Victaulic Style 77 or 177.
 - .3 AGS "W" Series Couplings (350mm (14") and Larger): Victaulic Style W07 (rigid) and Style W77 (flexible) two housings cast with a wide key profile and flat bolt pads for metal-to-metal contact, wide-width FlushSeal® gasket, and plated steel bolts and nuts.
 - .4 Gaskets: Water Services EPDM Grade "E", with green colour code identification, conforming to ASTM D-200 for water services up to 110°C (230°F) or Grade "EHP" EPDM, with red colour code identification, conforming to ASTM D-2000 for water services up to 120°C (250°F).
 - .5 Fittings Victaulic full flow fittings manufactured of ductile iron to ASTM A 536 Grade 65 4 12 or steel to ASTM A-53, Grade B, with grooved ends designed to accept Victaulic couplings.
- .3 Flanges: Provide either flat-face or raised-face flanges as required to match flange faces on valves and equipment.
 - .1 Up to 862 kPa (125 psi WSP) Threaded: Threaded cast iron flanges, ANSI/ASME B16.1, Class 125.
 - .2 1035 kPa (150 psi WSP): Weld neck or slip-on steel flanges, ASTM A181/A181M, Class 60, ANSI/ASME B16.5, Class 150.
 - .3 1725 kPa (250 psi WSP) Threaded: Threaded cast iron flanges, ANSI/ASME B16.1, Class 250.
- .4 Flange Bolts:
 - .1 Up to 862 kPa (125 psi WSP): ASTM A307, Grade B, square-head machine bolts with heavy hex-nuts.
 - .2 Above 862 kPa (125 psi WSP): ASTM A193/A193M, Grade B7 bolts, with Grade 7 nuts.
- .5 Unions for sizes up to 50mm (2"):

- .1 Up to 862 kPa (125 psi WSP) Soldered: Wrought bronze or copper, ground joint, solder end unions.
 - .2 1035 kPa (150 psi WSP) Threaded: ASTM A197/A197M, ANSI/ASME B16.39, Galvanized malleable iron unions with ground joints, brass seat, threaded ends.
- .6 Natural gas piping: Provide as required by the Authorities having jurisdiction as follows:
- .1 ASTM A53 Schedule 40 seamless wrought steel with schedule 40 threaded malleable fittings to ANSI standard B16.3; welded in concealed areas and X rayed if required by Authorities having jurisdiction.
 - .2 ASTM A53 Schedule 40 wrought steel seamless with schedule 40 wrought steel butt welding fittings to ANSI B16.9. Welding procedures to comply with standards as required by the Authorities having jurisdiction.
 - .3 Connections to equipment: provide extra heavy duty pattern unions with ground joints, brass seats and threads to ANSI B1.20.1. Where flanges are required, provide standard weight type to ANSI B16.1 with neoprene gaskets.

2.02 VALVES

- .1 All valves to have minimum certified rating of 1380 kPa (200 psi) WOG. Refer to Section 23 05 05 for fire protection service valves.
- .2 Conform to requirements of ANSI, ASTM, ASME, and applicable MSS standards.
- .3 Manufacturer:
 - .1 Provide valves of same manufacturer throughout, where possible.
 - .2 Provide valves with manufacturer's name and pressure rating clearly marked on body (per MSS-SP-25).
 - .3 Product shall carry valid CRN (Canadian Registration Number) issued by respective Provinces.
- .4 Valve Materials:
 - .1 Bronze: to ASTM B62 (406°F/208°C) or B61 (550°F/288°C) as applicable
 - .2 Brass: to ASTM B283 C3770
 - .3 Cast Iron: to ASTM A126, Class B (353°F/178°C) at 125 PSIG.
 - .4 Forge Steel: to ASTM A105N (800°F/427°C)
 - .5 Cast Steel: to ASTM A216WCB (800°F/427°C)
- .5 Testing and Design:
 - .1 MSS-SP-80 - Bronze, Gate & Check Valves.
 - .2 MSS-SP-110 - Ball Valves.
 - .3 MSS –SP-70, 85, 71 - Cast Iron Gate, Globe & Check Valve.
 - .4 MSS-SP-72 - American Valve
 - .5 MSS-SP-67 – Kitz, Butterfly Valves.
 - .6 API 602 – Forge Steel Valves (Design)
 - .7 API 598 – Cast Steel Valves, Forge Steel Valves (Testing)
 - .8 API 609 – WKM High Performance BFV
- .6 Gate valves:
 - .1 50mm (2") and smaller with bronze body and rising stem: Jenkins #810, Crane #428, Newman Hattersley #T607, Red and White #293.
 - .2 Valves for copper ends: Jenkins #813J, Crane #1334, Grinnell #3000, Toyo 299 or Newman Hattersley #T607, Kitz #44.

- .3 Gate valves 65mm (2½") and up: Iron body, bronze trim, OS&Y, rising stem, Jenkins #454J, Crane #465 ½, Toyo #421A, Grinnell #6060A or Newman Hattersley #504, Kitz #72.
- .4 For valves 150 mm (6") and greater where mounted overhead, provide O. S. & Y. valves with chain wheel operation - length of chain to be determined on site.
- .7 Ball valves:
 - .1 Up to 50 mm (2"):
 - .1 Brass and/or bronze body, full port, PTFE seats, double O-Ring design or PTFE packing, chrome plated solid bronze ball, lever handle.
 - .2 1034 kPa (150 psig) / 4137 kPa (600 psig) WOG rating.
 - .3 Kitz 58 (threaded) or 59 (solder), Crane 9201 (threaded) or 9202 (solder), Toyo 5044E (threaded) or 5049A (solder), Watts FBV-4 (threaded) or FBVS-4 (solder), Apollo 77F-100 (threaded) or 77F-200 (solder), Nibco T-FP600A (threaded) or S-FP600A (solder)
 - .2 It is preferable that ball valves be used in place of gates valves for sizes 12 to 50 mm (1/2" to 2").
- .8 Globe valves:
 - .1 50mm (2") and smaller: Grinnell #3240, Jenkins 106B, Crane #7, Toyo #221, or Newman Hattersley #13, Kitz #9.
 - .2 Valves 50mm (2") and smaller for copper ends: Grinnell #3240SJ, Jenkins #1068AP, Crane #1312, Red and White #212, Newman Hattersley Fig. 13 with adapters, Kitz #10.
 - .3 Valves 2½" and greater, iron body, bronze seat and disc: Jenkins #234J, Crane #351, Red & White #400A, Newman Hattersley #731.
- .9 Butterfly valves:
 - .1 Flanged:
 - .1 Enameled cast iron lug type body, stainless steel disc, blow-out proof stainless steel stem, EPDM seat
 - .2 Bi-directional tight shut-off to 1100 kPa (150 psi)
 - .3 Bi-directional dead-end service to 345 kPa (50 psi)
 - .2 Handles and operators:
 - .1 Up to and including 100mm (4"): lever with infinite adjustment.
 - .2 150mm (6") and over: wheel/gear operated.
 - .3 Provide chain operator where mounted overhead.
 - .3 It is preferable, except for gas and steam services, that butterfly valves be used in place of gate valves for sizes 65 mm (2½") and greater.
 - .4 As manufactured by Challenger, Centerline, Keystone, DeZurick, Crane, Jenkins, Bray, Victaulic
- .10 Swing check valves - other than at pump discharge:
 - .1 50mm (2") and smaller: Grinnell #3320, Jenkins #4092, Crane #37, Toyo #236, Newman Hattersley #47, Victaulic Series 712, Kitz #22.
 - .2 65mm (2½") and larger: Iron body, brass trim, flanged: Grinnell #6300A, Jenkins #587, Crane #373, Toyo #435JA, Newman Hattersley #651, Kitz #78.
 - .3 At pump discharge use wafer type check valve as manufactured by Grinnell #300, Victaulic Series 716H/716 or W715, Streamflo, Checkrite or M & G #1515WM5S with 316 stainless steel disc.
- .11 Balancing cocks:

- .1 50mm (2") and smaller: DeZurick series 425. 65mm (2½") and larger: Flanged DeZurick Series 100. Both types to be complete with memory stops.
- .12 Gas valves, CGA approved - lubricated plug type: 12 to 50 mm (½" to 2"): Hattersley #170M. 65 mm (2½") and greater, flanged: Newman Hattersley #171M.
- .13 Corporation stops and site service valves:
 - .1 Corporation Stops 2" to 12": Cambridge Brass "Century" brass body ball valve with connections to suit piping. Ball to be stainless steel with teflon seats. Provide cast iron housing with threaded cover to suit depth of bury.
 - .2 Valves 2" to 12" FM, UL and ULC approved: Kennedy Valve mod. 4701 to AWWA standard C509. Flanged epoxy coated cast iron body, non-rising stem, 2" operating nut and post plate complete with Clow Canada Series 900-S/900-C adaptor flange/restrainer where connection to PVC pipe is required. Provide extension stem and cast iron housing complete with cover to suit depth of bury. Valves as manufactured by Clow are also acceptable.
- .14 Balancing Valves: Where specified at items of equipment and where shown on schematic piping diagrams, provide circuit balancing valves. Each valve to have features as follows:
 - .1 Manual Balancing Valves:
 - .1 All manual balancing valves shall incorporate the following features:
 - .1 'Y' pattern, equal percentage globe style.
 - .2 With tamperproof balance setting, positive shut-off and drain.
 - .3 Valves shall provide precise flow measurement, precision flow balancing, positive drip-tight shut-off.
 - .4 Valves shall provide multi-turn 360° adjustment with micrometer type indicators located on the valve handwheel.
 - .2 Up to 50 mm (2"):
 - .1 Bronze, brass or brass alloy body.
 - .2 2068 kPa (300 psi) maximum working pressure, 121°C (250°F) maximum operating temperature.
 - .3 Armstrong model CBV, Victaulic TA Series 78KH (male NPT x female NPT), 786H (solder end), 787H (female NPT threaded end), Bell & Gossett model CB, Hattersley model 1732.
 - .3 65 mm (2.5") and over:
 - .1 Cast or ductile iron body.
 - .2 ANSI 125 flanged connections or grooved connections.
 - .3 Armstrong model CBV, Victaulic TA Series 788 (flanged end), 789 (grooved end), Bell & Gossett model CB, Hattersley model MH737.
 - .2 Automatic Balancing Valves:
 - .1 All automatic balancing valves shall incorporate the following features:
 - .1 Valve shall be accurate to within +/-5% of set GPM within the valve's pressure control range.
 - .2 Valve shall have a maximum differential pressure control range of 60 psi.
 - .3 Valve body shall include tow integrated pressure/temperature ports.
 - .4 Valve shall maintain a constant flow rate, regardless of pressure fluctuations in the system (pressure independent operation).
 - .2 Up to 50 mm (2"):
 - .1 Ductile iron body.
 - .2 2517 kPa (365 psi) maximum working pressure, 121°C (250°F) maximum operating temperature.

- .3 Victaulic TA Series 76T (female x female threaded NPT / solder), 76B (female x female threaded NPT / solder, with ball valve kit), 76K (male x female threaded NPT / solder / union), 76V (male x female threaded NPT / solder / union, with ball valve kit), Bell & Gossett Circuit Sentry Flo-Setter II model FS (NPT female) or AF (NPT female/solder with union tailpiece).
- .3 65 mm (2.5") and over:
 - .1 Ductile iron body.
 - .2 2517 kPa (365 psi) maximum working pressure, 110°C (230°F) maximum operating temperature.
 - .3 Victaulic TA Series 76G (grooved ends)

2.03 HANGERS AND PIPING SUPPORTS

- .1 Hangers:
 - .1 Provide adjustable Clevis type equal to Grinnell Fig. 65 for pipe sizes up to and including 65mm (2½"). For pipe sizes 75mm (3") and over, provide adjustable Clevis type equal to Grinnell Fig. 260. Use rod sizes as recommended by the manufacturer. Provide Grinnell FM approved Fig. 104 split swivel or Fig. 69 swivel type hangers on fire protection piping. On copper piping, provide copper plated type hanger or separate piping from hanger with an approved insulating tape or plastic coating. Grinnell adjustable ring type fig. 97 and fig. 97c (coated) are acceptable on copper piping up to 65 mm (2½"). Where insulation covers hanger, refer to Section 20 05 25.
 - .2 Provide oversized hangers to pass over insulation on all cold water piping. Refer to detail drawings and Section 20 05 25.
 - .3 For corrosive environments (pool areas) shall be stainless steel.
- .2 Piping supports:
 - .1 For roof mounted piping, provide pipe roller supports with clamps as manufactured by Portable Pipe Hangers installed to Manufacturer's specifications. Use PPH model SS-8R or PP10 with roller for piping up to 65mm (2½") and use model PS-1-2 for pipes over 75mm (3") and up to 200mm (8"). For refrigeration piping and conduits, use PPH model PS1-2. For pipes over 75mm (3"), use PPH-RB18 with clamps, base and all other applicable support. Supports to be aluminium with stainless steel clamps and rollers. Membrane pads to be close-cell extruded polystyrene insulation equal to Dow Chemical Roofmate.
 - .2 For roof mounted gas piping: On stable flatbed roof, use pipe supports by Quick Block with oversized stainless steel clamps for roof mounted gas piping up to 125mm (5"). Supports for gas piping must be CGA certified & listed and meeting the requirement of gas code B149.1.
 - .3 For pipe risers, provide supports equal to Grinnell Fig. 40, black carbon steel, sized to carry the operating weight of the piping.

2.04 INSERTS

- .1 Use only factory made, threaded or toggle type inserts as required for supports, and anchors, properly sized for the load to be carried.
- .2 Use factory made expansion shields where inserts cannot be placed, but only as accepted by the Consultant and for light weights.
- .3 Do not use explosive activated tools except with written acceptance of the Consultant.

2.05 SLEEVES

- .1 Piping: Machine cut schedule 40 steel pipe, medium cast iron or 18 gauge galvanized steel; refer to detail drawings.
- .2 Ductwork: At fire dampers refer to detail drawings: Other locations formed to accommodate duct size or access opening as required.

2.06 AIR VENTS

- .1 Provide air vents as manufactured by Maid O Mist No. 7 series or Braukmann. Where system pressure exceeds 345 kPa (50 psig) provide air vents with 1035 kPa (150 psig) rating.

2.07 STRAINERS

- .1 Provide where shown on the drawings, strainers as manufactured by Kitz, Mueller or Spirax Sarco:
 - .1 50 mm (2") and smaller:
 - .1 863 kPa (125 psig) / 1379 kPa (200psi) WOG rating
 - .2 Cast bronze body, screwed cap, Y-pattern, threaded or soldered ends.
 - .3 Kitz 15 (threaded)/16 (soldered), Mueller 351M (threaded)/353 1/2MM (soldered)
 - .2 65 mm (2½") and greater:
 - .1 Class 125
 - .2 Cast iron body, bolted cover, Y-pattern, flanged ends.
 - .3 Kitz 80, Mueller 758
- .2 Unless noted otherwise, provide an integral strainer for pressure relief valves, pressure regulating valves and backflow preventers.
- .3 Strainer baskets:
 - .1 Type 304 stainless steel or Monel,
 - .1 2" and smaller strainer size:
 - .1 20 mesh perforations for water [0.838mm (0.033") perforations for steam]
 - .2 2 ½" to 4" strainer size:
 - .1 1.57mm (0.062") perforations for water [1.14mm (0.045") perforations for steam]
 - .3 5"-10" strainer size
 - .1 3.17mm (0.125") perforations for water [1.14mm (0.045") perforations for steam]
 - .4 10" and larger size
 - .1 3.17mm (0.125") perforations for water [1.57mm (0.062") perforations for steam]
 - .5 For pump suction service, provide 3.175mm (0.125") perforations.
- .4 Combination strainers and pump inlet diffusers, with screens as specified above, manufactured by S.A. Armstrong Ltd. (Suction Guide), Victaulic (Style 731) or Taco Model SDO are also acceptable.

2.08 THERMOMETERS AND GAUGES

- .1 Pressure Gauges:
 - .1 Gauges where indicated on the drawings: Winters model P1S-100 Series to ANSI B40.100 grade "1A" level with SI and Imperial scales 115mm (4½") complete with ball valves and PSN B snubbers. Scale: To meet operating pressure ranges.
 - .2 Provide brass, bronze or copper fittings only.
- .2 Thermometers

- .1 Provide bi-metal dial type thermometers complete with stainless steel separable wells as shown on the Drawings and as manufactured by Trend (Winters). Model 32 adjustable angle 75mm (3") diameter with external reset. Range: 0°C to 50°C (32°F to 122°F) for chilled and condenser water and 10°C to 150°C (50°F to 302°F) for hot water
- .2 Gauges and thermometers as manufactured by Terice and Ashcroft will also be accepted.
- .3 Provide brass, bronze or copper fittings only.

2.09 WIRING

- .1 Electric power wiring for equipment (connection of motors through starters and disconnects) provided by mechanical trades is specified in Division 26. Electrically operated equipment: to CSA Standard and bear Certification label.
- .2 Provide motor control wiring (at any required voltage) between starter panels and control components to all requirements specified for similar wiring in Division 26.
- .3 Provide wiring of items supplied by equipment manufacturers such as filter advance motors and control, high level alarms, low water cut offs, anti-vibration lock outs, flow switches, remote and local thermostats for unitary heating equipment and rooftop HVAC units, sump pump alternators, level controllers, water treatment equipment, and oil/grease interceptor alarms, and control wiring between starters and control panels (e.g. air cooled condensers, cooling towers and condensing units). Also provide wiring for communications interface panels, sensors, oil pumps, purge pumps and oil heaters supplied with water chillers.

2.10 ELECTRIC MOTORS

- .1 CSA labelled, refer to Electrical Drawings and Mechanical Equipment Schedules for exact details. Motors to meet NEMA standards for maximum sound level ratings under full load. Service factor on all motors to be 1.15.
- .2 Motor bearings: to be permanently lubricated ball type for motors up to and including 3725 W (5 hp). Bearings for all motors over 3725 W to be self-aligning greaseable ball bearings sized to provide life of at least 50,000 hours under belt driven service.
- .3 Single Phase Motors: Provide permanent split capacitor type. Motors 14.9 kW (20 hp) and greater: Provide thermistor over temperature protection for each winding, wire in series, with leads terminated in the motor junction box.
- .4 All motors over 186 W (1/4 HP) to be TEFC. All motors over 1 HP to be high efficiency type with ratings based on statistically valid Quality Control procedures conforming to ANSI/IEEE 112 (Ref. 10), Test Method B (dynamometer), using NEMA MG1 (MG1-12.54 and MG1-12.55) (Ref.11), and conforming to efficiency ratings as defined in Table 10.4.1.A (a) under SB-10 of Ontario building Code. Motors to be approved under the Canadian Electrical Safety Code.
- .5 For motors used with variable frequency drives, provide Class H motor winding insulation and be inverter duty type manufactured to NEMA Standard MG-1 part 31 "Definite purpose inverter-fed motors". Ensure that drive Manufacturer reviews motor shop drawings prior to releasing order.
- .6 Acceptable electric motor manufacturers: Westinghouse, CGE, Reliance, Brook-Crompton, Marathon, US Motors, WEG and Siemens.

2.11 MECHANICAL IDENTIFICATION

- .1 Equipment Nameplates

- .1 Provide apparatus (including electric motors) with proper nameplates affixed thereto, showing the size, name of equipment, serial number and all information usually provided, which also includes voltage, cycle, phase and horsepower of motors and the name and address of the Manufacturer.
 - .2 Nameplate wording shall also include equipment tag information, generally to be as per drawings (i.e. EF-1, AHU-1, etc.), and is to include equipment service and building area/zone served.
 - .3 Nameplates for equipment suspended above floor level or generally not within easy viewing from floor level are to be increased in size so as to be easily readable from floor level.
- .2 Valve Tags
- .1 Valve tags are to be coloured, 40 mm (1-½") square, 2-ply laminated plastic with bevelled edges, red-white, green-white, yellow-black, etc., to match piping identification colour, each complete with a 3.2 mm (1/8") diameter by 100 mm (4") long brass plated steel bead chain, and four lines of engraved maximum size identification wording, i.e.:
VALVE V12
200 mm (8")
CHILLED WATER
NORMALLY OPEN
- .3 Pipe Identification
- .1 Standard pipe identification to be Smillie McAdams Summerlin Ltd., Brady or Primark Manufacturing Inc. vinyl plastic with indoor/outdoor type vinyl ink lettering and directional arrows, as follows:
 - .1 For pipe less than or equal to 150 mm (6") diameter, coiled type snap-on markers of a length to wrap completely around pipe or pipe insulation;
 - .2 For pipe larger than 150 mm (6") diameter, saddle type strap-on markers with 2 opposite identification locations and complete with nylon cable ties.
 - .2 Identification wording and colours for pipe identification materials are to be as follows:

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
domestic cold water	Green	DOM. COLD WATER
domestic hot water supply	Green	DOM. HW SUPPLY
domestic hot water recirculation	Green	DOM. HW RECIRC.
tempered domestic water	Green	TEMP. DOM. WATER
chilled drinking water	Green	CH. DRINK WTR.
storm drainage	Green	STORM
sanitary drainage	Green	SAN.
plumbing vent	Green	SAN. VENT
irrigation water	Green	IRRIGATION
ground water	Green	GROUNDWATER
acid sanitary drainage	Yellow	ACID DRAIN
acid drainage vent	Yellow	ACID VENT
fire protection standpipe	Red	F.P. STANDPIPE

DIVISION 20 MECHANICAL
SECTION 20 05 10
BASIC MECHANICAL MATERIALS AND METHODS

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
fire protection sprinklers	Red	F.P. SPRINKLER
natural gas	to Code	to Code, c/w pressure
natural gas vent	to Code	to Code
propane gas	to Code	to Code, c/w pressure
propane gas vent	to Code	to Code
fuel oil supply	Yellow	FUEL OIL SUPPLY
fuel oil return	Yellow	FUEL OIL RETURN
fuel oil vent	Yellow	FUEL OIL VENT
heating water supply	Yellow	HTG. WTR. SUPPLY
heating water return	Yellow	HTG. WTR. RETURN
heating water drain	Yellow	HTG. WTR. DRAIN
glycol heating supply	yellow	GLY. HTG. SUPPLY
glycol heating return	Yellow	GLY. HTG. RETURN
glycol heating drain	Yellow	GLY. HTG. DRAIN
Glycol heat reclaim return	Yellow	GLY. HTG. RECLAIM R.
Glycol heat reclaim supply	Yellow	GLY. HTG. RECLAIM S.
Heat pump geothermal loop – source side supply	Green	GEO. LOOP SOURCE SUPPLY
Heat pump geothermal loop – source side return	Green	GEO. LOOP SOURCE RETURN
Heat pump geothermal loop – load side supply	Green	GEO. LOOP LOAD SUPPLY
Heat pump geothermal loop – load side return	Green	GEO. LOOP LOAD RETURN
Condenser water supply	Green	COND. WTR. SUPPLY
Condenser water return	Green	COND. WTR. RETURN
Chilled water supply	Green	CH. WTR. SUPPLY
Chilled water return	Green	CH. WTR. RETURN
Chilled water drain	Green	CH. WTR. DRAIN
Low pressure steam	YellowkPa STEAM
Medium pressure steam	YellowkPa STEAM
High pressure steam	YellowkPa STEAM
Low pressure condensate	Yellow	L.P. CONDENSATE
Medium pressure condensate	Yellow	M.P. CONDENSATE
High pressure condensate	Yellow	H.P. CONDENSATE

PIPE SERVICE	IDENTIFICATION COLOUR	LEGEND
Pumped condensate	Yellow	PUMPED CONDENSATE
Steam vent	Yellow	STEAM VENT
Boiler feedwater	Yellow	BLR. FEEDWATER
Boiler blowdown	Yellow	BLR. BLOW-OFF
Refrigerant suction	Yellow	REFRIG. SUCTION
Refrigerant liquid	Yellow	REFRIG. LIQUID
Refrigerant hot gas	Yellow	REFRIG. HOT GAS
Diesel engine exhaust	Yellow	ENGINE EXHAUST
Gasoline	Yellow	GASOLINE
Distilled water	Green	DISTILL. WATER
Demineralized water	Green	DEMIN. WATER
Compressed air (< 700 kpa)	GreenkPa COMP. AIR
Compressed air (>700 kpa)	YellowkPa COMP. AIR
Control air	Green	CONTROL AIR

.4 Duct Identification

- .1 Duct identification is to be custom made Mylar stencils with 50 mm (2") high lettering to accurately describe duct service, i.e. "AHU-1 SUPPLY", complete with a directional arrow, and coloured ink with ink pads and roller applicators. Ink colour is generally to be black but must contrast with lettering background. Supply, return and exhaust ducts shall all be properly identified.

PART 3 - EXECUTION

3.01 INSTALLATION

- .1 Install equipment, ductwork, conduit and piping in a workmanlike manner to present a neat appearance and to function properly to the acceptance of the Consultant. Install ducts and pipes parallel and perpendicular to building planes. Install piping and ductwork concealed in chases, behind furring, or above ceiling. Install exposed systems grouped to present a neat appearance. Comply with manufacturer's installation instructions.
- .2 Install gauges and thermometers to permit easy observance from floor level.
- .3 Install all equipment and apparatus with adequate space allowance for wiring, maintenance, adjustment and eventual replacement.
- .4 Install control devices to guarantee proper sensing. Shield elements from direct radiation and avoid placing them behind obstructions.
- .5 Include in the Work all requirements of Manufacturers shown on shop drawings.
- .6 Install all ceiling mounted components (Diffusers, Grilles,) in accordance with reflected ceiling Drawings.

- .7 Leave space clear and install all work to accommodate future materials and/or equipment and to accommodate equipment and/or materials supplied by other trades. Verify spaces in which work is to be installed. Install pipe and ductwork runs to maintain maximum headroom and clearances and to conserve space in shaft and ceiling spaces.
- .8 Confirm on the site the exact location of equipment and fixtures. Confirm location of equipment supplied by other trades and mechanical requirements thereof.
- .9 Where FMP "flow measurement port" is shown on the Drawings, make installation as described on the Detail Drawings and in a location as shown on the schematic piping drawings. Install the flow measurement port in straight run of pipe at least 3 m (10 ft. +/-) downstream from any valve, thermometer, tee, elbow or any other pipeline device.

3.02 EQUIPMENT CONNECTIONS

- .1 Install piping connections to pumps and all other equipment without strain at the pipe connections. Remove, where requested by the Consultant, bolts in flanged connections or disconnect piping after the installation is complete to demonstrate that the piping has been so connected.
- .2 Provide shut off valves on supply and return piping connections on all items of equipment.
- .3 Provide flexible connectors on supply and return piping connections on all based mounted pumps.
- .4 Corrosion Prevention: Install dielectric couplings as specified in Part I at:
 - .1 Connections to copper/aluminum perimeter convectors, radiant ceiling panels and coils with copper connections in steel piping systems.
 - .2 Connections between copper and steel pipe.
 - .3 Connections to cooling coil condensate drains.
 - .4 Steel Valves used in a copper or copper alloy piping system. In this case, use brass or bronze valves whenever possible.
 - .5 Connections to expansion tanks and domestic hot water tanks in copper piping systems.
 - .6 In either steel or copper piping systems, do not put short black steel nipples and individual black steel fittings between brass or bronze components such as valves use only copper, brass or bronze components. Use a minimum of eight times the mass of steel pipe or components between any two brass, bronze or copper fittings or components.
 - .7 Do not use copper alloy (brass and bronze) fittings and valves in place of specified dielectric couplings.
 - .8 Steam boilers: Connections to the boilers are to be swing joints. Provide a minimum of 600mm (24") piping for swing joints.
- .5 Generators:
 - .1 Install and connect the flexible piping and muffler supplied by Division 26. Make installation in accordance with detail drawing.
 - .2 Install and connect the gas vent supplied by Division 23. Make installation in accordance with the manufacturer's instruction.
 - .3 Provide all supports, guides, bellow type expansion joints, pressure relief valves, guy sections, guy tensioners, roof thimbles, roof flashings, storm collars, flip top terminals and other necessary accessories and devices as required to provide a complete system per manufacturer's instruction.
 - .4 Generator exhaust system from muffler discharge to the termination point, including all accessories, shall be from one manufacturer.

3.03 DRAINS

- .1 Pipe all discharge from relief valves and drains from equipment, outside air plenum/louvre, chemical pot feeders and tanks to nearest floor drain or suitable receptacle.
- .2 Provide 20mm (¾") ball valves with hose ends, caps and chains at strainers, all piping system low points, pumps, coils and at each piece of equipment.
- .3 Provide deep seal traps (150mm trap seal) on all air handling equipment condensate drains and on floor drains located within air handling unit plenums. Provide trap seal primers on all floor drain traps and gang traps.

3.04 PIPING SYSTEM INSTALLATION

- .1 Install all piping in accordance with the best practices of the trade.
- .2 The piping shown on the drawings is diagrammatic for clearness in indicating the general run and connections and may or may not be, in all instances, shown in its true position. Take responsibility for the proper erection of systems of piping in every respect suitable for the work intended and as described herein.
- .3 Keep plugged or capped all openings in pipe or fittings during installation.
- .4 Install piping to avoid any interference with the installation or removal of equipment, other piping and ducts.
- .5 Install all valves, strainers and specialties to permit easy operation and access. On horizontal piping, install valves in an upright position. Where there are space constraints mount valves at a 45 deg. off vertical maximum. Install strainers to provide easy strainer basket removal.
- .6 Install systems to provide thorough drainage and air elimination.
- .7 During welding or soldering procedures, provide a fire retardant cloth, mat or blanket to protect the structure, and adequate fire protection equipment at all locations where work is being done. Close off shaft or confined areas with a fire retardant mat or cloth to prevent sparks or pieces of hot metal from falling down the shaft or area way.
- .8 Provide long turn pipe fittings having not less than pipe wall thickness. Provide line size tees. Where branch lines are more than two sizes smaller than the main, weldolets may be used.
- .9 Where steel piping is required to be buried, apply two coats of Densopaste (Denso of Canada Ltd.) primer to all buried surfaces after assembly and testing. Hot or cold applied tape as manufactured by Tapecoat, selected for the application and applied to manufacturer's instructions, is also acceptable.
- .10 Where it is necessary to offset piping to avoid obstructions, use 45 degree rather than 90 degree elbows.
- .11 Provide suitable cleanouts on every other change in direction and slope all condensate drip drains.
- .12 Make all threaded pipe joints on water piping using a thread paste or teflon tape suitable for the service for which the pipe is to be used. Use of hemp or similar materials on threaded joints will not be permitted.
- .13 For Grooved Couplings and Fittings: Comply with manufacturer's installation instructions for all products. Ensure that grooved pipes are in compliance with the current manufacturer's specifications and recommendations.

- .1 Ensure that the "A" dimension, i.e. the area from the pipe end to the front edge of the groove is free from indentations, scores, seams, projections or roll marks.
- .2 Use only lubricants which are nontoxic and non-injurious to the gasket material.
- .3 Upon completion of assembly, the bolt pads of each coupling must be fully drawn together, except for HP 70 (Victaulic) couplings in sizes to 100mm (4").
- .4 All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- .5 The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. .
- .6 A factory-trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. Factory-trained representative shall periodically review the product installation as requested by the Consultant. Contractor shall remove and replace any improperly installed products.
- .14 Natural Gas Piping: Install in accordance to relevant Codes. Provide vents to atmosphere for all safety switches and regulators as required by Code. Provide approved type pipe supports under roof mounted piping and install all supports according to Code and manufacturer's instruction. Refer to the Gas Code for spacing requirements.
- .15 Steam and Condensate Piping: Install steam piping level, or where possible, grade in direction of flow. On branch lines from mains feeding risers, pitch branch lines towards the horizontal mains to prevent water hammer. Grade all condensate piping in direction of flow.
- .16 Compressed air piping: slope piping in direction of air flow. Provide drip points at all low points in the piping system consisting of a line size or 25 mm (1") minimum diameter 300 mm (12") long down leg with a reducer to a 12 mm (½") ball valve with nipple and cap.
- .17 Install all piping requiring insulation with sufficient clearance to apply, seal and finish the insulation.
- .18 Provide sufficient space between piping to install valves arranged in straight rows or equally spaced steps. Valve wheels, handles and operators to be easily accessible and operable.
- .19 Do not install horizontal piping within masonry walls. Any piping installed in this manner will not be accepted.
- .20 Use only non-ferrous metals in high humidity areas.
- .21 Do not suspend any equipment, piping, ducting or any other mechanical components from formed hollow steel decking.
- .22 Acid waste and vents: Vents to be taken directly to roof vents and installed separately from non-acid waste systems. Vents to be C.I. where they pass through building roof. Provide fibreglass protective packing at sleeves. Provide rigid fibreglass pads (sections of pipe covering) at all support points in accordance with manufacturer's instructions.
- .23 Sanitary and storm piping: Provide all necessary restraining devices for all vertical and horizontal piping in major piping offsets or where turn of direction occurs. Restraining devices are to be an engineered product and designed solely for restraining application. Installation of restraining devices to be provided according to manufacturer's requirement.
- .24 Underground sanitary and storm piping: Underground sanitary and storm piping required to be hung under structure slab are to be cast iron piping meeting the requirements of the Authorities having jurisdiction.
- .25 Victaulic Piping:

- .1 Victaulic Certified Contractor Training:
 - .1 The grooved coupling manufacturer's (the "manufacturer") factory trained representative shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. All contractor field personnel installing Victaulic couplings must have completed the Victaulic Certification Program. This shall be at the expense of the installing contractor
 - .2 Victaulic Inspection Services:
 - .1 A Victaulic factory trained representative shall periodically visit the job site and review the installation for best practices. Victaulic product that has been examined and has not met the visual inspection criteria for proper installation must be corrected and re-examined by Victaulic Inspection Services prior to the completion of the project. The installing Contractor shall correct any identified deficiencies.
 - .2 Victaulic product that has been examined and has not met the visual inspection criteria for proper installation must be corrected and re-examined by Victaulic Inspection Services prior to the completion of the project. Any Victaulic product that has not been corrected or was not examined will not be considered as part of the successful completion of Victaulic Inspection Services.
 - .3 Application:
 - .1 Upon completion of the manufacturer's inspection of the installation and any identified corrections, the manufacturer must provide the owner or purchaser with a warranty on manufacturer's products and their installation. The manufacturer shall provide a letter confirming that upon review, all products were adequately installed and the system meets their installation requirements. The manufacturer must determine the number of fittings that need to be reviewed in order to provide this sign-off documentation. This letter shall be included as part of the close-out documentation.
- .26 Provide a stainless steel drip pan under all piping installed in: electrical, communications, security, CACF rooms or any room in which valuables can be damaged (ex. Locker Rooms). Drip pans to be sloped and piped to the nearest funnel floor drain.

3.05 CONTROL COMPONENTS

- .1 Install all pipe line devices required by the Section 25 01 01 sub-contractor such as flow switches, valves and separable wells for temperature controllers and sensors.

3.06 DIRT ACCUMULATION IN CONTROL VALVES

- .1 Remove any dirt accumulated under seats of automatic control valves during the first year's operation. Replace damaged valve parts at no additional cost to the Owner.

3.07 FIELD WELDING

- .1 Included in the scope of work, make arrangements and pay for registration and inspection by TSSA, for the following pressure piping systems:
 - .1 Steam piping including condensate piping at pressure 100 kPa (15 psig) or higher
 - .2 Service water piping at design temperature above 121°C (250°F) or at design pressures at and above 1070 kPa (160 psig)
 - .3 Chilled water and cooling water at design temperatures above 65°C (150°F) or design pressures above 1725 kPa (250 psig)
 - .4 Fuel oil piping at pressure 690 kPa (100 psig) or higher
 - .5 Compressed air, greater than 19mm (¾"), at pressures and over 100 kPa (15 psig)
 - .6 Medical gas piping system
 - .7 Other piping system as required certification by the Authorities Having Jurisdiction.

- .2 Piping standards to ASME B31.1 Code for Pressure Piping, for registered pressure piping system.
- .3 Welding to be carried out using approved procedures by welders certified for pressure piping by TSSA.
- .4 Arrange and pay for services of an Inspection Company specializing in making and interpreting x-rays of pipe welds. Examine a minimum of 10% of welds in piping carrying steam at 700 kPa (100 psi) or over using random selection procedure.
- .5 Only persons holding current welding certificates for the applications required for the Work to be permitted to do any welding. Perform all welding to Standards specified by Authorities. Do not weld to structural members of the building.

3.08 HANGERS

- .1 Hanger rods may be attached to beam or joist clamps, brackets, or concrete inserts. Explosive actuated tools are not permitted. Do not weld to structural steel unless accepted by the Consultant.
- .2 Install hangers to the following table.

STEEL PIPE	
Nominal Pipe Size	Distance Between Supports
Up to 32mm (1¼")	2,400mm (8 ft.)
40mm (1½") - 65mm (2½")	3,000mm (10 ft.)
75mm (3") and over	3,600mm (12 ft.)

COPPER TUBING	
Nominal Pipe Size	Distance Between Supports
Up to 20mm (¾")	1,800mm (6 ft.)
20mm (¾") - 25mm (1")	2,400mm (8 ft.)
32mm (1¼") - 50mm (2")	3,000mm (10 ft.)
65mm (2½") and over	3,600mm (12 ft.)

3.09 AIR VENTS

- .1 Provide air vents on water piping at all high points in the system and at each piece of equipment. Provide ball valves on automatic vents.
- .2 Provide automatic air vents on piping mains except where a possibility from water damage would occur, in which case, use manual vents.
- .3 Provide manual air vents at each piece of equipment.
- .4 For all vents, except for screw driver operated type at convectors and unitary heating equipment, provide 9mm (⅜") copper drains to nearest floor drain.

3.10 PROTECTION

- .1 Cover openings in equipment and cover equipment where damage may occur from weather. Cover temporary openings in ducts and pipes with polyethylene sheets, until final connection is made. Cover all items cast into concrete floors or walls such as floor drains and cleanouts prior to pour, with heavy plastic tape or duct tape.
- .2 Cover and seal, with polyethylene sheeting, all equipment, coils and motors in place during construction to prevent entry of dust, paint and debris.

3.11 RIGGING OF EQUIPMENT

- .1 Provide all rigging, hoisting and handling of equipment as necessary in order to place the equipment in the designated area in the building.
- .2 Direct this work by qualified personnel normally engaged in rigging, hoisting and handling of equipment.

3.12 CONCRETE

- .1 Except as specifically indicated on the Mechanical Drawings or where indicated on the Architectural or Structural Drawings as provided by other Sections, provide all concrete work required for mechanical work (bases, curbs, anchors, thrust blocks, manholes, catch basins) in accordance with requirements of Division 3. Provide reinforced concrete housekeeping pads (equipment bases) at least 100 mm (4") high under all floor mounted equipment. Provide 150 mm (6") high bases under equipment with cooling coils to provide sufficient clearance for deep seal condensate traps.
- .2 Provide in good time, all inserts, sump frames, anchors etc., required to be built into forming for mechanical services.

3.13 CUTTING AND PATCHING

- .1 Give timely notice concerning required openings. In work already finished the Contractor will perform all cutting and patching at the expense of Divisions 20, 21, 22, 23 and 25. Obtain the approval of the Consultant before doing any cutting.
- .2 Provide all cutting and patching for mechanical services penetrating walls, floors and roofs as shown on the Drawings. Cut only to suit dimensions required and for minimum clearances.
- .3 Seal around services passing through cut openings with materials commensurate with the fire rating of the wall, floor or roof. Ensure sealing is weatherproof for openings through exterior walls and roofs. Before sealing, provide prime coat of paint on all repaired surfaces.

3.14 FLASHING

- .1 Flash all mechanical parts passing through or built into an outside wall, roof or a waterproof floor.
- .2 Provide copper flashing for sleeves passing through exterior walls or water proof floors.
- .3 Provide counter flashing on stacks, ducts and pipes passing through roofs to fit over flashing or curb.

3.15 INSTALLATION OF ROOF MOUNTED EQUIPMENT

- .1 Flashing of equipment bases and curbed openings for ductwork or roof mounted fans and flashing of roof drains and plumbing vents is specified in Division 07. Equipment bases and curbs for openings to be supplied and set in place by Divisions 20, 21, 22, 23 and 25. Refer to the Detail Drawings.

3.16 INSERTS, SLEEVES AND ESCUTCHEONS

- .1 Provide all sleeves required for ductwork, piping and access openings unless they are specifically shown on Architectural and Structural Drawings.
- .2 Place inserts only in portion of the main structure and not in any finishing material.

- .3 Supply and locate all inserts, holes, anchor bolts and sleeves in time when walls, floors and roof are erected.
- .4 Provide the following for pipe sleeves:
 - .1 Through interior walls, exterior walls above grade, interior non waterproof floors: Machine cut schedule 40 steel pipe, medium cast iron or 18 gauge galvanized steel.
 - .2 Through walls below grade, waterproof floors, floors in janitor's closets, equipment rooms, and kitchens: machine cut medium cast iron, DWV copper or copper sheet extended 100mm (4") above the floor and cut flush with the underside.
- .5 Provide the following for ductwork:
 - .1 Where fire dampers are not required in poured walls; removable wood box out of required size. In block or brick walls; masonry to be built around ducting.
 - .2 Where fire dampers are required; 18 gauge galvanized steel or heavier sleeves complete with steel angle framing both sides installed in accordance with requirements of Authorities. See also detail drawings.
 - .3 Through Equipment Room floors, provide 100mm (4") high concrete curbs for ductwork and any piping so spaced that sleeving is impractical.
- .6 Seal all sleeves as follows:
 - .1 Through fire rated walls and floors and within mechanical assemblies (ducts): Stop insulation flush with all wall and floor surfaces and seal space between duct or pipe and sleeve with ULC approved and listed fire stopping material as manufactured by Double AD Distributors Ltd. (416) 292-2361 or M. W. McGill and Associates Ltd. "Fire Bloc" (416) 291-8393 or Dow RTV Silicon Foam or "Metacaulk" as distributed by EMCO Ltd. (416) 742-6220.
 - .2 Approved and listed products from 3M and Hilti Fire Stop are acceptable.
 - .3 Through all non-fire rated walls and floors stop insulation, where applicable, at wall and floor surfaces. Ram pack ULC labelled mineral wool materials around piping and ductwork. Apply an approved caulking compound over the ram packed material on both sides.
 - .4 Through foundation walls: Use either of the two following methods:
 - .1 Cooperate with the Waterproofing trade and apply an approved caulking compound over ram packed mineral wool on both sides. Over this, on both sides, apply a layer of glassfab tape embedded in two coats of an approved mastic compound.
 - .2 Provide Link-Seal Model S mechanical seal mechanism with stainless steel bolting, EPDM seal element and composite pressure plates as supplied by Power Plant Supply Company (905) 845-7951. Follow Manufacturer's instructions in all aspects of installation procedure.
 - .5 Cover sleeves and openings around exposed piping in all finished areas with chrome plated escutcheons. Cover exposed duct sleeves in finished areas with an 18 gauge galvanized steel collar fixed to wall or floor.

3.17 PAINTING

- .1 Provide all exposed ferrous metal work on equipment with at least one factory prime coat, or paint one prime coat on job. Clean up or wire brush all equipment before painting. Finish painting is specified in Division 09. This Division is not required to prime coat or paint ductwork or piping.
- .2 For factory applied finishes, repaint or refinish surfaces damaged during shipment, erection or construction work.

3.18 MECHANICAL WORK IDENTIFICATION

- .1 Identify new exposed piping and ductwork in locations as follows:
 - .1 At every end of every piping or duct run;
 - .2 Adjacent to each valve, strainer, damper and similar accessory;
 - .3 At each piece of connecting equipment;
 - .4 On both sides of every pipe and duct passing through a floor, wall or partition, unless otherwise specified;
 - .5 At 6 m (20') intervals on pipe and duct runs exceeding 6 m (20') in length;
 - .6 At least once in each room, and at least once on pipe and duct runs less than 6 m (20') in length.
- .2 Unless otherwise specified identify new concealed piping and ductwork in locations as follows:
 - .1 At points where pipes or ducts enter and leave rooms, shafts, pipe chases, furred spaces, and similar areas;
 - .2 At maximum 6 m (20') intervals on piping and ductwork above suspended accessible ceilings, and at least once in each room;
 - .3 At each access door location;
 - .4 At each piece of connected equipment, automatic valve, etc.
- .3 Provide an identification nameplate for equipment provided as part of this project, including items such as control valves, motorized dampers, instruments, and similar products. Secure nameplates in place, approximately at eye level if possible, with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces. Locate nameplates in the most conspicuous and readable location. Where equipment is locally switched (e.g. Room exhaust fans) provide identification plate at switch.
- .4 Paint new natural and/or propane gas piping with primer and 2 coats of yellow paint in accordance with local governing code requirements and requirements of Division 09. Identify piping at intervals as specified above.
- .5 Provide an identification nameplate for each motor starter or disconnect switch located in a motor control centre or on a motor starter panel, and on each individually mounted starter provided as part of mechanical work, and on each disconnect switch provided as part of the electrical work for motorized equipment provided as part of mechanical work.
- .6 Co-ordinate with Section 25 01 01 Building Automation System subcontractor and obtain list of automatically operated equipment and provide warning identification on lamacoid plate for each item as follows:

"Warning: This equipment may start at any time. Do not service without disconnecting power."
- .7 For electrically traced mechanical work, identification wording is to include "ELECTRICALLY TRACED".
- .8 Tag valves and prepare a valve tag chart in accordance with following requirements:
 - .1 Attach a valve tag to each new valve, except for valves located immediately at equipment they control;
 - .2 Prepare a computer printed valve tag chart to list tagged valves, with, for each valve, the tag number, location, valve size, piping service, and valve attitude (normally open or normally closed);
 - .3 If an existing valve tag chart is available at site, valve tag numbering is to be an extension of existing numbering and new valve tag chart is to incorporate existing chart;
 - .4 Frame and glaze one copy of chart and, unless otherwise directed, affix to a wall in each main Mechanical and/or Equipment Room;

- .5 Include a copy of valve tag chart in each copy of operating and maintenance instruction manuals;
- .6 Hand an identified USB of valve tag chart to Owner at same time O&M Manuals are submitted.
- .9 Where shut-off valves, control dampers, sensors, and similar items which will or may need maintenance and/or repair are located above accessible suspended ceilings, provide round coloured ceiling tacks in ceiling panel material, or stickers equal to Brady "Quick Dot" on ceiling grid material to indicate locations of items. Unless otherwise specified, ceiling tack or sticker colours are to be as follows:
 - .1 HVAC piping valves and equipment: Yellow
 - .2 Fire protection valves and equipment: Red
 - .3 Plumbing valves and equipment: Green
 - .4 HVAC ductwork dampers and equipment: Blue
 - .5 Control system hardware and equipment: Orange

3.19 EXPOSED WORK

- .1 Wherever any mechanical work (plumbing, heating and sprinkler piping, ductwork, and associated thermal insulation) is exposed in finished areas, co-ordinate the work with the Consultant prior to installation. If unsatisfactory installation results due to not following this procedure, perform remedial work to the Consultant's acceptance.
- .2 For purposes of the foregoing, finished areas do not include parking garages and equipment rooms.

3.20 PIPING SYSTEMS CLEANING

- .1 System Preparation for Chemical Treatment
 - .1 During construction:
 - .1 Ensure reasonable care is exercised to prevent debris, dirt and other foreign material from entering the pipe.
 - .2 This is to include proper protection of piping on site prior to installation, temporary caps on partial systems, and complete evacuation of moisture within systems being hydrostatically pressure tested.
 - .2 Review connections for complete draining and venting of the systems with Division 20, 21, 22 23 and 25 Subtrades.
 - .3 Upon initial filling, utilize water meter to record capacity within each system.
 - .4 Do not install instrumentation components such as flow meters, orifice plates, pitot tubes, turbine meters until system flush is complete and confirmed by water treatment specialists.
 - .5 Control Valves:
 - .1 Prior to flushing and cleaning remove all terminal unit control valves 25 mm or smaller.
 - .2 Coordinate with Divisions 20, 21, 22 23 and 25 Subtrades to provide temporary connections to ensure complete system circulation during cleaning.
 - .3 Reinstall the control valves when the system flush and cleaning is complete.
 - .4 Coordinate with Divisions 20, 21, 22 23 and 25 Subtrades to ensure that all control valves 25mm and larger and all other system valves are 100% open to ensure all pipes have flow.
 - .6 Bypass plate heat exchangers, boilers, chillers, etc. during flushing and chemical treatment procedure.
 - .7 Hydronic Terminal Units:
 - .1 Radiant panels, terminal box coils, unit heaters, heat pumps, radiation, force flows are not to be connected to heating piping during system flush.

- .2 Install temporary connection between supply and return branch lines and connect to heating system after flushing is completed.
- .8 Construction Screens and filters
 - .1 Install all filter cartridges, beginning with larger micron size filters. The first few filter changes may be required every few hours to remove any suspended solids not removed by the final flushing. Filters changes will become less frequent as filter inspections reveal clean filters. Repeat this process with smaller micron filters.
 - .2 Remove construction screens from pumps and any other equipment once this process is complete.
- .9 Strainers:
 - .1 Remove, inspect and replace strainers on all systems before initial fill.
 - .2 Provide temporary strainers on systems without permanent strainers. Remove, clean and replace strainers until no further fouling occurs.
- .2 General Procedures for Systems Cleaning and Inhibiting
 - .1 Perform cleaning and chemical treatment activities in a continuous process without interruption.
 - .2 Perform a complete water analysis of the domestic water source before cleaning and filling. Submit report to Consultant.
 - .3 Submit a detailed written procedural report to Consultant before system cleaning, outlining the following:
 - .1 System status and description.
 - .2 Cleaning procedures, flow rates, elapsed time.
 - .3 Chemical cleaners and concentrations.
 - .4 Inhibitors and concentrations.
 - .5 Specific requirements to complete work.
 - .6 Special precautions for protecting piping system materials and components.
 - .4 Pipe cleaning to be completed after hydrostatic test.
 - .5 Flush through all low point drains of the piping system.
 - .6 Low Points:
 - .1 Inspect, clean of sludge and flush all low points with clean water after cleaning and degreasing process is completed.
 - .2 Include disassembly of components as required.
 - .3 All cleaning and flushing of low points, coils and boilers shall be done prior to final fill and chemical treatment.
 - .7 Ensure flush velocity is adequate in all pipe mains and branches to ensure debris is removed.
 - .8 Where necessary, create a loop at the end of the system to ensure no dead legs.
 - .9 Circulation of Cleaning Solution:
 - .1 System pumps may be used for circulating cleaning solution provided velocities are adequate.
 - .2 If used for circulation, dismantle pump and inspect, replace worn parts, install new gaskets and seals. Turn over used seals.
- .3 Hydronic Systems Cleaning and Inhibiting Procedures
 - .1 Open high point vent(s).
 - .2 Fill systems completely with clean water from system low points; ensure air is completely vented from systems.
 - .3 Draw one sample of water from the filled piping and test it for colour, clarity, pH and conductivity.

- .4 Circulate the system for a minimum of four hours at full flow. Flush low point drains, etc., while circulating to help remove any debris that has been dislodged. Flush with constant circulation until the flush water conductivity, pH and turbidity are approximately equal to the fresh water source. If the water is unusually dirty, drain and refill.
- .5 Add chemicals for cleaning and recirculate for 1 hour.
- .6 Draw one sample of water and test to confirm addition of cleaning chemical product at appropriate concentration.
- .7 For closed loop systems, recirculate system cleaner at 60°C for a minimum 48 hours. Ensure that required temperature and velocity is maintained throughout. Frequently flush all low point drains, etc. while circulating to remove loosened debris.
- .8 Drain system as quickly as possible. Safely dispose of the cleaner solution. Prior to discharging into sanitary drain confirm that it is acceptable to do so with the Authorities having jurisdiction. If disposal by sanitary drain is not acceptable, provide alternative means of removal of chemically treated water from site, complying with the requirements of the Authorities having jurisdiction.
- .9 Flush the pipe with clean water until all the cleaner is out. Allow at least one day for flushing. Flush until the effluent is clear and flush water conductivity, pH and turbidity are equal to the fresh water source.
- .10 The inspection and cleaning of all strainers is recommended after flushing. A simultaneous flush and fill with system recirculation is best during the final stages of the flushing to ensure that all the air is removed and all the cleaner is out. This is best accomplished by draining from the low points and adding water at the makeup point while ensuring the required system pressure, so as not to cause recirculation pump cavitation, is maintained.
- .11 Provide final flush samples in 2 x 250 ml bottles to verify the cleaner is out. All samples should be dated and labelled as to system and location of sample. If the samples are coloured or foamy upon agitation, further flushing will be required. A written sign-off report will be provided to the Consultant.
- .12 Once cleaner is completely flushed from the system, corrosion inhibitor addition will take place. This must be done immediately following cleaning or the pipe will begin to rust and re-cleaning may be required.
- .13 Refill with water (fill from low points, vent from high points) and add inhibitors.
- .14 Circulate for 24 hours.
- .15 Test concentrations and adjust to recommended levels defined in procedural report.
- .16 Test glycol systems to prove concentration will resist freezing at intended freeze protection temperature.
- .17 Test inhibitor strength and record in procedural report.
- .4 Steam and Condensate System Cleaning and Inhibiting Procedure
 - .1 Isolate steam boiler(s) from piping system.
 - .2 Fill boiler to normal operating level.
 - .3 Add cleaner.
 - .4 Fire to 50% of design operating pressure.
 - .5 Blowdown boiler every 4 h including water columns, controls, skimmer lines and valves, test cocks and blowdown valves.
 - .6 Add water to return to operating level.
 - .7 Maintain procedure for 24 h.
 - .8 Allow boiler to cool, then drain, flush and inspect.
 - .9 Refill with clean softened water and immediately add chemical inhibitors.
 - .10 Condensate Dump:
 - .1 Dump condensate from steam system to sewer for a period of 96 h after initial operation.
 - .2 During this period, the boilers must be chemically treated with the inhibitors to assure complete removal of oils, grease and millscale from the steam/condensate system.

- .3 Provide cooling water lines, if necessary.
- .11 Open steam header to operating pressure and start continuous feed of an Octadecylamine (ODA) based filming amine blended with morpholine and or diethylaminoethanol based neutralizing amine, such as GE Water's Steamate NF4630 at 20 ppm to achieve a condensate pH of 7.5 to 8.0 for a period of not less than 48 hours. All condensate shall be discharged to drain.
- .12 Collect condensate samples every twelve hours and retain for inspection by a qualified water treatment specialist.
- .13 After 48 hours:
 - .1 In addition to the feed of Steamate NF4630, begin continuously feeding additional neutralizing amine blend of cyclohexylamine, morpholine and diethylaminoethanol, such as GE Water's Steamate NA5640 to achieve a pH of 8.3 to 9.0.
 - .2 Both products can be batched and fed together.
 - .3 pH measurements shall be supplemented with phenolphthalein ("P") alkalinity testing. The "P" alkalinity shall be maintained between 2 and 10 ppm in the condensate.
- .14 Continue feeding the chemicals for another 48 to 96 hours.
- .15 Continue to collect condensate samples every 12 hours and retain for inspection by a qualified water treatment specialist. All condensate shall continue to be dumped to drain.
- .16 Testing:
 - .1 After minimum 7 days of steam and condensate purging, the condensate shall be tested for residual oil, hardness and iron.
 - .2 Approval shall be dependent on no detectable oil, not detectable calcium or magnesium hardness and suspended iron in the condensate of less than 100 ppb using a standard Babcock and Wilcox Millipore suspended iron test.
 - .3 Discontinue feed of filming amine blend (Steamate NF4630), but continue feeding neutralizing amine (Steamate NA5640) to maintain the 2-10 ppm "P" alkalinity the condensate.
- .5 Domestic Hot, Cold and Recirculating Water System
 - .1 Flushing:
 - .1 Before disinfecting, flush all foreign matter from the pipeline.
 - .2 Provide hoses, pumps, temporary pipes, ditches, etc., as required to dispose of flushing water without causing damage to adjacent properties.
 - .3 The flushing velocities shall be at least 1 m/s, for a period of 10 minutes.
 - .4 Open and close valves, hydrants, and services connections to ensure thorough flushing.
 - .5 For large diameter pipe, where it is impractical or impossible to flush the pipe at 1 m/s velocity, the pipeline shall be cleaned in place from the inside by brushing and sweeping, then flushing the line at a lower velocity.
 - .2 Disinfection:
 - .1 Pipes intended to carry potable water shall be disinfected before being placed in service.
 - .2 Disinfection procedures shall conform to AWWA C651 as hereinafter modified or expanded, and the requirements of any governing agency having jurisdiction.
 - .3 Ensure that the disinfection solution is distributed throughout the entire domestic water system.
 - .3 Disinfection Mixture:
 - .1 The mechanical contractor shall prepare the disinfection mixture with a chlorine-water solution having a free chlorine residual of 40 - 50 PPM.
 - .2 The disinfection mixture shall be prepared by injecting calcium or sodium hypochlorite and water into the piping and allowing it to flow at a measured rate so that water-chlorine solution is of the specified strength.

- .3 If the calcium hypochlorite procedure is used, first mix the dry powder with water to make a thick paste, then thin to approximately a one percent solution (10,000 PPM Chlorine).
- .4 If the sodium hypochlorite procedure is used, dilute the liquid with water to obtain a one percent solution.
- .4 Point of Application:
 - .1 The chlorine mixture shall be injected into the piping to be treated at the beginning of the line, and through a corporation stop or suitable tap in the top of the line.
 - .2 Water from the existing system or other approved sources shall be controlled so as to flow slowly into the newly installed pipe during the application of chlorine.
 - .3 The rate of chlorine mixture flow shall be in such proportion to the rate of water entering the pipe that the combined mixture shall contain 40-50 PPM of free available chlorine.
 - .4 Valves shall be manipulated so that the strong chlorine solution in the line being treated will not flow back into the line supplying the water.
 - .5 Check valves shall be used if deemed necessary.
 - .6 The chemical treatment representative shall analyze and record the free chlorine residual at the farthest fixtures from the injection point.
- .5 All valves, fixtures and other appurtenances shall be operated during disinfection to ensure that the disinfection mixture is dispersed into all parts of the line, including dead ends, new services and similar areas that otherwise may not receive the treated water.
- .6 Retention Period:
 - .1 Treated water shall be retained in the pipeline long enough to destroy all nonspore-forming bacteria.
 - .2 With proper flushing and the specified solution strength, 24 hours is adequate.
 - .3 At the end of the 24-hour period, the disinfection mixture shall have a strength of at least 25 PPM of chlorine.
 - .4 The chemical treatment representative shall analyze and record the free chlorine residual at the farthest fixtures from the injection point.
- .7 The above procedure shall be repeated at the mechanical contractor's expense if the free chlorine level drops below the minimum requirements.
- .8 Arrange and pay for water quality tests to be performed by an independent testing laboratory acceptable to the Consultant as follows:
 - .1 Test for chlorine residuals at extreme ends of all piping systems. After a chlorine residual of not less than 50 ppm has been achieved in all parts of the system, let the system stand for 24 hours. After this period, take further samples to ensure that there is still not less than 10 ppm of chlorine residual throughout the system.
 - .2 When chlorine residuals of 10 ppm have been maintained for a minimum of 24 hours, flush the system and refill to put the system into service.
 - .3 Submit copy of report as prepared by the testing laboratory as well as a certificate attesting to level of safety of water supply being in conformance with standards of Authority having jurisdiction.
- .9 After chlorination, the water from the line shall be flushed until it meets health department requirements.
- .10 Disposal of Disinfection Water:
 - .1 Disposal of disinfecting water shall be done in an approved manner.
 - .2 Disinfecting water should not be allowed to flow into a waterway without adequate dilution or other satisfactory method of reducing chlorine concentrations to a safe level.
- .6 When new systems are to be connected to existing systems
 - .1 Take samples of water in existing piping and submit to Chemical Treatment Subcontractor for water quality testing.

- .2 Should the water quality in the existing piping not be sufficient, include the existing piping in the above flushing and cleaning scope.
- .3 If flushing scope & cleaning is restricted to new piping only:
 - .1 Provide isolation valves as required to fully isolate new piping from existing piping during cleaning and flushing procedure.
 - .2 Create additional loops at the end of the system, as necessary to ensure no dead legs and that flushing only takes place in new piping.
 - .3 Complete one final water quality test for new piping prior to opening up to existing system.

3.21 PIPING SYSTEM TESTS

- .1 Do not insulate piping systems until completed, perfected, and proven tight.
- .2 Should leaks develop in any part of the piping system, remove and replace defective sections, fittings and equipment.
- .3 Test piping system in sections as required by the progress of work.
- .4 Test all heating and chilled water and dual temperature piping hydraulically to a minimum pressure of 1100 kPa (150 psi) or 1.5 times the normal working pressure, whichever is the greater, and prove tight for a period of 8 hours. Testing with nitrogen is also acceptable provided a pressure of 1.25 times values specified previously is used. Test natural gas piping as required by codes and authorities.
- .5 All plumbing, heating and cooling mains and branches are to be flushed and cleaned without fixtures and appliances connected.
- .6 All tests must be recorded. Submit recorded data to the Consultant.

3.22 AIR AND WATER BALANCING AND TESTING

- .1 Costs to perform air and water balancing **to** be included in the Tender for the Work of Divisions 20, 21, 22, 23 and 25.
- .2 Provide the services of an independent firm specializing in air and water balancing, acceptable to the Consultant, to undertake this work as follows:
 - .1 Provide personnel to review the Drawings and Specifications, make site visits, prepare reports and take responsibility for measuring and adjusting all air supply, exhaust, return and transfer systems and water and other fluid pumping systems operate in accordance with specified requirements with tolerance of plus or minus five percent (5%).
 - .2 Review and check working drawings to ensure that modifications, if required, are implemented prior to execution of work.
 - .3 Provide inspections during the course of construction and issue reports making whatever recommendations are necessary in the interests of achieving specified performance.
 - .4 When the work is adequately completed, inspect, check and test all systems and equipment. Cooperate with the controls systems subcontractor to achieve required flow rates where modulating dampers, valves etc., are installed.
 - .5 Prepare and submit testing and balancing reports to the Consultant for review. All reports shall include instrument calibration certificates, a report summary and remarks section explaining the rationale for how the system was configured for testing, and a listing of any deficiencies.
 - .6 Provide assistance to the Consultant for on-site spot verification of the testing and balancing report.
- .3 Air Balancing

- .1 Perform air balancing in accordance with current NBCTA, NEBB or AACB procedural standards by adjusting fan speed. Use damper throttling only in systems where fan motor is less than 1 HP or where throttling results in no greater than one additional fan HP over a reduced RPM condition.
 - .2 Where ductwork is subject to static pressure in excess of 75mm (3 in.) WC, leak test 25% minimum of total installed duct area of all representative sections of the total system. All testing to conform to requirements of HVAC Duct Leakage Test Manual, 1985, Sections 5 and 6 and tested duct leakage class at a test pressure equal to the design duct pressure class rating to be equal to or less than leakage Class 6 as defined in 4.1 of Ref. 35.
 - .3 Where ductwork is subject to static pressure below 75mm (3 in.) WC, leak test all mains and major branches. All testing to conform to requirements of HVAC Duct Leakage Test Manual, 1985, Sections 5 and 6 and tested duct leakage class at a test pressure equal to the design duct pressure class rating to be equal to or less than leakage Class 6 as defined in 4.1 of Ref. 35.
 - .4 Provide Dial 1000 or Dial 2000 or acceptable alternative, duct pilot tube test opening enclosures for installation by the Section 23 31 13 Subtrade. Provide all required test opening locations and installation instructions to the Section 23 31 13 Subtrade.
 - .5 After inspection and tests, report all required replacement of sheaves and belts and all required adjustments and ductwork modifications to achieve system performance as specified.
 - .6 After deficient items have been rectified, retest and issue a final report and certificate covering the following:
 - .1 Specified and achieved total air quantities per system supported by curves for all fans over 150 l/s (300 cfm) capacity.
 - .2 Specified and achieved individual air quantities per outlet with supporting schematic diagrams showing test points. On variable air volume distribution systems adjust each VAV terminal for specified minimum and maximum flows. Balancing downstream from the VAV terminals is also required as part of the Work.
 - .3 Specified and achieved air pressure differential across all pressurized stair shaft doors, and the door force required to open each door in accordance with MMAH Supplementary Standard SB-4
 - .4 Nameplate and actual motor loading in amperes at actual voltage and installed overload heater size and manufacturer.
 - .5 Specified and actual fan total static pressures with breakdown showing inlet and discharge pressures with data shown on fan curves.
 - .6 Sheave and belt sizes and quantities per unit.
 - .7 Provide personnel, tools and materials to assist and work under the direction of the air balancing firm to perform the following:
 - .1 Removal and replacement of ceiling tiles.
 - .2 Installation of Pitot tube test opening enclosures.
 - .3 Installation of dampers and baffles as required for specified air balance and elimination of stratification.
 - .4 Provision of access openings and covers.
 - .5 Provision of ladders and scaffolds
 - .6 Removal and replacement of belt guards.
 - .7 Removal and replacement and provision of required sheaves and belts as directed, and other items as necessary for complete and acceptable air balancing procedures.
- .4 Water Balancing

- .1 Perform hydronic system balancing by minor throttling for pumps that are less than 7.45 kW (10 HP) provided this results in a power draw of no greater than 10% of that required if the impeller were trimmed. For pumps greater than 7.45 kW (10 HP), the same limit applies but in no case is it to exceed 2.23 kW (3 HP). In either case where these limits are exceeded by throttling, the impeller is to be trimmed or replaced.
 - .2 Make adjustments to achieve specified [temperature drops across all finned radiation sections and] flows through [chillers and coils]. Also report all pump data such as suction, and discharge pressure, current draw at tested voltage and starter OL heater sizes and pump motor nameplate ratings.
 - .3 Provide pump curves indicating the operating point with superimposed power draw, RPM, impeller size, etc.
 - .4 Instruct piping system installers on proper locations of flow measurement ports.
 - .5 Report any required pump impeller adjustments to achieve specified performance.
 - .6 After adjustments, retest systems and issue final report confirming systems are operating in compliance with design.
 - .7 Provide flow measurement ports as shown on detail drawings and piping schematics in locations as directed by the water balancing specialist. Provide balancing valves where required as directed by the water balancing specialist.
 - .8 Provide any pump impeller modifications as recommended by the water balancing firm.
- .5 Acceptable Air and Water Balancing Contractors:
- .1 Aerodynamics Inspecting Consultants Ltd.
 - .2 Dasstab Inc.
 - .3 Designtest & Balancing Co. Ltd.
 - .4 Dynamic Flow Balancing Ltd.
 - .5 VPG Associates Ltd.

END OF SECTION 20 05 10

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PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.
- .2 Comply with requirements of Section 20 05 05 Mechanical Work General Instructions and Section 20 05 10 Basic Mechanical Materials and Methods.

1.02 WORK PERFORMED BY THIS SECTION

- .1 Provide all vibration isolation and control equipment, properly selected to provide noise and vibration control for all motor driven equipment.

1.03 QUALITY ASSURANCE

- .1 Execute work of this section in accordance with the manufacturer's instructions by workman only experienced in the installation of vibration isolation systems and equipment.
- .2 Ensure isolators and restraining devices factory supplied with equipment meet the requirements of this Section.
- .3 Engage the vibration isolation equipment manufacturer to provide inspection and supervision services during construction to ensure all equipment is installed as required to achieve effective vibration isolation and noise control.
- .4 Finishes are to be ULC labelled and listed for flame spread rating of less than 25 and smoke development classification of less than 50.
- .5 Types of isolators, types of equipment bases, and applications for various types of equipment specified herein are based on ASHRAE Handbook HVAC Applications.
- .6 Coordinate with vibration isolation manufacturer and structural engineer of record to locate and size structural supports underneath vibration isolated equipment (e.g. roof curbs, cooling towers, chillers and other similar equipment).
- .7 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Division 01 to suit Health and Safety Requirements.

1.04 SUBMITTALS

- .1 Submit shop drawings on all product/equipment specified in this Section. Include detailed dimension drawings, construction, performance and finishes in accordance with Section 20 01 05 – Shop Drawings, Product Data & Samples.
 - .1 Vibration Isolation Bases: Dimensional drawings including anchorage and attachments to structure and to supported equipment, if needed or required. Include auxiliary motor slides and rails, base weights, equipment static loads.
 - .2 Vibration Restraint Details: Detailed submittal drawings of vibration restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors. Include ratings for loads.

- .3 Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
- .2 Provide certified test data or calculations as prepared by a registered Professional Engineer attesting to conformance with the requirements of this section.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.06 WARRANTY

- .1 Provide warranties as outlined in Section 20 05 05 - Mechanical Work General Instructions.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATION – GENERAL

- .1 All springs are to have a minimum additional travel to solid equal to 50% of the rated deflection. All springs, except internal nested springs, are to have an outside diameter not less than 0.8 of the compressed height of the spring. Ends of springs are to be square and ground for stability. Laterally stable springs are to have k_x/k_y ratios of at least 0.9. Spring elements are to be colour-coded.
- .2 Steel equipment bases are to be of welded construction with cross members to form an integral support platform. Design structural steel members to match supported equipment. Minimum clearance under steel equipment bases is 25 mm (1").
- .3 Concrete inertia bases are to be of welded steel construction with concrete in-fill supplied by the installing contractor on site, incorporate reinforcing bars, spaced 300 mm (12") maximum on centres each way, be a minimum of 150 mm (6") thick, and of sufficient weight to lower the center of gravity to or below the isolator support plane.
- .4 Ensure isolation systems have a natural frequency no higher than 10% to 15% of the lowest forcing frequency unless otherwise specified.
- .5 Provide weatherproof coating on springs and housings for all isolation equipment exposed to outdoors.
- .6 Isolators and seismic restraints to meet the requirements of the current Ontario Building Code. Use horizontal force factor SP-10 for mechanical equipment, and SP-15 for equipment containing toxic or explosive materials including steam (these requirements generally mean 0.8 g and 1.4 g respectively for maximum impact loads transmitted to the structure).
- .7 Provide seismic restraining devices for resiliently mounted equipment.
- .8 Acceptable manufacturers are: Vibro-Acoustics, Kinetics Noise Control, Mason Industries.

2.02 VIBRATION ISOLATORS – TYPES

- .1 Provide all vibration isolation equipment as manufactured by one approved supplier.
- .2 Provide isolators as follows:
 - .1 Type 1 - Pad Isolators:

- .1 Neoprene steel neoprene (NSN) pad isolators, 20 mm (¾") nominal thickness, selected for 3.2 mm (1/8") static deflection unless otherwise specified, consisting of 2 waffle type or ribbed 50 durometer neoprene pads permanently bonded to a minimum #10 gauge steel plate, and complete with rubber bushed bolt holes and equipment anchor bolts with neoprene isolation grommets.
- .2 Type 2 - Rubber Floor Isolators or Hangers:
 - .1 Rubber Floor Isolators: Captive, bridge bearing quality neoprene mount selected for a minimum 4 mm (0.15") static deflection unless otherwise specified, with an integral ductile iron housing and integral equipment anchor bolt.
 - .2 Neoprene Hanger Isolators: Neoprene double deflection rod isolators with steel housing and hanger rod bushing, selected for a minimum 4 mm (0.15") static deflection unless otherwise specified.
- .3 Type 3 - Spring Floor Isolators or Hangers:
 - .1 Open Spring Mounts: Base mount free-standing assemblies, each complete with a stable steel spring welded in place, drilled mild steel mounting plate bonded to a ribbed rubber or neoprene acoustical pad, and an external 16 mm (5/8") diameter level adjustment bolt.
 - .2 Closed Spring Mounts: Base mount free-standing enclosed assemblies, each complete with stable spring(s), 2-piece cast housing, non-binding rubber horizontal stabilizers, a ribbed rubber or neoprene acoustical pad bonded to base of the closed housing, and an external level adjustment bolt.
 - .3 Spring Hangers: Welded steel plate housing with top and bottom rod mounting holes and spring retainer, neoprene double deflection isolation element, stable colour coded spring, and heavy-duty rubber washers.
- .4 Type 4 - Restrained Spring Isolators:
 - .1 Restrained Spring Isolator: Base mount free-standing enclosed and retained assemblies to limit both vertical and lateral movement of mounted equipment, each complete with stable spring(s), drilled welded steel housing and top plate, ribbed rubber or neoprene acoustical pad bonded to bottom of housing, vertical limit adjusting hardware, and a level adjustment bolt.
- .5 Type 5 - Thrust Restraints:
 - .1 High deflection, large diameter, laterally stable steel coil springs assembled into a threaded rod and angle bracket assembly complete with moulded neoprene end load plate assemblies for light capacities or stamped steel end cups for heavier capacities, threaded adjustment rod with zinc-plated hardware, polyester powder coated lateral spring stiffness greater than 1.0 times the rated vertical stiffness with a minimum of 50% overload deflection, and safe when temporarily loaded to solid capacity.

2.03 EQUIPMENT BASES – TYPES

- .1 Type A – No base, isolators attached directly to equipment:
 - .1 Direct Isolation: Used when equipment is unitary and rigid and does not require additional support.
- .2 Type B – Structural Steel Rails or Bases:
 - .1 Steel Equipment Base: Fully welded structural steel equipment and motor support bases, each complete with a wide flange steel frame, full depth cross members, brackets for spring mounts, and adjustable motor slide rails.
- .3 Type C – Concrete Inertia Base:

- .1 Concrete Inertia Type Base: Welded steel bases, each complete with a structural black steel channel frame, concrete reinforcing rods, and brackets for spring mounts welded to frame.
- .2 Combination Steel/Concrete Inertia Base: Welded steel bases with a structural black steel channel frame, concrete reinforcing rods, bottom sheet steel pan, brackets for spring mounts welded to frame and adjustable motor slide rails.
- .4 Type D – Curb-Mounted Base:
 - .1 Continuous Rail Type for Roof Mounted Equipment: Continuous rooftop isolation shipped completely assembled, consisting of:
 - .1 galvanized steel sections formed to fit roof curb and associated equipment with a flexible air and weather seal joining upper and lower rail sections;
 - .2 stable springs, cadmium plated and selected to provide minimum deflection with 50% additional travel to solid;
 - .3 neoprene cushioned and wind restraints allowing 6 mm (¼") movement before engaging and resisting wind loads in any lateral direction.

2.04 GENERAL VIBRATION ISOLATION SCHEDULES

- .1 Provide vibration isolation in accordance with the following schedule:

Equipment	Base Type	Isolator Type	Equipment Installation	Static Deflection, mm (in.)	Notes
Vertical Inline Pumps	A	1	Floor Mounted	2.5 (0.1)	4
	N/A	3	Ceiling Suspended	25 (1)	
ERVs	A	3	Ceiling Suspended	25 (1)	
Heat Exchangers	A	1	Floor Mounted	2.5 (0.1)	
1. Contractor to provide structural base if equipment is not suitable for direct isolation. 2. Unit to be provided with internal isolation. 3. Wind load calculations/restraints must be included for equipment located outdoors. 4. Provide inline pump suspension bracket if equipment is suspended.					

- .2 Table above is for general reference only. Successful vibration isolation manufacturer is to review all equipment shop drawings and structural drawings in order to provide properly selected bases and isolators.

2.05 SPHERICAL TYPE FLEXIBLE CONNECTORS / EXPANSION JOINTS

- .1 Double sphere or "twin sphere" complete with peroxide cured EPDM throughout with either Kevlar or Nylon tire cord, a ductile iron external ring between the two spheres, and either ductile iron or steel flanges. Provide control rods where required.
- .2 Ensure materials are suitable for connecting piping and for service temperature and pressure.
- .3 Acceptable manufacturers are: Mason Ind., Kinetics Noise Control, Vibro-Acoustics.

2.06 BRAIDED FLEXIBLE CONNECTORS

- .1 Double wall, braided stainless steel flexible connectors for piping connections to vibration isolated equipment, each selected by manufacturer to suit the application. Shop drawings or product data sheets must indicate construction and performance requirements that suit the application.

- .2 Acceptable manufacturers are: Mason Ind., Kinetics Noise Control, Vibro-Acoustics.

PART 3 - EXECUTION

3.01 INSTALLATION OF VIBRATION ISOLATION

- .1 Obtain all relevant equipment information and provide shop and installation drawings for all vibration isolation elements and steel bases. Include details of attachment to both the equipment and the structure to meet the specified forces involved. Do not perform any work or order any materials or equipment prior to review of shop and installation drawings by the Consultant.
- .2 Refer to details on mechanical drawings for additional information.
- .3 For all equipment mounted on vibration isolators, provide a minimum clearance of 50 mm (2") to other structures, piping, equipment, etc.
- .4 Do not install any rigid connections between equipment and building structure that degrades the noise and vibration isolation system herein specified. Electrical conduit connections to isolated equipment are to be looped to allow free motion of isolated equipment. Coordinate with Electrical Contractor as required.
- .5 Ensure pipe, duct and electrical connections to isolated equipment do not reduce system flexibility. Ensure that pipe, conduit and duct passing through walls and floors do not transmit vibrations.
- .6 Space isolators under equipment so that the minimum distance between adjacent corner isolators is at least equal to the height of the centre of gravity of the equipment or specifically designed for increased forces on the supports. If improved supports are proposed, include design calculations with shop drawings, for approval.
- .7 Unless noted otherwise, provide flexible connectors for chillers, cooling towers and all pumps with motors higher than 3.7 kW (5 HP). Provide braided type for domestic water applications and for equipment located outdoors. Provide spherical type for all other equipment located indoors.
- .8 Isolate all floor or pier mounted equipment on Type 3 or Type 4 isolators unless otherwise specified.
- .9 Use the lowest RPM scheduled for 2-speed equipment.
- .10 Under equipment mounted on Type 3 mounts, provide neoprene/steel/neoprene (Type 1) pads, adjacent to the springs selected for the manufacturer's optimum loading, and shimmed to be just clear of the base of the equipment under operating conditions. Bolt these pads to the floor slab, maintaining the top of the bolt below the top of the pads. These pads are to minimizing rocking of the equipment in the event of an earthquake and can be deleted if other provision is designed into the isolator to control rocking.
- .11 For equipment mounted on slab on grade including chillers and pumps, mount on Type 1 neoprene/steel/neoprene sandwich pads unless otherwise specified.
- .12 Use Type 3 spring hangers for a minimum static deflection of 25 mm (1") for all ceiling hung fans, air handling units and emergency generator exhaust silencers.
- .13 Provide Type 3 resilient hangers on all piping connected to a vibrating source if the piping is supported from walls or ceiling slabs adjoining occupied spaces, and if the piping is in excess of 40 mm (1-½") diameter. Provide the hangers for a distance of 4 m (13 ft.) plus 0.03 X (pipe diameter mm) from the vibrating source - e.g. for 250 mm (10") pipe, required distance is 4 m (13 ft.) plus 0.03 X 250 = 11.5 m (37.7 ft.). Use Type 1 pads under pipe pedestals on slab on grade. Bolt down equipment mounted on neoprene pad isolators using neoprene grommets.

- .14 To limit noise transmission to the structure, generator(s) should be mounted on spring isolators with neoprene pads in series and all exhaust piping up to and including the mufflers resiliently suspended using spring isolators with fibreglass or felt in series.
- .15 Vertical in-line pumps shall be supported by spring hangers having a static deflection of at least 32 mm (1-¼") plus an additional neoprene mount in the isolator. In addition, these pumps shall include a Mason twin-sphere (or equivalent) expansion joint to reduce pipe and fluid-borne noise transmission near both the suction and discharge of these pumps. These flexible connectors should be located just beyond the first isolation hanger outside the pump drop-down piping. All condenser or chilled water piping penetrating walls on the mechanical level shall be clear at penetrations. Any penetrations that need to be fire-rated shall be sealed using an approved flexible fire-stopping system.
- .16 Cooling towers and/ or closed circuit fluid coolers are to be mounted on concrete piers extending above 1 m (3 ft.) above the slab and should be isolated from these piers using springs plus neoprene pads in series. Individual spring mounts with a minimum static deflection of 50 mm (2") plus double-layer ribbed or waffled neoprene pads below are preferred. If a manufacturer-supplied spring isolation rail is used in lieu of individual springs, double-layer rubber pads should be used between the I-beam that supports the rail and the top of each pier. Shop drawings for all noise and vibration control equipment shall be submitted for review and approval prior to installation.
- .17 All boilers, including hot water boilers, are to be supported on 25 mm (1") thick neoprene-steel-neoprene pads, properly selected for the weight involved. All in-line heating pumps and associated piping are to be isolated using spring and neoprene isolation hangers having at least 25 mm (1") of static deflection. This applies to all heating pipes over 50 mm (2") in diameter on the mechanical level. Pipes 50 mm (2") or smaller shall be isolated where clamped to shear walls using rubber or Armaflex sleeves.
- .18 Provide vibration isolation on all motor driven equipment with electric motors of 0.37 KW (0.5 H.P.) and greater power output and on piping and ductwork as specified herein. For equipment less than 0.37 KW, provide neoprene grommets at the support points.
- .19 Provide horizontal limit springs or snubbers on all spring isolated fans (except vertical discharge) in excess of 1 kPa (4" water gauge) static pressure, and on hanger supported horizontally mounted axial fans.
- .20 Provide, for equipment as designated in the Equipment Schedules and/or shown on the Drawings, concrete inertia bases or structural steel frames located between all vibrating equipment and vibration isolation elements. Structural steel frames will not be required if the equipment manufacturer certifies direct attachment capabilities. Provide inertia bases on centrifugal fans with static pressure in excess of 876 Pa (3.5") and/or motor in excess of 30 KW (40 HP) and on base mounted pumps over 8 KW (10 HP).
- .21 On fans, as designated in the Equipment Schedules and/or on the Drawings, provide stabilizing springs to eliminate movement at flexible connections to 25% of fabric width under steady state conditions and 40% at start up. Flexible duct connectors between all isolated fans and non-isolated ductwork are specified in Section 23 33 00 Air Duct Accessories.
- .22 Refer to Section 20 05 10 for the provision of housekeeping pads.

3.02 VIBRATION ISOLATION INSPECTION

- .1 Engage the services of the local representative of the vibration isolation materials manufacturer to conduct periodic inspections of the installation of materials herein specified, and report in writing to the Contractor of any deviations from good installation practice observed.

- .2 On completion of installation of all noise and vibration isolation devices herein specified, the local representative of the isolation materials manufacturer is to inspect the completed system and report in writing any installation errors, improperly selected isolation devices, or other fault in the system that could affect the performance of the system. Supplier shall provide conformance

3.03 CLEANING

- .1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 20 05 20

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PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.
- .2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

1.02 WORK PERFORMED BY THIS SECTION

- .1 Supply and installation of piping, ductwork, and equipment insulation.

1.03 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - means "not concealed" as previously defined.
 - .3 Insulation systems - insulation material, fasteners, jackets and other accessories.

1.04 QUALITY ASSURANCE

- .1 Qualifications: Execute work of this section only by skilled tradesmen regularly employed in the application of insulation to piping, ductwork, plenums, tanks, pressure vessels, equipment casings and heating panels for building heating, cooling, ventilating and plumbing systems.
- .2 Insulation, self-adhesive tape, adhesives and any insulation finishes to be ULC labelled and listed for flame spread rating of less than 25 and smoke development classification of less than 50.
- .3 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Division 01, Health and Safety Requirements.
- .4 Acceptable Manufacturers:
 - .1 Insulation: Fiberglas Canada Inc., Knauf Fiber Glass, Manson, Roxul.
 - .2 Preformed flexible elastomeric insulation: ARMACELL – AP Armaflex SS Pipe Insulation, Johns Manville, Rubatex.
 - .3 Tape: Avery Dennison, Mactac, Tuck, Compac.
 - .4 Canvas: Fattal Thermocanvas, Alpa-Maritex 3451-RW, Clairmont Diplag 60.
 - .5 Lagging adhesive: Childers CP.50A-HV2, Fosters 30-36 asbestos free.

1.05 SUBMITTALS

- .1 Submit manufacturer's printed product literature and datasheets for insulation adhesives, coatings and finishes, include product characteristics, performance criteria, physical size, finish and limitations in accordance with Section 20 05 01 – Shop Drawings, Product Data & Samples.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.07 WARRANTY

- .1 Provide warranties as outlined in Section 20 05 05 - Mechanical Work General Instructions.

PART 2 - PRODUCTS

2.01 INSULATION

- .1 Preformed: ULC Listed sectional glass fibre pipe insulation in compliance with ASTM C335 in sections 900 mm (36") long, split and ready for application with a maximum Thermal Conductivity of 0.033 W/m°C at 24°C mean temperature and be capable of use on service from -40°C to 260°C and with factory applied vapour seal jacket of vinyl coated foil Kraft laminate with reinforcing of open mesh glass fibre.
- .2 Preformed Foam: ULC Listed sectional DOW Trymer 2000 XP Polyisocyanurate Foam pipe insulation in compliance with ASTM C335 in sections 900 mm (36") long, split and ready for application with a density of 32.8 kg/m³ (2.05 lb/ft³) according to ASTM D1622, R-value of 0.93 m² °C/W at 24°C mean temperature, water absorption of not more than 0.7% by volume according to ASTM C272, be capable of use on service from -183°C to 149°C and with factory applied vapour seal jacket.
- .3 Rigid board: 72 kg/m³ (4.5 lbs/ft³) density ULC listed glass fibre board with glass fibre reinforced aluminium foil vapour seal facing and maximum thermal conductivity of 0.035 W/m°C at 24°C mean temperature.
- .4 Blanket: 24 kg/m³ (1.5 lbs/ft³) ULC listed flexible glass fibre blanket with glass fibre reinforced aluminium foil vapour seal facing with thermal conductivity of 0.036 W/m°C.
- .5 High temperature (over 200°C): Preformed calcium silicate or Roxul 1200 mineral fibre piping insulation.
- .6 Low temperature: 20 mm fire retardant closed cell Armaflex in sheet form or preformed for piping.
- .7 Preformed flexible elastomeric closed cell insulation for installation on cold and dual temperature (hot and cold) system piping, valves and fittings: to ASTM C534. Thermal performance: 0.04 W/m/°C @ 24°C (0.28 btu/hr/in/sq ft/°F @ 75°F) established in accordance with ASTM C 177 or ASTM C 518 and CAN2-51.40-M80+Amendments. service temperature: -40°F to 203°F (-40°C to 95°C), tubular with self-sealing seams, noncombustible meeting 25/50 flame spread/smoke developed when tested to ASTM E84, a water vapour transmission rating of 0.08 in accordance with ASTM E96-90, Procedure A. Provide manufacturer specific sealer/adhesive.

2.02 FINISHES AND PROTECTIVE COVERINGS

- .1 Canvas: 170 g/m² with lagging adhesive, ULC labelled.
- .2 Protective covering (aluminium): .020 Childers corrugated aluminium preformed covering complete with strapping and seals.
- .3 For pipework, ductwork or equipment exposed to the elements, provide and external PVC jacket to the insulation which is to be a white UV resistant PVC jacket. Extra thick material is to be used on outdoor installations only. Normal thickness for indoor installation. 25/50 flame and smoke rated grade PVC shall be used.
 - .1 Finish is to be high gloss white.
 - .2 Minimum thickness to be 10mm
 - .3 Must be resistant to fungi and bacterial growth and comply with ASTM G 21 & G22.

- .4 PVC must be in compliance with ASTM 1784 & CAN/CGSB 51.53.95.
- .5 When installing PVC jacket, jacket must overlap a minimum of 50mm
- .4 Polyvinyl Chloride (PVC) (For use inside mechanical room only):
 - .1 ULC labelled One piece moulded type to CAN/CGSB 51.53 with pre formed shapes as required.
 - .2 Colours: [to match adjacent finish paint.
 - .3 Minimum service temperatures: 20°C.
 - .4 Maximum service temperature: 65°C.
 - .5 Moisture vapour transmission: 0.02 perm.
 - .6 Thickness: 6 mil.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks.
 - .3 Pressure sensitive vinyl tape of matching colour.
 - .8 Special Requirements:
 - .1 Outdoor: UV rated material at least 0.5 mm thick.

PART 3 - EXECUTION

3.01 APPLICATION

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

3.02 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure test ductwork piping systems and equipment complete, witness and certify.
- .2 Ensure surfaces are clean, dry, free from foreign material.

3.03 EQUIPMENT AND MISCELLANEOUS APPLICATIONS

- .1 Chilled water pump casings: 25mm (1") thick blanket insulation. On steel or cast iron surfaces, apply one coat of Densopaste Primer prior to applying insulation. Apply flexible blanket insulation and seal all joints in vapour seal facing with self-adhesive foil tape. Finish with insulating cement and canvas.

3.04 DUCTWORK

- .1 Installation
 - .1 Exposed ductwork: rigid board Insulation
 - .1 Rectangular ductwork: Impale rigid board on weld pins and speed washers 300mm (12") OC with a minimum of two rows per side on any side greater than 300mm (12"). Cut pins flush with surface of insulation and cover with foil faced type. Cover all joints with foil faced self-adhesive tape. Finish with canvas.
 - .2 Round ductwork: Score and mitre rigid board to fit contours of duct and secure with 12mm x 0.38mm (2" x 0.015") galvanized steel bands 300mm (12") OC. Point up all joints with insulating cement and seal with foil faced self-adhesive tape. Finish with canvas.
 - .2 Concealed ductwork:

- .1 Blanket type insulation. Apply flexible blanket insulation with an approved adhesive brushed on in 100mm (4") wide strips 300mm (12") OC and at all joints. For rectangular ducts over 450mm (18"), blanket type insulation should be secured to the bottom side of the duct with mechanical fasteners spaced on 450mm (18") centres. Care should be taken to avoid over-compressing the insulation with the retaining washer. Seal all joints and perforations with foil-faced self-adhesive tape.
 - .2 Ductwork over 1500mm (5') in width or ductwork located in vertical shaft: Use rigid board insulation.
 - .3 Ductwork exposed to outdoors: Impale rigid board on weld pins and speed washers 300mm (12") OC with a minimum of two rows per side on any side greater than 300mm (12"). Cut pins flush with surface of insulation and cover pins and joints with foil-faced self-adhesive tape. Finish with two applications of weather protective coating trowelled smooth.
 - .4 Where ductwork is symbolized as external acoustic: apply over rigid board two coats of hard plaster at 9.53mm thick each, trowel smooth and finish with canvas.
- .2 Application: Provide external ductwork insulation in thickness as listed below:
- .1 All supply air ductwork from fan discharge or unit outlet of air handling systems delivering air at temperatures less than 18°C and greater than 30°C. This includes supply air ductwork connected to discharge side of fan coil units, heat pumps, reheat coils and VAV terminals and air handling systems with cooling and/or heating coils and direct or indirect fired burner sections.
 - .1 Provide 25mm (1") thick for systems with 18°C or less air supply temperature.
 - .2 Provide 40mm (1½") thick for systems with 30°C or greater air supply temperature.
 - .3 Outdoor intake ductwork, ductwork conveying mixed outdoor/return air and mixed air plenums: 50mm (2") thick.
 - .4 Supply and return air ductwork located outdoors: 75mm (3") thick.
 - .5 Exhaust ductwork located outdoors: 50mm (2") thick.
 - .6 Exhaust ductwork located indoors for a minimum of 3 m (10 ft.) back from the discharge point to outdoors: 25mm (1") thick.
 - .7 Exhaust ductwork located indoors from ERV or heat wheel to the discharge point: 25mm (1" thick), except for residential suites.
 - .8 Where specifically noted on drawings that could be an exception to the foregoing.
 - .2 Exceptions: external duct insulation is not required where:
 - .1 Supply air ductwork installed exposed within conditioned space.
 - .2 Note: Supply air ductwork installed concealed in ceiling spaces, whether ceiling space used as return air plenum or not, is to be totally insulated.
 - .3 Ductwork is internally insulated and located indoors.
 - .4 Collars to registers, grilles and diffusers are 900mm (3 ft.) or less in length.
 - .5 Acoustic type flexible ductwork is used.
 - .6 Duct silencers with acoustic media on all four sides are installed.
 - .3 Where a supply or return duct is not protected by an insulated exterior wall or where the duct is exposed to an unheated space, provide a minimum of 75mm (3") of rigid board insulation with a minimum RSI 2.1 (R-12) insulation value.
 - .4 Where exhaust ducts containing air from heated space pass through or are adjacent to unheated spaces, provide a minimum of 75mm (3") of rigid board insulation with a minimum RSI 2.1 (R-12) insulation value.

3.05 PIPING APPLICATION SCHEDULE

Item	Conductivity Range W/m°C	Insulation Thickness & Type
Heating system piping (Design operating temperature below 93 °C)	0.036 – 0.042	40mm (1½") pre-molded 31mm (1¼") pipe and below.

Item	Conductivity Range W/m°C	Insulation Thickness & Type
		50mm (2") pre-molded for 40mm (1 ½") pipe and greater.
Heating system piping (Design operating temperature above 93 °C)	0.039 – 0.043	65mm (2½") pre-molded 75mm (3") pipe and below. 75mm (3") pre-molded for 100mm (4") pipe and greater.
Chilled water piping (Design operating temperature 5-13 °C)	0.030 – 0.039	25mm (1") pre-molded
Chilled water piping (Design operating temperature below 5 °C)	0.029 – 0.037	25mm (1") pre-molded for 19mm (¾") pipe and including 100mm (4"). 40mm (1½") pre-molded for pipe greater than 100mm (4").
Steam piping and Condensate (Design operating temperature between 94 °C and 121 °C)	0.039 – 0.043	65mm (2.5") pre-molded for pipe below 100mm (4"). 75mm (3") pre-molded for pipe 100mm (4") and larger.
Condensate Horizontal drains from fan coil units, heat pumps, and cooling coils, suspended horizontal drains receiving cooling coil condensate, suspended horizontal drains from urinals and water closets and roof drain receptors and horizontal rainwater leaders and fittings	0.033	25mm (1") pre-molded
Condenser water piping for systems that operate summer and winter.	0.033	50mm (2") pre-molded outdoors 25mm (1") pre-molded indoors

3.06 PIPING

- .1 Apply insulation at temperature of approximately 8°C over clean, dry surfaces. Butt adjoining sections of insulation firmly together with the longitudinal seam of the jacket located on the bottom half of the pipe.
- .2 Insulate and finish in the same manner and same thickness as piping, all valves, fittings and flanges on chilled water and dual temperature piping. Use mitred sections of the specified pipe covering or preformed insulation to suit fitting.
- .3 Seal longitudinal lap joints with a suitable vapour barrier adhesive for cold and chilled water piping and a suitable cement capable of withstanding service temperature on hot water piping. Cover circumferential butt joints with a strip of the same material as the jacket and cement as indicated above. Cover all joints with foil faced self-adhesive tape on chilled and cold water piping.
- .4 Concealed insulated items require no further finish than provided in factory applied jacket. Cover exposed insulation and all insulated equipment with canvas, field applied, adhered and lap sealed and finished off by a brush coat of approved sizing.

- .5 Insulated piping exposed to outdoors: Apply aluminium protective covering over all insulated pipe and fittings. Seal all joints with approved sealants.
- .6 Seal valves, fittings and flanges on cold and chilled water application in a manner as specified for circumferential joints. On strainers, insulate over blow-down valves and bushings or flanges required for strainer basket removal by providing a removable prefabricated Armaflex cover held in place with a stainless steel gear clamp. Do not insulate over blow-down valves and bushings or flanges for strainer basket removal on condenser water piping.
- .7 Seal end joints and perforation with 100mm (4") vapour barrier strips applied with the same adhesives and cements as previously specified for cold and chilled water.
- .8 On all domestic cold and chilled water piping:
 - .1 Where oversized hangers are used, protect insulation with a sheet metal saddle installed over the vapour barrier. For piping 40mm (1½") and larger provide a section of rigid insulation or non-compressible material under the vapour barrier the same length as the saddle - see detail drawing.
 - .2 Where oversized hangers are not used, apply 12 mm (1/2") insulation with vapour seal over hanger and support rod for a distance of two pipe diameters up the rod from the attachment point at the ring, clamp or clevis.
- .9 Apply blanket type insulation on piping using an approved adhesive and seal all longitudinal and transverse joints with foil faced tape. Insulate pipe hanger in similar manner for a distance of two pipe diameters up the rod beyond the attachment point at the ring, clamp or clevis.
- .10 Insulation on piping where Victaulic couplings are used:
 - .1 In concealed areas, provide insulation over couplings to same thickness as specified for piping.
 - .2 In exposed areas, (except mechanical and service rooms) increase insulation thickness and provide one-half specified thickness over couplings to achieve the appearance of uniform diameter of pipe and fittings.
 - .3 Where aluminium sheet cladding is required, increase insulation thickness as described in (2) above to achieve a standard and uniform diameter.
- .11 On water to water heat pump circuits utilizing 50mm (2") insulation: At all ball valves, use 1" insulation to allow space for valve handle operation.

3.07 FINISHES

- .1 PVC over insulated items where exposed indoors.
- .2 28 ga. aluminium over all insulated piping exposed to outdoors.
- .3 Weatherproof mastic, two coats trowelled smooth, over ductwork insulation where exposed outdoors.
- .4 Breeching Insulation: Apply 13mm (1/2") coat of hydraulic setting insulating cement trowelled smooth over metal mesh.

3.08 CLEANING

- .1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 20 05 25

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PART 2 - PRODUCTS

- 2.01 VARIABLE FREQUENCY CONTROLLERS

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- 3.01 INSTALLATION OF VARIABLE FREQUENCY DRIVES
- 3.02 VARIABLE FREQUENCY CONTROLLER TEST
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PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Comply with requirements of Division 01, General Requirements and all documents referred to therein.
- .2 Comply with requirements of Section 20 05 05, Mechanical work General Instructions and Section 20 05 10, mechanical Basic Mechanical Materials and Methods.

1.02 WORK PERFORMED BY THIS SECTION

- .1 Supply and installation of Variable Frequency Drives.

1.03 QUALITY ASSURANCE

- .1 Qualifications: Execute work of this section only by skilled licensed tradesmen regularly employed in the installation of variable frequency drives.
- .2 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Division 01 to suit Health and Safety Requirements.
- .3 Acceptable manufacturers: ABB, AC Tech, Allen Bradley, Danfoss (Graham), Siemens, Nidec, Schneider Electric factory assembled units.

1.04 SUBMITTALS

- .1 Submit shop drawings on variable frequency controllers and starters in accordance with Section 20 05 01 – Shop Drawings, Product Data & Samples.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.06 WARRANTY

- .1 Provide warranties as outlined in Section 20 05 05.
- .2 Variable Frequency Drives will be accepted after start-up, a minimum of 10 hours of logged trouble-free operation, 10 hours of connected EMCS trouble-free operation, four hours of instruction to Owner's operating staff and submission of written verification attesting thereto by manufacturer's representative. The Consultant must also witness a portion of this procedure
- .3 Include verification of acceptance certificates with the maintenance and operating manuals in the appropriate sections.

PART 2 - PRODUCTS

2.01 VARIABLE FREQUENCY CONTROLLERS

- .1 General: Provide as indicated in the Equipment Schedules factory fabricated and tested pulse width modulating frequency controllers compatible with the motor horse powers listed for the variable volume air handling units, return air fans, pumps and/or cooling tower fans.
- .2 Application:
 - .1 The load characteristics of the application are:
 - .1 Variable torque (e.g. fans).
 - .2 Operating speed range from 180 to Normal Motor RPM (refer to FAN MOTOR DATA table in item .18).
- .3 Operating Conditions:
 - .1 Drive to accept power nominal AC voltage of 600V **[480V]** $\pm 15\%$, three-phase, frequency 60 Hertz.
 - .2 Operating ambient condition to have a temperature range of 0 to 40°C with a relative humidity of up to 95% (non-condensing).
 - .3 Altitude: 0 - 215m (0 - 700 ft.) above sea level.
- .4 AC Adjustable Speed Drive Systems:
 - .1 Adjustable frequency AC drives to convert 600V / 480V / 208V $\pm 15\%$, 3 phase, 60 Hertz utility input power to an adjustable AC frequency and voltage for controlling variable torque through speed of AC squirrel cage fan motors. Converters to be of the voltage source design with a pulse width modulated inverter section utilizing insulated gate bi-polar transistors (IGBT). The use of input/output transformers is not acceptable. The drive controllers to be rated for 110% continuous of rated motor current and have capacity to provide speed control of motors throughout speed range specified.
 - .2 Controllers to include power conversion components, power control logic devices and regulator circuitry. Regulators to incorporate microprocessor technology for control of power semiconductors.
 - .3 Variable speed drive to be supplied in a NEMA 1 enclosure with drip hood if in sprinklered area and to be completely pre-wired and pre-piped for the specified control sequences, and require only field wiring from a power source to each motor and wiring of control points and safeties.
- .5 The drive to contain the following, all interconnected and factory-wired to an identified terminal strip:
 - .1 Variable frequency controllers (VFC).
 - .2 Motor control components such as overload relays, fused control circuit transformers, pushbuttons, pilot lights and other items required to perform the specified sequences of operation.
 - .3 Terminals to which specified remote devices like start/stop; etc. may be wired to the Building Management System. Field wiring for these control devices to be the responsibility of Division 25.
[If disconnect required]
 - .4 Through-the-door disconnect switch.
- .6 Operating Characteristics:
 - .1 The adjustable frequency drives to have the following features:
 - .1 $\pm 1\%$ frequency regulation.
 - .2 $\pm 1\%$ voltage regulation.
 - .3 0 to 66 Hertz operating frequency range.
 - .4 Active current limit function, adjustable 0 to 100% of controller rating.
 - .5 Maximum efficiency at full load and speed of 98%.

- .6 Minimum incoming line power factor throughout the load speed range of 0.95.
- .7 Drive Diagnostics:
 - .1 Provide fault diagnostics to simplify troubleshooting. Each of the following points to be indicated by on LCD or LED screen:
 - .1 Lockout - (fault shutdown after three (3) restart attempts)
 - .2 Line Fault - (Line over/under voltage, phase loss/unbalance)
 - .3 Controller Overtemperature
 - .4 Motor I²t Thermal Protection
 - .5 DC Bus Overvoltage
 - .6 DC Bus Undervoltage
 - .7 Auxiliary Power Supply Fault
 - .8 Output Fault - Phase A
 - .9 Output Fault - Phase B
 - .10 Output Fault - Phase C
 - .2 Provide keypad accessibility to a non-volatile Fault History Memory which is not operator erasable. This memory to store the following data for each of the thirty (30) most recent drive shutdowns and include date, time and elapsed time meter:
 - .1 The fault which caused the shutdown
 - .2 Output frequency at time of trip
 - .3 Output voltage at time of trip
 - .4 Output load (power) at time of trip
 - .5 Whether the load was accelerating or decelerating
- .8 Protective Functions:
 - .1 Active limiting of fundamental current by frequency fold back on acceleration loads and frequency hold on decelerating loads.
 - .2 Over current protection.
 - .3 Short circuit protection.
 - .4 Fast acting supply fuses.
 - .5 Supply voltage phase loss.
 - .6 DC intermediate bus under voltage.
 - .7 DC intermediate bus over voltage.
 - .8 Power section over temperature.
 - .9 Power section faults.
- .9 Adjustments:
 - .1 Active current limit 0-100%.
 - .2 Maximum frequency 40-100%.
 - .3 Minimum frequency 0-50%.
 - .4 Acceleration/Deceleration separately adjustable from 1 to 999 seconds.
 - .5 All adjustments shall be programmable from the front panel of VFD. Potentiometer or dip switch adjustments are not acceptable.
- .10 Auxiliary Contacts for Drive Logic Status:
 - .1 The following (NO, NC) contacts to be provided for the following logic conditions.
 - .2 Fault
 - .3 Start
 - .4 Motor contactor at the inverter output.
 - .5 Input card with auto/manual logic for isolation of analog input reference signals 4-20 mA.

- .11 Output card providing isolated 4-20 mA output for drive signals including output frequency, active or total output current.
- .12 Provide diagnostics for operator on-line status information. Each of the following status points shall be indicated on door mounted LCD screen:
 - .1 Power on
 - .2 Ready
 - .3 Run
 - .4 Jog
 - .5 Motor Accelerating
 - .6 Motor Decelerating
 - .7 Direction of rotation (forward or reverse) (if function enabled)
 - .8 Auto Mode (if function enabled)
 - .9 Manual Mode
 - .10 Stop
 - .11 Low Reference (missing or zero speed reference)
 - .12 External Trip (interlocks open)
 - .13 Current Limit
 - .14 Power Lost
 - .15 Fire Alarm Shut Down Contacts
- .13 Provide the following control functions on the door mounted keypad:
 - .1 Run
 - .2 Stop
 - .3 Jog (enabled in Stop Mode only)
 - .4 Auto/Manual (if Auto Mode is enabled)
 - .5 Forward/Reverse (if function enabled)
 - .6 Accelerate (Manual Mode)
 - .7 Decelerate (Manual Mode)
 - .8 Direct Speed Set (Manual Mode)
 - .9 Load meter to indicate active current
 - .10 Frequency meter
 - .11 Manual frequency reference potentiometer
- .14 Provide diagnostic to allow signal tracing of the logic and base or gate driver circuit boards plus additional fault diagnostics.
- .15 Provide terminals for interlocking of up to six (6) external interlocks e.g. Firestat, Freezestat, etc.
- .16 Provide the following to interface with the Energy Management Control System (EMCS):
 - .1 Dry contact closure or software connection from EMCS for run Command (Auto Mode).
 - .2 Isolated 4-20 mA (0-10 VDC, 0-5 VDC) signal from EMCS for speed control (Auto Mode).
 - .3 Dry contact or software connection (NO) output to EMCS to indicate:
 - .1 Inverter Ready
 - .2 Inverter Fault
 - .3 Inverter Running
 - .4 Isolated 4-20 mA or isolated 0-10 VDC output to EMCS, proportional to 0-110% speed.
 - .5 Isolated 4-20 mA or isolated 0-10 VDC output to EMCS, proportional to 0-110% load power.
 - .6 Provide for logic card or built in interface suitable for BAS. Provide for PC connection to download setup parameters.
- .17 Start-stop for manual operation of motor in by-pass starter mode.

.18 Provide for Remote Shut Down of Inverter Circuitry

The variable frequency drive shall be fitted with a low voltage relay having normally closed contacts in the solid state electronic circuitry of the inverter to allow the power down of the inverter from a remote stop button mounted in a remote disconnected switch. This shall protect the inverter solid state electronic circuits prior to the line power being shut off at the remote disconnect switch.

.19 AC Drive Quality Assurance:

- .1 Power semiconductors (thyristors, diodes, etc.) to be tested for proper electrical characteristics (dv/dt, di/dt, etc.) on LEM testers.
- .2 All chips (CMOS, TTL, LINEAR, etc.) to be given a 100% burn-in with applied voltage, and then functionally tested.
- .3 All power capacitors active components to be functionally tested.

.20 Provide guarantee that harmonics generated will not exceed 10% THD. If necessary provide line reactor or other filters to achieve this at no additional cost. External line reactors to be mounted in NEMA 1 enclosure.

.21 Provide load reactor, if drive to be located more than 50 feet from motor. Co-ordinate with contractors of Divisions 20, 22, 23 and 26 for location of the motors and drives.

.22 Provide call back within 30 minutes of receiving emergency call for service and provide on-site service within two (2) hours.

- .1 All component parts must be maintained in a local based storage. Provide evidence of this in submission of shop drawings.

.23 Start-Up Service:

- .1 Provide on-site commissioning (start-up) of the adjustable frequency drives by a qualified technician. Allow a minimum of half a day per system. Also include an allowance for a second visit to site of one day duration to train operating personnel in the operation and maintenance of the drives.

PART 3 - EXECUTION

3.01 INSTALLATION OF VARIABLE FREQUENCY DRIVES

- .1 Install variable frequency drive units in locations shown on the contract drawings to provide the best possible connection arrangement and accessibility for service.

Provide clearances on all sides of the equipment as required by authorities having jurisdiction or manufacturers, whichever is greater.

- .2 Floor mounted units to be installed on a 100mm (4") thick concrete pad extending a minimum of 100mm (4") beyond foot print of drive unit. Pad to have all edges chamfered to avoid spalling.

- .3 Install drive units in accordance with the manufacturer's instructions and all applicable building and Canadian Electrical codes.

- .4 Co-ordinate the installation of variable frequency drives with the Division 26 Sub-Trade.

- .5 Co-ordinate the installation and commissioning of drive units with the Energy Management Control Contractor (Division 25 Sub-Trade) and Air & Water Balancing Contractor.

- .6 The Divisions 20, 21, 22, and 23 contractors shall notify the Division 26 contractor of the requirement to provide remote disconnects of all motors controlled through variable frequency drives to be fitted with a low voltage push button for inverter circuit isolation.
- .7 The Divisions 20, 21, 22 and 23 contractors shall provide warning labels at remote disconnects stating that:

"Before shutting off main power, isolate the VFD inverter by depressing the low voltage push button".

"Push button to be reset and disconnect closed prior to restart of variable frequency drive."

3.02 VARIABLE FREQUENCY CONTROLLER TEST

- .1 Follow manufacturer's instructions and have manufacturer's representative present to certify the installation.
- .2 Check each item of equipment to ensure proper electrical connections, etc., and to verify proper operation.
- .3 Upon completion of installation of equipment start-up, operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, then retest to demonstrate compliance.
- .4 Start each piece of equipment controlled via frequency controller and by varying the control set point check that speed variation is linear throughout the full control range.
- .5 Check that annunciator panel and alarms are functioning in accordance with the specifications, and that all signals between the variable frequency drive and EMCS are accurate.

3.03 CLEANING

- .1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 20 05 30

CONTENTS

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- 1.01 DESCRIPTION
- 1.02 WORK PERFORMED BY THIS SECTION
- 1.03 QUALITY ASSURANCE
- 1.04 ASBESTOS AND HAZARDOUS MATERIALS
- 1.05 DELIVERY, STORAGE AND HANDLING

PART 2 - PRODUCTS

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- 3.01 DISCONNECTION AND REMOVAL OF EXISTING MECHANICAL WORK
- 3.02 EXAMINATION
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- 3.04 PIPING
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- 3.06 HAZARDOUS WASTE
- 3.07 INTERRUPTION TO AND SHUT-DOWN OF MECHANICAL SERVICES AND SYSTEMS
- 3.08 PIPE FREEZING
- 3.09 DECOMMISSIONING OR ALTERATIONS TO EQUIPMENT CONTAINING HAZARDOUS WASTE
- 3.10 ROOFING WORK
- 3.11 PROTECTIONS
- 3.12 CLEANING

PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.
- .2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

1.02 WORK PERFORMED BY THIS SECTION

- .1 This Section specifies requirements, criteria, methods and execution for mechanical demolition work that are common to one or more mechanical work Sections, and it is intended as a supplement to each Section and is to be read accordingly.

1.03 QUALITY ASSURANCE

- .1 Qualifications: Execute work of this section only by skilled tradesmen regularly employed in the demolition of mechanical piping, equipment, ductwork, etc.

1.04 ASBESTOS AND HAZARDOUS MATERIALS

- .1 If asbestos, PCBs or other hazardous materials are encountered in the course of the work, stop work in the vicinity of such materials and report their presence to the Owner and Consultant.

1.05 DELIVERY, STORAGE AND HANDLING

- .1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

PART 2 - PRODUCTS

2.01 MATERIALS

- .1 Materials used for patching and finishing shall be of the same quality and texture as the adjacent undisturbed areas. Refer to Section 20 05 10 – Basic Mechanical Materials and Methods for additional information regarding cutting and patching.

PART 3 - EXECUTION

3.01 DISCONNECTION AND REMOVAL OF EXISTING MECHANICAL WORK

- .1 Where indicated on drawings, disconnect and remove existing mechanical work, including hangers, supports, insulation, etc. Disconnect at point of supply, remove obsolete connecting services and make system safe. Cut back obsolete piping behind finishes and cap water-tight, unless otherwise specified.
- .2 Drain down existing piping prior to demolition. Safely dispose of fluids within piping, unless specified otherwise.

- .3 Where existing mechanical services extend through, or are in an area to serve items which are to remain, maintain services in operation. Include for rerouting existing services concealed behind existing finishes and which become exposed during renovation work, so as to be concealed behind new or existing finishes.
- .4 Unless otherwise specified, remove from site and dispose of existing materials which have been removed and are not to be relocated or reused.
- .5 Where existing mechanical equipment, ductwork, piping, etc. penetrating walls is removed, leaving an opening in the wall, the wall shall be sealed and patched by the mechanical contractor. The opening shall be sealed commensurate with the rating of the rest of the wall.
- .6 Perform cutting and patching on fire rated surfaces to maintain the existing fire rating.
- .7 Contractor shall pay for all fees for disposal of equipment.
- .8 Remove existing piping, ductwork, equipment, etc. as far back and as close to walls as possible, to leave the maximum amount of space for new construction activities.
- .9 Removed materials shall not be reused in the new construction work unless specifically noted or approved.

3.02 EXAMINATION

- .1 Verify that abandoned or removed apparatus and equipment serve only abandoned facilities.

3.03 DEMOLITION AND EXTENSION OF EXISTING HVAC WORK

- .1 Remove, relocate and extend existing installation to accommodate new construction.
- .2 Remove abandoned piping and ductwork to source of supply.
- .3 Disconnect and remove existing apparatus and equipment where noted.
- .4 Extend existing installations using materials and methods compatible with existing HVAC installations, or as specified.

3.04 PIPING

- .1 All welded piping shall be cut off square at the locations indicated on the demolition drawings.
- .2 All threaded piping shall be disconnected at the location indicated on the demolition drawings.
- .3 All openings of any remaining valves, piping or fittings shall be closed off with weld caps or blind flanges to prevent debris from entering the existing systems.
- .4 All pipe hangers, supports and/or anchors shall be removed along with all piping shown to be removed.

3.05 INSULATION

- .1 Insulation shall be removed from all ductwork, piping, fittings, valves and equipment designated for demolition.
- .2 Comply with all safety precautions related to insulation removal.

3.06 HAZARDOUS WASTE

- .1 Be advised that items such as drainage sumps, catch basins, interceptors, and the like may contain unidentified hazardous waste and caution is to be taken when disconnecting and removing these items.
- .2 If hazardous waste not listed in Specification is found, notify Owner and Consultant immediately and await directions.

3.07 INTERRUPTION TO AND SHUT-DOWN OF MECHANICAL SERVICES AND SYSTEMS

- .1 Where disruptions of existing mechanical services are required, co-ordinate shut down with the Owner and do the work at a time and in a manner mutually acceptable.
- .2 Perform work associated with shut-downs and interruptions as continuous operations to minimize shut-down time and to reinstate systems as soon as possible, and, prior to any shut-down, ensure materials and labour required to complete the work for which shut-down is required are available at site.
- .3 Submit a written concise schedule of each disruption at least 72 (seventy two) hours in advance and obtain Owner's written consent prior to implementation. Do not shut-down or

3.08 PIPE FREEZING

- .1 Pipe freezing may be used to connect new piping to existing piping without draining existing piping. Pipe freeze equipment is to be equal to "NORDIC FREEZE" equipment supplied by Mag Tool Inc. or Rigid Tool Co. RIGID "SuperFreeze", or approved equal.
- .2 Mechanical Line Stopping may also be utilized as an alternative to pipe freezing.

3.09 DECOMMISSIONING OR ALTERATIONS TO EQUIPMENT CONTAINING HAZARDOUS WASTE

- .1 Remove and reclaim refrigerant, glycol and other hazardous waste materials from applicable equipment to be decommissioned and/or altered. Work is to be in accordance with Refrigerant Management Canada guidelines, and governing codes and regulations. Do not under any circumstances vent from existing equipment to atmosphere or drain into building drains.
- .2 Use proper recovery equipment designed specifically to reclaim and recycle specific hazardous waste materials, and use only skilled mechanics to perform reclaim and recycle work.
- .3 Provide approved, properly sized and sealable refrigerant containers for reclaimed hazardous waste.
- .4 Dispose of reclaimed hazardous waste by engaging services of a licensed firm specializing in recycling of reclaimed hazardous waste. Submit copies of license of company performing work. Submit documentation to confirm hazardous waste has been properly removed from site and recycled or properly disposed.

3.10 ROOFING WORK

- .1 Where roof revisions and/or replacements are part of project, include for disconnecting, lifting, or temporarily removing mechanical equipment on roof as required to permit completion of roofing work, and for re-installing equipment when roofing work is complete.

3.11 PROTECTIONS

- .1 Contractor shall coordinate with all trades for all work specified in this project and shall provide the necessary barricades and dust control to protect Owner's personnel, the general public, etc. from injury, provide them safe passage to and from occupied portions of the building, and protect floors, walls, ceilings, furnishings, and equipment from damage or exposure to dust or debris.

3.12 CLEANING

- .1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 20 05 40

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PART 2 - PRODUCTS

- 2.01 NIL

PART 3 - EXECUTION

- 3.01 EQUIPMENT AND TERMINALS
- 3.02 EQUIPMENT STARTUP

PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.
- .2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

1.02 WORK PERFORMED BY THIS SECTION

- .1 Heating and Cooling
 - .1 Heating, cooling, refrigeration piping systems.
 - .2 Supply and installation of boilers, pumps, convectors, chillers, cooling towers, condenser, tanks, coils, unit heaters, air handling units, heat exchangers, rooftop HVAC units and other heating/cooling systems piped components.
- .2 Air Distribution
 - .1 Provide a complete installation of ventilation systems as shown of the Drawings and Detail Drawings including ductwork, grilles, and diffusers, fans, VAV terminals, dampers, hoods and provision of personnel and materials to assist in air balancing.
 - .2 Install all automatic dampers supplied by Division 25 Building Automation System.

1.03 QUALITY ASSURANCE

- .1 Qualifications: execute work of this section only by skilled tradesmen regularly employed in the installation of pressure piping systems and heating and cooling equipment.
- .2 All filters to be ULC labelled and listed for flame spread rating of less than 25 and smoke classification of less than 50.
- .3 Large air conditioners, heat pumps and condensing units to meet the Energy Efficiency Performance Standard of CAN/CSA-C746 (current version).

1.04 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 20 05 01 – Shop Drawings, Product Data & Samples.
- .2 Closeout Submittals:
 - .1 Provide operation and maintenance data for incorporation into manual specified in Division 01 closeout submittals and as outlined in Section 20 05 05.
 - .2 Site records and Record Drawings: Refer to Section 20 05 05:
 - .3 Provide co-ordination/interference drawings, as required per Section 20 05 05, Co-ordination Drawings.

1.05 MAINTENANCE

- .1 Furnish spare parts in accordance with Division 01, to suit Close-out Submittals and in accordance with Section 20 05 05, 20 05 01 and 20 05 10, as follows:
 - .1 One set of packing for each pump.

- .2 One casing joint gasket for each size pump.
 - .3 One head gasket set for each heat exchanger.
 - .4 One glass for each gauge glass.
 - .5 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
-
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Division 01, to suit Close-out Submittals.
 - .3 Furnish one commercial quality grease gun, grease and adapters to suit different types of grease and grease fittings.

1.06 DELIVERY, STORAGE, AND HANDLING

- .1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

PART 2 - PRODUCTS

2.01 NIL

PART 3 - EXECUTION

3.01 EQUIPMENT AND TERMINALS

- .1 Deliver equipment to the Site of the Work and store in area as designated by the [Contractor]. Set equipment on temporary bases to avoid contact with the ground. Protect equipment from damage.
- .2 Comply with manufacturer's requirements for the installation of all specified equipment.
- .3 Locate equipment as shown on the drawings to provide best possible connection arrangement and accessibility for servicing. Provide clearances on all sides of equipment as required by Authorities having jurisdiction or manufacturer, whichever is greater.
- .4 Install items of equipment such as convectors with due regard to Architectural treatment, and ensure all items are level and finished in keeping with good workmanship. Grade all convector elements upward in direction of flow refer to detail drawings.
- .5 Provide drains to nearest floor drain on all back flow preventors.
- .6 Pitch coils for air handling systems 18mm/m (3"/ft) toward access end of unit.
- .7 Provide branch take-offs from mains of heating and cooling pipes with shut off valves.
- .8 Install and connect remote components such as thermostats, humidistats, control panels, level controllers, etc., that are supplied with the equipment. Install in locations as shown on the drawings.
- .9 Install rooftop HVAC and H&V equipment on bases per Manufacturer's instructions and in locations as shown on the Drawings. Provide PVC condensate drains to roof for HVAC units. Provide condensate drains with deep traps equivalent to 25 mm (1") deeper than air pressure in the unit with the top of the trap 50 mm (2") minimum below the unit condensate outlet. Condensate must be effectively trapped to avoid condensate hang-up in the unit and to prevent air flowing into the unit through the trap.

3.02 EQUIPMENT STARTUP

DIVISION 23 HEATING, VENTILATION AND AIR CONDITIONING

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

- .1 Follow manufacturer's instructions and have manufacturer's representative present to certify the installation.
- .2 Check each item of equipment to ensure proper electrical connections, etc., and to verify proper operation.

END OF SECTION 23 05 00

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PART 2 - PRODUCTS

- 2.01 ALL PUMPS
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- 3.05 PERFORMANCE VERIFICATION (PV)
- 3.06 OPERATION REQUIREMENTS
- 3.07 CLEANING

PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.
- .2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05, Basic Mechanical Materials and Methods Section 20 05 10.
- .3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

- .1 Provide all hydronic pumps for HVAC systems.
- .2 Section Includes:
 - .1 Materials and installation for hydronic pumps.
 - .2 Sustainable requirements for construction and verification.

1.03 REFERENCES

- .1 American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 Standard 90.1, Energy Standard for Buildings except Low-Rise Residential Buildings.
- .2 Electrical Equipment Manufacturers Advisory Council (EEMAC)
- .3 Canadian Standards Association (CSA International)
 - .1 CSA-B214, Installation Code for Hydronic Heating Systems.
- .4 National Electrical Manufacturers' Association (NEMA)
 - .1 NEMA MG 1, Motors and Generators.

1.04 QUALITY ASSURANCE

- .1 Materials in accordance with Section 20 05 05 and 20 05 10.
- .2 Size and select components to: CSA-B214
- .3 Acceptable manufacturers: Bell & Gossett, S.A. Armstrong, PACO, Grundfos, TACO, Hydromatic, Patterson.

1.05 SUBMITTALS

- .1 Provide manufacturer's printed product literature and datasheets for pump, circulator and equipment and include product characteristics, performance criteria, physical size, finish and limitations indicate point of operation and final location in field assembly in accordance with Section 20 05 01 – Shop Drawings, Product Data & Samples.
- .2 Submit manufacturer's detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices or ancillaries, accessories and controllers.

1.06 DELIVERY, STORAGE, AND HANDLING

- .1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.07 WARRANTY

- .1 Provide warranties as outlined in Section 20 05 05.

PART 2 - PRODUCTS

2.01 ALL PUMPS

- .1 All pumps: equipped with mechanical seals, non-overloading (not including motor service factor) over entire performance curve except where pumps are fitted with integrated VFD with non-overloading logic and bronze fitted except where noted. Provide split coupling for pumps having a motor equal to or higher than 5.6 kw (7½ HP). All vertical inline pumps to be complete with equally sized suction and discharge flanged connections, tapping for gauge, drain and flush line connections. Base mounted pumps: complete with coupling guards. All vertical inline and base mounted pumps with mechanical seals to be equipped with factory installed Micro-Wynd II Cuno filters and Arkon flow indicators. Provide an additional set of filters to replace original filters after system is cleaned and treated.
- .2 Each pump shall be hydrostatically tested 1.5 times the maximum rated working pressure and name-plated before shipment.
- .3 Motors shall meet scheduled horsepower, speed, voltage, and enclosure design. Motors through 1 HP shall be resilient mounted, motors over 1.5 HP shall be rigid mounted. Motors shall have permanently lubricated ball bearings and must be completely maintenance free. Larger motors requiring lubrication maintenance must be fitted with grease points (zerks). Motors shall be non-overloading at any point on the pump curve except where pumps are fitted with integral VFD with non-overloading logic and shall meet NEMA specifications. Efficiency of motors above 1.0 HP shall be NEMA Premium as standard.

2.02 SPLIT COUPLED VERTICAL IN-LINE PUMPS

- .1 Provide Vertical In-Line pumps, single stage, single suction type, with pump characteristics which provide rising heads to shut off. Refer to pump schedule for pump flows and heads and motor speed, enclosure, efficiency and power requirements and other system conditions.
- .2 Pump Construction: Pump Casing - Cast Iron with 125 psig ANSI/PN16 flanges for working pressure below 175 psig (12 bar) at 250°F (121°C) and Ductile Iron with 250 psig ANSI/PN25 flanges for working pressures to 250 psig (17 bar) at 250°F (121°C). Suction and discharge connections shall be flanged and the same size and shall be drilled and tapped for seal flush and gauge connections.
- .3 Pump shaft shall connect to a stainless steel or bronze impeller. Impeller shall be hydraulically and dynamically balanced to Hydraulic Institute Standards ANSI/HI 9.6.4.5-2000. The allowable residual imbalance conforms to ANSI grade 6.3, keyed to the shaft and secured by a stainless steel locking capscrew or nut.
- .4 The pumps shall have a 416 stainless steel shaft that is guided by a carbon graphite lower throttle bushing.

- .5 Coupling - Rigid spacer type of high tensile aluminum alloy. Coupling to be designed to be easily removed on site to reveal a space between the pump and motor shafts sufficient to remove all mechanical seal components for servicing and to be replaced without disturbing the pump or motor. Coupling shall incorporate tapered washer shaft jacking design.
- .6 Pump shall be equipped with a Unitized inside mechanical seal assembly with flush line. The seal assembly shall have an EPR elastomer bellows and a positive metal-to-metal drive system to reduce torsional stress on the bellows. The bellows will be pressure supported without creases or folds for long life. The mechanical seal shall have a rotating carbon face against a stationary ceramic face. (As an option, an outside mechanical seal may be used in lieu of the inside mechanical seal design. The outside seal materials shall be EPR elastomer with carbon-sintered silicon carbide faces.)
- .7 All split coupled pumps shall be provided with a lower seal chamber throttle bushing to ensure seals maintain positively cooling and lubrication.
- .8 Seal flush line accessories, if required to improve seal chamber cleanliness: Supply in the flush line to the mechanical seal a 50 micron cartridge filter and sight flow indicator, to suit the working pressure encountered.
- .9 Alternately, a maintenance-free accessory needing pump differential pressures exceeding 70 ft./30 psig/200 kPa for effective operation: Supply in the flush line to the mechanical seal a maintenance-free sediment separator, with sight flow indicator.

2.03 CLOSE COUPLED VERTICAL IN-LINE PUMPS

- .1 Pump casing shall be cast iron or ductile iron,
- .2 Suitable standard operations at 225F and 175 PSIG (1206kpa) working pressure, extended operations up to 250°F 250 PSIG (1724 kPa) working pressures and 300psi (2068 kPa) working pressures. Working pressure shall not be de-rated at temperatures up to 250°F.
- .3 Pump should be designed to allow for true back pull-out access to the pump's working components for ease of maintenance.
- .4 The casing suction and discharge connections shall be the same size and shall be provided with drilled and tapped seal vent and pressure gauge connections.
- .5 Pump impeller shall be stainless steel or bronze, fully enclosed type. Impeller shall be hydraulically and dynamically balanced.
- .6 A non-ferrous shaft sleeve, extending the full length of the mechanical seal area, shall be provided.
- .7 Seal assembly shall have a stainless steel housing, Buna bellows and seat gasket, stainless steel spring, and be of a carbon ceramic design with the carbon face rotating against a stationary ceramic face. Seal vent line shall be factory installed and shall be piped from the seal area to the pump suction connection.
- .8 Motors shall meet scheduled horsepower, speed, voltage, and enclosure design. Motors shall have heavy-duty grease lubricated ball bearings to offset the additional bearing loads associated with the closed-coupled pump design. Motors shall be non-overloading at any point on the pump curve and shall meet NEMA specifications.

PART 3 - EXECUTION

3.01 APPLICATION

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

3.02 INSTALLATION

- .1 Install hydronic pumps to: CSA-B214
- .2 In line circulators: Install as indicated by flow arrows.
 - .1 Support at inlet and outlet flanges or unions.
 - .2 Install with bearing lubrication points accessible.
- .3 Base mounted type: Supply templates for anchor bolt placement.
 - .1 Include anchor bolts with sleeves. Place level, shim unit and grout.
 - .2 Align coupling in accordance with manufacturer's recommended tolerance.
 - .3 Check oil level and lubricate. After run-in, tighten glands.
- .4 Ensure that pump body does not support piping or equipment.
 - .1 Provide stanchions or hangers for this purpose.
 - .2 Refer to manufacturer's installation instructions for details.
- .5 Pipe drain tapping to floor drain.
- .6 Install volute venting pet cock in accessible location.
- .7 Check rotation prior to start-up.
- .8 Install pressure gauge test cocks.

3.03 EQUIPMENT INSTALLATION

- .1 Pumps: Install pumps as shown on detail drawings. Mount all vertical in line pumps over 3.73 KW (5 HP) at floor level as shown on the detail drawings. Provide a minimum of 1.83 m (6' 0") of pipe on pump suction one size larger than pump inlet complete with strainer and valve.
- .2 Provide 12mm (½") drain lines with ball valves from Cuno filters to nearest floor drain.

3.04 START-UP

- .1 General:
 - .1 In accordance with Division 01 and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements; supplemented as specified herein.
 - .2 In accordance with manufacturer's recommendations.
- .2 Procedures:
 - .1 Before starting pump, check that cooling water system over-temperature and other protective devices are installed and operative.
 - .2 After starting pump, check for proper, safe operation.
 - .3 Check installation, operation of mechanical seals, packing gland type seals. Adjust as necessary.
 - .4 Check base for free-floating, no obstructions under base.
 - .5 Run-in pumps for 12 continuous hours minimum.
 - .6 Verify operation of over-temperature and other protective devices under low- and no-flow condition.

- .7 Eliminate air from scroll casing.
- .8 Adjust water flow rate through water-cooled bearings.
- .9 Adjust flow rate from pump shaft stuffing boxes to manufacturer's recommendation.
- .10 Adjust alignment of piping and conduit to ensure true flexibility.
- .11 Eliminate cavitation, flashing and air entrainment.
- .12 Adjust pump shaft seals, stuffing boxes, glands.
- .13 Measure pressure drop across strainer when clean and with flow rates as finally set.
- .14 Replace seals if pump used to degrease system or if pump used for temporary heat.
- .15 Verify lubricating oil levels.

3.05 PERFORMANCE VERIFICATION (PV)

- .1 General:
 - .1 Verify performance in accordance with Division and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements, supplemented as specified herein.
- .2 Verify that manufacturer's performance curves are accurate.
- .3 Ensure valves on pump suction and discharge provide tight shut-off.
- .4 Net Positive Suction Head (NPSH):
 - .1 Application: Measure NPSH for pumps which operate on open systems and with water at elevated temperatures.
 - .2 Measure using procedures prescribed in Division 01 and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements Where procedures do not exist, discontinue PV, report to the Consultant and await instructions.
- .5 Multiple Pump Installations - Series and Parallel:
 - .1 Repeat PV procedures specified above for pump performance and pump BHP for combinations of pump operations.
- .6 Mark points of design and actual performance at design conditions as finally set upon completion of TAB.
- .7 Commissioning Reports: In accordance with Division 01 and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements. Reports to include:
 - .1 Record of point(s) of actual performance at maximum and minimum conditions and for single and parallel operation as finally set at completion of commissioning on pump curves.
 - .2 Use Report Forms specified in Division 01, to suit General Commissioning (Cx) Requirements: Report Forms and Schematics.
 - .3 Pump performance curves (family of curves).

3.06 OPERATION REQUIREMENTS

- .1 Filters shall be changed, by the installing contractor, after system is flushed and on a regular basis until turned over to the owner.
- .2 Operational requirements in accordance with Division 01, to suit Sustainable Requirements and include:
 - .1 Repair and maintenance materials and instructions.

3.07 CLEANING

DIVISION 23 HEATING, VENTILATION AND AIR CONDITIONING
SECTION 23 21 23
HYDRONIC PUMPS

- .1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 21 23

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- 1.02 SCOPE OF WORK OF THIS SECTION
- 1.03 QUALITY ASSURANCE
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- 2.01 PIPING CORROSION PREVENTION
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PART 3 - EXECUTION

- 3.01 GENERAL INSTALLATION REQUIREMENTS
- 3.02 STEAM AND CONDENSATE PIPING SYSTEMS
- 3.03 EQUIPMENT START-UP
- 3.04 CLEANING

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- .1 Comply with requirements of the Owner's General Requirements and all documents referred to therein.
- .2 Comply with requirements of Section 20 01 10 Mechanical General Requirements.
- .3 Comply with requirements of Section 20 01 50 Basic Materials and Methods.
- .4 Comply with requirements of Section 20 05 70 Motors, Motor Starters, Motor Control Centres, and Wiring

1.02 SCOPE OF WORK OF THIS SECTION

- .1 Provision of Steam and Condensate piping systems, pumping systems, heat exchangers and all related ancillaries.

1.03 QUALITY ASSURANCE

- .1 Qualifications: execute work of this section only by skilled tradesmen regularly employed in the installation of steam and condensate pressure piping and pumping systems.

1.04 SUBMITTALS

- .1 Submit shop drawings for the following Products:
 - .1 Steam and Condensate Piping System valves;
 - .2 Steam and Condensate Piping System strainers;
 - .3 Steam Pressure Reducing Valves/ Temperature Control Valves;
 - .4 Steam Separators;
 - .5 Steam System Safety Pressure Relief Valves;
 - .6 Drip Pan Elbows;
 - .7 Steam Vent Terminations;
 - .8 Steam Piping System Air vents;
 - .9 Steam traps;
 - .10 Steam vacuum breakers;
 - .11 Flash Tanks;
 - .12 Condensate Coolers;
 - .13 Steam Meters.

1.05 SITE VISIT

- .1 Visit the site prior to tender and verify all conditions. Prior to submitting price, the Mechanical Division Contractor is to review all discrepancies and verify the locations of all existing services that are being extended and the routing of new services. Also report all ambiguities, discrepancies, departures from building by-laws and/or from good practice. Failure to do so will result in all additional costs being the responsibility of the Mechanical Division Contractor. Include for any alternate routing of new or rerouting of existing services to accommodate all site conditions in the tender price.

1.06 WARRANTY

- .1 Provide warranties as outlined in Section 20 05 05.

PART 2 - PRODUCTS

2.01 PIPING CORROSION PREVENTION

- .1 Provide V-line insulating piping dielectric couplings as supplied for prevention of galvanic corrosion at specific points where connections are required between copper, brass or bronze and black or galvanized steel piping.
- .2 Acceptable manufacturers are: by H & G Specialities Limited, EPCO, Watts, or accepted alternative.

2.02 STEAM AND CONDENSATE PIPING SYSTEMS

- .1 Piping:
 - .1 Provide for steam service pressures up to {875 kPa} [125 psi], black steel pipe which meets ASTM A53 Grade B (seamless or ERW) or ASTM A135 (ERW) and the following:
 - .1 For sizes {12 mm to 50 mm} [1/2" to 2"] - Schedule 40 threaded or plain end.
 - .2 For sizes {65 mm} [2-1/2"] and over - standard wall, bevel end.
 - .2 Provide for steam service pressures over {875 kPa} [125 psi] and up to {2100 kPa} [300 psi] black steel pipe which meets ASTM A106 Grade A (seamless) and the following:
 - .1 For sizes {12 mm to 50 mm} [1/2" to 2"] - Schedule 80, threaded or plain end.
 - .2 For sizes {65 mm} [2-1/2"] and over - Schedule 40, bevel end.
 - .3 Provide for condensate service, black steel pipe which meets ASTM A106 Grade A (seamless), and the following:
 - .1 For sizes {12 mm to 50 mm} [1/2" to 2"] - Schedule 80 threaded or plain end.
 - .2 For sizes {65 mm} [2-1/2"] and over - Schedule 80 bevel end.
 - .4 Provide Schedule 40 black steel for all steam vent piping.
- .2 Fittings and joints:
 - .1 Provide fittings for steam service pressures up to {875 kPa} [125 psi] as follows:
 - .1 For sizes {12 mm to 50 mm} [1/2" to 2"] - threaded {875 kPa} [125 psi] cast iron meeting ASTM A126 and ANSI B16.4.
 - .2 For sizes {65 mm} [2-1/2"] and over, welded standard wall seamless bevel end wrought carbon steel meeting ASTM A234 Grade WPB and ANSI B16.9.
 - .2 Provide fittings for steam service pressures over {875 kPa} [125 psi] and up to {2100 kPa} [300 psi] as follows:
 - .1 For sizes {12 mm to 50 mm} [1/2" to 2"] - threaded {2100 kPa} [300 psi] forged steel meeting ASTM A105 and ANSI B16.5.
 - .2 For sizes {65 mm} [2-1/2"] and over - welded standard wall carbon steel meeting ASTM A234 Grade WPB and ANSI B16.9.
 - .3 Provide fittings for condensate service as follows:
 - .1 For sizes {12 mm to 50 mm} [1/2" to 2"] - threaded {875 kPa} [125 psi] cast iron meeting ASTM A126 and ANSI B16.4.
 - .2 For sizes {65 mm} [2-1/2"] and over - welded Schedule 80 carbon steel meeting ASTM A234 Grade WPB and ANSI B16.9.
 - .4 Provide {2100 kPa} [300 psi] threaded couplings, nipples, and unions for pipe sizes {12 mm to 50 mm} [1/2" to 2"] as follows:
 - .1 Couplings with ASTM A105 Grade II caps and plugs
 - .2 Nipples {12 mm to 20 mm} [2" to 3/4"], Schedule 160 meeting ASTM A105
 - .3 Nipples {25 mm to 50 mm} [1" to 2"], Schedule 80 meeting ASTM A105
 - .4 Unions with steel-to-steel ground joint meeting ASTM A105 Grade II
 - .5 For steam service pressures up to {875 kPa} [125 psi], and pipe sizes {65 mm} [2-1/2"] and larger, provide {1050 kPa} [150 psi] slip on or weld neck, bored, standard wall flanges meeting ASTM A105.

- .6 For steam service pressures over {875 kPa} [125 psi] and up to {2100 kPa} [300 psi], and for pipe sizes {65 mm} [2-1/2"] and larger, provide weld neck, forged carbon steel flanges with raised face and serrated finish meeting ASTM A-181.
- .7 Provide full face compressed flange asbestos-free gaskets, graphite impregnated, self-lubricating {1.6 mm} [1/16"] thick suitable for {2100 kPa} [300 psi] and {260°C} [500°F]
- .8 Pipe the discharge of each steam safety relief valve to atmosphere. Provide a properly sized drip pan elbow on sizes {50 mm} [2"] and above.
- .9 Provide long radius fittings.
- .10 Do not use field fabricated fittings.

- .3 Valves:
 - .1 Provide for steam service pressures up to {875 kPa} [125 psi] Crane, Jenkins, Bonney Forge, Kitz or Newman Hattersley valves according to the following Kitz Figure Numbers:
 - .1 Gate Valves - {12 mm to 50 mm} [1/2" to 2"]; {875 kPa @ 178°C} [125 psi @ 353°F] bronze body, screwed bonnet, integral seat, back seating, rising stem, solid wedge disc, screwed, Fig. 24.
 - .2 Gate Valves - {65 mm to 300 mm} [2-1/2" to 12"]; {875 kPa @ 178°C} [125 psi @ 353°F] iron body, bolted bonnet, solid wedge disk, OS&Y, flanged, bronze seats, bronze rising stem, Fig. 72.
 - .3 Globe Valves - {50 mm} [2"] and smaller; {1050 kPa @ 186°C} [150 psi @ 366°F] bronze body, union bonnet, regrind renew hardened alloy disc and seat, rising stem, back seating threaded, Fig 17S.
 - .4 Globe Valves - {65 mm} [2-1/2"] and larger; {875 kPa @ 178°C} [125 psi @ 353°F] iron body, bolted bonnet, OS&Y, flanged, rising stem, bevel disc and bronze regrind-renew seat ring, Fig. 76.
 - .5 Check Valves - {50 mm} [2"] and smaller; {875 kPa @ 178°C} [125 psi @ 353°F] bronze, swing check valve, threaded cap, bronze rotating disc, integral seat, threaded, Fig. 22.
 - .6 Check Valves - {65 mm} [2-1/2"] and larger; {875 kPa @ 178°C} [125 psi @ 353°F] iron body, bolted cover, swing check, flanged, rotating disc, and regrind-renew bronze seat ring, Fig. 78.
 - .7 Drains - {20 mm to 32 mm} [1/2" to 1-1/4"]; Provide globe valves as listed above for all drains within this pressure range and valve size, Fig. 17S.
 - .2 Provide for steam service pressures over {875 kPa} [125 psi] and up to {2100 kPa} [300 psi] Crane, Vogt, Kitz, or Newman Hattersley valves according to the following Kitz and Vogt Figure Numbers:
 - .1 Gate Valves - {12 mm to 50 mm} [1/2" to 2"]; {11,500 kPa @ 216°C} [1670 psi @ 421°F], forged steel valves, solid wedge disc, OS&Y, rising stem, 13% chromium stainless steel trim with hard faced seating surfaces, bolted bonnet, threaded, Vogt Fig. 12111.
 - .2 Gate Valves - {65 mm to 300 mm} [2-1/2" to 12"]; {2100 kPa @ 216°C} [300 psi @ 421°F], cast steel solid wedge disc, OS&Y, bolted bonnet, flanged ends with serrated finish, 13% chromium stainless steel trim with hard faced seating surfaces, back seating, Kitz Fig. K300SCLS.
 - .3 Globe Valves - {12 mm to 50 mm} [1/2" to 2"]; {11,500 kPa @ 216°C} [1670 psi @ 421°F], forged steel valves, OS&Y, bolted bonnet, threaded, 13% chromium stainless steel trim with hard faced seating surfaces, Fig. Vogt 12141.
 - .4 Globe Valves - {65 mm to 200 mm} [2-1/2" to 8"]; {2100 kPa @ 216°C} [300 psi @ 421°F], cast steel plug type disc, OS&Y, bolted bonnet, flanged ends with serrated finish, 13% chromium stainless steel trim with hard faced seating surfaces, back seating, Kitz Fig. K300SCJS.
 - .5 Check Valves - {12 mm to 50 mm} [1/2" to 2"]; {11,500 kPa @ 216°C} [1670 psi @ 421°F], forged steel valves, piston check, bolted bonnet, 13% chromium stainless steel trim with hard faced seating surfaces, threaded, ends. Vogt Fig. 701.

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- .6 Check Valves - {65 mm to 300 mm} [2-1/2" to 12"] - {2100 kPa @ 216°C} [300 psi @ 421°F], cast steel swing check, bolted cover, flanged ends with serrated finish, 13% chromium stainless steel trim with hard seating surfaces, Kitz Fig. K300 SCOS.
- .3 Where ball valves are shown, provide Spirax/Sarco Model 10 steel ball valves for service up to {1380 kPa @ 198°C} [200 psi @ 388°F]. Ball valves to be carbon steel body, stainless steel ball and stem, with reinforced PTFE seat and stem seals.
- .4 For warmup service, where shown, provide {11,500 kPa @ 216°C} [1670 psi @ 421°F] Class 800 forged steel globe valves by Crane, Vogt or Newman Hattersley according to the following Vogt figure number. Globe valve to be OS&Y, round bolted bonnet, threaded, 13% chromium stainless steel trim with hard faced seating surfaces, loose V-port disc, dial and indicator, Fig. Vogt 12443.
- .4 Strainers:
- .1 Provide Spirax Canada Limited "Y" type pipeline strainers with type 304 stainless steel screens according to the following:

Service Press	Pipe Size	Model	Max Steam Press	Connection	Screen Perforation
up to {875 kPa} [125 psi]	{12 mm to 50mm} [1/2" to 2"]	IT Cast Iron	{1750 kPa} [250 psi]	Threaded	20 mesh
up to {875 kPa} [125 psi]	{65 mm to 100 mm} [2-1/2" to 4"]	CI 250 Cast Iron	{1960 kPa} [280 psi]	Flanged	2-1/2"=20 mesh 3"=20 mesh 4"={3.2 mm} [1/8"] perforation
up to {875 kPa} [125 psi]	{125 mm to 300 mm} [5" to 12"]	F250	{1750 kPa} [250 psi]	Flanged	{3.2 mm} [1/8"] perforation
{875 kPa to 2100 kPa} [125 psi to 300 psi]	{12 mm to 50 mm} [1/2" to 2"]	Cast Steel	{6790 kPa} [984 psi]	Threaded	20 mesh
{875 kPa to 2100 kPa} [125 psi to 300 psi]	{65 mm to 300 mm} [2-1/2" to 12"]	YF Cast Steel	{2100 kPa} [300 psi]	Flanged	{3.2 mm} [1/8"] perforation

- .2 Supply startup strainer screens in addition to the standard specified strainer screens. Remove startup screens and replace with new standard operating screens after systems have been thoroughly cleaned.
- .3 Equip each strainer {50 mm} [2"] and smaller in size, with plugged blow off tappings.

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- .4 Equip each strainer {65 mm} [22"] and larger in size, with blow off tapping. Provide blow off piping complete with capped shutoff valve. Terminate in downward vertical position. Size blow off piping and valve the same size as the blow off tapping.
- .5 Ensure that each strainer can be isolated from piping systems with isolating valves on each side of strainer, located not more than {3 meters} [10 ft] away from strainer.
- .5 Steam Pressure Reducing Valves/ Temperature Control Valves – Pneumatic or Pilot Operated:
- .1 Steam pressure reducing valves, temperature control valves shall be pneumatic type with cast steel body, capable of reducing pressure as shown on the steam schematic and schedule and capable of handling the indicated steam flow. Valves shall be flanged ANSI 300 end connections.
- .2 Valves shall be provided complete with the appropriate actuators, and pneumatic positioners.
- .3 Pneumatic actuator shall have spring extended pneumatic actuator with a control spring range of 30-60 psi and a travel of 30 mm. Compressed air connection shall be ¼" NPT.
- .4 The positioner shall compare the output signal from a pneumatic controller with the valve position feedback and vary the pneumatic output signal to the actuator accordingly. The valve position shall be guaranteed for any controller output signal and the effects of varying valve differential pressure, stem friction and diaphragm hysteresis.
- .5 The controller shall be of pressure bourdon type Range 0-100 psig, with an output of 3-15 psig.
- .6 Two (2) pneumatic pressure reducing valves in series shall be used when the pressure drop across a single valves exceed a ratio of 40:1. Maintain no less than 8' (2.5 mm) of pipe sized to carry twice the full load at a velocity of no more than 50 fps, between each valve. Adjust each station as required. Check operation of relief valves.
- .7 For system pressures 60 psi and less:
- .8 Valve body shall be cast steel with screwed or flanged connections as required.
- .9 Valve shall be rated for ANSI 150.
- .10 For system pressures of 65 psi and greater:
- .11 Valve body shall be cast steel.
- .12 Valve body shall be cast steel/ductile iron for sizes 1/2" to 2".
- .1 Valve body shall have stainless steel trim. Valve travel shall be 20 mm for valve sizes up to 2" (50 mm) and 30 mm for valves over 2 ½" (65mm). Valve CVs shall be as follows:

Size	CV
1/2" (12 mm)	4.7
3/4" (20 mm)	7.4
1" (25 mm)	11.7
1-1/4" (32 mm)	18.7
1-1/2" (40 mm)	29
2" (50 mm)	42
2-1/2"(65 mm)	74
3" (75 mm)	117
4" (100 mm)	187
6" (150mm)	304-445
8"(200mm)	445-761

- .13 Actuator pressure control to be remote controller mounted on steam pipe.

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- .1 For valves less than 2 1/2" Standard of Acceptance: Forbes Marshall Series 100, Series S- 8C or S-6N (6 & 8"), Fisher Controls, Masonellan Regulator Company, Armstrong International Model 1100, Spirax Sarco Canada Ltd. Model KEA71/73, Flanged end ratings shall be determined by valve inlet pressure to be ANSI 150 or ANSI 300.
- .2 For valves larger than 2 1/2" Standard of Acceptance: Forbes Marshall Series 1100, , Fisher Controls, Masonellan Regulator Company, Armstrong International Model 1100, Spirax Sarco Canada Ltd. Model KEA71/73. Flanged end ratings shall be ANSI 300.

.6 Steam Pressure Reducing/ Temperature Control Valves – Electric Operated:

- .1 Steam pressure reducing valves shall be electric type with cast steel body, capable of reducing pressure as shown on the steam schematic and schedule and capable of handling the indicated steam flow. Valves shall be flanged ANSI 300 end connections.
- .2 Valves shall be provided complete with the appropriate actuators.
- .3 Actuators shall be programmable 24VAC fast acting linear actuators with 4.5mm/second speed. The actuators shall have an integral 4 to 20 mA positioner cards and a max thrust force of 4.5 kN. Actuator failure mode shall be OPEN/CLOSED/LAST POSITION as determined by the Consultant at Submittal review stage.
- .4 Valve body shall have stainless steel trim. Valve travel shall be 20 mm for valve sizes up to 2" (50 mm) and 30 mm for valves over 2 1/2" (65mm). Valve CVs shall be as follows:

Size	CV
1/2" (12 mm)	4.7
3/4" (20 mm)	7.4
1" (25 mm)	11.7
1-1/4" (32 mm)	18.7
1-1/2" (40 mm)	29
2" (50 mm)	42
2-1/2" (65 mm)	74
3" (75 mm)	117
4" (100 mm)	187
6" (150mm)	304-445
8" (200mm)	445-761

- .5 Actuator pressure control to be remote controller mounted on steam pipe.
 - .1 For valves less than 2 1/2" Standard of Acceptance: Forbes Marshall Series 1100, Fisher Controls, Masonellan Regulator Company, Armstrong International Model 1100, Spirax Sarco Canada Ltd. Model KEA71/73, Flanged end ratings shall be determined by valve inlet pressure to be ANSI 150 or ANSI 300.
 - .2 For valves larger than 2 1/2" Standard of Acceptance: Forbes Marshall Series 100, Series S-8C or S-6N (6 & 8"), Fisher Controls, Masonellan Regulator Company, Armstrong International Model 1100, Spirax Sarco Canada Ltd. Model KEA71/73. Flanged end ratings shall be ANSI 300.

.7 Steam Separators:

- .1 Provide Spirax Sarco, or Colton Industries, baffle type steam separators complete with steam trap module. Separators shall be line size with threaded connections for sizes {50 mm} [2"] and below, ANSI 300 flanged end connections for {65 mm} [2 1/2"] and larger, and as follows:
 - .1 Model No. S4A cast steel separator complete with float and thermostatic trap modules on {1000 kPa} [145 psi] or higher steam lines.
 - .2 Model No. S1 or S3 cast iron separator complete with float and thermostatic trap module on lines conveying less than {1000 kPa} [145 psi] steam.
- .8 Safety Pressure Relief Valves (0 to 250 psig Service):
 - .1 Safety Pressure Relief Valves shall be ASME tested, rated and certified.
 - .2 Valve shall be cast iron/bronze relief valve, factory tested sealed and certified with tamper-proof setting to 110 % steam pressure.
 - .3 Each valve shall be capable of discharging the full rated capacity of the steam pressure reducing valve or valves located upstream.
 - .4 All valves shall be of the spring loaded type with bottom entry and side discharge.
 - .5 Provide drip pan elbows on all valves whose outlet is 2" or greater; reduction of outlet at the valve or at any point in the vent line will not be acceptable.
 - .6 Vent line to be free of any obstructions or restrictions whatsoever.
 - .7 Standard of Acceptance (as listed or equal): Spirax, Conbraco (Apollo) 19 or 119 series, Kunkle, Consolidated.
- .9 Drip Pan Elbows:
 - .1 Cast iron drip pan elbow sized to the discharge pipe size of the associated pressure relief valve, each complete with screwed or flanged connections as required, and a drain connection tapping.
- .10 Steam Vent Terminations:
 - .1 Gooseneck type pipe terminations sized to extend approximately 600 mm above the roof, each complete with bronze bird-screen permanently secured over the open pipe end.
- .11 Air Vents-Low Pressure Steam:
 - .1 Cast iron body float and thermostatic type air vent with stainless steel float, element and valve head, bronze valve seat, and nylon ball valve.
- .12 Steam Traps (20 psig and Below Service):
 - .1 Float Thermostatic type with modulating discharge mechanical ball float, ductile iron for 1/2" (12mm), to 1" (25mm) and cast iron for 1-1/2" (40mm) and 2" (50mm) 175 psig rated body, stainless steel float, and float arm, hardened stainless steel valve and seat, and an integral automatic encapsulated stainless steel air thermostatic air vent capable of withstanding 45°F of superheat over saturated steam temperature and water hammer without sustaining damage.
 - .2 Internals of the trap shall be completely serviceable without disturbing the piping.
 - .3 Standard of Acceptance (as listed or equal): Spirax Sarco Model FT14-10), Armstrong International; A, B, JD & KD, Colton, Nicholson
- .13 Steam Vacuum Breakers:
 - .1 Screwed brass body vacuum breakers, each complete with screw-in brass cap, and stainless steel valve and valve seat.
- .14 Condensate Receiver and Condensation Pumps

- .1 Furnish and install according to drawings and manufacturer's instructions the quantity of DS or LPC DUPLEX condensation pump(s) as shown on the drawings. Each unit shall consist of (1) steel receiver minimum 3/16" thick, (2) water pump, (1) mechanical alternator, electrical controls and accessories.
- .2 The condensate receiver shall be minimum 3/16" thick steel. The receiver shall be equipped with: (1) externally adjustable 2-pole mechanical alternator, and (2) lifting eyes (on receivers 21 gallon and larger). The receiver size shall be as shown on the drawings.
- .3 The centrifugal water pump shall be flange mounted on the receiver. The pump shall be close coupled vertical design, and shall have a cast bronze impeller that is bronze fitted to the cast iron pump housing with a renewable bronze wearing ring. The mechanical seal shall be rated for 250°F service. The entire pump assembly shall be permanently aligned and dynamically balanced to deliver its full rated capacity. The pump shall be driven by a vertical 3500 RPM industry standard motor available "off the shelf." The motor shall have a NEMA standard shaft. The horsepower and electrical characteristics shall be as shown on the drawings.
- .4 The pump manufacturer shall furnish, mount on the pump unit, and wire a U.L. labelled NEMA 1 control cabinet with hinged door, containing:
 - 1 Main disconnect switch c/w door interlocked handle
 - 2 Thermomagnetic motor protector
 - 2 Across-the-line contactor.
 - 2 "Hand-Off-Auto" selector switch.
 - 2 Pump Run and Power On pilot lights
- .5 A control circuit transformer shall be provided when the motor voltage exceeds 250 volts. All factory installed wiring shall be numbered for easy identification and the numbers shall coincide with those shown on the wiring diagrams. A control circuit transformer for each circuit shall be provided when the motor voltage is three phase or code requires 115 volt controls. All factory installed wiring shall be numbered for easy identification and the numbers shall coincide with those shown on the wiring diagrams.
- .6 The entire pump package will be CSA labeled when a control panel is furnished.
- .7 The manufacturer shall furnish a certified pump performance test. The pump manufacturer shall furnish complete elementary and connection wiring diagrams, piping diagrams, and installation and operation instructions.
- .8 Manufacturer shall be SHIPCO® PUMPS, P.O. Box 279, Shippensburg, PA 17257.
- .9 Refer to schedule on drawings for details on capacity

PART 3 - EXECUTION

3.01 GENERAL INSTALLATION REQUIREMENTS

- .1 Comply with Manufacturer's requirements for the installation of all specified equipment and all requirements of the Authorities Having Jurisdiction ("AHJs").
- .2 Locate equipment as shown on the drawings to provide connection arrangement and accessibility for servicing.
- .3 Provide clearances on all sides of equipment as required by the Manufacturer's Installation Instructions.
- .4 Install items of equipment with due regard to Architectural treatment, and ensure all items are level and finished in keeping with good workmanship.

- .5 Provide chemical treatment connections on steam and condensate circuits as directed by chemical treatment supplier.
- .6 Provide branch take-offs from mains of steam and condensate pipes with shut off valves.
- .7 Install and connect remote components such as thermostats, humidistats, control panels, level controllers, and other similar components, that are supplied with the equipment. Install in locations as shown on the drawings.

3.02 STEAM AND CONDENSATE PIPING SYSTEMS

- .1 Install steam and condensate piping as follows:
 - .1 Slope steam piping a minimum of {12 mm in 3 m} [1/2" in 10 ft] in the direction of flow. Slope condensate return lines {65 mm} [2-1/2"] and larger a minimum of {12 mm in 3 m} [2" in 10 ft]. Slope smaller condensate return lines and condensate drip piping not less than {25 mm in 3 m} [1" in 10 ft]. Slope all condensate piping in the direction of flow. Grade horizontal vent piping upward a minimum of {63 mm in 3 m} [2.5" in 10 ft].
 - .2 Slope steam supply and condensate return branch connections to and from equipment a minimum of {25 mm in 1.8 m} [1" in 6 ft], the slope being downward to the risers to which the branch piping connects. Increase this slope where necessary to prevent trapping due to expansion of the risers, or provide steam drip trap assemblies.
 - .3 Install line size tee drip stations every 45.7m (150ft.) on horizontal steam lines less than and up to 100mm (4") diameter, and every 36.6m (120 ft.) on horizontal steam lines greater than 100mm (4") diameter. Provide line size drip legs at the base of each riser, at low points and at the end of each piping run.
 - .4 Extend branch steam supply piping off the top of horizontal mains.
 - .5 Install the entire system of return line piping so that all condensate will be returned by gravity to the existing condensate system without water hammer. Direct the manufacturer of steam specialties to supervise their attachment and make all adjustments necessary for their operation.
 - .6 Lifting of condensate shall not be permitted after steam traps used to drain condensate from any temperature controlled process.
 - .7 Terminate each steam and safety valve vent a minimum of {3000 mm} [10 ft] above the roof. Cut piping end point at a minimum angle of 5:1 height to diameter ratio.
- .2 Install steam and condensate fittings as follows:
 - .1 Install eccentric reducing fittings flush with the pipe bottom so as not to trap condensate.
 - .2 Provide flanges or unions at connections to all equipment.
 - .3 Provide screwed or flanged joints only in accessible locations. Provide access doors as required.
- .3 Install steam and condensate valves as follows:
 - .1 Use valves and strainers of the same size as pipe in which it is installed, unless otherwise indicated.
 - .2 Provide gate valves for shutoff, service.
 - .3 Ball valves may be substituted for gate valves in condensate systems for valve sizes of {25 mm} [1"] and smaller.
 - .4 Provide a shut-off valve in each steam and condensate piping connection to equipment, at the base of each piping riser, and wherever else shown or required for proper operation and maintenance of the systems.
 - .5 Unless otherwise specified, valve types shall be as specified below:
 - .1 low pressure steam & condensate: valves in piping where a throttling or balancing action is required shall be globe type. All other valves shall be ball or gate type.

- .6 Equip low points with {20 mm} [3/4"] drain valve piped to floor drain. Provide, at high points on lines and on equipment connections, collection chambers and manually operated air vents. Vent all air vents to roof or tie into permitted vents.
- .4 Provide strainers in the following locations:
 - .1 at the condensate inlets of a packaged pressure powered pump/condenser receiver unit;
 - .2 immediately upstream of each pressure reducing valve;
 - .3 immediately upstream of each temperature or pressure control valve;
 - .4 immediately upstream of each steam trap;
 - .5 where shown on Drawings.
- .5 Clean strainer baskets after piping system flushing and cleaning is complete.
- .6 Pressure Reducing Valves:
 - .1 Provide a safety relief valve on the low pressure side of the pressure reducing valve.
 - .2 Immediately downstream from a pressure reducing valve, provide an eccentric increaser from the pressure reducing valve to line size.
 - .3 Immediately upstream from a pressure reducing valve, reduce from line size to valve size using an eccentric reducing fitting.
 - .4 Inlet strainer preceding pressure reducing valve shall be full line size, located upstream of straight run into valve. The strainer shall be installed on its side to prevent condensate build-up. Interpret the expression "full line size" to be the pipe size of steam main for the applicable design pressure.
 - .5 Isolating gate valves shall be full line size, located outside the straight run boundaries of a pressure reducing station.
 - .6 Install all takeoffs for pressure sensing lines to meet manufacturer's instructions, but not less than 10 pipe diameters after any change in direction, branch, takeoff or valve.
 - .7 Pressure sensing lines to pilot operated pressure reducing valves to be pitched upward back towards PRV.
 - .8 All pressure gauges shall be installed with tubing loops to maintain liquid exposure to the gauge.
 - .9 Provide a full line size steam separator complete with a steam trap module upstream of each pressure reducing station.
- .7 Safety Pressure Relief Valves:
 - .1 Provide safety pressure relief valves where required.
 - .2 Pipe the discharge of each steam safety relief valve to atmosphere through a properly sized drip pan elbow.
 - .3 Check and test the operation of all steam relief valves and adjust as required.
- .8 Steam Vents:
 - .1 Pipe all drip pan elbow drains to nearest funnel floor drain.
 - .2 Terminate all vent lines from flash or condensate tanks to a vent head.
 - .3 Reductions of vent line size from the outlet of safety relief valves or equipment, or at any point in the vent line will not be accepted.
- .9 Provide air vents at the top of all steam risers.
- .10 Steam traps:

- .1 Provide a steam drip trap assembly in the condensate return piping from each piece of equipment, at the base of each riser, in horizontal steam mains as required and wherever it is necessary to raise the piping to avoid a reduction in ceiling height or minimum headroom allowances.
- .2 Size drip traps to correspond with condensate return piping sizes unless otherwise specified.
- .3 Equip each drip trap with shut-off valve(s), two unions located immediately upstream and downstream of the trap, a strainer, sensing chamber, and a dirt pocket.
- .4 Connect low pressure condensate drip piping from steam drip trap assemblies into condensate return piping unless otherwise required.
- .5 Do not connect condensate return piping into the discharge of traps draining steam mains. Generally, drip trap types shall be as follows:
 - .1 thermodynamic traps: drip traps in steam mains with a working pressure greater than 138 kPa and greater piping to equipment, unless otherwise specified, shall be thermodynamic type traps;
 - .2 float & thermostatic traps: drip traps in low pressure (138 kPa) steam mains and in 138 kPa or less piping to equipment, unless otherwise specified, shall be float and thermostatic type traps;
 - .3 balanced pressure thermostatic traps: drip traps for direct steam radiation units shall be balanced pressure thermostatic type.
- .11 Steam Vacuum Breakers:
 - .1 Provide vacuum breakers in steam inlet piping after each temperature control valve to closed steam actuated vessels such as coils and heat exchangers, and in steam piping wherever required to control induced vacuum within safety limits when condensate is discharged into the return line by gravity.
 - .2 Mount each vacuum breaker vertically, unless otherwise specified.
- .12 Testing:
 - .1 Meet testing requirements of all Authorities Having Jurisdiction. Provide certification of all tests.
 - .2 Hydrostatically test steam and condensate piping to 150% of design working pressure but not less than {700 kPa} [100 psi]. Test without pressure drop for a period of not less than 8 hours.
 - .3 Provide a spool piece blank section of pipe in place of self acting pressure reducing valves during cleaning of system. Self acting pressure reducing valves with diaphragms must not be exposed to water.
 - .4 Perform tests before piping is covered or concealed.
 - .5 Remove all components which will not withstand test pressure and replace after tests.
 - .6 Eliminate leaks or remove and refit defective parts. Do not caulk threaded or welded joints.
 - .7 Sequentially blow down the entire piping system. Repeat as often as required to remove all debris and air. Clean strainers, dirt pockets and other line devices on completion.
 - .8 After work is completed, adjust and put all parts of the system into proper working order. Adjust all valves to achieve specified heating capacities.

3.03 EQUIPMENT START-UP

- .1 Follow manufacturer's instructions and have manufacturer's representative present to certify the installation.
- .2 Check each item of equipment to ensure proper piping connections, electrical connections, pump rotation and similar, to verify proper operation.

3.04 CLEANING

DIVISION 23 HEATING, VENTILATION AND AIR CONDITIONING
SECTION 23 22 10
STEAM AND CONDENSATE PIPING SYSTEMS

- .1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 22 10

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PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.
- .2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.
- .3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

- .1 Section includes:
 - .1 Materials and installation for ductwork and accessories including plenums and casings.
 - .2 Materials and installation of flexible ductwork, joints and accessories.
 - .3 Sustainable requirements for construction and verification.
- .2 Related Sections:
 - .1 Division 01
 - .2 Division 02

1.03 REFERENCES

- .1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE).
- .2 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .2 Transportation of Dangerous Goods Act, 1992 (TDGA), c. 34.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .4 National Fire Protection Association (NFPA).
 - .1 NFPA 90A, Standard for the Installation of Air-Conditioning and Ventilating Systems.
 - .2 NFPA 90B, Standard for Installation of Warm Air Heating and Air-Conditioning Systems.
- .5 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA HVAC Duct Construction Standards - Metal and Flexible, (Addendum No.1, November 1997).
 - .2 SMACNA IAQ Guideline for Occupied Buildings under Construction, 1st Edition.
- .6 Underwriters' Laboratories Inc. (UL).
 - .1 UL 181, Standard for Factory-Made Air Ducts and Air Connectors.
- .7 Underwriters' Laboratories of Canada (ULC).
 - .1 CAN/ULC-S110, Fire Tests for Air Ducts.

1.04 QUALITY ASSURANCE

- .1 Materials in accordance with Section 20 05 05 and 20 05 10.
- .2 Manufacture in accordance with SMACNA HVAC Duct Construction Standards.
- .3 Flexible Ducts:
 - .1 Factory fabricated to CAN/ULC-S110.
 - .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
 - .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.
- .4 Develop and implement an Indoor Air Quality (IAQ) Management Plan in accordance with Division 01, for construction and preoccupancy phases of building.
- .5 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.
- .6 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Division 01, to suit Construction Progress Schedules.
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .7 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Division 01, to suit Health and Safety Requirements.
- .8 Construction requirements: In accordance with Division 01, to suit Sustainable Requirements.
- .9 Verification: Contractor's verification in accordance with Division 01, to suit Sustainable Requirements.

1.05 SUBMITTALS

- .1 Submit manufacturer's printed product literature, specifications and data sheet, indicate flexible connections, thermal properties, friction loss, acoustical loss, leakage, fire rating, smoke development in accordance with Section 20 05 01.
- .2 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .1 Certification of ratings: Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.
- .3 Samples: Submit samples with product data of different types of flexible duct being used in accordance with Section 20 05 01.
- .4 Manufacturer's Field Reports: Manufacturer's field inspection reports specified.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.07 WARRANTY

- .1 Provide warranties as outlined in Section 20 05 05.

PART 2 - PRODUCTS

2.01 DUCTWORK

- .1 Provide rectangular and round ductwork constructed of ASTM A525 hot dip galvanized steel sheets in arrangements as shown on the Drawings complete with reinforcement, hanging methods, joints, seams and fittings as specified in Sections I through 6 as well as appendices A-1 through A-32 in the SMACNA HVAC Duct Construction Standards - Metal and Flexible latest version.
 - .1 For exhaust, return and air supply systems where system static pressure does not exceed 0.124 kPa (½" wg), positive or negative, provide reinforced ductwork in metal gages and reinforcement requirements as specified in SMACNA table 1-3.
 - .2 For exhaust, return and air supply systems where system static pressure does not exceed 0.248 kPa (1" wg), positive or negative, provide reinforced ductwork in metal gages and reinforcement requirements as specified in SMACNA table 1-4.
 - .3 For exhaust, return and air supply systems where system static pressure does not exceed 0.496 kPa (2" wg), positive or negative, provide reinforced ductwork in metal gages and reinforcement requirements as specified in SMACNA table 1-5.
 - .4 For exhaust, return and air supply systems where system static pressure does not exceed 0.744 kPa (3" wg), positive or negative, provide reinforced ductwork in metal gages and reinforcement requirements as specified in SMACNA table 1-6.
 - .5 For exhaust, return and air supply systems where system static pressure does not exceed 1.0 kPa (4" wg), positive or negative, provide reinforced ductwork in metal gages and reinforcement requirements as specified in SMACNA table 1-7.
 - .6 For exhaust, return and air supply systems where system static pressure does not exceed 1.5 kPa (6" wg), positive or negative, provide reinforced ductwork in metal gages and reinforcement requirements as specified in SMACNA table 1-8.
- .2 Factory fabricated rectangular and round sheetmetal ductwork, factory fabricated "Spirosafe" ductwork and gasketed self sealing fittings as manufactured by Lindab Inc. to Lindab published specifications (manufacture and installation) and performing to specified system static pressure requirements is also acceptable.
- .3 Ventotube: where indicated on Drawings, provide Aerodyne vento tube ductwork as designed and supplied by Aerodynamics Engineering and Testing Lab. Ltd., Tel: (416) 847-2839. Design duct air supply orifices and angle of discharge to deliver air quantities as indicated on drawings. Evenly space orifice openings along length of active ductwork.
- .4 Button lock longitudinal seam may be used on systems up to 0.125 kPa (½" w.g.) positive or negative static pressure provided seam is sealed or caulked with high velocity duct sealer.
- .5 Spin-on type connections from main trunk to VAV terminals may be used. Provide balancing dampers at all connections to ceiling diffusers.
- .6 In place of duct joints previously specified, "Nexus" or "Ductmate" gasketed flanges, installed to Manufacturer's instructions, may be used provided gasketing meets approval of ULC and installation is to SMACNA Standards.

2.02 PLENUMS AND CASINGS

- .1 All apparatus sheet metal connections, plenum chambers and casings above 400mm (16") in any dimension, or air handling unit casings: 20 gauge galvanized steel sheet as shown on the Detail Drawings, reinforced with 40mm x 40mm x 5mm (12" x 12" x 3/16") galvanized steel angles. Galvanized fluted 0.76mm (.03") thick roof decking with a 38mm (12") deep and 142mm (5.6") wide ribs spaced at a 203mm (8") oc may also be used.
- .2 Refer to detail drawings regarding air handling unit plenum access doors, drip trays and coil mounting, construction details.
- .3 Special prefabricated enclosures: Provide, in the configurations and dimensions shown on the drawings, built-up system enclosures constructed of prefabricated acoustic panels complete with access doors.
 - .1 Side and top Panels: 100mm (4") nominal thickness consisting of 72 kg/m; (4.5 lbs/ft;) density insulation packed between 18 ga. galvanized steel outer shell and 22 ga. galvanized perforated steel inner shell, reinforced by 10 ga. galvanized steel channels spot welded or riveted in place. Panel joints: Interlocking tongue and groove design. Trim angles: 16 ga. galvanized steel.
 - .2 Doors: 600mm x 1500mm (24" x 60") located as shown on the drawings constructed in the same manner as the panels except with solid sheets both sides, and complete with two butt hinges, two camlocking latches operable from inside and outside with single air seal gasket. Door action: To swing open against plenum pressure.
 - .3 Acceptable Manufacturers: Vibron, Vibro Acoustics.
 - .4 Submit shop drawings for all field or shop fabricated plenums, casings and enclosures.

2.03 SEALANTS

- .1 Duct Sealants
 - .1 Provide water based duct sealant, Unimastic 181 as manufactured by United McGill Corporation, conforming to NFPA 90A, 90B and ASTM E 84 requirements and with UL classification of 0 flame spread and smoke development based on a .0028 mm (0.011 inch) thick application and UL test methods.
 - .2 Sealant to comply with ASHRAE 90.1-2010 and SMACNA leakage requirements and be unyielding up to 10 times operating stress and permanently flexible when cured.
 - .3 Sealant odour to be mild and non-irritating when wet and be odourless when dry.
- .2 Internal Insulation Sealants
 - .1 Provide Superseal joint and edge sealants on internal duct insulation as manufactured by Shuller.
 - .2 Sealant to be acrylic polymer conforming to ASHRAE 62-89 as well as ASTM G-21 and G-22 for prevention of fungus and bacterial growth.

2.04 METALLIC – FLEXIBLE DUCTWORK

- .1 Flexible ductwork: provide, where indicated on the Drawings, flexible ductwork bearing ULC Class 1 Label, insulated or acoustic, as manufactured by Flexmaster. Alpha Industries, or Thermaflex are acceptable alternative manufacturers. Refer to Section 23 33 53 for insulation requirement of flexible ducts. Use Flexmaster model T/L-VT and T/L-A for insulated and acoustic flexible ducts. Flexible duct to be manufactured of aluminum with a continuous seam capable of delivering air without leakage up to positive pressures of 3.0 kPa (12" w.g.) and negative pressure of 0.25 kPa (1" w.g.).

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 DUCT INSTALLATION

- .1 Install all ductwork and fittings using crossbreaking, joining, attachment and hanging methods as specified in the SMACNA HVAC Duct Construction Standards - Metal and Flexible 1995.
- .2 Provide hangers for rectangular and round ductwork as specified in tables 4-1 and 4-2 as specified in the SMACNA HVAC Duct Construction Standards - Metal and Flexible 1985.
- .3 Refer to Section 20 05 10, Air and Water Balancing and Testing for testing requirements and procedures.
- .4 Ground across flexible connectors with No. 2/0 braided copper strap.
- .5 Install balancing dampers at branch ducts.
- .6 Sealing of ductwork and plenums:
 - .1 Apply sealant on all seams and joints on all air supply, return and exhaust ducts and all plenums in accordance with ASHRAE 90.1-2010 and as described in the SMACNA HVAC Duct Construction Standards (latest version). In case of conflicts between the standards or codes, the stringent requirement takes precedence. Apply sealants on all seams and joints on built-up air handling unit casings.
 - .2 Refer to article 6.4.4.2 of ASHRAE 90.1-2010. Ductwork and all plenums are to be constructed to seal class A. Openings for rotating shafts to be sealed with bushings or other devices that seal off air leakage. Pressure sensitive tape is not to be used as the primary sealant unless it has been certified to comply with UL-181A or UL-181B by an independent laboratory and the tape is used in accordance with that certification. All connections such as spin-ins, taps, branch connections, access doors, access panels and duct connection to equipment are to be sealed.
 - .3 Refer to SMACNA HVAC Duct Construction Standards Table 1-1 for Pressure Classification For Ductwork.
- .7 Where interior of duct is visible through grilles, registers or diffusers, paint interior of duct with flat black Tremco paint formulated for galvanized surfaces.
- .8 Apply full coverage of adhesive (all internal surfaces) for internal insulation.
- .9 Apply internal insulation edge, joint and pin sealant to manufacturer's instructions. Thoroughly seal all exposed edges, perforations and joints on internal duct lining.
- .10 Ductwork installed outdoors (not externally insulated): Seal all joints with paintable Silicon caulking compound.
- .11 Provide spin on connections c/w dampers at each boot or plenum supplying integrated ceiling air supply outlets.
- .12 During installation of ductwork, protect open ends of ducts to prevent entry of debris and dust.
- .13 Place ductwork as close as possible to partitions where shown on the Drawings in such locations.

- .14 Ventilation ducts for refrigeration exhaust systems of chiller rooms to be extended to 300mm (12") above finished floor.
- .15 All outdoor air intake and exhaust systems are to be equipped with motorized dampers. Unless noted otherwise, back draft gravity dampers are acceptable with a design capacity of 141 l/s (300 cfm) or less

3.03 FLEXIBLE DUCTWORK INSTALLATION

- .1 Install in accordance with: CAN/ULC-S110, UL-181, NFPA 90A, NFPA 90B and SMACNA.
- .2 Install all ductwork and fittings using crossbreaking, joining, attachment and hanging methods as specified in the SMACNA HVAC Duct Construction Standards - Metal and Flexible 1995.
- .3 Provide hangers for rectangular and round ductwork as specified in tables 4-1 and 4-2 as specified in the SMACNA HVAC Duct Construction Standards - Metal and Flexible 1985.
- .4 Maximum installed length: One continuous length at 1600 mm (5' 0"). Use standard sheetmetal elbows at drop points to outlets. Refer to detail drawings. Do not bend flexible ductwork any greater than 1.5 X diameter.

3.04 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product/s and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of the Work, after cleaning is carried out.
 - .4 Obtain reports, within 3 days of review and submit, immediately, to the Consultant
- .2 Verification requirements in accordance with Division 01 and include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource re-use.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Certified Wood.
 - .8 Low-emitting materials.
- .3 Refer to detail drawings in the Specifications and layouts and arrangements as shown on the Drawings. Install hinged doors to swing outward on the suction side of the fan and inward where a positive pressure may exist in the plenum. Provide gasketing around all doors and seal all seams and joints with high velocity duct sealer. Construct coil mounting racks to ensure convenient filter removal and replacement. Provide two coats of mastic compound on inner surface of drip trays. Seal all joints in filler pieces to prevent bypass and install filter banks for easy servicing.

Provide independently gasketed removable panels for access to coils and coil headers. Provide split escutcheon plates with gasketing, securely screwed in place, at all points where panels are penetrated by piping and conduit.

Where fabricated panels are placed near walls, provide 50mm (2") spacing to prevent vibration transmission.

3.05 AIR BALANCING

- .1 Air balancing is specified in Section 20 05 10 Basic Materials and Methods.
- .2 Provide personnel, tools and materials to assist and work under the direction of the air balancing firm to perform the following:
 - .1 Removal and replacement of ceiling tiles.
 - .2 Installation of pitot tube test opening enclosures.
 - .3 Installation of dampers and baffles as required for specified air balance and elimination of stratification.
 - .4 Provision of access openings and covers.
 - .5 Provision of ladders and scaffolds
 - .6 Removal and replacement of belt guards.
 - .7 Removal and replacement and provision of required sheaves and belts as directed, and other items as necessary for complete and acceptable air balancing procedures.

3.06 VIBRATION AND OBJECTIONABLE NOISE

- .1 Install ductwork free from pulsation, chatter, vibration or objectionable noises. Should any of these defects appear after the system is in operation, correct same by either removing and replacing or reinforcing the work as directed by the Consultant.

3.07 FLASHING

- .1 Provide flashings to suit installation.
- .2 Follow detail Drawings for vents and pipes penetrating roofs.

3.08 CLEANING

- .1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 31 13

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PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.
- .2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.
- .3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

- .1 Section includes:
 - .1 Materials and installation for duct accessories including flexible connections, access doors, vanes and collars, balancing dampers, fire and smoke dampers.
 - .2 Sustainable requirements for construction and verification.
- .2 Related Sections:
 - .1 Division 01
 - .2 Division 02

1.03 REFERENCES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
- .2 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA).
 - .1 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.04 QUALITY ASSURANCE

- .1 Materials in accordance with Section 20 05 05 and 20 05 10.
- .2 Manufacture in accordance with SMACNA HVAC Duct Construction Standards.
- .3 Develop and implement an Indoor Air Quality (IAQ) Management Plan in accordance with Division 01, for construction and preoccupancy phases of building.
- .4 During construction meet or exceed the requirements of SMACNA IAQ Guideline for Occupied Buildings under Construction.
- .5 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Division 01, to suit Construction Progress Schedules.
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.

.6 Health and Safety:

- .1 Do construction occupational health and safety in accordance with Division 01, to suit Health and Safety Requirements.

.7 Construction requirements: In accordance with Division 01, to suit Sustainable Requirements.

.8 Verification: Contractor's verification in accordance with Division 01, to suit Sustainable Requirements.

1.05 SUBMITTALS

- .1 Submit manufacturer's printed product literature, specifications and data sheet. Indicate flexible connections, duct access doors, turning vanes, instrument test ports in accordance with Section 20 05 01.

.2 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

- .1 Certification of ratings: Catalogue or published ratings to be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

.3 Manufacturer's Field Reports: Manufacturer's field reports specified.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.07 WARRANTY

- .1 Provide warranties as outlined in Section 20 05 05.

PART 2 - PRODUCTS

2.01 FLEXIBLE CONNECTIONS

- .1 Frame: Galvanized sheet metal frame with fabric clenched by means of double locked seams.

.2 Material:

- .1 Fire-resistant, self-extinguishing, neoprene coated glass fabric, temperature rated at minus 40 degrees C to plus 90 degrees C, density of 1.3 kg/m².

2.02 ACCESS DOORS IN DUCTS

- .1 Ductwork: Provide latched access doors where required constructed of No. 22 gauge materials with flat iron or angle iron stiffening frame so constructed that the door can be operated without twisting or distortion. Doors in insulated ductwork: double panel construction with a 25mm (1") insulating filler. Refer to Detail Drawings.

- .2 Access panels for kitchen exhaust duct shall be listed and shall have a gasket or sealant that is rated for 815.6 C (1,500 F) and shall be grease tight.

- .3 Acceptable alternative: for non hinged type, provide cam-latched insulated access doors model 08 as manufactured by Nailor Industries Inc.
- .4 Non-Insulated Ducts: Sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame.
- .5 Insulated Ducts: Sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm thick complete with sheet metal angle frame and 25 mm thick rigid glass fibre insulation.
- .6 Gaskets: neoprene foam rubber.
- .7 Hardware:
 - .1 Up to 300 x 300 mm: Two sash locks complete with safety chain.
 - .2 301 to 450 mm: Four sash locks complete with safety chain.
 - .3 451 to 1000 mm: Piano hinge and minimum two sash locks.
 - .4 Doors over 1000 mm: Piano hinge and two handles operable from both sides.
 - .5 Hold open devices.
 - .6 300 x 300 mm glass viewing panels.

2.03 TURNING VANES

- .1 Factory or shop fabricated single thickness double thickness with without trailing edge, to recommendations of SMACNA and as indicated.

2.04 INSTRUMENT TEST

- .1 1.6 mm thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.

2.05 SPIN-IN COLLARS

- .1 Conical galvanized sheet metal spin-in collars with lockable butterfly damper.
- .2 Sheet metal thickness to co-responding round duct standards.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION

- .1 Flexible Connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans.
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.

- .2 Length of connection: 100 mm.
- .3 Minimum distance between metal parts when system in operation: 75 mm.
- .4 Install in accordance with recommendations of SMACNA.
- .5 When fan is running:
 - .1 Ducting on sides of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .2 Access Doors and Viewing Panels:
 - .1 Size:
 - .1 600 x 600 mm for person size entry.
 - .2 450 x 450 mm for servicing entry.
 - .3 300 x 300 mm for viewing.
 - .1 As indicated.
 - .2 Locations:
 - .1 Fire and smoke dampers.
 - .2 Control dampers.
 - .3 Devices requiring maintenance.
 - .4 Required by code.
 - .5 Reheat coils.
 - .6 Elsewhere as indicated.
- .3 Instrument Test Ports:
 - .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments.
 - .3 Install insulation port extensions as required.
 - .4 Locations:
 - .1 For traverse readings:
 - .1 Ducted inlets to roof and wall exhausters.
 - .2 Inlets and outlets of other fan systems.
 - .3 Main and sub-main ducts.
 - .4 And as indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by the Consultant.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.
- .4 Turning vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated.
- .5 Fire Dampers and Ceiling Dampers
 - .1 Install to ULC requirements. Locate in fire walls, ceilings and partitions where indicated. Coordinate with and provide ULC installation details to drywall installer.
 - .2 Seal around fire damper assembly.
 - .3 After completion, have installation approved prior to concealment.

3.03 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .2 Manufacturer's Field Services: Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of the Work, after cleaning is carried out.
 - .4 Obtain reports, within 3 days of review and submit, immediately, to the Consultant
- .2 Verification requirements in accordance with Division 01 and include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource re-use.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Certified Wood.
 - .8 Low-emitting materials.

3.04 CLEANING

- .1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 33 00

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- 3.02 INSTALLATION
- 3.03 FIELD QUALITY CONTROL
- 3.04 CLEANING

PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.
- .2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.
- .3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

- .1 Section Includes:
 - .1 Fire and smoke dampers and fire stop flaps.
 - .2 Operating dampers and Balancing dampers for mechanical forced air ventilation and air conditioning systems.
 - .3 Sustainable requirements for construction and verification.
- .2 Related Sections:
 - .1 23 31 13 – Ductwork
 - .2 23 33 00 – Air Duct Accessories

1.03 QUALITY ASSURANCE

- .1 Materials in accordance with Section 20 05 05 and 20 05 10.
- .2 Health and Safety Requirements:
 - .1 Do construction occupational health and safety in accordance with Division 01 and to suit Health and Safety Requirements.
- .3 Certificates:
 - .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

1.04 REFERENCES

- .1 Sheet Metal and Air Conditioning National Association (SMACNA)
 - .1 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
- .3 American National Standards Institute/National Fire Protection Association (ANSI/NFPA)
 - .1 ANSI/NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

- .1 Material Safety Data Sheets (MSDS).
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 CAN4-S112, Fire Test of Fire Damper Assemblies.
 - .2 CAN4-S112.2, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
 - .3 ULC-S505, Fusible Links for Fire Protection Service.

1.05 SUBMITTALS

- .1 Submit manufacturer's printed product literature, specifications and datasheet. Indicate performance data, fire dampers, smoke dampers, fire stop flaps, operators, fusible links, design details of break-away joints in accordance with Section 20 05 01.
- .2 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .3 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Closeout Submittals
 - .1 Refer to Section 20 05 05.
- .5 Spares:
 - .1 Provide maintenance materials in accordance with Division 01 and Section 25 05 01.
 - .2 Provide following:
 - .1 6 fusible links of each type.

1.06 DELIVERY, STORAGE, AND HANDLING

- .1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.07 WARRANTY

- .1 Provide warranties as outlined in Section 20 05 05.

PART 2 - PRODUCTS

2.01 SUSTAINABLE REQUIREMENTS

- .1 Materials and products in accordance with Division 01 and to suit Sustainable Requirements: Construction.

2.02 GENERAL

- .1 Manufacture to SMACNA standards.

2.03 MULTI-LEAF DAMPERS

- .1 Blade type as indicated.
- .2 Extruded aluminum, interlocking blades, complete with extruded vinyl seals, spring stainless steel side seals extruded aluminum frame.

- .3 Pressure fit self-lubricated bronze bearings.
- .4 Linkage: Plated steel tie rods, brass pivots and plated steel brackets, complete with plated steel control rod.
- .5 Performance:
 - .1 Leakage: In closed position less than 2% of rated air flow at 1000 Pa differential across damper.
 - .2 Pressure drop: At full open position less than 7.5 Pa differential across damper at 5 m/s.
- .6 Insulated aluminum dampers:
 - .1 Frames: Insulated with extruded polystyrene foam with RSI 0.88.
 - .2 Blades: Constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, RSI 0.88.

2.04 BACK DRAFT DAMPERS

- .1 Backdraft dampers shall meet the following minimum construction standards:
 - .1 Frame shall be 0.125" (3.2 mm) wall thickness 6063T5 extruded aluminum.
 - .2 Frame shall have galvanized steel braces at all corners.
 - .3 Blades shall be 0.070" (1.8 mm) wall thickness 6063T5 extruded aluminum.
 - .4 Blades shall begin to open at approximately 0.12 in. wg. and be fully open at approximately 0.20 in.wg. static pressure.
 - .5 Blade edge seals shall be extruded vinyl mechanically locked into blade edge; adhesive type seals are unacceptable.
 - .6 Bearings shall be corrosion resistant long life synthetic for quiet operation.
 - .7 Linkage shall be ½" (13mm) tie bar with stainless steel pivot pins; linkage shall have the capability of being manually locked in the closed position for independent fan isolation from the remained of fans in the array.
 - .8 Damper shall be designed for 3500 fpm maximum spot air velocity.

2.05 MOTORIZED DAMPERS

- .1 Standard Dampers for Return Air: TAMCO series 1000 supplied by the automatic control manufacturer. Provide parallel blade type for mixing applications. All bearings to be "oilite" bronze. Size all dampers as NET dimensions (damper blade area = duct cross sectional area) as shown on drawings.
- .2 Low Leakage Dampers for Outdoor Intake and Exhaust Applications: Provide, in sizes and in locations as shown on the drawings, parallel blade (air flow directed upwards) extruded aluminium Tamco air foil dampers series 9000 as manufactured by T.A. Morrison with features as follows:
 - .1 1% leakage at 1 kPa (4") static pressure differential.
 - .2 12 ga. extruded aluminium air foil single unit internally reinforced blades with continuous extruded overlapping vinyl seals.
 - .3 12 ga. extruded frame with extruded vinyl seals on all sides.
 - .4 Out-of-airstream aluminium alloy linkages and crank arms with celcon bearings.
 - .5 Celcon and polycarbonate bearings with no metal to metal contact.
- .3 Sized for "flanged" installation (damper blade area to be equal to duct cross sectional area).
- .4 Actuators are specified in Building Automation, Section 25 01 01

2.06 SINGLE BLADE DAMPERS

- .1 Fabricate from same material as duct, but one sheet metal thickness heavier. V-groove stiffened.
- .2 Size and configuration to recommendations of SMACNA
- .3 Locking quadrant with shaft extension to accommodate insulation thickness.
- .4 Inside and outside end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

2.07 MULTI-BLADED DAMPERS

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: Configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height: 100 mm.
- .4 Bearings: pin in bronze bushings.
- .5 Linkage: Shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.

2.08 FIRE DAMPERS

- .1 Fire dampers shall be listed, bear a label of ULC approval, shall conform to the requirements of UL555 Standard for Fire Dampers and shall meet with requirements of NFPA 90A and Authorities having jurisdiction.
- .2 Unless otherwise noted on the drawings, furnish "Type B" fire dampers for rectangular or square ductwork and "Type C" fire dampers for round ductwork.
- .3 Furnish fire dampers and frame constructed of same material as the duct in which they are installed. Damper(s) shall be factory fabricated for fire rating requirements to maintain integrity of fire wall and/or fire separation.
- .4 Top hinges shall be offset, round or square; multi-blade hinged or interlocking type and sized to maintain full duct cross section.
- .5 Where dynamic fire dampers are required based on code requirements and/or operating pressure and velocity, dynamic fire dampers shall meet Dynamic Closure Test (formerly the Operation Test). Dynamic dampers shall be classified for dynamic closure against air airflow velocity of 2000 fpm (10 m/s) at 4" WC (1 kPa) static pressure differential across a closed damper. The dampers shall be labeled to verifying airflow and closure pressure ratings as established by the Dynamic Closure Test. Each fire damper shall also be marked with the words "For use in dynamic systems"; dampers without the labels will not be accepted for dynamic applications.
- .6 Fusible link actuated. Fusible link shall be rated for 74°C. (165°F.) unless otherwise noted on the drawings. Dampers shall be provided with closing features as follows:
 - .1 Vertical Fire Damper with Horizontal Air Flow:
 - .1 weighted to close and lock in closed position when released.
 - .2 Horizontal Fire Damper with Vertical Air Flow or MultiLeaf Fire Dampers:
 - .1 provided with a stainless steel closure spring.
- .7 Angle Iron Frames:

- .1 Duct sizes less than 48" (1200 mm) width or 60" (1500 mm) in height provide the following:
 - .1 1-1/2" x 1-1/2" x 16 gauge (40 mm x 40 mm x 16 gauge) angle iron on full perimeter of frame on both sides of the wall or floor being pierced. Angles shall be fastened to the sleeves with one (1) of the following:
 - .1 1/4" (6 mm) diameter nuts and bolts;
 - .2 welding 6" (150 mm) on centre;
 - .3 No.10 sheet metal screws 6" (150 mm) on centre;
 - .4 3/16" (5 mm) steel pop rivets.
 - .2 Duct sizes 48" (1200 mm) width or 60" (1500 mm) height or greater, provide the following:
 - .1 1-1/2" x 1-1/2" x 1/8" (40 x 40 x 3 mm) angle iron on full perimeter of frame on both sides of wall or floor being pierced. Angles shall be fastened to the sleeves with one of the following:
 - .2 1/4" (6 mm) diameter nuts and bolts;
 - .3 welding 6" (150 mm) on centre;
 - .4 No. 14 sheet metal screws 8" (200 mm) on centre;
 - .5 3/16" (5 mm) steel pop rivets.
 - .3 The maximum single damper of a multiple damper assembly shall be 60" x 54" (1530 mm x 1375 mm) in vertical mountings and 40 x 36" (1000 mm x 900 mm) in horizontal mountings. In cases where the openings are larger than these dimensions, a 12" (300 mm) wide brick or reinforced concrete mullion shall be provided between adjacent assemblies.
 - .4 Sleeves shall be of the same gauge or heavier than the duct they are connecting to. Sleeves shall extend 3" (75 mm) on either side of the wall or floor to facilitate the joining of the sleeve to the duct. In cases where the width of the retaining angle is such that it would inhibit joining the sleeve to the duct, the collar may extend approximately 2" (50 mm) beyond the edge of the angles.
- .8 Standard of Acceptance: Nailor Industries, EH Price, Canada Advanced Air Ltd., Penn Ventilator Canada Ltd. and Ruskin (Kerr-Hunt). Alternative Fire Dampers may be considered by the Consultant provided a cost savings to the Owner can be demonstrated.

2.09 SMOKE DAMPERS

- .1 Smoke dampers shall be listed and bear a label of ULC approval, shall conform to the requirements of UL 555S Standard For Smoke Dampers and shall meet the requirements of NFPA 92A and Authorities having jurisdiction.
- .2 Frame shall be a minimum of 16 gauge metal formed into a structural hat channel reinforced at corners for added strength. The blades shall be airfoil shaped single-piece hollow construction with 14-gauge equivalent thickness. Blade action shall be parallel blade. Damper material shall be the same as the material of the duct that it is installed into.
- .3 Bearings shall be stainless steel sleeve(s), turned into an extruded hole in the frame. Blade edge seals shall be silicone rubber and galvanized steel, mechanically locked into the blade edge. Jamb seals shall be non corrosive stainless steel flexible metal compression type.
- .4 Damper(s) shall be rated for leakage in accordance with UL 555S and shall bear a ULC seal. Leakage shall not exceed 8 cfm per ft² at 4.0" static pressure. Linkage shall be a concealed type for maximum free area. Damper(s) shall have demonstrated capacity to operate under
- .5 HVAC system operating conditions, with pressures up to 4 in.wg. in the closed position and 4000 fpm air velocity in the open position.
- .6 Damper(s) shall be actuated from the smoke sensor or smoke detection system. All wiring and conduit to the smoke damper(s) shall be provided by the Electrical Contractor.

- .7 Appropriate actuator(s) shall be installed by the damper manufacturer at the time of damper fabrication. Damper(s) and actuator(s) shall be supplied as a single entity which meets all applicable UL555S qualifications for both damper(s) and actuator(s). Damper(s) shall be 120 V. Damper(s) shall be spring return.
- .8 Damper(s) and actuator(s) shall be factory cycled for a minimum of ten (10) times to assure operation.
- .9 Each damper shall be provided with a 2-position indicator switch linked directly to the damper blade to provide the capability of remote indicating blade position. All wiring and conduit to the detection system shall be provided by Electrical Contractor.
- .10 Maximum single unit size shall be 40" x 40" (1000 x 1000 mm) vertical mount and 30" x 40" (760 x 1000 mm) horizontal mount.
- .11 Standard of Acceptance: Ruskin, EH Price, Nailor Industries Inc. and Penn Ventilator Canada Ltd. Alternative Low Leakage Smoke Dampers may be considered by the Consultant provided a cost savings to the Owner can be demonstrated.

2.10 COMBINATION FIRE AND SMOKE DAMPERS

- .1 Dampers shall meet all requirements identified in Article "Low Leakage Smoke Dampers" above.
- .2 Combined actuator shall be an electrical control system actuated from the smoke sensor or smoke detection system and from fusible link.
- .3 Electro thermal link dual responsive fusible link which melts when subjected to local heat of 165°F. (74°C.) and from external electrical impulse of low power and short duration; ULC or UL listed and labelled.
- .4 Standard of Acceptance: Nailor Industries, National Controlled Air., Canada Advanced Air Ltd., Penn Ventilator Canada Ltd. and Ruskin (Kerr-Hunt). Alternative Combination Fire and Smoke Dampers may be considered by the Consultant provided a cost savings to the Owner can be demonstrated.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 Locate balancing dampers in each branch duct, for supply, return and exhaust systems.
- .4 Run-outs to registers and diffusers: Install single blade damper located as close as possible to main ducts.
- .5 Seal multiple damper modules with silicon sealant.
- .6 Install access door adjacent to each damper. See Section 23 33 00 - Air Duct Accessories.

- .7 Dampers: Vibration free.
- .8 Ensure damper operators are observable and accessible.
- .9 Corrections and adjustments conducted by Engineer.
- .10 Fire Dampers, Smoke Dampers, Ceiling Dampers and Fire Stop Flaps
 - .1 Fire Dampers and Ceiling Dampers
 - .1 Install to ULC requirements. Locate in fire walls, ceilings and partitions where indicated. Coordinate with and provide ULC installation details to drywall installer.
 - .2 Seal around fire damper assembly.
 - .3 After completion, have installation approved prior to concealment.
 - .2 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.
 - .3 Maintain integrity of fire separation.
 - .4 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
 - .5 Co-ordinate with installer of firestopping.
 - .6 Ensure access doors/panels, fusible links damper operators are easily observed and accessible.
 - .7 Install break away joints of approved design on each side of fire separation.

3.03 FIELD QUALITY CONTROL

- .1 Tests:
 - .1 Tests to demonstrate that system is functioning as specified.
- .2 Verification requirements in accordance with Division 01 and include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource re-use.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Low-emitting materials.

3.04 CLEANING

- .1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 33 10

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- 1.02 SUMMARY
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PART 3 - EXECUTION

- 3.01 MANUFACTURER'S INSTRUCTIONS
- 3.02 INSTALLATION
- 3.03 GRILLES, REGISTERS AND DIFFUSERS
- 3.04 FIELD QUALITY CONTROL
- 3.05 CLEANING

PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.
- .2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.
- .3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 SUMMARY

- .1 Section Includes:
 - .1 Supply, return and exhaust grilles and registers, diffusers and linear grilles, for commercial and residential use.
 - .2 Sustainable requirements for construction and verification.

1.03 QUALITY ASSURANCE

- .1 Materials in accordance with Section 20 05 05 and 20 05 10.
- .2 Health and Safety Requirements:
 - .1 Do construction occupational health and safety in accordance with Division 01 and to suit Health and Safety Requirements.
- .3 Certificates:
 - .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.
- .4 Performance Requirements:
 - .1 Catalogued or published ratings for manufactured items: Obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.
- .5 Grilles, registers and diffusers of same generic type, products of one manufacturer.

1.04 SUBMITTALS

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 20 05 01. Include product characteristics, performance criteria, and limitations. Indicate capacity, throw and terminal velocity, noise criteria, pressure drop and neck velocity.
- .2 Samples:
 - .1 Submit samples in accordance with Section 20 05 01.
- .3 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Spares:

- .1 Provide maintenance materials in accordance with Division 01 and Section 25 05 01.
- .2 Provide following:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.

1.05 DELIVERY, STORAGE, AND HANDLING

- .1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.06 WARRANTY

- .1 Provide warranties as outlined in Section 20 05 05.

PART 2 - PRODUCTS

2.01 GENERAL

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity.
- .2 Frames:
 - .1 Full perimeter gaskets.
 - .2 Plaster frames where set into plaster or gypsum board.
 - .3 Concealed fasteners.
- .3 Concealed manual volume control damper operators.
- .4 Colour: as directed by Consultant.
- .5 For corrosive environments (pool areas) construction, fasteners, screws and supports shall be stainless steel.

2.02 REGISTERS, GRILLES, DIFFUSERS

- .1 Provide registers, grilles and diffusers by manufacturer and sizes, styles and finishes as scheduled on the Drawings.
- .2 Ensure that the items supplied will be compatible with ceiling or wall construction.
- .3 Equipment as manufactured by E.H. Price, Carnes, Barber Coleman, Titus, Nailor Industries, Tuttle & Bailey, Metalaire and Krueger is acceptable.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION

- .1 Install in accordance with manufacturer's recommendations.
- .2 Install with flat head screws in countersunk holes where fastenings are visible.

3.03 GRILLES, REGISTERS AND DIFFUSERS

- .1 Fit frame with gasket to prevent leakage, and smudging.
- .2 Install with oval head plated screws in countersunk holes where fastenings are visible.
- .3 Ensure unit is compatible with ceiling or wall construction.
- .4 Make connections of rigid or flexible ductwork to diffusers, VAV terminals and air distribution boots using a minimum of 3 self tapping screws and seal with glass fab tape and high velocity duct sealer.

3.04 FIELD QUALITY CONTROL

- .1 Verification requirements in accordance with Division 01 and include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource re-use.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Low-emitting materials.

3.05 CLEANING

- .1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 37 13

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- 3.02 INSTALLATION
- 3.03 OUTSIDE AIR AND EXHAUST LOUVRES
- 3.04 FIELD QUALITY CONTROL
- 3.05 CLEANING

PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.
- .2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.
- .3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

- .1 Section Includes:
 - .1 Mechanical louvres, intakes, vents and reinforcement and bracing for air vents, intakes and gooseneck hoods.
 - .2 Sustainable requirements for construction and verification.

1.03 QUALITY ASSURANCE

- .1 Materials in accordance with Section 20 05 05 and 20 05 10.
- .2 Health and Safety Requirements:
 - .1 Do construction occupational health and safety in accordance with Division 01 and to suit Health and Safety Requirements.
- .3 Certificates:
 - .1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

1.04 REFERENCES

- .1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)
 - .1 ANSI/NFPA 96, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society for Testing and Materials International (ASTM)
 - .1 ASTM E90, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)
- .5 Society of Automotive Engineers (SAE)

1.05 SUBMITTALS

.1 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 20 05 01. Include product characteristics, performance criteria, and limitations. Indicate pressure drop, face area, free area.

.2 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.3 Test Reports:

.1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

1.06 DELIVERY, STORAGE, AND HANDLING

.1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.07 WARRANTY

.1 Provide warranties as outlined in Section 20 05 05.

PART 2 - PRODUCTS

2.01 GRAVITY ROOF OUTSIDE AIR INTAKES AND RELIEF VENTS

.1 Factory manufactured aluminum.

- .1 Complete with integral birdscreen of 2.7 mm diameter aluminum wire.
- .2 Horizontal backdraft dampers.
- .3 Maximum throat velocity: 800 fpm intake.
- .4 Maximum loss through unit: 0.15 in.wg. exhaust static pressure.
- .5 Shape: as indicated.

2.02 FIXED LOUVRES

.1 Stationary, extruded aluminum, site proof, weatherproof as manufactured by Ruskin Type ELF211, 150mm (6") deep, 35° blades, complete with 12mm (2") mesh 16 ga. aluminum removable bird screen 50% minimum free area.

.2 Other acceptable manufacturers: Nailor, Airolite, Ventex, Construction Specialties.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION

.1 Install in accordance with manufacturer's recommendations.

.2 Reinforce and brace as indicated.

- .3 Anchor securely into opening. Seal with caulking to ensure weather tightness.

3.03 OUTSIDE AIR AND EXHAUST LOUVRES

- .1 Install to ULC requirements. Locate in fire walls, ceilings and partitions where indicated. Coordinate with and provide ULC installation details to drywall installer.
- .2 Seal around fire damper assembly.
- .3 After completion, have installation approved prior to concealment.

3.04 FIELD QUALITY CONTROL

- .1 Verification requirements in accordance with Division 01 and include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource re-use.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Low-emitting materials.

3.05 CLEANING

- .1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

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PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.
- .2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.
- .3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

- .1 Section Includes:
 - .1 Filters and filter gauges for various types of mechanical air handling equipment.
 - .2 Sustainable requirements for construction and verification.

1.03 QUALITY ASSURANCE

- .1 Materials in accordance with Section 20 05 05 and 20 05 10.
- .2 Health and Safety Requirements:
 - .1 Do construction occupational health and safety in accordance with Division 01 and to suit Health and Safety Requirements.
- .3 Certificates:
 - .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

1.04 REFERENCES

- .1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)
 - .1 ANSI/NFPA 96, Ventilation Control and Fire Protection of Commercial Cooking Operations.
- .2 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)
 - .1 ASHRAE 52.1, Gravimetric and Dust Spot for Testing Air-Cleaning Devices Used in General Ventilation for Removing Particulate Matter (ANSI Approved).
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-115.10-M90, Disposable Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .2 CAN/CGSB-115.11-M85, Filters, Air, High Efficiency, Disposable, Bag Type.
 - .3 CAN/CGSB-115.12-M85, Filters, Air, Medium Efficiency, Disposable, Bag Type.
 - .4 CAN/CGSB-115.13, Filter Media, Automatic Roll.
 - .5 CAN/CGSB-115.14-M91, High Efficiency Cartridge Type Supported Air Filters for the Removal of Particulate Matter from Ventilating Systems.
 - .6 CAN/CGSB-115.15-M91, High Efficiency Rigid Type Air Filters for Removal of Particulate Matter from Ventilating Systems.
 - .7 CAN/CGSB-115.16-M82, Activated Carbon for Odour Removal from Ventilating Systems.

- .8 CAN/CGSB-115.18-M85, Filter, Air, Extended Area Panel Type, Medium Efficiency.
- .9 CAN/CGSB-115.20 Polarized Media Air Filter.
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Underwriters' Laboratories of Canada ULC -S111, Standard Method of Fire Tests for Air Filter Units.
 - .1 ULC-S649, Exhaust Hoods and Related Controls for Commercial and Institutional Kitchens.

1.05 SUBMITTALS

- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 20 05 01. Include product characteristics, performance criteria, and limitations. Indicate, face area, pressure drop, face velocity, physical size and depth.
- .2 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Close-out Submittals:
 - .1 Provide in accordance with Section 20 05 05.
- .4 Spares:
 - .1 Provide maintenance materials in accordance with Section 20 05 01.
 - .2 Furnish list of individual manufacturer's recommended spare parts for equipment such as frames and filters, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing for inclusion in operating manual.
 - .3 Spare filters: In addition to filters installed immediately prior to acceptance by the Consultant, supply 1 complete set of filters for each filter unit or filter bank in accordance with Section 20 05 05.

1.06 DELIVERY, STORAGE, AND HANDLING

- .1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.07 WARRANTY

- .1 Provide warranties as outlined in Section 20 05 05.

PART 2 - PRODUCTS

2.01 GENERAL

- .1 Media: Suitable for air at 100% RH and air temperatures between minus 40 and 50 degrees C.
- .2 Number of units, size and thickness of panels, overall dimensions of filter bank, configuration and capacities: as indicated.
- .3 Pressure drop when clean and dirty, sizes and thickness: As indicated on schedule.

2.02 ACCESSORIES

- .1 Holding frames: Permanent channel section construction of galvanized steel or extruded aluminum 1.6 mm thick, except where specified.
- .2 Seals: To ensure leak-proof operation.
- .3 Blank-off plates: As required, to fit all openings and of same material as holding frames.
- .4 Access and servicing: through doors/panels on each side and/or from upstream face of filter bank.

2.03 FIBROUS GLASS PANEL FILTERS

- .1 Disposable fibrous glass media: To CAN/CGSB-115.10 with adhesive.
- .2 Holding frame: 1.2 mm minimum thick galvanized steel with 3 mm diameter hinged wire mesh screen.
- .3 Performance: minimum average synthetic dust weight arrestance 70 % to ASHRAE 52.
- .4 Fire-rated: To ULC -S111.
- .5 Nominal thickness: 100 mm.

2.04 FILTER SECTIONS

- .1 Provide filter banks for built up air handling systems as shown on the Drawings consisting of framed units field assembled.
 - .1 Prefilter: 50mm (2") thick disposable ULC Class 2 listed and labelled with 85% to 90% arrestance.
 - .2 After Filter: ULC Class 2, 100mm (4") deep disposable filters with non woven cotton fabric media pleated over a welded wire support grid bonded to a rigid high wet strength beverage board enclosing frame.
 - .3 Performance: 25% to 35% efficiency and 90% to 92% arrestance to ASHRAE arrestance test standard 52 76.
 - .4 Maximum Face Velocity 2.54 m/s (500 ft./min.).
 - .5 Holding Frame: Factory fabricated 16 ga. galvanized steel with gaskets and four spring type positive sealing fasteners per unit fasteners to be attached and removable without use of tools.

2.05 RIGID, SUPPORTED BAG TYPE FILTERS, 30-35 % EFFICIENCY

- .1 Media: Disposable preformed fibrous glass, acrylic fibre 100 mm thick cartridge.
- .2 Holding frame: Galvanized steel with bracing.
- .3 Media support: Welded wire grid.
- .4 Performance:
 - .1 Average atmospheric dust spot efficiency 30% to ASHRAE 52.1.
 - .2 Average synthetic dust weight arrestance 90% to ASHRAE 52.1.
- .5 Fire-rated: To ULC -S111.

2.06 CARTRIDGE TYPE FILTERS, 80-85 % EFFICIENCY

- .1 Media: Deep pleated, disposable, high efficiency, to CAN/CGSB-115.14.

- .2 Holding frame: Galvanized steel with bracing.
- .3 Media support: Welded wire grid.
- .4 Performance: Average atmospheric dust spot efficiency 80-85 % to ASHRAE 52.1.
- .5 Fire-rated: To ULC -S111.

2.07 CARTRIDGE TYPE FILTERS 95 % EFFICIENCY

- .1 Media: Disposable, high efficiency, to CAN/CGSB-115.15.
- .2 Holding frame: Galvanized steel with bracing.
- .3 Media support: Welded wire grid.
- .4 Performance: Average atmospheric dust spot efficiency 95 % to ASHRAE 52.1.
- .5 Fire-rated: To ULC-S111.

2.08 BAG TYPE FILTERS, 80-85% EFFICIENCY

- .1 Disposable media bag type of self-inflating ultrafine glass:
 - .1 High efficiency to CAN/CGSB-115.11.
 - .2 Medium efficiency to CAN/CGSB-115.12.
- .2 Holding frame: Galvanized steel.
- .3 Media support: Welded galvanized steel.

2.09 HEPA ABSOLUTE PACKAGE FILTERS 99.97 % EFFICIENCY

- .1 Media: Water resistant fibrous glass.
- .2 Holding frame: Cadmium plated steel by unit manufacturer.
- .3 Housing and sealing system: Manufacturers' standard, suitable for pressure application.
- .4 Unit bank installation: Class 100 level, to US Federal Standard 209A.
- .5 Efficiency: Minimum 99.97 % overall on hot DOP test, using 0.003 mm particles MIL-STD-282.

2.10 HIGH EFFICIENCY FILTERS

- .1 Provide a high efficiency filter assembly consisting of a prefilter and extended surface pocket type after filter.
- .2 Prefilters: ULC Class 2, 50mm thick disposable pleated type.
- .3 Capacity: 25% to 30% efficient to ASHRAE standard 52 76 at 2.54 m/s (500 ft./Min) face velocity.
- .4 After Filter: 300mm (12") deep cell type ULC Class 1 as detailed on the Drawings with 90% average efficiency based on ASHRAE standard 52 76 and conforming to Section 7-4 of ARI Standard 850-78. Max. face velocity: 2.54 m/s (500 ft./min.)
- .5 Acceptable Manufacturers: Farr, Cambridge, American Air Filter.

- .6 Filter efficiency:
 - .1 One pass efficiency of 60% when using particulate of 3.0 micron or larger and tested in accordance with CEA 906 U 708.
 - .2 Submit copies of test reports with shop drawings.

2.11 FILTER GAUGES - DIAL TYPE

- .1 Diaphragm actuated, direct reading.
- .2 Range: 0 to 2 times initial pressure.

2.12 FILTER GAUGES - MANOMETER TYPE

- .1 Inclined acrylic tube.
- .2 Complete with levelling screws.
- .3 Range: 0 to 2 times initial pressure.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION GENERAL

- .1 Install in accordance with manufacturer's recommendations and with adequate space for access, maintenance and replacement.

3.03 ACTIVATED CARBON TYPE FILTERS

- .1 During testing, adjusting and balancing, install substitute media.
- .2 Install permanent media only after painting is completed.

3.04 REPLACEMENT MEDIA

- .1 Replace media with new upon acceptance.
- .2 Filter media new and clean, as indicated by pressure gauge, at time of acceptance.

3.05 HEPA FILTERS

- .1 Use components and devices recommended by manufacturer to ensure complete integrity and to ensure easy removal and replacement, even when dressed in anti-contamination clothing.
- .2 Provide proper permanent facilities for challenging integrity with aerosol injector downstream of pre-filters and test sampling manifold downstream of HEPA filter. Location of injector and sampling manifold approved by manufacturer.
- .3 During TAB, install substitute media having similar pressure drop.
- .4 Before acceptance, perform tests to demonstrate integrity of complete installation.

3.06 FILTER GAUGES

- .1 Install type as indicated across each filter bank (pre-filter and final filter) in approved and easy readable location.
- .2 Mark each filter gauge with value of pressure drop for clean condition and manufacturer's recommended replacement (dirty) value.

3.07 FIELD QUALITY CONTROL

- .1 Verification requirements in accordance with Division 01 and include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource re-use.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Low-emitting materials.

3.08 CLEANING

- .1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 44 00

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PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.
- .2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05, Basic Mechanical Materials and Methods Section 20 05 10.
- .3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

- .1 Section Includes:
 - .1 Materials and installation for piping and fittings used in HVAC heat exchangers.
 - .2 Sustainable requirements for construction and verification:
- .2 Related Sections:
 - .1 Division 01
 - .2 Division 02

1.03 REFERENCES

- .1 American Society of Mechanical Engineers (ASME)
 - .1 ASME Boiler and Pressure Vessel Code.
 - .1 BPVC-VIII B, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 01.
 - .2 BPVC-VIII-2 B, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 02 - Alternative Rules.
 - .3 BPVC-VIII-3 B, BPVC Section VIII - Rules for Construction of Pressure Vessels Division 03 - Alternative Rules High Press Vessels.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA B51, Boiler, Pressure Vessel and Pressure Piping Code.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).

1.04 QUALITY ASSURANCE

- .1 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Division 01, to suit Construction Progress Schedules.
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .2 Health and Safety:

- .1 Do construction occupational health and safety in accordance with Division 01, to suit Health and Safety Requirements.
- .3 Construction requirements: In accordance with Division 01, to suit Sustainable Requirements.
- .4 Verification: Contractor's verification in accordance with Division 01, to suit Sustainable Requirements.
- .5 Heat exchangers for pool water heating to be provided with titanium plate material and EPDM gaskets.

1.05 SUBMITTALS

- .1 Submit manufacturer's printed product literature, specifications, and datasheet for heat exchangers in accordance with Section 20 05 01. Indicate project layout including layout, dimensions of heat exchangers and system.
- .2 Indicate manufacturer's recommended clearances for tube withdrawal and manipulation of tube cleaning tools.
- .3 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
 - .1 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Manufacturer's Field Reports: Manufacturer's field reports specified.
- .5 Closeout Submittals
 - .1 Refer to Section 20 05 05.
- .6 Spares:
 - .1 Provide maintenance materials in accordance with Division 01 and Section 25 05 01.
 - .2 Head gaskets.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.07 WARRANTY

- .1 Provide warranties as outlined in Section 20 05 05.

PART 2 - PRODUCTS

2.01 SHELL AND TUBE HEAT EXCHANGER

- .1 General:
 - .1 Steam to water. Heating media in tube, 2 pass design.
 - .2 Designed, constructed and tested in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, CSA B51 and provincial pressure vessel regulations.

- .2 Shell: steel with operating pressure of 1035 kPa (150 psi). Flanged inlet connection, sizes as indicated. Flanged outlet connection, sizes as indicated. Tappings for relief valve, gauge, drain, vacuum breaker.
- .3 Head: Cast-iron flanged inlet and outlet. Tapped connections for drain and vacuum breaker.
- .4 Tubes: copper, with tube support. Maximum tube velocity: 7.5 ft/s.
- .5 Tube sheet: steel.
- .6 Fouling factor: steam side 0.0005, water side 0.001.
- .7 Capacity: as indicated.
- .8 Dimensions: as indicated.
- .9 Mounting supports: Steel or cast iron saddles.
- .10 Domestic Water Application: Heat exchangers for domestic water application are to be double wall construction.
- .11 Acceptable Manufacturer: S.A. Armstrong, Bell and Gossett.
- .12 Tested and inspected as required by ASME and other local codes.
- .13 Operating and capacity characteristics: Refer to equipment schedules.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION

- .1 General: Install level and firmly anchored to supports in accordance with manufacturer's recommendations.
- .2 Tube in shell heat exchangers: Arrange piping so that tube bundle can be removed after disconnecting two unions or flanges adjacent to head and without disturbing other equipment and systems.
- .3 Plate exchangers: Install in accordance with manufacturer's recommendations.
- .4 Plate and frame heat exchanger: Install heat exchanger level with shims under supports. Arrange piping around heat exchangers to allow plate and gasket removal and re-assembly.

3.03 APPURTENANCES

- .1 Install with vacuum breakers, steam trap, and hose bib drain valves as required.
- .2 Install thermometer wells with thermometers on inlet and outlet of secondary side.
- .3 Install pressure gauge on steam inlet.

3.04 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Have manufacturer of products supplied under this Section review work involved in handling, installation/application, protection and cleaning of its product/s, and submit written reports, in acceptable format, to verify compliance of work with Contract.
 - .2 Provide manufacturer's field services, consisting of product use recommendations and periodic site visits for inspection of product installation, in accordance with manufacturer's instructions.
 - .3 Schedule site visits to review work at stages listed:
 - .1 After delivery and storage of products and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of the Work, after cleaning is carried out.
 - .4 Obtain reports, within 3 days of review and submit, immediately, to the Consultant
- .2 Upon completion of work, after cleaning is carried out.
- .3 Start-up:
 - .1 General: Perform start-up operations in accordance with Division 01 and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements, supplemented as specified herein.
 - .2 Check heater for cleanliness on primary and secondary sides.
 - .3 Check water treatment system is complete, operational and correct treatment is being applied.
 - .4 Check installation, settings, operation of relief valves and safety valves.
 - .5 Check installation, location, settings and operation of operating, limit and safety controls.
 - .6 Check supports, seismic restraint systems.
- .4 Verification requirements in accordance with Division 01 and include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource re-use.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Low-emitting materials.
- .5 Performance Verification:
 - .1 General: Perform performance verification in accordance with Division and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements, supplemented as specified.
 - .2 Timing: Only after TAB of hydronic systems have been successfully completed.
 - .3 Primary side:
 - .1 Measure flow rate, pressure drop, and either one steam pressure and temperature at heater inlet or two water temperature at heater inlet and outlet.
 - .2 Verify operation of steam traps. Measure temperature of condensate return at trap outlet.
 - .4 Control valve: Verify proper operation without binding, slack in components. Measure either steam pressure and temperature at control valve inlet or two if control is three-port type, pressure drop across inlet to common, bypass to common, inlet to bypass.
 - .5 Secondary side:
 - .1 Measure flow rate, pressure drop and water temperature at heater inlet and outlet.
 - .2 Verify installation and operation of air elimination devices.

DIVISION 23 HEATING, VENTILATION AND AIR CONDITIONING

SECTION 23 57 00

HEAT EXCHANGERS FOR HVAC

- .6 Calculate heat transfer from primary and secondary sides.
- .7 Simulate heating water temperature schedule and repeat above procedures.
- .8 Verify settings, operation, safe discharge from safety valves and relief valves.
- .9 Verify settings, operation of operating, limit and safety controls and alarms.
- .10 Reports:
 - .1 In accordance with Division and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements, supplemented as specified herein.

3.05 DEMONSTRATION

- .1 Training: Provide training in accordance with Division 01 and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements, supplemented as specified.

3.06 EQUIPMENT START UP

- .1 Follow manufacturer's instructions and have manufacturer's representative present to certify the installation.
- .2 Check each item of equipment to ensure proper electrical connections, etc., and to verify proper operation.

3.07 CLEANING

- .1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 57 00

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PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.
- .2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.
- .3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

- .1 Section Includes:
 - .1 Materials, components, framing, installation and testing for packaged air handling units.
 - .2 Sustainable requirements for construction and verification.

1.03 REFERENCES

- .1 American National Standards Institute/Air-Conditioning and Refrigeration Institute (ANSI/ARI)
 - .1 ANSI/ARI 430, Central-Station Air-Handling Units.
- .2 American Society of Heating, Refrigeration and Air Condition Engineers (ASHRAE)
 - .1 ANSI/ASHRAE 90.1, (I-P) Energy Standard for Buildings Except Low-Rise Residential Buildings.
 - .2 ANSI/ASHRAE 52.2, Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.181, Ready-Mixed Organic Zinc-Rich Coating.
- .4 Green Seal Environmental Standards (GSES)
 - .1 Standard GS-11, Environmental Standard for Paints.
- .5 Master Painters Institute (MPI)
 - .1 MPI-INT 5.3, Galvanized Metal.
- .6 South Coast Air Quality Management District (SCAQMD), California State (SCAQMD)
 - .1 SCAQMD Rule 1113, Architectural Coatings.

1.04 QUALITY ASSURANCE

- .1 Materials in accordance with Section 20 05 05 and 20 05 10.
- .2 Health and Safety Requirements:

- .1 Do construction occupational health and safety in accordance with Division 01 and to suit Health and Safety Requirements.
- .3 Certificates:
 - .1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency.

1.05 SUBMITTALS

- .1 Provide manufacturer's printed product literature and datasheets for chillers and include product characteristics, performance criteria, physical size, finish and limitations in accordance with Section 20 05 01. Shop Drawings to include:
 - .1 Actual cooling, heating fluid entering, and leaving conditions for stated airside requirements.
 - .2 Fan, fan curves showing point of operation, motor drive, bearings, filters, mixing box, dampers coils, drain locations; include performance data, air volume, total cooling, sensible cooling, EDB, EWB, OAT, SAT.
- .2 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .3 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Closeout Submittals
 - .1 Refer to Section 20 05 05.
 - .2 Include:
 - .1 Description of equipment giving manufacturers name, type, model year, capacity.
 - .2 Start-up and commissioning procedures.
 - .3 Details of operation, servicing and maintenance.
 - .4 Recommended spare parts list.
- .5 Spares:
 - .1 Provide maintenance materials in accordance with Division 01 and Section 25 05 01.
 - .2 Provide one spare set of filters for each filter unit or filter bank.
 - .3 Furnish spare parts data for each different item of equipment specified, after approval of detail drawings.
 - .4 Include with data complete list of parts and supplies, with current unit prices, source of supply, recommended spare parts list for 1 year of operation and list of parts recommended by manufacturer to be replaced on routine basis.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.07 WARRANTY

- .1 Warranty periods for air handling equipment to start on the date of verification of acceptance issued in writing by the Consultant.

- .2 The date of verification of acceptance is independent of Substantial Performance of the Work and may occur after certification of Substantial Performance.
- .3 Air handling equipment will be accepted after start up, a minimum of six hours of logged operation and submission of written verification of same by manufacturer's representative. The Consultant may also witness a portion of any of these this procedure.
- .4 Include verification of acceptance certificates with the maintenance and operating manuals in the appropriate sections.
- .5 Provide warranties as outlined in Section 20 05 05.

PART 2 - PRODUCTS

2.01 GENERAL

- .1 Factory assembled components to form units supplying air at designed conditions as indicated.
- .2 Certify ratings: To ANSI/ARI 430 with ARI seal.

2.02 PACKAGED ENERGY RECOVERY VENTILATOR

- .1 Provide in the arrangements and types as shown on the drawings and described in the Equipment Schedules, factory fabricated packaged energy recovery ventilator constructed with features as follows:
 - .1 Unit Casings: IP34 Enclosure class when cover is closed. Provide removable access doors on service side of unit for servicing of fans and wheel.
 - .2 Fans: statically and dynamically balanced centrifugal SISW with shafts operating less than 80% of first critical speed, bearings selected for average life of 150,000 hours and provided with lubrication fittings extended to the side of the unit where there is sufficient space for convenient servicing, refer to equipment layouts on drawings. Refer to unit schedules for fan performance.
 - .3 Filters: ULC Class 2, 100mm (4") thick pleated type disposable with 25 to 30% efficiency and 90 92% arrestance to ASHRAE standard 52 76 in slide out permanent metal frames. Maximum Face Velocity: 2.03 m/s (400 ft./min.)
 - .4 Drives: Complete with motors as specified in Section 20 05 10, adjustable motor slide rail base, adjustable sheaves and belts.
 - .5 Vibration Isolation: Spring isolators for either suspended or floor mounted application as indicated. Refer to Section 20 05 20.
 - .6 Heat Wheel: Minimum 80% efficient, Heat Recovery Energy Wheels integral to air handling unit.
 - .7 Units as manufactured by Swegon (CASA) or approved alternative.

2.03 VIBRATION ISOLATION

- .1 Flexible connections at inlet and outlet of fan ports: Refer to Section 23 33 00 - Air Duct Accessories.
- .2 Vibration isolators: In accordance with Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment.

PART 3 - EXECUTION

3.01 APPLICATION

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

3.02 INSTALLATION

- .1 Provide appropriate protection apparatus.
- .2 Install units in accordance with manufacturer's instructions and as indicated.
- .3 Ensure adequate clearance for servicing and maintenance.

3.03 FANS

- .1 Provide fan sheaves required for final air balance.
- .2 Install flexible connections at fan inlet and fan outlets.
- .3 Install vibration isolators.

3.04 FIELD QUALITY CONTROL

- .1 Site Tests:
 - .1 Test under actual operating conditions to verify specified performance.
- .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 Verification requirements in accordance with Division 01 and include:
 - .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource reuse.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Low-emitting materials.

3.05 DRIP PAN

- .1 Install deep deal P traps and trap seal primer on drip lines.
 - .1 Depth of water seal to be 1.5 times static pressure at this point.

3.06 CLEANING

- .1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 73 11

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- 3.01 GENERAL
- 3.02 INSTALLATION
- 3.03 START-UP SERVICE

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- .1 Comply with requirements of the Owner's General Requirements and all documents referred to therein.

1.02 DESCRIPTION

- .1 Comply with requirements of Section 20 01 10 Mechanical General Requirements.
- .2 Comply with requirements of Section 20 01 50 Basic Materials and Methods.
- .3 Comply with requirements of Section 20 05 70 Motors, Motor Starters, Motor Control Centres, Variable Frequency Drives and Wiring

1.03 WORK PERFORMED BY THIS SECTION

- .1 Provision of Custom Air handling Units.

1.04 QUALITY ASSURANCE

- .1 Qualifications: execute work of this section only by skilled tradesmen regularly employed in the construction and installation of Custom Air Handling Units.
- .2 Submittals: Submit shop drawings for the following Products:
 - .1 Custom Air Handling Units and all components and accessories

1.05 REFERENCE STANDARDS

- .1 Provide fan ratings based on tests meeting ASHRAE and AMCA procedures and provide only fans carrying the AMCA seals. No fan will be accepted which has a point of rating not listed in the published data or which is not rated for air and sound performance.
- .2 Fans shall be factory balanced, statically and dynamically to AMCA Standards.
- .3 Factory finish coat over primer on all parts. Spray paint before assembly and repaint after reassembly.
- .4 Units shall be designed and constructed to meet the following standards:
 - .1 CSA Z317.2-15 Special Requirements for Heating, Ventilation, and Air-Conditioning (HVAC) Systems in Health Care Facilities. Note: Not all the requirements in this CSA Standard are summarized in this Section of Specification. Manufacturer shall make reference to and comply with this CSA standard.
 - .2 ASHRAE 51-07 – Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating.
 - .3 ASHRAE 90.1 – 2010 Standard for Energy Efficient Design for New Buildings.
 - .4 AMCA Standard 300-2006 Reverberant Room Method for Sound Testing of Fans.
 - .5 AMCA Standard 301-2006 Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 - .6 ARI Standard 575-94 Method of Measuring Machinery Sound Levels within Equipment Rooms.
 - .7 ARI Standard 350-2000 Sound Rating of Non-Ducted Indoor Air-Conditioning Equipment.
 - .8 ASHRAE Standard 68-97/ AMCA Standard 330-97 Method of Testing In-Duct Sound Power Measurement Procedure for Fans.
 - .9 ASHRAE 52.2
 - .10 ANSI Standard 221.47
 - .11 ARI 850-93 Section 7.4

- .12 CGA, ETLC, CSA or UL/ULC certified for prewired equipment
- .13 NRCA Standard for Roof Curbs
- .14 NFPA 90A for flame and smoke spread for adhesives

1.06 ACOUSTICAL PERFORMANCE

- .1 Acoustical performance shall be established by AMCA standard 330, ASHRAE Standard 68 or ARI 260P procedures.
- .2 Sound data shall be supplied that does not exceeds levels requirements indicated on schedules or fan performance data sheets; any sound data presented as 'sones' or 'Bels' is not acceptable.

1.07 SITE VISIT

- .1 Visit the site prior to tender and verify all conditions. Prior to submitting price, the Mechanical Division contractor is to review all discrepancies and verify the locations of all existing services that are being extended and the routing of new services. Also report all ambiguities, discrepancies, departures from building by-laws and/or from good practice. Failure to do so will result in all additional costs being the responsibility of the Mechanical Division Contractor. Include for any alternate routing of new or rerouting of existing services to accommodate all site conditions in the tender price.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

- .1 Provide factory assembled custom air handling unit in configuration as indicated on drawings. Unit shall include all specified components installed at the factory. Field fabrication of units and their components will not be accepted unless otherwise specified; verify shipping arrangement with Mechanical Contractor during shop drawing review stage.
- .2 Provide factory fabricated and assembled air handling units with the following components:
 - .1 Weather hood arranged to avoid snow entrainment to inlet dampers and filter section.
 - .2 Modulating opposed blade insulated outdoor air intake dampers and exhaust discharge air dampers;
 - .3 Pre-filters filter section;
 - .4 Hydronic water/glycol preheating coil, incorporating coil racks, downstream of filer section;
 - .5 Heat recovery section with speed controlled enthalpy wheel.
 - .6 Hydronic water/glycol main heating coil, incorporating coil racks, downstream of heat recovery section;
 - .7 Hydronic cooling coil, incorporating drain pans and coil racks;
 - .8 Supply air blower section including supply fans, motors, and drives.
 - .9 Final filters at outdoor air intake/ fan discharge (arrangement as shown on the drawings);
 - .10 Pre-filters for return air sections upstream of heat recovery wheel section;
 - .11 Return air blower section including return fans, motors and drives.
- .3 Access plenums arranged to clean and service all coil faces, heat recovery wheel, and replace filters.
- .4 Factory controls with interface to BAS;
- .5 Intake and exhaust located to avoid short circuiting of exhaust air into intake of unit.
- .6 Air handling units and related equipment and components shall be shipped "knocked down" suitable for rigging and hoisting onto place as shown on the drawings; disassembly and reassembly shall not adversely affect air handling unit(s) warranty.

- .7 All air handling units shall be suitable for use with variable speed drives to control the supply and return air volumes.
- .8 Air handling units shipped to site double wrapped in polyethylene wrapping. Units shall be factory cleaned utilizing neutral cleanser prior to shipment to site.
- .9 Testing:
 - .1 The unit manufacturer shall factory pressure test one (1) representative sample air handling units to ensure that the leakage rate of the casing does not exceed 1.5 percent of the unit air flow capacity at 1.5 times the highest internal static pressure. Leakage test shall be performed with humidification and heat wheel installed (where units with wheels are specified).
 - .2 Consultant will determine which units will be pressure tested.
 - .3 Test shall be conducted in accordance with SMACNA duct construction manual. A calibrated orifice shall be utilized to measure leakage air flow.
 - .4 An Officer of the air handling unit manufacturer shall conduct pressure certification tests in the presence of the Consultant. Copies of the certified pressure test results shall be forwarded as a Shop Drawing in accordance with Section 20 05 10.
- .10 Semi-Custom Air Handling Unit Acceptable Manufacturer: VTS, or approved alternate.

2.02 CABINET FAN ASSEMBLIES

- .1 Casing:
 - .1 All walls shall be constructed of minimum 2" (50mm) thick, "double wall" solid thermal panels.
 - .1 Exterior wall panels shall be of minimum 16 (1.6 mm) gauge satin coat galvanized sheet metal.
 - .2 Provide minimum 4000 hrs salt spray resistance on air handling unit wall exterior based on salt spray test verification report conducted within last five (5) years; air handling unit finished shall be as follows:
 - .1 Clean all surfaces to be painted with Hi-Lite Solution Paint Prep 4110 to remove any oils, grease or other contaminants from the surface to be painted.
 - .2 Ensure surface is clean and free from any dust before painting.
 - .3 Apply one coat of Industrial Wash Primer P60G2 minimum dry film thickness of 0.2 to 0.4 mils. Topcoat after 10 to 60 minutes and respect maximum recoat time of 4 hours.
 - .4 Apply two (2) coats of Polane S Plus, Polane 8890 or Polane G Plus at minimum of 1.8 mils and up to 2.5 mils dry film thickness each coat; dry film thickness film thickness minimum 3 mils total once complete.
 - .3 The inner wall shall be a minimum of 22-gauge solid galvanized sheet metal; except cooling coil section and humidifier section where 22-gauge stainless steel liner shall be used.
- .2 All walls, roofs and floors shall be of formed construction, with at least two breaks at each joint. Joints shall be secured by sheet metal screws or pop rivets. Wall and floor joints shall be broken in for rigidity. All joints shall be caulked with a water resistant sealant. Wall and roof seams shall be turned inward to provide a clean flush exterior finish. All panel seams shall be sealed during assembly to produce an airtight unit. All wall construction shall be waterproof construction to facilitate wash down of units.
- .3 All units shall be internally insulated with 2" (50 mm) thick 2.54 lb./cu.ft. (xx kg./cu.m.) density fibre glass thermal insulation. All insulation is to be covered by solid liner, as

described above. All permanently joined flanged panel surfaces shall be sealed with an individual strip of tape sealer. All insulation edges shall be protected with metal lagging.

- .4 Casing shall be uniform in cross sectional area throughout the unit; increase or reduction in unit cross section for certain sections will not be acceptable.
- .5 Supply air opening sizes and locations are for indication only. Opening sizes and locations are subject to change during shop drawing stage at Consultant's sole discretion; make allowance for changes at no extra costs.
- .6 For sections with operating pressure exceeding 6" WC (1500 Pa), provide continuous high pressure sealant between panels.
- .7 Duct plenum connections shall be radiuses bell mouth type with radius equal to wall thickness when there are dampers present.
- .2 Base Construction:
 - .1 Units shall be constructed from structural steel channel iron around the perimeter of unit, with intermediate channel and angle iron supports. Units with total fan static pressure less than or equal to 6" WC shall have a minimum 6" (1500mm) base; units with total fan static pressure greater than 6"WC shall have a minimum 10" (C10x15.3 ASTM A36 base) channel.
 - .2 8 gauge (0.125") aluminium checker plate floor shall be installed on the base. Floor shall be flat, reinforced from below, with all seams continuously welded. Base shall be provided with lifting lugs, minimum four (4) per unit section. The base shall be insulated with 2" (50 mm)
 - .3 2.54 lb/cu.ft (xx kg/cu.m) fiberglass and 22-gauge liner at underside of unit; liner shall be broken, tack welded and sealed for rigidity and vapour barrier integrity.
 - .4 Provide drain connections in all air handling unit sections. Air Handling Unit installation Trades shall connect drains in fan sections, upstream and downstream of all coils and humidifiers, in mixing/intake sections, and terminate over floor drains; provided threaded caps on drain connections where water or condensate is not expected to accumulate. Drain pans shall slope to drains in cooling coil and humidifier sections.
 - .5 All drain connections on floor mounted air handling units shall terminate at the side of the unit.
 - .6 Provide stainless steel sloped primary drain pans under the humidifier, and the cooling coil sections drain pan shall have a minimum slope of 2% in two directions with no dished areas, to ensure no standing water.
 - .7 Provide pans that extend a minimum of 8" (200 mm) downstream of the cooling coil face and to include all return bends and headers.
 - .8 Provide intermediate secondary stainless steel drain pans connected to the primary drain pan for stacked coils.
 - .9 Provide 1 1/2" (38 mm) drain stainless steel drain connections that extend through the exterior of the unit.
- .3 Access Doors:
 - .1 Units shall be provided with access doors to the following components: fans and motors; each bank of filters; dampers and operators; coils; humidifier; access plenums and wherever identified on the drawings. Access doors shall be large enough for easy access. Access doors at fan section shall be wide enough to remove motors but shall not be less than 24" (600mm), located at centerline of motor; other access doors to be minimum 18" wide. Removal of screwed wall panels will not be acceptable.
 - .2 Access doors shall be manufactured from 16-gauge galvanized steel. The doors shall be double wall construction with 22-gauge solid metal liner on the inside. Corners of the doors

shall be continuously welded for rigidity. A minimum of 2" (50mm) 4.5 lb/cu.ft. (xx kg/cum) density insulation shall be sandwiched between the 16-gauge outer layer and the 22-gauge solid inner layer.

- .3 Provide hinged access doors in welded steel frames. Doors shall be fully lined with 13mm hollow round automotive bulb gasket with a metal encapsulated reinforced backing that mechanically fastens to the door frame. Two (2) Ventlok 310 handles per door on continuous piano hinges (alternatively gate hinges with Allegis handles will be considered acceptable). Minimum door opening size shall be 72" (1800mm) high where unit height permits.
- .4 Provide 10" (250mm) round glazed tempered glass window in each fan plenum access door. All doors to be identical construction. Viewing windows shall be arranged that the centerline of the window shall be 5' (1500mm) from finished floor level based on 6" housekeeping pads where unit height permits.
- .5 Hinged access doors to areas of negative pressure shall open out, and to areas of positive pressure shall open in. In areas where clearance is limited positive pressure outward swing door may be considered provided and additional safety latch is provided. Handles shall be provided on both sides of doors.
- .4 Plenum Sections:
 - .1 Provide plenum sections, with access doors as specified previously, minimum {750 mm} [30"] long.
 - .2 Construct the plenum section casings in the same way as the unit casings.
- .5 Filter Gauges:
 - .1 Provide Dwyer 2000 magnehelic gauges or equal.
 - .2 Magnehelic gauges shall be accurate to +/-2% of full range.
 - .3 One gauge shall be provided for each bank of filters.
 - .4 Flush mount gauges on unit panel.
- .6 Test Ports:
 - .1 Provide a factory installed test port through the casing of the unit for each section of the air handling unit to allow the air balancer to read differential pressure across each section. Test port shall be Duro Dyne IP2, or equal.
 - .2 Provide a factory installed port for the wiring of the supply and return fans and a port for the freezestat located in accordance with the details and specification.
 - .3 Test port shall be a continuous tube to prevent fiberglass coming in contact with the air stream. Tube shall be factory welded on each end and capped with a plastic plug on the outside of the air handling unit.
 - .4 For units with flow stations mounted in the fan housing provide ports in the casing of air handling unit to allow for installation of the air flow station.
- .7 Control Dampers:
 - .1 Provide insulated low leak fresh air intake and relief air control dampers in accordance with Section 23 33 10.
 - .2 Insulated control dampers shall be equipped with an all-weather PVC seal, fastened with a positive grip PVC backing, on all interlocking edges, extruded aluminium blades with internal insulation and stainless steel side seals.

2.03 FANS

- .1 General Requirements:

- .1 Base fan performance at standard conditions (air density 0.075 lb. /ft³).
- .2 Fans selected shall be capable of accommodating static pressure and flow variations of +/- 15% of scheduled values.
- .3 Each fan shall be direct drive in AMCA arrangement 4 only according to drawings.
- .4 Fans are to be equipped with lifting points.
- .2 Fan Housing:
 - .1 Plenum fans shall be of the unhooded direct drive centrifugal type.
 - .2 Fan plate shall be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.
 - .3 Panels and framework shall be constructed of galvanized steel to provide a rigid structure to support the shaft and bearings and reduce low frequency vibration.
 - .4 Fan base angles shall be recessed to reduce overall width of the assembly.
- .3 Fan Wheel:
 - .1 The fan wheel shall be non-overloading airfoil centrifugal type. Wheels shall be statically and dynamically balanced to balance grade G6.3 per ANSI S2.19.
 - .2 The fan wheel shall be manufactured with a minimum of 12 continuously welded aluminum airfoil blades to move the blade pass frequency into the mid-octave bands.
 - .3 The entire wheel shall be constructed of aluminum to reduce the rotational weight of the wheel and reduce vibration. Fan sizes through 49 shall use 6063-T5 extruded aluminum blades, fan sizes greater than 49 shall use 5052-H32 laser cut and die formed aluminum blades to ensure precision blade tolerances, improve efficiency and reduce vibration.
 - .4 Wheel hubs shall be cast of 319 aluminum alloy.
 - .5 Aluminum fan wheels shall not require finish coating.
 - .6 The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.
- .4 Fan Motor:
 - .1 Provide Totally Enclosed Fan Cooled (TEFC) with a 1.15 service factor in accordance with Section 20 05 70.
 - .2 Structural steel bases to be designed and manufactured by the fan supplier to ensure proper alignment of the fan and motor and structural integrity of the base to prevent vibration.
- .5 V-Belt Drives and Guards:
 - .1 For belt drive fans, provide V-Belt drives and guards between fans and fan motors.
- .6 Vibration Isolation:
 - .1 Integral vibration isolation shall be provided for the fan and motor. Isolators shall be free standing with sound deadening pads and leveling bolts.
 - .2 Spring diameter to compressed operating height ratio shall be 1 to 1; deflection to be minimum 2" (50 mm).
 - .3 Provide a fiberglass reinforced neoprene coated flexible connection between fan outlet and unit casing and return air fan outlet and unit casing.
 - .4 Provide temporary tie-down of fan base for shipment.
 - .5 Fan assembly bases and isolators shall have earthquake restraints.
- .7 Backdraft Dampers:

- .1 For air handling units with a supply or return fan array assembly provide heavy duty backdraft dampers equal to Ruskin model BD6 at the discharge of each fan to prevent short circuiting of air in the fan array in the event of a fan shut down for servicing or in a failure mode.
- .2 Backdraft dampers shall be leakage tested and certified to AMCA Standard 500 to produce a maximum of 17.5 CFM/sq.ft. (0.7%) when subject to a differential pressure of 1.0 in.wg with a back pressure of 12 in.wg. for a 24" wide damper section and 2500 ft/min air velocity.
- .3 Backdraft dampers shall meet the following minimum construction standards:
 - .1 Frame shall be 0.125" (3.2 mm) wall thickness 6063T5 extruded aluminum.
 - .2 Frame shall have galvanized steel braces at all corners.
 - .3 Blades shall be 0.070" (1.8 mm) wall thickness 6063T5 extruded aluminum.
 - .4 Blades shall begin to open at approximately 0.12 in. wg. and be fully open at approximately 0.20 in.wg. static pressure.
 - .5 Blade edge seals shall be extruded vinyl mechanically locked into blade edge; adhesive type seals are unacceptable.
 - .6 Bearings shall be corrosion resistant long life synthetic for quiet operation.
 - .7 Linkage shall be 1/2in. (13 mm) tie bar with stainless steel pivot pins; linkage shall have the capability of being manually locked in the closed position for independent fan isolation from the remained of fans in the array.
 - .8 Damper shall be designed for 3500 fpm maximum spot air velocity.

2.04 COILS

- .1 Coils shall be fully enclosed within casing and mounted on stainless steel racks for cooling coils and heat recovery coils, and galvanized steel racks for heating coils manufactured to allow coils to slide out individually. Cooling coil and heat recovery coil casings shall be stainless steel construction, heating coil casings shall be galvanized steel construction.
- .2 Removable coil access panels shall be provided to remove coils through casing wall without dismantling upstream or downstream components.
- .3 Coils shall be individually removable on either side of the unit.
- .4 Coils shall be designed for chilled water cooling, low temperature heating water, or hot glycol water service as required.
- .5 Equip all coils with a vent tapping at top of coil header and a drain tapping at the bottom header each extended to terminate external of the unit.
- .6 Coils shall be certified in accordance with ARI Standard 410-81.
- .7 Construct coils of 5/8" (16mm) OD copper tubing, 0.020" tube wall thickness with copper headers and aluminium fins attached to the tubes with a positive and permanent bond. Return bends for pre-coils and re-coils in make-up air units shall be not less than 0.028" tube wall thickness.
- .8 Coils shall be hydrostatically tested at 400 psig, (2758 KPa) and shall be suitable for working pressures and temperatures up to 200 psig (1379 KPa) and 220°F (104°C).
- .9 Coils shall have serpentine circuiting arranged for counter flow between the air and water.
- .10 Pipe connections shall be on the same end, and shall be threaded.
- .11 On cooling coils use vertically corrugated fins, if required.
- .12 Air handling unit manufacturer to extend coil connections, coil drain and vent connections through the casing wall and properly grommet and seal to ensure leakage specification is met.
- .13 Drain pans shall be continually welded stainless steel. All drain pans at different level shall be internally piped to one common drain connection for each section. Interconnecting drain spouts

shall be at least 1-1/2" (40mm) dia stainless steel. Multiple drains for cooling coil section for field connection is not acceptable.

- .14 Coil and drain connections shall be capped with soldered caps for shipment.
- .15 Where noted, provide opposed blade bypass dampers across coils; dampers shall be Tamco 1000 or equal, sized to bypass 10% of air flow.
- .16 Where noted for low temperature coils, provide face dampers for each tier of coil to maintain controllability of the coils.

2.05 HEAT ENERGY RECOVERY WHEELS

- .1 Where indicated on the drawings, provide Heat Recovery Energy Wheels integral with Air Handling Units.
- .2 The Heat Recovery Energy Wheel shall be the sole responsibility of the Air Handling Unit Manufacturer.
- .3 Heat recovery wheels shall be designed and installed with seismic restraints such that the heat recovery wheels can operate normal under and after any earthquake conditions.
- .4 The performance of the heat recovery wheel shall meet the performance outlined in the drawing/equipment schedule.
- .5 The Air Handling Unit Manufacturer shall guarantee the performance of the wheel as to its total heat transfer capacity and its operation.
- .6 The wheel shall be shipped to the air handling unit manufacturer for factory installation in the Air Handling Unit Manufacturer's cabinet. Any required field assembly, by design, will be limited to a minimum.
- .7 Heat Transfer Media:
 - .1 The wheel shall be constructed of sheet aluminium, with alternate layers corrugated and with adjacent layers glued to each other for stability.
 - .2 Wheels shall be tension wound on to a central hub.
 - .3 All aluminium services shall be coated with a non-migrating adsorbent specifically developed for the selective transfer of water vapour.
 - .4 Latent heat transfer rate shall be equal to the sensible heat transfer rate, +/- 6%, throughout the complete range of operation.
 - .5 The method for calculating the performance shall be certified in accordance with ASHRAE 84-2008 and ARI 1060 standards. The certification shall be conducted by a qualified independent organization.
 - .6 The heat wheel shall be cleanable with compressed air without damage to the aluminium or desiccant.
- .8 Wheel Housing:
 - .1 The motor housing shall be a structural framework which limits the deflection of the motor due to pressure loss to less than 1/32" (0.78 mm).
 - .2 Housing shall be constructed of galvanized tubular construction painted with epoxy paint.
- .9 Wheel Structure:
 - .1 The wheel shall be held securely together with wheel spokes extending radially from the hub to the peripheral banding.
 - .2 Spokes shall be flush mounted in the rotor media.
 - .3 The media shall be segmented to allow for field erection or replacement of one section at a time without requiring side access.

- .4 Wheels of 1800 mm diameter and smaller shall be provided in one piece construction provided that they will fit through the access door. Larger wheels shall be constructed in 4 to 8 removable pieces in order to fit through the door.
- .10 Wheel Support:
 - .1 The wheel shall be supported by two pillow block bearings which in turn are supported by a steel support coated with epoxy paint.
 - .2 The bearings shall be located in the shadow of the bearing support member and the division between air streams, to maximize the free area of the rotor as much as possible.
 - .3 The bearings shall be replaceable without removing the wheel from the air handling unit.
- .11 Wheel Seals:
 - .1 Wheels shall be provided with non-contact labyrinth seals around the perimeter of the wheel and across the face at division between the supply and exhaust sectors.
 - .2 Adjustable seals shall be spaced not more than 1/32" (0.8mm) from the rotor surface.
 - .3 These multi-pass seals shall utilize at least four labyrinth stages for optimum performance.
- .12 Purge System:
 - .1 The unit shall be provided with a purge system to allow a percentage of outdoor air to sweep through the exhaust air sector to eliminate the possibility of exhaust air to the supply air stream.
 - .2 The Manufacturer shall ensure that the pressure at the entering side of the exhaust air sector of the wheel is lower than the pressure at the entering side of the supply air sector. In the case of draw through fans this will necessitate a field adjustable damper in the exhaust system. Upstream of the total energy wheel.
 - .3 The manufacture shall select the supply and exhaust fans to provide the additional air for purge where required.
 - .4 The purge shall limit cross contamination to less than 0.04 percent of the exhaust air stream concentration.
- .13 Wheel Drive System:
 - .1 The motor shall be driven by a self-adjusting belt system.
 - .2 The wheel shall be driven by a continuous V belt around the perimeter of the wheel connected to a AC gear motor, permanent magnet type.
 - .3 Access to the motor and drive shall be from the face of the wheel. Provide variable speed control by the use of an A/C inverter.
 - .4 Provide a speed adjustment pot mounted on the front of the enclosure.
 - .5 The motor and drive system must allow for a turndown ratio of 80:1 (20 rpm to ¼ rpm).
 - .6 Provide internal overload protection and vibration sensor.
- .14 Controls:
 - .1 The controls for the wheel shall be provided by the BAS Trades.
 - .2 The controls shall control the wheel as follows:
 - .3 The following controls shall be provided:
 - .1 Discharge air temperature control.
 - .2 Free cooling function
 - .3 Summer/Winter changeover
 - .4 Prevention of Frost Formation

- .5 Heat recovery wheel bypass
- .4 The BAS shall provide an exhaust air temperature sensor, supply air temperature sensor downstream of the wheel and an exhaust air relative humidity sensor. The outside air temperature sensor(s) provided for the facility shall be utilized to determine whether the unit is in summer or winter mode.
- .5 The BAS shall send a 4 – 20 mA signal to the variable speed drive provided by the unit manufacturer to vary the speed of the wheel as required by the following control sequence.
- .6 In the heating mode, as the discharge air temperature nears setpoint the speed of the wheel shall be slowed to maintain setpoint. When the minimum speed is reached and there is a cooling demand, the wheel shall stop completely.
- .7 The wheel shall remain off until the outdoor air temperature exceeds the exhaust air temperature, at which time the wheel will resume operation at full rpm.
- .8 When the outdoor air temperature drops below the frost threshold (see schedule) the wheel speed shall be controlled to maintain the relative humidity in the exhaust air at less than 90% RH.
- .9 The wheel manufacturer shall coordinate with the BAS manufacturer at the shop drawing stage of the project.
- .10 The control panel shall receive an input signal from the BAS to reset the supply air temperature as required.

2.06 FILTERS

.1 General:

- .1 Allow minimum 18" (450mm) clearance upstream of filter to allow full utilization of all filter elements.
- .2 Filters: Suitable for air at 100% RH and air temperatures up to 350°F.
- .3 Filters shall bear burst strength of 10 in.wg. (2500 Pa).
- .4 Provide air filter section in each air handling unit to accept specified filters including frames for removal through the plenum section, upstream of the filters.
- .5 Provide frames reinforced to prevent deflection by the air stream with a 6 in.wg. (1500 Pa) pressure drop.
- .6 Provide blank-off plates and gaskets to prevent air bypass.

.2 Pre-filters:

- .1 Provide filter racks on each side of heating coil to accept pre-filters.
- .2 Pleated Panel Filters: 2" deep (50mm), MERV 8, UL 900 Class 2 and as follows:
 - .1 Each filter shall consist of an individual pleated media pack, enclosed in a clay coated board frame, with integral pleat stabilizers and support straps.
 - .2 Filter media shall be a blend of 100% virgin synthetic fibres.
 - .3 Filter media must be self-supporting in pleated form, with no metal or plastic material laminated to the media to provide pleat support.
 - .4 The pleated media pack must be enclosed in a 1-piece, 28 pt. moisture resistant beverage carrier board frame.
 - .5 Filter must have three pleat stabilizers bonded to the media on the air leaving side and three support straps adhered to the air entering side of the filter. The pleat stabilizers must be made of moisture resistant beverage carrier board, and bonded to the media to maintain the proper pleat spacing throughout the life of the filter.

The support straps are to be made from moisture resistant beverage carrier board and must be adhered along the tips of each pleat.

- .3 Filters of the size and air flow capacity shall meet the rated performance specifications based on the ASHRAE 52.2-1999 test method. Pertinent tolerances specified in Section 7.4 of the Air-Conditioning and Refrigeration Institute (ARI) Standard 850-93 shall apply to the performance ratings. All testing is to be conducted on filters with a nominal 600mm x 600mm (24"x24") face dimension.
- .4 The filters shall be approved and listed by Underwriters' Laboratories, Inc. as Class 2 when tested according to UL 900 and CAN 4-5111.
- .3 Final Filters - High Efficiency:
 - .1 Extended Surface V-Bank Cartridge Filters: 4" (100mm) deep, MERV 13 per the equipment schedules, UL 900 Class 2 and as follows:
 - .1 The moulded end panels are to be made of high impact polystyrene plastic.
 - .2 The centre support members shall be made of ABS plastic; no metal components are to be used.
 - .3 The media shall be made of micro glass fibres with a water repellent binder. The media shall be a dual density construction, with coarser fibres on the air entering side and finer fibres on the air leaving side.
 - .4 The media shall be pleated using separators made of continuous beads of low profile thermoplastic material.
 - .5 Media packs shall be bonded to the structural support members at all points of contact to ensure rigidity and to eliminate potential air bypass.
 - .2 Filters of the size, air flow capacity and nominal efficiency (MERV) shall meet the rated performance specifications based on the ASHRAE 52.2-1999 test method. Where applicable, performance tolerance specified in Section 7.4 of the Air-Conditioning and Refrigeration Institute (ARI) Standard 850-93 shall apply to the performance ratings. All testing is to be conducted on filters with a nominal 600mm x 600mm (24"x24") header dimension.
 - .3 The filters shall be approved and listed by Underwriters' Laboratories, Inc. as Class 2 when tested according to UL 900 and CAN 4-5111.
- .4 Acceptable filter manufacturers (as listed or equal): AAF "PerfectPleat M8", Farr, Flanders, PM Wright, Dafco, Thermotech.

PART 3 - EXECUTION

3.01 GENERAL

- .1 Comply with Manufacturer's requirements for the installation of all specified equipment and all requirements of the Authorities Having Jurisdiction ("AHJs").
- .2 Provide all required labour necessary for the installation of control components and devices supplied by Controls Trades. Include all additional labour necessary for the successful completion of point-to-point verification of devices, and performance verification of devices and systems as part of the project commissioning requirements.
- .3 Air handling units with humidifier section shall be shipped as a complete packaged system. Shop drawings shall be submitted as one system.
- .4 Manufacturer shall allow for multiple deliveries and shall coordinate with the Mechanical Contractor on multiple deliveries.

3.02 INSTALLATION

- .1 Provide cabinet fan assemblies for systems as shown.

- .2 Secure each fan, unless otherwise noted, in place on vibration isolation as shown.
- .3 Provide adjacent factory made sections for systems as shown and secure in place as for fan cabinets but less vibration isolation hardware.
- .4 Adjust housekeeping pad to accommodate air handling unit manufacturer's recommended condensate trap height requirements.
- .5 Ensure that each section and the associated cabinet fan is level and plumb, and properly aligned.
- .6 Provide variable frequency drive for systems where required;
- .7 Provide all required air filters, located and arranged as required. Provide all required filter assembly frames and install to prevent air by pass and to permit easy filter removal. Construct frames from the same material as the plenum, casing or duct the filters are associated.
- .8 Provide a filter gauge for each main air handling system. Install the filter gauge across each filter section. Secure gauges in place on the filter section casing in an easily readable location. Adjust each gauge to suit the design pressures of the system with new fresh filters in place.
- .9 Reassembly requirements:
 - .1 Air handling units noted to be supplied to the site "knocked down" shall be reassembled on site by the Contractor under supervision of the air handling unit manufacturer.
 - .2 Completely disassemble air handling unit following factory performance testing;
 - .3 Cover all openings exposed during disassembly and reassembly;
 - .4 Provide mating connections (flanges, dowels or similar) to allow for proper alignment in the field;
 - .5 Reconnect all electrical and communication conduit connections;

3.03 START-UP SERVICE

- .1 Provide a factory-trained service technician to start and commission the units. In addition, factory shall allow for each unit to carry out start-up, commissioning and instruct Owner's representatives; dates will be determined by Owner's representative. These shall be in addition to the field pressure testing of the air handling units.
- .2 Manufacturer shall allow for additional site visits to ensure compliance of the installation; these are in addition to those specified for start-up, testing and commissioning noted above. Dates will be assigned by Owner's representative.
- .3 Provide a start-up log by the manufacturer to document the unit start-up.

END OF SECTION 23 75 10

CONTENTS

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PART 2 - PRODUCTS

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PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.
- .2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.
- .3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

- .1 Section Includes:
 - .1 Materials and installation for cabinet heaters, unit heaters and infrared heaters.
 - .2 Sustainable requirements for construction and verification.
- .2 Related Sections:
 - .1 Division 01
 - .2 Division 02

1.03 REFERECES

- .1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .2 Hydronic Institute of Boiler and Radiator Manufacturers (IBR)

1.04 QUALITY ASSURANCE

- .1 Materials in accordance with Section 20 05 05 and 20 05 10.
- .2 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Division 01, to suit Construction Progress Schedules.
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .3 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Division 01, to suit Health and Safety Requirements.
- .4 Construction requirements: In accordance with Division 01, to suit Sustainable Requirements.
- .5 Verification: Contractor's verification in accordance with Division 01, to suit Sustainable Requirements.

1.05 SUBMITTALS

- .1 Provide manufacturer's printed product literature and datasheets and include product characteristics, performance criteria, physical size, finish and limitations in accordance with Section 20 05 01. Shop Drawings to include:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Mounting methods.
 - .4 Physical size.
 - .5 kW rating, voltage, phase.
 - .6 Cabinet material thicknesses.
 - .7 Limitations.
 - .8 Colour and finish.
 - .9 Equipment, capacity and piping connections.
 - .10 Dimensions, internal and external construction details, recommended method of installation with proposed supports, sizes and location of mounting bolt holes
- .2 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .3 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Manufacturer's Field Reports: Manufacturer's field reports specified.
- .5 Closeout Submittals
 - .1 Refer to Section 20 05 05.
 - .2 Include:
 - .1 Description of equipment giving manufacturers name, type, model year, capacity.
 - .2 Start-up and commissioning procedures.
 - .3 Details of operation, servicing and maintenance.
 - .4 Recommended spare parts list.
- .6 Samples:
 - .1 Provide samples in accordance with Division 01 and Section 25 05 01.
 - .2 Submit 1200 mm length sample enclosure showing method of securing to structure and connecting to adjacent length of enclosure.

1.06 DELIVERY, STORAGE, AND HANDLING

- .1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.07 WARRANTY

- .1 Provide warranties as outlined in Section 20 05 05.

PART 2 - PRODUCTS

2.01 COILS

- .1 Water Type: Provide cooling and heating coils as detailed on the coil schedule, A.R.I. rated and constructed of copper tubes and aluminium fins unless otherwise noted, and pressure tested for operation up to 1380 kPa (200 psi) for water coils. Refer to drawings for piping connections and dimensional data.
- .2 Coils as manufactured by Trane, McQuay, Sheldons, York, Carrier, Aerofin, Sentry Guard and Engineered Air are acceptable.

PART 3 - EXECUTION

3.01 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Provide double swing pipe joints as indicated.
- .3 Check final location with Consultant if different from that indicated prior to installation.
 - .1 Should deviations beyond allowable clearances arise, request and follow Consultant's directive.
- .4 Hot water units: For each unit, install gate valve on inlet and lock shield globe calibrated balancing valve on outlet of each unit. Install drain valve at low point.
 - .1 Install manual air vent at high point.
- .5 Steam units: For each unit, install gate valve on inlet, steam trap assembly on outlet.
- .6 Clean finned tubes and comb straight.
- .7 Provide supplementary suspension steel as required.
- .8 Install thermostats in locations indicated.
- .9 Before acceptance, set discharge patterns and fan speeds to suit requirements.

3.02 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product/s and submit written reports, in acceptable format, to verify compliance of Work with Contract.
 - .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of the Work, after cleaning is carried out.
 - .4 Obtain reports, within 3 days of review and submit, immediately, to the Consultant
- .2 Verification requirements in accordance with Division 01 and include:
 - .1 Materials and resources.

- .2 Storage and collection of recyclables.
- .3 Construction waste management.
- .4 Resource re-use.
- .5 Recycled content.
- .6 Local/regional materials.
- .7 Certified Wood.
- .8 Low-emitting materials.
- .3 Commissioning Reports:
 - .1 In accordance with Division and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements, supplemented as specified herein. Include:
 - .1 Report Forms and Schematics.

3.03 DEMONSTRATION

- .1 Training: Provide training in accordance with Division 01 and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements, supplemented as specified.

3.04 CLEANING

- .1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 82 39

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- 2.01 HUMIDIFIERS

PART 3 - EXECUTION

- 3.01 MANUFACTURER'S INSTRUCTIONS
- 3.02 INSTALLATION
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PART 1 - GENERAL

1.01 DESCRIPTION

- .1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.
- .2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.
- .3 Comply with the requirements of Section 23 05 00 Common Work Results for HVAC.

1.02 WORK PERFORMED BY THIS SECTION

- .1 Section Includes:
 - .1 Materials and installation for steam injection mechanical, atomizing, plenum mounted drum, plenum or duct-mounted pad, packaged electrode steam generating, packaged, gas fired, steam generator type humidifiers and accessories.
 - .2 Sustainable requirements for construction and verification.
- .2 Related Sections:
 - .1 Division 01
 - .2 Division 02
 - .3 Section 23 31 13 Ductwork

1.03 REFERENCES

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

1.04 QUALITY ASSURANCE

- .1 Materials in accordance with Section 20 05 05 and 20 05 10.
- .2 Pre-Installation Meetings:
 - .1 Convene pre-installation meeting one week prior to beginning work of this Section and on-site installations in accordance with Division 01, to suit Construction Progress Schedules.
 - .1 Verify project requirements.
 - .2 Review installation and substrate conditions.
 - .3 Co-ordination with other building subtrades.
 - .4 Review manufacturer's installation instructions and warranty requirements.
- .3 Health and Safety:
 - .1 Do construction occupational health and safety in accordance with Division 01, to suit Health and Safety Requirements.
- .4 Construction requirements: In accordance with Division 01, to suit Sustainable Requirements.
- .5 Verification: Contractor's verification in accordance with Division 01, to suit Sustainable Requirements.

1.05 SUBMITTALS

- .1 Provide manufacturer's printed product literature and datasheets and include product characteristics, performance criteria, physical size, finish and limitations in accordance with Section 20 05 01. Shop Drawings to include:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Mounting methods.
 - .4 Physical size.
 - .5 kW rating, voltage, phase.
 - .6 Pipe sizing and panel performance.
 - .7 Absorption distances.
 - .8 Catalog data on all supports, tube guides, spacers and associated items necessary for the installation to the tubing and manifolds.
 - .9 Approved Design Calculation Record forms.
 - .10 Water treatment requirements.
 - .11 Airside pressure drop.
- .2 Test Reports: Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .3 Certificates: Submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .4 Manufacturer's Field Reports: Manufacturer's field reports specified.
- .5 Closeout Submittals
 - .1 Refer to Section 20 05 05.
 - .2 Include:
 - .1 Description of equipment giving manufacturers name, type, model year, capacity.
 - .2 Start-up and commissioning procedures.
 - .3 Details of operation, servicing and maintenance.
 - .4 Recommended spare parts list.
- .6 Samples:
 - .1 Provide samples in accordance with Division 01 and Section 25 05 01.
- .7 Spares:
 - .1 Furnish list of individual manufacturer's recommended spare parts for equipment, addresses of suppliers, list of specialized tools necessary for adjusting, repairing or replacing, for inclusion into operating manual.
 - .2 Provide following:
 - .1 One complete set of renewable evaporator media.
 - .2 One complete set of nozzles.

1.06 DELIVERY, STORAGE AND HANDLING

- .1 Do Delivery, Storage and Handling in accordance with Section 20 05 05 - Mechanical Work General Instructions.

1.07 WARRANTY

- .1 Refer to the Warranty section in section 20 05 05 for applicable warranty terms.

PART 2 - PRODUCTS

2.01 HUMIDIFIERS

- .1 Provide as listed in the equipment schedules and shown on the drawings with characteristics as follows:
 - .1 ULC and CSA listed and approved.
 - .2 Steam distributor; rapid absorption tube bank consisting of a horizontal header and required quantity of vertical dispersion tubes necessary to achieve the required steam absorption within 600mm (24 in.) downstream. Header to span the width of the duct, be constructed of stainless steel and be fitted with tee outlets for dispersion tube connections. The dispersion tubes to extend the height of the duct and be fitted with high temperature steam distribution inserts with calibrated orifices.
 - .3 Automatic drain valve and control, field adjustable from 5 to 50 hours of "on" time and one to 30 minutes of drain time.
 - .4 Electric multiple step control complete field installed duct mounted humidistat.
 - .5 High limit duct humidistat.
 - .6 Air flow proving switch.
- .2 Acceptable Manufacturer: Steam-O-vap.

Acceptable alternative: DriSteem, Dryomatic and Neptronic.

PART 3 - EXECUTION

3.01 MANUFACTURER'S INSTRUCTIONS

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

3.02 INSTALLATION

- .1 Install in accordance with manufacturers instructions.
- .2 Humidifier and evaporator media to be new and clean when project is accepted.
- .3 Install humidistat in accessible location.
- .4 Water service overflow drain: to manufacturers' recommendation.
- .5 Install access doors or panels in adjacent ducting.
- .6 When installing in ducting, provide waterproof duct up and downstream of humidifier.
- .7 Install capped drain connection at low point in duct.

3.03 FIELD QUALITY CONTROL

- .1 Manufacturer's Field Services:
 - .1 Have manufacturer of products, supplied under this Section, review Work involved in the handling, installation/application, protection and cleaning, of its product/s and submit written reports, in acceptable format, to verify compliance of Work with Contract.

- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Schedule site visits, to review Work, at stages listed:
 - .1 After delivery and storage of products and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of the Work, after cleaning is carried out.
 - .4 Obtain reports, within 3 days of review and submit, immediately, to the Consultant
- .2 Verification requirements in accordance with Division 01 and include:
- .1 Materials and resources.
 - .2 Storage and collection of recyclables.
 - .3 Construction waste management.
 - .4 Resource reuse.
 - .5 Recycled content.
 - .6 Local/regional materials.
 - .7 Certified Wood.
 - .8 Low-emitting materials.
- .3 Performance Verification (PV):
- .1 General: In accordance with Division 01 and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements,, supplemented as specified.
 - .2 Timing:
 - .1 After TAB of ducted air systems.
 - .2 At same time as PV of related air handling units.
 - .3 PV procedures:
 - .1 Direct Steam Injection Humidifiers.
 - .2 Mechanical Atomizing type
 - .3 Plenum mounted drum type.
 - .4 Plenum mounted pad type.
 - .5 Packaged Electrode Steam Generating type.
 - .4 Gas-fired steam generator.
- .4 Start-up:
- .1 General: In accordance with Division 01 and Section 20 05 05 and 20 05 10 - General Requirements, supplemented as specified.
 - .2 Verify:
 - .1 Steam lines are sloped to ensure steam condensate is drained away from the humidifier.
 - .2 Vapour lines and manifolds are sloped to ensure condensate is drained away from the duct system.
 - .3 Visually check distribution manifold to ensure:
 - .1 Even distribution of vapour.
 - .2 Freedom from water deposits.
- .5 Commissioning Reports:
- .1 In accordance with Division and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements, supplemented as specified herein. Include:
 - .1 Report Forms and Schematics.

3.04 DEMONSTRATION

- .1 Training: Provide training in accordance with Division 01 and Sections 20 05 05 and 20 05 10 - General Commissioning (Cx) Requirements, supplemented as specified.

3.05 CLEANING

- .1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 23 84 13

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PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- .1 Comply with Requirements of Division 01, General Requirements and all documents referred to therein.
- .2 Comply with requirements of Mechanical Work General Instructions Section 20 05 05 and Basic Mechanical Materials and Methods Section 20 05 10.

1.02 WORK INCLUDED

- .1 Work of this Section will be performed by the Owner's own Building Automation System (BAS) forces. Be responsible for coordinating the Work of the Controls Vendor and provision of 120V power as required. The following is included in the Owner's scope of work and is included for reference only.

1.03 QUALITY ASSURANCE

- .1 The system shall use BACnet protocol for communication to the operator workstation and for communication between control modules. Schedules, set points, trends, and alarms specified (Sequences of Operation) shall be BACnet objects.

1.04 SUBMITTALS

- .1 Submit control shop drawings and wiring diagrams with I/O points, written sequences of operation and components description.

1.05 WARRANTY

- .1 Guarantee the control system and all components thereof free from defects in operating sequences, materials and workmanship for a period of two (2) years of normal use and service from the date of certified acceptance by the Consultant.
- .2 This date of acceptance is independent of Substantial Performance of the Work and may occur after certification of Substantial Performance.
- .3 Include these certificates in the Operating and Maintenance Manuals.

1.06 ACCEPTANCE

- .1 Acceptance by the Consultant will be granted when:
 - .1 All components have been installed, calibrated, commissioned and proven to be fully operational.
 - .2 DDC programming complete and operating personnel have received a minimum instruction.
 - .3 As-built drawings and operating instructions submitted.

1.07 INSTRUCTION, ADJUSTMENT AND "AS BUILT" DRAWINGS

- .1 On completion of the Work, calibrate and adjust all components to operate as required. Provide three complete instruction manuals with "as constructed" control drawings and instruct the Owner's operating personnel in the operation and function of the system.
- .2 Provide a minimum of two (2) four (4) hour long call-back sessions during the first year of operation.

1.08 EMCS OPERATION SUMMARY

- .1 The EMCS Operation Summary is a supplement to the drawings and the written sequence of operation.
 - .1 It is intended as a guide and clarification of requirements.
 - .2 It is not an I/O summary, but only a brief description of requirements for each type of system and unit component. The quantities of systems and components are shown on the drawings.

1.09 EMCS LIMITATIONS

- .1 The use of Owner inaccessible software with proprietary EPROM or ROM CHIPS in field processing panels where EPROM burners are required (and for which software agreements need be signed) will not be accepted.

1.10 SYSTEM PERFORMANCE

- .1 Performance Standards. System shall conform to the following minimum standards over network connections. Systems shall be tested using manufacturer's recommended hardware and software for operator workstation (server and browser for web-based systems).
 - .1 Graphic Display. A graphic with 20 dynamic points shall display with current data within 1 sec.
 - .2 Graphic Refresh. A graphic with 20 dynamic points shall update with current data within 8 sec. and shall automatically refresh every 15 sec.
 - .3 Configuration and Tuning Screens. Screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic shall automatically refresh within 6 sec.
 - .4 Object Command. Devices shall react to command of a binary object within 2 sec. Devices shall begin reacting to command of an analog object within 2 sec.
 - .5 Alarm Response Time. An object that goes into alarm shall be annunciated at the workstation within 15 sec.
 - .6 Program Execution Frequency. Custom and standard applications shall be capable of running as often as once every 5 sec. Select execution times consistent with the mechanical process under control.
 - .7 Performance. Programmable controllers shall be able to completely execute DDC PID control loops at a frequency adjustable down to once per sec. Select execution times consistent with the mechanical process under control.
 - .8 Multiple Alarm Annunciations. Each workstation on the network (one only required initially) shall receive alarms within 5 sec of other workstations.
 - .9 Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in Table 1.
 - .10 Control Stability and Accuracy. Control loops shall maintain measured variable at setpoint within tolerances listed in Table 2.

Table 1 - Reporting Accuracy

Measured Variable	Reported Accuracy
Space Temperature	±0.5°C (±1°F)
Ducted Air	±0.5°C (±1°F)
Outside Air	±1.0°C (±2°F)
Dew Point	±1.5°C (±3°F)
Water Temperature	±0.5°C (±1°F)

Delta-T	±0.15°C (±0.25°F)
Relative Humidity	±5% RH
Water Flows	±2% of full scale
Airflow (terminal)	±10% of full scale (see Note 1)
Airflow (measuring stations)	±5% of full scale
Airflow (pressurized spaces)	±3% of full scale
Air Pressure (ducts)	±25 Pa (±0.1 in. w.g.)
Air Pressure (space)	±3 Pa (±0.01 in. w.g.)
Water Pressure	±2% of full scale (see Note 2)
Electrical (A, V, W, Power Factor)	±1% of reading (see Note 3)
Carbon Monoxide (CO)	±5% of reading
Carbon Dioxide (CO2)	±50 ppm

Note 1: 10% - 100% of scale

Note 2: For both absolute and differential pressure

Note 3: Not including utility-supplied meters

Table 2 - Control Stability and Accuracy

Controlled Variable	Control Accuracy	Range of Medium
Air Pressure	±50 Pa (±0.2 in. w.g.) ±3 Pa (±0.01 in. w.g.)	0-1.5 kPa (0-6 in. w.g.) -25 to 25 Pa (-0.1 to 0.1 in. w.g.)
Airflow	±10% of full scale	
Space Temperature	±1.0°C (±2.0°F)	
Duct Temperature	±1.5°C (±3°F)	
Humidity	±5% RH	
Fluid Pressure	±10 kPa (±1.5 psi) ±250 Pa (±1.0 in. w.g.)	MPa (1-150 psi) 0-12.5 kPa (0-50 in. w.g.) differential

1.11 AS-BUILT DOCUMENTATION

- .1 Electronically submit as-built drawings and operating and maintenance manuals to the Consultant for review and approval.
- .2 As-built documentation shall include the following as a minimum:
 - .1 An Information sheet that contains:
 - .1 Project Name and address
 - .2 A brief description of the control details. i.e. total # of points, list of equipment controls and which panels they are connected to.
 - .3 Panel's information i.e. part numbers for panels used and their serial numbers and revision # (if applicable)
 - .4 Software version

- .5 Modem telephone number
- .6 Warranty start date and duration
- .7 BAS contractor Name, address, and Phone number
- .2 Detailed sequence of operation for each controlled system.
- .3 Control schematics for each system. Including a System Architecture indicating the type and model number for all BAS components, the proposed interconnection and location of all panels, network connection and key peripheral devices (workstations, modems, printers, repeaters, etc)
- .4 BAS Points List indicating the panel ID, panel location, hardware address, point acronym, point description, field device type, point type (i.e. AO/DO/AI/DI), end device fail position, end device manufacture and model number and wire tag ID.
- .5 Floor plan with the location of all field mounted control devices.
- .6 Programming code for all DDC controllers
- .7 Wiring diagrams including complete power system, interlocks, control and data communications.
- .8 Manufacturers' data/specification sheets and catalogue cuts for all material and equipment supplied including the workstation PC and any equipment (e.g. valves, starters, VFDs, etc.) supplied under the mechanical scope of work. This section shall include a summary sheet that indicates all BAS Device, Manufacturers', model number, and quantity of each used on this job.
- .9 Automatic control valve and damper, VAV box and terminal unit schedules where required.
- .10 Electrical Authority Inspection Certificates – General Inspection and Product Approval Inspection.
- .11 Commissioning list including the name of the Commissioning agent of the BAS Contractor, his signature and the date of commissioning.
- .12 Licensed BAS workstation software.
- .13 BAS programming database stored on a CD-R disk.
- .14 Workstation PC documentation, original Windows operating system/recovery disks, licenses, and warranty.

PART 2 - PRODUCTS

2.01 DAMPERS

- .1 Motorized Dampers are specified in Dampers, Section 23 33 10. Actuators are specified below.

2.02 ACTUATORS

- .1 Electric/Electronic sized to provide adequate power for opening, closing and modulating dampers or valves in specified time.
- .2 Provide each actuator with a bracket for attaching to ductwork, building structure, or equipment. Do not install actuators in ducts or fresh air intakes.
- .3 Provide electric low temperature protected actuators in unheated areas such as parking garages, ventilation shafts and transformer rooms and on any equipment located outdoors.
- .4 Wherever possible, actuators to be provided to the original equipment manufacturer for factory installation (i.e. VAV terminal and fan manufacturers). Provide actuators to equipment manufacturer's specifications.
- .5 All damper and valve actuators to be provided with spring return to normal position.

- .6 Provide actuators for smoke/fire dampers including linkages and power wiring. Also provide relays adjacent to the actuators for interface to fire alarm system by Division 26 Subcontractor. Wire relays to actuators. Co-ordinate with Division 26 subcontractor and provide instructions on wiring to achieve full open and full closed damper operation.
- .7 Unless shown otherwise on drawings, actuators to be provided and set up such that all heating valves and return air dampers are normally open and cooling valves, exhaust and outdoor air dampers are normally closed.
- .8 Actuators for Valves:
 - .1 Each automatic control valve shall be fitted with a "fail-safe" operator capable of tight shut-off against the differential imposed by the system.
 - .2 Valve actuators on valves 3 in. dia. and larger shall be provided with a manual position override.
 - .3 Floating point control of valves is not acceptable under any circumstances.
 - .4 The standard of acceptance shall be Belimo.
- .9 Actuators for Dampers:
 - .1 All actuators for control dampers shall be electric type and be powered by a single phase AC 24V overload-proof synchronous motor.
 - .2 All actuators shall be direct-coupled type for both modulating and two position control dampers.
 - .3 All damper actuators shall be selected to operate maximum damper loads of 28 sq.ft. (2.6 sq.m.).
 - .4 Each actuator shall be "fail safe", complete with external adjustable stops to limit the length of stroke in either direction and mounted on an adjustable bracket. Operating arms shall have double yoke linkages and double set of screws for fastening to the damper shaft.
 - .5 The standard of acceptance shall be Belimo.

2.03 ENERGY CONTROL VALVE ASSEMBLIES

- .1 Where noted in the Documents, provide Belimo, or equal, energy control valve assemblies for water-side control of hydronic heating and cooling heat transfer applications.
- .2 Energy control valve assemblies shall provide pressure independent control to optimize, document and hydronic heat transfer energy performance to improve hydronic system temperature differential (ΔT) performance.
- .3 Energy control valve assemblies shall incorporate the following components:
 - .1 Characterized Control Valve (CCV);
 - .2 Electromagnetic flow sensor;
 - .3 Integral control system equal to Belimo "Delta T Manager";
 - .4 Supply and return water temperature sensors, for energy management;
 - .5 BACnet MS/TP or BACnet IP network communication.
- .4 Energy control valve assemblies shall be as follows:
 - .1 Service: chilled or hot water, 60% glycol max (closed loop/steam not allowed)
 - .2 Flow characteristic: equal percentage
 - .3 Controllable flow range: 75° rotation
 - .4 Rangeability: 100:1
 - .5 Size: 2½" (65mm), 3" (75mm), 4" (100mm), 5" (125mm), 6" (150mm)
 - .6 End fitting: pattern to mate with ANSI 125 flange
 - .7 Materials of construction:

- .1 Body: cast iron - GG25 and ductile iron - GGG50
- .2 Ball: stainless steel
- .3 Seat: PTFE
- .4 Characterizing disc: stainless steel
- .5 Packing: 2 EPDM O-rings, lubricated
- .8 Body pressure rating: according to ANSI 125, standard class B
- .9 Media temperature range: 14°F to 248°F (-10°C to 120°C)
- .10 Maximum sound level: 70 dBA
- .11 Conductivity: min. 20uS/cm (no fully desalinated systems)
- .12 Leakage: 0%
- .13 Differential pressure range(ΔP): 5 to 50 psi (differential)
- .14 Inlet length required in front of valve: fixe time nominal pipe size (5 x DN)
- .15 Ambient humidity range:
 - .1 Actuator: <95% RH non-condensing
 - .2 Sensor: <95% RH non-condensing
 - .3 System: <95% RH non-condensing
- .16 Flow control tolerance: $\pm 10\%$ of the setpoint from 25% to 100% of maximum valve body flow. When the flow is below 25% of the maximum valve body flow; the accuracy is a fixed GPM = $\pm 10\%$ of 25% maximum valve body flow.
- .17 Flow measurement tolerance: $\pm 2\%$ of the measured flow from 25% to 100% of maximum valve body flow. When the flow is below 25% of the maximum valve body flow; the accuracy is a fixed GPM = $\pm 2\%$ of 25% maximum valve body flow.
- .18 Temperature sensors: 32 ft. (10m)
- .19 Rated impulse voltage: actuator/sensor: 0.8 kV (in accordance with EN 60730-1)
- .20 Flow sensor: PT1000 insertion sensors Thermal well $\frac{1}{2}$ NPT
- .21 Power supply for the flow sensor: actuator is powered by the sensor
- .22 Remote temperature sensor length: 32 ft. (10m)
- .5 Energy control valve assembly integral control system:
 - .1 Belimo Delta T Manager, or equal, shall continuously monitor heat transfer temperature differential and compare the process variable (actual temperature differential) to the temperature differential setpoint (minimum ΔT).
 - .2 The energy control valve assembly normally operates as a pressure dependent control valve. If the measured ΔT is lower than the defined minimum ΔT setpoint, regardless of the control signal, the maximum flow will be limited by the Delta T Manager logic.
 - .3 The software within the actuator shall monitor and trend all sensed or calculated data. Data shall be archived for thirteen (13) months and be accessible via a personal computer or laptop. Archived data shall include:
 - .1 water flow,
 - .2 return and supply water temperature,
 - .3 power,
 - .4 energy.
- .6 Provide water proof mounting cover to protect the actuator.

2.04 AUTOMATIC CONTROL VALVES

- .1 Properly sized and selected by the manufacturer in accordance with load requirements and characteristics of the systems to which they are applied. Do not provide, under any conditions, valves smaller than 20mm (").
- .2 Water pressure drop through all two-way modulating control valves: 18 kPa (2.5 PSI) Water pressure drop through all three-way modulating major system valves; 35 kPa (5 PSI).
- .3 Minimum close off pressure for valves in reheat coil application to be 400 kPa (58 PSI).

- .4 All valves: provide with integral seats ground into the body. Disc assemblies: replaceable and selected for fluid to be controlled.
- .5 Modulating applications: provide valves with throttling plugs for linear lift-flow ratio.
- .6 Where butterfly type valves are required, provide "high cycle" type. Provide industrial type actuators as manufactured by Rotork, Grinnell or Bettis.
- .7 Where butterfly type valves are used in a 3 port arrangement, mount valves on a common "tee" and use one actuator only.

2.05 THERMOSTATS AND/OR SPACE SENSORS

- .1 Sensors to be equipped with a port to allow connection of portable local command and display device for programming, set point adjustment and calibrating.
- .2 Sensors to have pushbuttons in the housing which will allow the occupant to override time programs and automatically switch a zone to occupied mode. The override time available shall be programmed via the operator terminal. The operator terminal to display the override time remaining.
- .3 Override pushbuttons to be software configurable in such a manner that one sensor can be assigned to initiate a schedule override for one or more zones.
- .4 Provide a log of all overrides for each sensor override push button showing date and time of each override occurrence and duration.
- .5 All sensors to be provided with local set point adjust. The occupant to have the ability to adjust the pre-programmed set point within pre-programmed limits, (2°C). The adjustment shall be performed using Increase/decrease pushbutton sensor controls. The resulting set point shall be visually displayed on the sensor. The default sensor display value shall be the zone temperature or set point as selected by the User. The display shall be User programmed to "BLANK" after a period of time if selected.

2.06 SENSORS AND CONTROL DEVICES

- .1 A general guideline requires all new only devices to be supplied/ installed as specified. Sensors must provide responses which deliver accurate, reliable control of HVAC equipment.
- .2 Sensors and control devices are to be industry standard products that can be purchased by the Owner from the manufacturer.
- .3 Temperature Sensors.
 - .1 10 k NTC @ 25 °C Thermistor. Encapsulated to protect against moisture and permit an acceptable TC for the application.
Acceptable products:
All DDC based temperature sensors as supplied by:
 - .1 MAMAC
 - .2 Greystone
 - .3 Enercorp.
 - .2 Each sensor shall be provided with a custom label which indicates the model, manufacturer, specifications, and DDC point I.D.
 - .3 Duct mounted sensors shall be S.S. probe type or Cu averaging element type as specified. Probe sensors are suitable for any duct as preferred.
 - .4 Space sensors shall be provided with ventilating conductive protective covers, mounted 1.2 metres from the floor level.

- .5 Provide space sensors as specified.
 - .6 Stainless Steel (S.S.) plate sensors are specified for use in the GP rooms and as specified.
 - .7 Smart programmable Display (LCD) Sensors (SDT) shall be installed for all DDC VAV terminal boxes. The SDT power shall originate from the respective B-(A)ASC panel.
 - .8 Submit samples to Owner for final approval with shop drawings.
 - .9 Liquid immersion sensors shall be spring loaded tip sensitive devices mounted in brass wells rated for the working temperature and pressure of the fluid.
 - .10 Outdoor air sensor shall be weather proof and properly shielded from direct solar radiation. Only the probe shall be externally mounted on the building skin and properly sealed to eliminate the effect of internal air temperatures. Wiring connections shall be made inside the building for easy testing/access service. Sensors located in the fresh air intake duct of air systems will not be permitted.
- .4 Duct Temperature Sensors:
- .1 Provide duct mounted temperature sensors (DTS) with the following minimum characteristics:
 - .1 Sensor encapsulated in a 200mm long, 6mm OD copper or stainless steel probe.
 - .2 Operating range 0-60 degrees C.
 - .3 End-to-end accuracy +/- 0.3 °C.
 - .4 Assembly complete with wiring housing and mounting flange.
 - .2 Standard of Acceptance:
Enercorp TS-D-12-T-10K
- .5 Duct Averaging Temperature Sensors:
- .1 Provide plenum mounted mixed air temperature averaging type sensors with the following minimum characteristics:
 - .1 Constructed of FT6 plenum rated cable incorporating a minimum of 9 temperature sensors encapsulated at equal distances along the 24 foot length of the element. The assembly acts as a single sensor reporting the average temperature from all individual sensors.
 - .2 End-to-end accuracy +/- 0.3 °C.
 - .3 Mount in a zigzag manner to provide continuous coverage of the entire duct cross-sectional area.
 - .4 The use of thermister type sensors is acceptable.
 - .2 Standard of Acceptance:
Enercorp TS-FC-24-9-T-RTD
- .6 Outdoor Air Temperature Sensors:
- .1 Provide outdoor air temperature sensors with the following minimum characteristics:
 - .1 Each sensor shall be a 6", 10K thermistor probe
 - .2 Minimum two sensors shall be installed for each site.
 - .3 Both sensors shall be mounted inside a heavy-duty (blow-proof) solar shield.
 - .4 Provide a heavy-duty, metal, wire guard.
 - .2 Standard of Acceptance:
Enercorp TS-O-T-10K
- .7 Immersion Temperature Sensors:
- .1 Use immersion temperature sensors with thermwells for all applications where a temperature of a fluid in a pipe is being sensed.
 - .2 Provide well-mounted water temperature sensors with the following minimum characteristics:

- .1 The sensors shall be 10k ohm thermistor encapsulated in a 6mm OD, 50m long probe, with screw fitting for insertion into a standard thermowell.
- .2 Operating range -10 to +100 degrees C.
- .3 End-to-end accuracy +/- 0.3 °C over the entire operating range.
- .4 The sensors shall be complete with brass thermowell. Provide a stainless steel thermowell where exposed to corrosive liquids.
- .5 Use conductive gel when mounting the sensor in the thermowell. The sensors to be mounted on insulated piping shall be installed clear of the insulation.
- .3 Standard of Acceptance:
Enercorp TS-P-4-T-10K

2.07 WIRING

- .1 Provide all electrical wiring and components required (of any voltage) within the temperature control system such as low limit protection, thermostats, alarms, refrigeration system components, relays and interlocks as required to achieve the control function specified in the schematic drawings and sequences of operation. This work to include wiring into prefabricated control circuits (as co-ordinated with the appropriate sub trade or supplier) of boilers, chillers, air cooled condensers, pump sets and fire alarm panels. Also provide suitably rated relays for single phase motors wired in series with manual starters where EMCS start/stop operation is required. Provide "Hand-Off-Auto" switch on relays.
- .2 Provide all power and interconnecting wiring to EMCS field panels. Co-ordinate with Division 26 Subtrade for appropriate locations of all power outlets for head-end equipment (monitor/keyboard, printers, clock). Do not wire any EMCS components into emergency power supply.
- .3 Refer to Electrical Division drawings for locations of all power outlets for electric actuators, sensors and control devices or panels. Provide all wiring from these locations to the above devices as necessary and provide all low voltage control wiring between devices. Refer to Electrical Division for wiring and conduit requirements. 24 volt voltage wiring to room thermostats, VAV terminals and radiation valves may be routed in enclosed ceiling spaces utilizing approved plenum cable, provided that this Contractor checks acceptability of such cable with ALL applicable authorities.

2.08 COMPONENTS

- .1 General standard of quality to be equal to the following:
 - .1 Flow Switches for Coil Freeze Protection Service and flow proving for boilers and chillers: ULC labelled McDonnell Standard No. FS7.
 - .2 Timers: Rex (Davis Controls) Maxirex BDI single channel digital type with a minimum of 4 separate switch on - switch off programs for each day of the week with LCD continuous display of program status, 1 minute shortest switching period, rechargeable 100 HR reserve battery back-up, automatic or manual on-off operation and suitable for cut-out panel mounting.

2.09 FREEZE PROTECTION

- .1 Freeze protection devices (low limits) shall have manual reset features and shall NOT automatically recycle. Freeze controls shall have 6.0 m (20 ft.) capillary arranged in ducts for best possible protection. Provide freezestat for each 5.6 m² (60 ft²) of duct area where necessary, wired in series.

2.10 FIRE PROTECTION

- .1 Fire protection devices (high limits) shall have manual reset feature and shall not automatically recycle.

2.11 RELAYS

- .1 Relays shall be solid state, heavy duty type. Supply, install and wire all relays for outside lighting circuit control, and for other line voltage applications. All equipment controlled by ECMS shall be provided with H.O.A. Switch by same manufacturer as equipment motor control starter mounted on front of panel and wired as follows:

AUTO: Equipment shall be controlled by EMCS in series with all limits and other protective devices.

OFF: No operation.

HAND: Equipment shall be operated independently of EMCS, but still in series with all limits and other protective devices.

2.12 HUMIDITY SENSORS

- .1 Humidity sensors shall utilize polymer film technology and shall have a +/- 2% accuracy over a range of 10 to 90% R.H.
- .2 Provide sampling chamber for duct-mounted sensors.
- .3 Duct Humidity Sensors:
- .1 Provide humidity sensors with the following minimum characteristics:
 - .1 Operating range from 10% - 90%RH over 0-60 °C temperature range.
 - .2 End-to-end accuracy of +/- 1% of operating range, with maximum temperature dependence of 0.2% per °C change.
 - .3 200mm long probe, with enclosure for mounting in duct.
 - .4 4-20mA output only. Voltage output is not acceptable.
 - .2 Standard of Acceptance:
Enercorp HTC-D-420-2

2.13 SWITCHES

- .1 Pressure electric switches shall have diaphragm operated SPDT snap acting contacts with electrical rating suitable for applications as specified. Pressure electric switches shall withstand up to 25 psig and be provided with adjustable cut-in and cut-out settings between 3 and 20 psig.
- .2 Water flow switches shall be general purpose with a paddle actuated, snap acting SPDT switch rated at 16 amp 120/1/60 AC full load.
- .3 Air proving (differential pressure) switches shall utilize a differential pressure activated, diaphragm actuated, snap acting SPDT switch rated at 9.8 amp 120/1/60 AC full load. Differential pressure range shall be selected to suit the application, set point shall be adjustable. Mount switches with diaphragm in a vertical plane. Switches shall be CSA approved.
- .4 Minimum positioning switches shall be installed inside local cabinets. After system balancing, switches shall be locked.
- .5 Damper status switches shall be lever operated, activated by damper blade movement and mounted securely on damper frame. Switches shall have a contact rating of 5A to 120 VAC and shall be CSA approved.

2.14 ELECTRICAL LOW VOLTAGE THERMOSTAT

- .1 Provide complete with heat anticipator, and backplate and bracket for mounting on standard size outlet box where required. Include sub-base with fan On-Off-Auto switch with each thermostat where summer ventilation is required. Include modulating heating or cooling stage where used in conjunction with control valves; step controllers; SCR's; or similar equipment requiring modulation, and mercury switches where On-Off control is required.

2.15 NAMEPLATES

- .1 Provide Lamicoid nameplates, 25mm x 550mm (1" x 22") at all control system devices to clearly indicate the service of a particular device. All manual switches, unless they come with standard nameplates, are labelled. All thermostats, thermometers and switches installed on all local panels shall be similarly labelled. Permanent painted stencil labels may be used on all controllers and relays mounted inside local panels, if so desired. Tape labels are not acceptable.
- .2 All duct and pipe mounted sensors, ASC's, etc. are to be similarly labelled.

2.16 SWITCHES AND RELAY

- .1 Current Sensing Status Switch, ON/OFF
 - .1 Current sensing relays shall be solid state, two wire, now powered devices.
 - .2 Acceptable products:
 - .1 Veris Industries, USA
Hawkeye model H-800 N.O. contact @ 0.5-200 A as supplied
- .2 Air Pressure Switches, ON/OFF
 - .1 Switches shall be field adjustable over the operating pressure range and provide snap-acting Form C contacts.
- .3 Hydronic Pressure Transducers
 - .1 Pressure transducers shall be S.S. devices matched to the operating pressure of the application. Provide 2x over pressure protection c/w a new brass snuber, pressure gauge and isolation brass valve for service.
Provide a 4-20 ma signal for the working pressure range.
 - .2 Acceptable products by:
 - .1 ITT
 - .2 Other by approval
- .4 Electronic-to-Pneumatic Transducers
 - .1 The device shall be sufficient to provide full scale operation of the pneumatic operator. The transducer shall provide linearity of 1% of full scale. Hysteresis and repeatability of 0.75% full scale or less. A 1-5V d.c. output feedback signal, proportional and linear to the 21-138 kPa output signal shall be provided. A gauge tap shall be provided to mount a pressure gauge for pressure output indication.
 - .2 Acceptable products:
 - .1 Kreuter manufacturing Company, Kreuter Marketing Canada E/I-P Transducer, with mounting hardware, and 0-20 psig pressure gauge.
- .5 Control Relays
 - .1 Control relays are SPDT for control of electrical starters and equipment where shown on the control diagrams.
 - .2 Coil voltage matches the ASC. Contacts are rated a 5A to 120 VAC.

- .3 Control relay contacts shall be rated for 150% of the loading application, Form C double pole contacts. The relay shall provide a minimum, one million operations and contain coil transient suppression devices and DDC output LED pilot. All relays shall be mounted on a separate relay base and in ventilated indoor locations.
- .4 Acceptable products:
 - .1 CARLO GAVAZZI.
 - .2 FEME. Model Series M15, Pilot.
 - .3 Omron, HP rated, starter rated.
- .6 Solid State Relays (SSR)
 - .1 SSR with opto-electronic coupler for 3-32 V d.c. turn on/off input control shall be provided. Relays shall be rated for the application and mounted on a properly sized heat sink in order to regulate relay temperatures below 25°C continuously.
 - .2 Acceptable products:
 - .1 Crydom.

PART 3 - EXECUTION

3.01 GENERAL

- .1 The DDC controls project shall be performed in such a manner as to limit disruption of the normal daily operation of the building HVAC equipment. The work shall occur while the control system remains on-line in order to maintain a minimum level of comfort within the building. The Owner shall be notified about situations in which equipment will be off-line for extended periods of time during the project. The Contractor shall conduct all on-site work in conjunction with building operating staff to streamline the new system startup.

3.02 COMPONENTS

- .1 Mount all controllers and relays within control panel cubicles. Mount exposed components for easy access and protect from damage.
- .2 Cut-out mount switches and timers on control panel fronts.
 - .1 Identify all exposed components and equipment mounted on the control panel front with lamacoid nameplates screwed or pop-riveted in place. Identify instruments inside the cabinet with Dymo tape labels.
 - .2 Provide, on all equipment operated by EMCS, 50 x 100mm red lamacoid tags with white lettering held with screws or pop rivets, reading: "Warning This equipment may start at any time. Do not service without disconnecting power."
 - .3 Locate all local control panels as shown on the drawings or as directed by the Consultant.
 - .4 Provide electric freeze protection thermostats with averaging elements capable of sensitivity on any 300mm (12") portion. Mount element across coil face approximately 150mm (6") downstream of coil in rows 400mm (16") OC. Locate lowest row no higher than 1500 mm (6") above bottom of coil. Mount thermostats side-by-side 1500mm (60") above floor on service side of unit.
Provide relay such that on low temperature shut-down, one button will reset control circuit. Label and locate button on service side of equipment.
 - .5 Mount CO detectors between 900 to 1200mm (3'- 0" to 4'- 0") above floor. Provide a lockable wire guard enclosure over unit. Provide field calibration by manufacturer's designated representative.

3.03 CO-ORDINATION

- .1 Attend and assist in testing and commissioning the chiller, cooling tower, boiler and pumping systems.
- .2 Attend and assist in testing and commissioning air handling and distribution systems.
- .3 Set outdoor air dampers to minimum positions as verified by the air balancing specialist.
- .4 Calibrate air volumes and temperatures at each VAV terminal as verified by the air balancing specialist.
- .5 Attend and assist in commissioning, start-up and testing of fans and smoke/fire dampers.

3.04 WIRING

- .1 Install all wiring in conduit and conform to CSA, ULC and local Code requirements as well as requirements as specified in Division 26 except as stipulated in following paragraph .2.
- .2 EMCS 24 Volt Wiring:
 - .1 In ceiling spaces, approved plenum cable to be installed neatly clipped to structure in 8 foot intervals and run parallel and at right angles to building structural members. Plenum cable to be installed clear of any electrical or mechanical components requiring access or servicing.
 - .2 All EMCS wiring installed within walls and where exposed to be installed in conduit conforming to requirements of Division 26.
- .3 All wiring in connection with the control system shall be furnished by the Contractor.
- .4 All wiring shall conform to governing codes and shall be inspected by request of the Contractor for approval. The Contractor shall obtain and purchase all necessary permits as required.

3.05 VARIABLE FREQUENCY DRIVES

- .1 Co-ordinate with variable frequency drives manufacturers and provide all required wiring and components as required to achieve specified sequences of operation.

3.06 MOTORIZED DAMPERS

- .1 Provide motorized dampers for all outdoor air intake and exhaust systems with a design capacity of 141 l/s (300 cfm) and above. Co-ordinate with Division 23 Contractor.

3.07 LABELLING

- .1 All control equipment is to be labelled with lamacoid plates with a designation corresponding to the specific system point description/label. All lamacoids shall be mechanically fastened to surfaces. Submit samples to the Owner for approval.

3.08 COMMISSIONING – DDC SYSTEMS

- .1 Check the installation of each sensor, actuator and controlled device.
- .2 Verify and record in as built OEM drawings the wiring of each I/O sensor and device as installed.
- .3 Calibrate each sensor as required.
- .4 Manually operate each output for every system with a portable Display Terminal supplied by the contractor for commissioning.

- .5 Tune each control loop and print the response of trends for hard copy record. Identify correct PID parameters on all print outs.
- .6 Verify all start/stop operations, e.g. "schedule control", "Optimized control", "unoccupied mode" setback.
- .7 Verify all custom control programs and alarm functions.
- .8 Perform end-to-end checks from an operator terminal to all sensors and actuators to verify system communications and control.

3.09 FAIL STATE POSITION OF OUTPUTS

- .1 Unless specified otherwise, configure BAS output points for the following fail state (e.g. device position upon panel failure):

All Fans	OFF
Heating Valves	Full heat to terminal device
Mixing Dampers	Full recirculation air
Face/Bypass Dampers	Full heat
Zone Dampers	Full heat
Heating Pumps	ON (except boiler belly pumps)
Boiler Belly Pumps	OFF
Variable Frequency Drives	ON, minimum programmed speed
Lighting Relays	Last State
Boilers (1 stage)	ON
Boilers (Multi-stage)	LOW ON, HIGH OFF
Cooling Equipment	OFF
Electric Heating	OFF
Domestic Hot Water Pumps	OFF
Roof-top Gas Burners	OFF

3.10 CLEANING

- .1 Do Cleaning in accordance with Section 20 05 05 - Mechanical Work General Instructions.

END OF SECTION 25 01 01



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ELECTRICAL SPECIFICATIONS

FOR

**UNIVERSITY HALL VENTILLATION
UPGRADE**

TO

MCMASTER UNIVERSTIY

DATED

AUGUST 5, 2024

ISSUED FOR TENDER

Contact Person: Peera Butrsingkorn
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MCW Project No. 22227B

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PART 1 - GENERAL

1.01 SUMMARY

- .1 Section Includes:
 - .1 Through Penetration Firestopping.
 - .2 Fire Resistive Joint Systems.
- .2 Related Sections
 - .1 Division 1 – General Requirements.
 - .2 Division 3 – Concrete.
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 - .6 Division 22 – Plumbing.
 - .7 Division 23 – Heating Ventilating and Air Conditioning.
 - .8 Division 26 – Electrical.
 - .9 Division 27 – Communication.

1.02 REFERENCES

- .1 American National Standards Institute (ANSI):
 - .1 ANSI/UL 263 - Fire Tests of Building Construction and Materials.
 - .2 ANSI/UL 723 - Surface Burning Characteristics of Building Materials.
 - .3 ANSI/UL 1479 - Standard for Fire Tests of Through-Penetration Firestops.
 - .4 ANSI/UL 2079 - Tests for Fire Resistance of Building Joint Systems.
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - .2 ASTM E 119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - .3 ASTM E 814 - Standard Test Method for Fire Tests of Through-Penetration Firestops.
 - .4 ASTM E 1399 - Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems.
 - .5 ASTM E 1966 - Standard Test Method for Fire Resistive Joint Systems.
 - .6 ASTM E 2174 - Standard Practice for On-Site Inspection of Installed Firestops.
 - .7 ASTM E 2307 - Fire Tests of Perimeter Fire Barrier Systems Using Intermediate Scale, Multi-Story Test Apparatus.
 - .8 ASTM E 2393 - Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
- .3 Factory Mutual (FM) - FM4991 - Standard for Approval of Firestop Contractors.
- .4 International Code Congress (ICC):
 - .1 International Building Code (IBC).
 - .2 International Residential Code (IRC).
 - .3 International Mechanical Code (IMC)
 - .4 International Fire Code (IFC)
 - .5 International Code Congress Evaluation Service (ICC ES)

- .5 National Fire Protection Association (NFPA):
 - .1 NFPA 70 - National Electrical Code.
 - .2 NFPA 80 - Standard for Fire Doors and Other Opening Protectives.
 - .3 NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.
 - .4 NFPA 101 - Life Safety Code.
 - .5 NFPA 5000 - Building Construction and Safety Code.
- .6 Underwriters Laboratories (UL) - UL Building Materials Directory:
 - .1 Through-Penetration Firestops Systems (XHEZ).
 - .2 Joint Systems (XHBN).
 - .3 Firestop Devices (XHJI).
 - .4 Forming Materials (XHKU).
 - .5 Wall Opening Protective Materials (CLIV).
 - .6 Fill, Void or Cavity Materials (XHHW).
- .7 American Society of Sanitary Engineering (ASSE):
 - .1 ASSE Series 9000 – Professional Qualification Standard for Firestop Systems and Device Installers, Inspectors and Surveyors.
- .8 International Association of Plumbing and Mechanical Officials (IAPMO):
 - .1 Uniform Plumbing Code (UPC).
 - .2 Uniform Mechanical Code (UMC).
- .9 International Standards Organization (ISO):
 - .1 ISO 6944
 - .2 ISO 10295-1: 2007.
 - .3 ISO 10295-2: 2009.
 - .4 ISO 10295-3:

1.03 PERFORMANCE REQUIREMENTS

- .1 Provide systems that are listed by at least one the following:
 - .1 Underwriters Laboratories Inc. (UL), in "Fire Resistance Directory".
 - .2 Intertek Testing Service (Formerly known as Omega Point Laboratories), in "Directory of Listed Products".
 - .3 Factory Mutual (FM), in FMRC Approval Guide.
 - .4 Any other qualified independent testing and inspection agency that conducts periodic follow-up inspections and is acceptable to authorities having jurisdiction.
- .2 Provide firestop products that are flexible enough to allow for pipe vibration in a through penetration application.
- .3 Provide fire resistive sealants and sprays for construction joint applications that are flexible enough to satisfy the movement criteria per the test standards ASTM E 1399, ASTM E 1966 or ANSI/UL 2079.
- .4 Provide products with the appropriate flame spread index and smoke develop index, when tested in accordance with ASTM E 84.

- .5 Provide products that meet the intent of the L rating classification for the movement of smoke per ANSI/UL 1479 for through penetrations and ANSI/UL 2079 for construction joints.
- .6 Provide products identical to those tested and listed for classification by UL, Intertek or any other qualified independent testing agency.
- .7 Provide products that bear classification marking of qualified independent testing agency.
- .8 Where firestop systems not listed by any listing agency are required due to project conditions, submit a substitution proposal with evidence specified.
- .9 Use only products specifically listed for use in listed systems.
- .10 Provide products that are compatible with each other, with the substrates forming openings, and with the items, if any, penetrating the firestopping, under the conditions represented by this project, based on testing and field performance demonstrated by manufacturer.
- .11 Firestopping materials must meet and be acceptable for use by all building codes and NFPA codes cited in this section.
- .12 Provide products that meet the intent of the state or local guidelines on volatile organic compounds (VOC).
- .13 Where applicable provide products that meet the intent of the F rating classification for passage of flame per ANSI/UL 1479 for through penetrations.
- .14 Where applicable provide products that meet the intent of the T rating classification for the transfer of temperature per ANSI/UL 1479 for through penetrations.
- .15 Provide products that meet the intent of the L rating classification for the movement of smoke per ANSI/UL 1479 for through penetrations and ANSI/UL 2079 for construction joints.
- .16 Where applicable provide products that meet the intent of the W rating classification for passage of water per ANSI/UL 1479 for through penetrations.

1.04 SUBMITTALS

- .1 Submit under provisions of the Contract and Division 01 – General Requirements.
- .2 Shop Drawings: For each firestopping system, provide the following:
 - .1 Listing agency's detailed drawing showing opening, penetrating item(s), and firestopping materials, identified with listing agency's name and number or designation and fire rating achieved.
 - .2 For proposed systems that do not conform strictly to the listing, submit written instructions showing modifications and approved by firestop system manufacturer.
 - .3 Submit under provisions of the International Building Code (IBC) section 107 and 703 requiring a submittal package for fire-resistance ratings and fire tests.
- .3 Product Certificates: Submit certificates of conformance signed by firestop system manufacturer certifying that materials furnished comply with requirements.
- .4 Product Data: Furnish manufacturer's product data sheets on each material to be used in firestop systems. Information on manufacturer's product data sheet should include:
 - .1 Product characteristics including compliance with appropriate ASTM/UL/ANSI test standards.

- .2 Storage and handling requirements and recommendations.
- .5 Installation Instruction: Furnish manufacturer's installation instructions.
- .6 Sustainable or LEED Submittals:
 - .1 VOC Content: For sealants and sealant primers, furnish documentation of VOC content.

1.05 QUALITY ASSURANCE

- .1 General: All through-penetration firestop systems and construction gap fire resistive systems shall be installed with approved methods using materials that have been tested and classified to produce an approved assembly.
- .2 Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of twenty five (25) years experience.
 - .1 Products shall be manufactured in a facility that follows ISO 9001 best practices.
- .3 Installer Qualifications: Firm must be qualified by having experience, staff, and be properly trained to install the specified products, and meets the following criteria:
 - .1 Contractor is a **3M** Master Contractor.
 - .2 Contractor is a Certified **3M** Trained contractor.
 - .3 Contractor is acceptable to manufacturer.
 - .4 Contractor is acceptable to Authority Having Jurisdiction (AHJ).
 - .5 Contractor has completed the manufacturer's certified product installation training.
 - .6 Contractor must provide a list of completed projects as evidence of experience; include project name and address, owner's name and address, and architect's name and phone number.
 - .7 Certificate: Contractor should provide certificate of qualification.
- .4 Codes: Where manufacturer's application procedures are in conflict with those of the local Authority Having Jurisdiction, the more strict guidelines will prevail.
- .5 Pre-installation Meetings: Meetings to agree on firestop requirements, conditions, manufacturer's instructions.

1.06 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver and store products until ready for installation in manufacturer's original unopened packaging, legibly marked with manufacturer's name and product identification, date of manufacture, lot number, listing agency's classification marking, curing/dry time, mixing instructions (if applicable) and MSDS reference number.
- .2 Store and handle in such a manner as to prevent deterioration or damage due to moisture, temperature changes, contaminants, and other causes; follow manufacturer's instructions.
- .3 Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local Authority Having Jurisdiction.

1.07 PROJECT CONDITIONS

- .1 Coordinate construction and cutting of openings so that each particular firestop system may be installed in accordance with its listing, including assembly rating, L rating, sizing, sleeves, manufacturer's published STC rating and penetrating items.

- .2 Coordinate firestopping of dynamic and static construction joints (top-of-wall, bottom-of-wall, floor-to-floor, floor-to-wall), wall-to-wall, perimeter so that each particular system may be installed in accordance with its listing, including assembly rating, sizing, movement capabilities and manufacturer's published STC rating.
- .3 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install firestopping under environmental conditions outside manufacturer's absolute limits.
- .4 Provide ventilation as required by firestopping manufacturer, including mechanical ventilation if required.

1.08 WARRANTY

- .1 At project closeout, provide to Owner or Owners Representative an executed copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- .1 Acceptable Manufacturer: **3M** Fire Protection Products, which is located at: **3M** Center Bldg. 223-2N-21 ; St. Paul, MN 55144-1000; Toll Free Tel: 800-328-1687; Email: request info (firetech1@mmm.com); Web: www.**3M**.com/firestop
- .2 Requests for substitutions will be considered in accordance with provisions of Division 1- General Requirements.
- .3 Single Source: To maintain control and integrity of the firestop applications a single manufacturer should be used. Specific UL or approved listing agencies systems applicable to each type of firestop condition should be supplied by one manufacturer.

2.02 SCOPE/APPLICATION

- .1 Provide installed firestop products that limit the spread of fire, heat, smoke, and gasses through otherwise unprotected openings in rated assemblies, including walls, partitions, floors, roof/ceilings, and similar locations, restoring the integrity of the fire rated construction to its original fire rating.
- .2 Provide firestop systems listed for the specific combination of fire-rated construction, type of penetrating item, annular space requirements, and fire rating, and the following criteria:
 - .1 F-Rating: Equal to or greater than the fire-resistance rating of the assembly in which the firestopping will be installed.
 - .2 T-Rating: In habitable areas where penetrating items are exposed to potential contact with materials on fire side(s) of rated assembly, T-rating must equal its F-rating.
 - .3 L-Rating: L-rating of 1 cfm per linear foot (5.5 cu m/h/m) maximum at ambient temperatures.
 - .4 W-Rating: meets UL Water Leakage Test, W Rating – Class 1 requirements for systems tested and listed in accordance with ANSI/UL 1479.
 - .5 Wall Penetrations: Through penetration systems must be symmetrical, with the same rating from both sides of the wall. Membrane penetrations may be asymmetrical.
 - .6 Testing: Determine ratings in accordance with ASTM E 814 or UL 1479.
- .3 Provide fire-resistive systems listed for construction gaps per the specific combination of fire-rated construction type, configuration, gap dimensions, and fire rating, and the following criteria:

- .1 Fire resistance rating must be equal to or greater than that of the assembly in which it is to be installed.
- .2 Movement capability must be appropriate to the potential movement of the gap, demonstrated by testing in accordance with ASTM E 1399/ASTM E 1966/UL 2079 for minimum of 500 cycles at 10 cycles per minute.
- .3 L-Rating: L-rating of 1 cfm per linear foot (5.5 cu m/h/m) maximum.
- .4 Determine ratings in accordance with ASTM E 1966/UL 2079.

2.03 THROUGH PENETRATION FIRESTOP PRODUCTS

- .1 **3M** Fire Barrier Cast-in-Place Devices: Firestopping device for use prior to a concrete pour. Adjustable height with pull tabs, straight edge design for close placement to walls and adjacent devices.
 - .1 Fire Resistance: For use in 1, 2, or 3 hour fire-rated systems.
 - .2 Locations: Horizontal assemblies only.
- .2 **3M** Fire Barrier Ultra RC Pack: One piece metal collar assembly encasing intumescent material for firestopping of pipes and cables through rated walls and floors.
 - .1 Fire Resistance: For use in 1 or 2 hour fire-rated systems.
 - .2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- .3 **3M** Fire Barrier Ultra Plastic Pipe Device: Intumescent device for firestopping of plastic pipe and cables through rated walls and floors.
 - .1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
 - .2 Configuration: One-piece metal collar, with locking latch and bendable tabs to secure; equipped also for conventional anchoring.
 - .3 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- .4 **3M** Fire Barrier RC-1 Restricting Collar with either FS 195+ Wrap Strip or **3M** Interam Ultra GS Wrap Strip . (See product descriptions below): For firestopping of plastic pipes from 4 inches (102 mm) to 10 inches (254mm) in diameter.
 - .1 Fire Resistance: For use in 1 or 2 hour fire-rated systems.
 - .2 Material: 28 gauge steel.
 - .3 Size: 25 foot (7.6 m) roll.
 - .4 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- .5 **3M** Fire Barrier CP25WB+ Sealant: High-performance, intumescent, water-based sealant. No-sag, fast drying, paintable, red in color. Versatile firestop sealant for pipes (not for use with CPVC), cables, cable tray, blank opening and other penetrations along with mineral wool or other fire-rated assembly products.
 - .1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
 - .2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
 - .3 STC rating of 54 when tested in STC 54-rated wall assembly.
- .6 **3M** Fire Barrier IC 15WB+ Sealant: General-purpose, intumescent, water-based sealant. No-sag, fast drying, paintable, yellow in color. Economical firestop sealant for pipes, cables, cable tray, blank opening and other penetrations along with mineral wool or other fire-rated assembly products.
 - .1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
 - .2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
 - .3 STC rating of 54 when tested in STC 54-rated wall assembly.

- .7 **3M Fire Barrier Sealant FD 150+:** Single-part, water-based, acrylic latex sealant. No-sag, low-shrinkage, low VOC. Blue, red or limestone color. Used to firestop for pipe penetrations (not for use with CPVC).
 - .1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
 - .2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
 - .3 STC rating of 54 when tested in STC 54-rated wall assembly.
- .8 **3M Fire Barrier Water Tight Sealant 3000 WT:** Single-part, water-tight, intumescent silicone firestop sealant for filling voids in concrete gypsum, metal, plastic, wood and insulation. Light gray color with black flecks. Meets UL Water Leakage Test, W Rating – Class 1 requirements.
 - .1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
 - .2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
 - .3 STC rating of 53 when tested in STC 54-rated wall assembly.
- .9 **3M Fire Barrier Water Tight 1000 NS Sealant:** Single-part, non-slump firestopping silicone sealant for floor and wall openings. Light gray color. Meets UL Water Leakage Test, W Rating – Class 1 requirements.
 - .1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems..
 - .2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
 - .3 STC rating of 56 when tested in STC 56-rated wall assembly.
- .10 **3M Fire Barrier Water Tight Sealant 1003 SL:** Single-part, self-leveling firestopping silicone sealant for floor openings. Light gray color. Meets UL Water Leakage Test, W Rating – Class 1 requirements.
 - .1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems..
 - .2 Locations: For horizontal assemblies only.
 - .3 STC rating of 56 when tested in STC 56-rated wall assembly.
- .11 **3M Fire Barrier Sealant 2000 NS:** Single-part, non-slump elastomeric silicone firestop sealant. Sag-resistant, low VOC. Light grey color. Used in mechanical, electrical and plumbing applications to firestop openings and penetrations through fire-rated floor or wall assemblies. Typical penetrants include: metallic pipe, non-metallic pipe (FGG/BM system CPVC compatible), conduit, power and communication cable and telephone or electrical wiring.
 - .1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
 - .2 Locations: Vertical and horizontal assemblies.
 - .3 STC-Rating of 56 when tested in STC 56-rated wall assembly.
- .12 **3M Fire Barrier Sealant 2000+:** Single-part, elastomeric silicone firestop sealant. Sag-resistant, low VOC. Light grey color. Used in mechanical, electrical and plumbing applications to firestop openings and penetrations through fire-rated floor or wall assemblies. Typical penetrants include: metallic pipe, non-metallic pipe (FGG/BM system CPVC compatible), conduit, power and communication cable and telephone or electrical wiring.
 - .1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
 - .2 Locations: Vertical and horizontal assemblies.
 - .3 STC-Rating of 56 when tested in STC 56-rated wall assembly.
- .13 **3M Fire Barrier Moldable Putty+:** One-part, 100 percent solids intumescent firestop. Remains pliable, flexible and easily re-enterable. Non-toxic synthetic formula. Versatile putty for pipes, cables, cable tray, blank opening and other penetrations along with mineral wool or other fire-rated assembly products.

- .1 Type: Stick or Pad
 - .2 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
 - .3 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- .14 **3M** Fire Barrier 2001 Silicone RTV Foam: Two-part, liquid-silicone elastomer, foams in place when mixed. For use sealing large or complex openings such as cable bundles, cable trays and conduit banks.
- .1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
 - .2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- .15 **3M** Fire Barrier Mortar: For sealing openings in concrete and masonry walls and floors. Self Leveling, non-sag, low VOC.
- .1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
 - .2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- .16 **3M** Fire Barrier Self-Locking Pillow: Self-contained, intumescent firestop pillow with interlocking strips. Meets fire rating without the use of wire mesh. For use in firestopping larger openings
- .1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
 - .2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- .17 **3M** Fire Barrier Pillow: Self-contained, intumescent firestop product. Meets fire rating without the use of wire mesh. For use in firestopping larger openings
- .1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
 - .2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- .18 **3M** Fire Barrier CS-195+ Composite Sheet: Organic/inorganic intumescent elastomeric sheet, bonded on one side to a layer of 28 gauge galvanized steel. Other side reinforced with steel-wire mesh and covered with aluminum foil. Re-enterable. For use in firestopping larger openings
- .1 Thickness: Nominal 0.3 inch (7.6 mm).
 - .2 Thermal Expansion: 8 - 10 times original size.
 - .3 Tensile Strength (ASTM D412): 93.6 psi (645 kPa)/489 percent.
 - .4 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
 - .5 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- .19 **3M** Interam Ultra GS Wrap Strip: Graphite based, flexible, largely inorganic, intumescent mat. For use around non-metallic piping with or with RC-1 collar.
- .1 Fire Resistance: For use in 1, 2 or 3 hour fire rated systems.
 - .2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- .20 **3M** Fire Barrier FS-195+ Wrap/Strip: One-part, organic/inorganic intumescent strip with foil on one side. May be cut to fit irregular shapes. For use around non-metallic piping with or with RC-1 collar.
- .1 Length: 24 inch (610 mm).
 - .2 Width: 1 or 2 inches.
 - .3 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
 - .4 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- .21 **3M** Fire Barrier Pass-Through Devices: One-Piece device for firestopping of cable penetrations through rated walls and floors.
- .1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.

- .2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- .22 **3M** Fire Barrier Tuck-In: Graphite-based, flexible, intumescent wrap strip for use around non-metallic piping. Adhesive closure tab.
 - .1 Fire Resistance: For use in 1, 2 or 3 hour fire-rated systems.
 - .2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.
- .23 **3M** Fire Barrier Putty Sleeve Kit: Device used for firestopping of cable penetrations through fire rated walls and floors.
 - .1 Fire Resistance: For use in 1, 2 3 or 4 hour fire-rated systems.
 - .2 Locations: Vertical assemblies, horizontal assemblies and smoke barrier.

2.04 FIRE RESISTIVE JOINT PRODUCTS

- .1 **3M** Fire Barrier Sealant FD 150+: Single-part, water-based sealant. Sag-resistant, low-shrinkage, low VOC.
 - .1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire-rated systems.
 - .2 Location: For use at top-of-wall, bottom-of-wall, wall-to-wall and floor-to-floor.
 - .3 Compression/Extension Recovery: +/- 19 percent of original joint width.
 - .4 Meets optional L rating requirements.
 - .5 STC rating of 56 when tested in STC 56-rated wall assembly.
- .2 **3M** Fire Barrier Water Tight Sealant 1000 NS: Single-part, non-slump elastomeric silicone sealant. Sag-resistant, low VOC.
 - .1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire rated systems.
 - .2 Meets UL Water Leakage Test, W Rating – Class 1 requirements.
 - .3 Location: For use at top-of-wall, bottom-of-wall, wall-to-wall, floor-to-floor, floor-to-wall and perimeter joints.
 - .4 Compression/Extension Recovery: +/- 15 percent of original joint width.
 - .5 STC-Rating of 56 when tested in STC-56-rated wall assembly.
- .3 **3M** Fire Barrier Water Tight Sealant 1003 SL: Single-part, self-leveling elastomeric silicone sealant. Sag-resistant, low VOC.
 - .1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire rated systems.
 - .2 Meets UL Water Leakage Test, W Rating – Class 1 requirements.
 - .3 Location: For use at top-of-wall, bottom-of-wall, floor-to-wall and floor-to-floor joints.
 - .4 Compression/Extension Recovery: +/- 15 percent of original joint width.
 - .5 STC-Rating of 56 when tested in STC-56-rated wall assembly.
- .4 **3M** Fire Barrier Sealant 2000 NS: Single-part, non-slump elastomeric silicone sealant. Sag-resistant, low VOC.
 - .1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire rated systems.
 - .2 Service Flexibility: Accommodate vibration from normal building movement.
 - .3 Location: For use at top-of-wall, bottom-of-wall, wall-to-wall, floor-to-wall, floor-to-floor and perimeter joints.
 - .4 Compression/Extension Recovery: +/- 31 percent of original joint width.
 - .5 STC-Rating of 56 when tested in STC 56-rated wall assembly.
- .5 **3M** Fire Barrier Sealant 2000+: Silicone Sealant: Single-part, elastomeric silicone sealant. Sag-resistant, low VOC.

- .1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire rated systems.
 - .2 Compression/Extension Recovery: +/- 13 percent of original joint width.
 - .3 Location: For use at top-of-wall, bottom-of-wall, wall-to-wall, floor-to-wall and floor-to-floor joints.
- .6 **3M** FireDam Spray 200: Water-based, paintable, low VOC, freeze/thaw resistant spray applied fire resistive product. Applied with conventional airless spray equipment.
- .1 Fire Resistance: For use in 1, 2, 3 or 4 hour fire rated systems.
 - .2 Compression/Extension Recovery: +/- 50 percent of joint width.
 - .3 Location: For use at head-of-wall, wall-to-wall, floor-to-floor, bottom-of-wall, floor-to-wall and perimeter joints.
 - .4 STC-Rating of 56 when tested in STC 56-rated wall assembly.

2.05 FIRESTOPPING FOR SINGLE MEMBRANE PENETRATIONS

- .1 **3M** Fire Barrier Moldable Putty+: One-part, 100 percent solids intumescent firestop. Remains pliable, flexible and easily re-enterable. Non-toxic synthetic formula.
- .1 Type: Pad.
 - .2 Fire Resistance: For use in 1, 2 or 3 hour fire rated systems.
- .2 **3M** Endothermic Mat E-5A-4: Endothermic heat absorbing mat.
- .1 Type: Mat.
 - .2 Fire Resistance: For use in 1 or 2 hour fire rated systems.

PART 3 - EXECUTION

3.01 EXAMINATION

- .1 Do not begin installation until substrates have been properly prepared.
- .2 Conduct tests according to manufacturer's written recommendations to verify that substrates are free of oil, grease, rolling compounds, incompatible primers, loose mill scale, dirt and other foreign substances capable of impairing bond of firestopping.
- .3 Verify that items penetrating fire rated assemblies are securely attached, including sleeves, supports, hangers, and clips.
- .4 Verify that openings and adjacent areas are not obstructed by construction that would interfere with installation of firestopping, including ducts, piping, equipment, and other suspended construction.
- .5 Verify that environmental conditions are safe and suitable for installation of firestopping.
- .6 If substrate preparation is the responsibility of another installer, notify Architect or Engineer of Record of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- .1 Prepare substrates in accordance with manufacturer's instructions and recommendations.
- .2 Install masking and temporary coverings as required to prevent contamination or defacement of adjacent surfaces due to firestopping installation.

3.03 INSTALLATION

- .1 Install in strict accordance with manufacturer's detailed installation instructions and procedures.
- .2 Install so that openings are completely filled and material is securely adhered.
- .3 Where firestopping surface will be exposed to view, finish to a smooth, uniform surface flush with adjacent surfaces.
- .4 After installation is complete, remove combustible forming materials and accessories that are not part of the listed system.
- .5 Repair or replace defective installations in accordance with manufacturer's recommendations, listed systems details and applicable code requirements.
- .6 At each through penetration or fire-resistive joint system, attach identification labels on both sides in location where label will be visible to anyone seeking to remove penetrating items or firestopping.
- .7 Clean firestop materials off surfaces adjacent to openings as work progresses, using methods and cleaning materials approved in writing by firestop system manufacturer and which will not damage the surfaces being cleaned.
- .8 Notify Authority Having Jurisdiction when firestopping installation is ready for inspection; obtain advance approval of anticipated inspection dates and phasing, if any, required to allow subsequent construction to proceed.
- .9 Do not cover firestopping with other construction until approval of authority having jurisdiction has been received.

3.04 FIELD QUALITY CONTROL

- .1 Owner will engage an independent testing agency to inspect installed firestopping and to prepare reports indicating whether the installed work complies with the contract documents.
- .2 Notify testing agency at least 7 days prior to date when firestopping installation will be ready for inspection; obtain advance approval of general schedule and phasing, if any, required to allow subsequent construction to proceed.

3.05 CLEANING AND PROTECTION

- .1 Remove left over material and debris from Work area. Use necessary means to protect fire protection product(s) before, during, and after installation.
- .2 Touch-up, repair or replace damaged products before Substantial Completion.
- .3 Install identification Labels for Through Penetration and Construction Joint Systems: Pressure sensitive self-adhesive vinyl labels, preprinted with the following information:
 - .1 The applicable words "Warning - Through Penetration Firestop System - Do not Disturb. Notify Building Management of Any Damage." or "Warning – Construction Gap Fire Resistive System - Do not Disturb. Notify Building Management of Any Damage."
 - .2 Listing agency's system number or designation.
 - .3 System manufacturer's name, address, and phone number.
 - .4 Installer's name, address, and phone number.
 - .5 General contractor's name, address, and phone number (if applicable).
 - .6 Date of installation.

END OF SECTION 07 84 00

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- 1.28 ELECTRICAL LEGEND & SCHEDULES

PART 2 - PRODUCTS

- 2.01 NIL

PART 3 - EXECUTION

- 3.01 NIL

PART 1 - GENERAL

1.01 GENERAL REQUIREMENTS

- .1 Comply with the requirements of Division 1 and all documents referred to therein.

1.02 APPLICATION

- .1 This Section applies to and is a part of all Sections of Division 26.

1.03 DEFINITIONS

- .1 Wherever the term "This Sub-Contractor" is used in the Division 26 Drawings and Specifications, it means the firm having a subcontract with the "Contractor" to perform, supervise and co-ordinate all work of this Division.
- .2 Wherever the term "install" (and tenses of "install") is used in the Division 26 Drawings and Specifications, it means install and connect complete.
- .3 Wherever the term "supply" is used in the Division 26 Drawings and Specifications, it means supply only.
- .4 Wherever the term "Provide" or "Provision of" are used in relationship to equipment and other materials specified for the Work of Division 26 it means "Supply, Install and Connect". Wherever the terms "Provide" or "Provision of" are used in connection with services such as testing, start-up and commissioning for any part of the Work of Division 26, it means procure, supervise, take responsibility and pay for these services.
- .5 Whenever "Drawings and Specifications" are referred to herein, it means "the Contract Documents".
- .6 Wherever the terms "Authorities" or "Authorities having jurisdiction" are used in the Division 26, Drawings and Specifications, it shall mean any and all current laws and/or by-laws of any Federal, Provincial or local authorized agencies having jurisdiction over the sum total or parts of the work including, but not restricted to the Municipal Planning and Building Department, Municipal Fire Department, the Construction Safety Act, Municipal Public Works Department, Federal and/or Provincial Fire Marshall, the Gasoline Handling Act, the Ontario Electrical Safety Code and other codes in effect at the time of construction.
- .7 Wherever the term "Work" is used in the Division 26 Drawings and Specifications, it means all equipment, permits, materials and labour to provide a complete electrical installation as required and detailed in the Drawings and Specifications.
- .8 Wherever the term "Acceptable" is used in the Division 26 Drawings and Specifications it means acceptable to the Consultant.

1.04 WORK INCLUDED

- .1 Sections of Division 26 are not intended to delegate functions nor to delegate work and supply to any specific trade and the Work shall include all labour, materials, equipment and tools required for a complete and working installation as described, but not necessarily limited to items in the following Sections:
- | | |
|------------------|---------------------------------|
| Section 07 84 00 | Firestopping |
| Section 26 05 00 | Electrical General Requirements |

Section 26 05 01	Shop Drawings, Product Data and Samples
Section 26 05 03	Electrical Systems Commissioning
Section 26 05 05	Basic Materials and Methods
Section 26 05 10	Electrical Identification
Section 26 05 14	Work in Existing Building
Section 26 05 21	Wire and Cable up to 600 Volts
Section 26 05 27	Grounding and Bonding
Section 26 05 29	Hangers and Supports
Section 26 05 31	Splitter Trough
Section 26 05 33	Raceways and Boxes
Section 26 24 16	Panelboards
Section 26 27 26	Wiring Devices
Section 26 28 13	Fuses
Section 26 28 23	Safety Switches
Section 26 50 00	Lighting Luminaires
Section 26 70 01	Fire Alarm System

1.05 PERMITS, FEES AND INSPECTIONS

- .1 Apply for, obtain, and pay for all permits, licenses, inspections, examinations and fees required for Work of Division 26. If the municipality is structured as a "single permit jurisdiction", the Contractor will apply, pay for and obtain the municipal building permit. In this case, the Division 26 contractor has no financial obligation for permit application except for permits not covered in the "single permit".
- .2 Arrange for inspection of all Work by the Authorities having jurisdiction over the Work. On completion of the Work, present to the Consultant the final unconditional certificate of approval of the inspecting Authorities.
- .3 Comply with the requirements of the latest edition of the applicable CSA standards, the requirements of the Authorities, Federal, Provincial and Municipal Codes, the applicable standards of the Underwriters' Association and all other Authorities having jurisdiction. These codes and regulations constitute an integral part of these specifications.
- .4 In case of conflict, the codes take precedence over the Contract Documents. In no instance reduce the standard or scope of work or intent established by the drawings and specifications by applying any of the codes referred to herein.
- .5 Before starting any work, submit the required number of copies of drawings and specifications to the Authorities for their approval and comments. Comply with any changes requested as part of the contract, but notify the Consultant immediately of such changes. Prepare and furnish any additional drawings, details or information as may be required.

1.06 CONTRACT DRAWINGS

- .1 The Drawings for Electrical work are performance drawings, diagrammatic, intended to convey the scope of work and indicate general arrangement and approximate location of apparatus, fixtures and conduit runs. The Drawings do not intend to show architectural and structural details.
- .2 Do not scale Drawings. Obtain information involving accurate dimensions from dimensions shown on Architectural and Structural drawings, and by site measurement.
- .3 Make, at no additional cost, any changes or additions to materials, and/or equipment necessary to accommodate structural conditions (conduits around beams, columns, etc.)
- .4 Alter, at no additional cost, the locations of materials and/or equipment as directed, that do not necessitate additional material.
- .5 Install ceiling mounted components (e.g., light fixtures, speakers, heat or smoke detectors) in accordance with reflected ceiling drawings.
- .6 Confirm on the site the exact location and mounting elevation of outlets and fixtures as related to Architectural and Structural details.

1.07 EXAMINATION OF SITE AND DOCUMENTATIONS

- .1 Prior to submitting tender, carefully examine conditions at the site which could affect the Work. Refer to and examine all contract documents.
- .2 Be responsible for any damage done to existing underground services caused by neglect to determine and mark out the location of such services prior to excavation work commencing.
- .3 Refer to room finish schedules to determine finished, partially finished and unfinished areas of the building.
- .4 Ensure that materials and equipment are delivered to the site at the proper time and in such assemblies and sizes so as to enter into the building and to be moved into the spaces where they are to be located without difficulty. Be responsible for any cutting and patching involved in getting assemblies into place.

1.08 CO-ORDINATION DRAWINGS

- .1 Prepare drawings in conjunction with all trades concerned, showing sleeves and openings for passage through structure, and all inserts, equipment bases, and supports, and relate these to suitable grid lines and elevation datum.
- .2 When requested, provide weights of major items of equipment.
- .3 Prepare interference and co-ordination drawings for all areas where the work of this Division could conflict with and/or obstruct the work of other trades and/or other Sections of this Division. Submit drawings for review by the Consultant.

1.09 RECORD DRAWINGS

- .1 The drawings for this Project have been prepared using Revit/BIM 360. For the purpose of exchanging model and producing record (as-built) drawings, a model file will be made available to the trade for a cost of \$XXXXX. Edit Note: Price for model should be based on actual # of output drawings, example:

For 1 to 10 files \$550.00

For 11 to 20 files	\$650.00
For 21 to 50 files	\$850.00
For 51 to 100 files	\$1,350.00
For greater than 100 files, charge \$10.00 per file + \$350.00.	

In using the model from the Consultant to produce record drawings, the Contractor is deemed to have agreed to take full responsibility for any and all information on the drawings.

- .2 Obtain a set of white prints as the job progresses, mark this set to accurately indicate installed work. Show location by dimension from walls or columns for all buried services as well as invert depths. Have these white prints available for inspection at the site at all times, and present for scrutiny at each job meeting.
- .3 At completion of the project, transfer all information from the white prints to the CAD files, and provide one CD with updated CAD files to the Consultant as part of the close out documents.
- .4 The contractor is responsible for all cost associated with the production and services required, such as recreating, plotting and printing to produce "as-built" drawings.

1.10 PRODUCT STANDARDS AND ALTERNATIVES

- .1 Provide new material and equipment as specified and to the acceptance of the Consultant.
- .2 Manufacturer's names are listed as the "Basis of Design" and to set a standard of quality, performance, capacity, appearance and serviceability. Other acceptable manufacturers where listed may be used in the submission of the Electrical bid, however it is the bidders responsibility to ensure the equipment will perform and fit the available space used in the design.
- .3 Where no other acceptable manufacturers are indicated, provide the exact make specified. Requests for acceptance of manufacturers not listed must be submitted not less than seven working days prior to closing date of the tender, and submissions must bear proof of acceptance by the Consultant if used in the tender.
- .4 Assume full responsibility for ensuring that when providing other acceptable manufacturers all space, weight, connections, power and wiring requirements, etc., are considered, and costs therefore included in the tender. Equipment requiring greater than specified energy requirements or unduly limiting service space requirements will not be accepted.
- .5 All electrical equipment, material, wiring and devices to conform to the Ontario Electrical Safety Code for the purpose for which they are to be used and bear the approval of CSA or other acceptable testing agency, alternately the equipment must bear special approval of the inspection authority.

1.11 PATENTS

- .1 Pay all royalties and licence fees, and defend all suits or claims for infringement of any patent rights, and save the Owner and Consultant harmless of loss or annoyance on account of suit, or claims of any kind for violation or infringement of any letters, patent or patent rights, by this Subcontractor or anyone directly or indirectly employed by him or by reason of the use by him or them of any part, machine, manufacture or composition of matter on the work, in violation or infringement or such letters, patent or rights.

1.12 RIGHTS RESERVED

- .1 Rights are reserved to furnish any additional detail drawings, which in the judgement of the Consultant may be necessary to clarify the work, and such drawings shall form a part of this contract.

1.13 EQUIPMENT NAMEPLATES

- .1 Provide apparatus with proper nameplates affixed thereto, showing the size, name of equipment, serial number and all information usually provided, which also includes voltage, cycle, phase, horsepower of motors and the name and address of the manufacturer.

1.14 EXPEDITING AND DELIVERY

- .1 Continuously check and expedite delivery of equipment and materials. If necessary, inspect at the source of manufacture.
- .2 Continuously check and expedite the flow of necessary information to and from all parties involved.
- .3 Immediately inform the Consultant in case information is required from him.
- .4 Provide delivery records updated monthly.

1.15 SUPERINTENDENCE

- .1 Maintain at the job site, at all times, qualified personnel and supporting staff, with proven experience in erecting, supervising, testing and adjusting projects of comparable nature and complexity.
- .2 The supervising personnel and their qualifications are subject to the approval of the Consultant.

1.16 WORKMANSHIP

- .1 Install equipment, conduit and cables in a workmanlike manner to present a neat appearance to function properly to the satisfaction of the Consultant. Install runs parallel and perpendicular to building lines, in chases, behind furring or above ceilings, where such concealment is possible. In areas where systems are to be exposed install neatly and group to present a tidy appearance.
- .2 Install equipment and apparatus requiring maintenance, adjustment or eventual replacement with due allowance therefore.
- .3 Include in the work all requirements of manufacturers shown on the shop drawings or manufacturers installation instructions.
- .4 Replace work unsatisfactory to the Consultant without extra cost.
- .5 Make provision to accommodate future plant and equipment indicated on drawings.
- .6 Protect from damage all equipment delivered to the site and during installation. Any damage or marking of finished surfaces shall be made good to the satisfaction of the Consultant.

1.17 TRIAL USAGE AND TESTS

- .1 The Owner has the privilege of the trial usage of Electrical Systems or parts thereof for the purpose of testing and learning the operational procedures.
- .2 Assist in trial usage over a length of time as deemed reasonable by the Consultant at no extra cost and do not waive any responsibility because of trial usage.
- .3 Trial usage shall not be construed as Substantial Completion of the Work, or acceptance by the Owner.
- .4 Provide and pay for all testing required on the system components where, in the opinion of the Consultant, manufacturers ratings or specified performance is not being achieved.

1.18 CLEANING

- .1 Before energizing any systems, inspect and clean the inside of panel boards, switchgear and cabinets to ensure that they are completely free from dust and debris.
- .2 Clean all polished, painted and plated work bright. Clean all lighting fixtures.
- .3 Remove all debris, surplus material and all tools.
- .4 Carry out additional cleaning operating of systems as specified in other sections of the specification.

1.19 COMPLETION

- .1 Leave electrical work in specified working order.

1.20 WARRANTIES

- .1 Provide warranty certificates, wherever given or required, in excess of the normal warranty period showing the name of the firm giving the warranty, dated and acknowledged, on specific equipment and systems.

1.21 INSTRUCTION TO OWNERS

- .1 Instruct the Owner's representatives in all aspects of the operation of systems and equipment.
- .2 Arrange for and pay for services of service engineers and other manufacturers' representatives required for instruction on specialized portions of the installation.
- .3 Submit to the Consultant at the time of final inspection a complete list of systems stating for each system:
 - .1 Date instructions were given to the Owner's staff.
 - .2 Duration of instruction.
 - .3 Name of persons instructed.
 - .4 Other parties present (manufacturer's representative, consultants, etc.).
- .4 Signatures of the Owner's staff stating that they properly understood the system installation, operation and maintenance requirements.

1.22 DOCUMENTATION AND SYSTEMS ACCEPTANCE

- .1 Assemble three (3) copies of operating and instruction manuals in three ring binders with index tabs each containing this subcontractor's and suppliers names and telephone numbers.
- .2 Each manual shall contain the following data:
 - .1 A set of as-built prints.
 - .2 Letters of Owner's Instructions
 - .3 Final ESA Certificate.
 - .4 A copy of each "reviewed" shop drawing.
 - .5 Complete explanation of operation principles and sequences.
 - .6 Complete part lists with numbers.
 - .7 Recommended maintenance practices and precautions.
 - .8 Complete wiring and connections diagrams.
 - .9 Certificate of warranty.
 - .10 Representative certificates for:
 - .1 Fire Alarm System

.2 Generator Assemblies

- .3 Ensure that operating and maintenance instructions are specific and apply to the models and types of equipment provided.

1.23 OWNER'S RIGHT TO RELOCATE ELECTRICAL ITEMS

- .1 The Owner reserves the right to relocate electrical outlets at a later date, but prior to installation, without cost, assuming that the relocation per outlet does not exceed 3000 mm from the original location. No credits shall be anticipated where relocation per outlet of up to and including 3000 mm reduces materials, products and labour.
- .2 Should relocations per outlet exceed 3000 mm from the original location the Contract Price will be adjusted accordingly.
- .3 Necessary changes, due to lack of co-ordination, and as required and when approved, shall be made at no additional cost, to accommodate structural and building conditions. The location of conduits and other equipment shall be altered without charge to the Owner, if approved, provided the change is made before installation.

1.24 ELECTRICAL LIST OF MANUFACTURERS, SUBTRADES AND PRICES

- .1 At the time of tender closing, list the names of manufacturers or subtrades carried (one per item), the total cost of the Electrical Works, any separate, unit and alternative prices where indicated.
- .2 If this Subcontractor neglects to list the specified or acceptable manufacturers or lists more than one manufacturer per item, or lists manufacturers not specified, the Consultant will have the option of making the selection of the manufacturer.
- .3 There will be no substitutions of named manufacturers or subtrades after tender close except as approved by the Consultant.

1.25 PHASING AND SCHEDULING OF WORK

- .1 Refer to Scope of work for a detailed description of the phasing and scheduling of the work. Execute work in accordance with the phasing and construction schedule. Provide all necessary temporary connections and equipment to provide functional, operational systems during construction period when part of the building will be occupied and construction is still continuing in other portions.

1.26 MATERIALS FURNISHED BY OTHERS

- .1 Where materials are furnished by others for installation under this Division, the Sub-Contractor shall notify the supplier of dates he will be ready for delivery as specified in the General Conditions. The Sub-Contractor shall receive, unload, handle, store, protect and insure the material until ready for actual installation. Upon receipt of material furnished by others, the Sub-Contractor shall spot-check or check the entire shipment and promptly advise the Consultant in writing of any damage and/or missing components. Any material which is subsequently lost or damaged due to negligence on the part of the Sub-Contractor shall be promptly replaced (or repaired to the satisfaction of the Owner) at the Sub-Contractor's expense.

1.27 CONNECTIONS TO EQUIPMENT FURNISHED BY OTHERS.

- .1 Where the Drawings indicated equipment to be furnished by others, provide Electrical rough-in for each unit pursuant to its shop drawings, and make final connections, disconnect switches and other electrical facilities for a complete installation.

1.28 ELECTRICAL LEGEND & SCHEDULES

- .1 Refer to Electrical Drawings for Legend and Schedules

PART 2 - PRODUCTS

2.01 NIL

PART 3 - EXECUTION

3.01 NIL

END OF SECTION 26 05 00

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- 1.02 SHOP DRAWINGS
- 1.03 PRODUCT DATA
- 1.04 SAMPLES
- 1.05 SUBMISSION REQUIREMENTS
- 1.06 RESUBMISSION REQUIREMENTS
- 1.07 DISTRIBUTION

PART 2 - PRODUCTS

- 2.01 NIL

PART 3 - EXECUTION

- 3.01 NIL

PART 1 - GENERAL

1.01 REFERENCES

- .1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.
- .2 Designate in the Construction Schedule, or in a separate coordination schedule, dates for submission and dates that reviewed Shop Drawings, Product Data and Sample will be required. Give due consideration for review time required by the Consultant, with a minimum of fifteen (15) working days required. The submission of Appendix 'B' will be considered an acceptable submittal schedule.
- .3 All data and dimensions on shop drawings, product data and sample information to be based on units (Imperial or Metric) as shown on the contract documents.
- .4 Shop Drawings with errors or omissions and deviations will be returned "Not Reviewed".
- .5 The Contractor's responsibility for deviations in submission from the requirements of Contract Documents is not relieved by the Consultant's review of submittals, unless a deviation on the submittal is noted as such in writing and has been accepted by the Consultant.
- .6 Keep one (1) reviewed copy of each submission on site.

1.02 SHOP DRAWINGS

- .1 Review and stamp Shop Drawings, Product Data and Samples prior to submission to the Consultant. Confirm that necessary requirements have been determined and verified and that each submittal has been checked and coordinated with requirements of the Work and the Contract Documents. Submittals not stamped, signed, dated and identified as to the specific project, will be returned without being examined and shall be re-submitted when completed.
- .2 Submit drawings in a clear and thorough manner:
 - .1 Identify details by reference to drawing No. and detail, schedule or room numbers as shown on Contract Documents.
 - .2 Minimum sheet size and larger sheets to be multiples of 8½" x 11".
 - .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated. Indicate cross references to design drawings and specification.
 - .4 Adjustments to shop drawings by the Consultant do not change the cost of the work. If adjustments affect the cost of Work, advise through normal channels in writing prior to proceeding with the Work.
 - .5 Make changes in shop drawings as directed by the Consultant. Resubmit and note any revisions other than those requested.
 - .6 If only minor adjustments are made, shop drawings to be returned and fabrication and installation of work to proceed.
- .3 Determine and verify:
 - .1 Field measurements.
 - .2 Field construction criteria.
 - .3 Catalogue numbers and similar data.

- .4 Conformance with Specifications.
- .4 Co-ordinate each submittal with requirements of the Contract documents.
- .5 Each Shop Drawing will be stamped by the Consultant in the following format:
 - ☐ NOT REVIEWED ☐ REVIEWED
 - ☐ RESUBMIT ☐ REVIEWED AS MODIFIED
 - ☐ NOT SPECIFIED BY MCW, REVIEWED FOR MEP ONLY
- .6 This review by the Consultant is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the Consultant approved the detail design inherent in the shop drawings, responsibility for which shall remain with this Subcontractor submitting same, and such review shall not relieve this Subcontractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the contract documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication.
- .7 Products not specified by MCW are reviewed to confirm compliance with services provided only. Any changes required between provided services and shop drawing requirements will be identified for coordination between trades.
- .8 Shop drawings shall be accompanied by a complete copy of the attached "Shop Drawing Submittal Sheet" Section 26 05 01, Appendix 'A'.
- .9 Begin no fabrication or work which requires submittals until return of submittals reviewed by Consultant.

1.03 PRODUCT DATA

- .1 Where specified, Manufacturer's standard schematic drawings, catalogue sheets, diagrams, schedules, performance charts, illustrations and other standard descriptive data is acceptable provided there is conformance with the following:
 - .1 Clearly identify pertinent products or models.
 - .2 Show performance characteristics and capacities.
 - .3 Show dimensions and clearances required.
 - .4 Show wiring or piping diagrams and controls.
- .2 Manufacturer's standard schematic drawings and diagrams may require modifications to drawings and diagrams to provide information applicable to the Work.
- .3 Provide information specifically applicable to the Work.

1.04 SAMPLES

- .1 Samples to be labelled, of sufficient size and quantity to clearly illustrate:
 - .1 Functional characteristics integrally related parts and attachment devices.
 - .2 Full range of colour, texture and pattern.
- .2 Field Samples and mock-ups:
 - .1 Erect, at the project site and in location acceptable to the Consultant.
 - .2 Fabricate each sample and mock-up complete and finished.
 - .3 Remove mock-ups at conclusion of Work or as specified by the Consultant.

1.05 SUBMISSION REQUIREMENTS

- .1 Submit promptly to approved schedule and in sequence to prevent submission delay in the Work.
- .2 Submission requirements:
 - .1 Shop Drawings: Acceptable submissions are: Submit shop drawings electronically as agreed to during the kick off meeting with the Consultant.
 - .2 Product Data: Submit a copy for each O & M Manual.
 - .3 Samples: Submit as specified, or as requested during the shop drawing review period.

1.06 RESUBMISSION REQUIREMENTS

- .1 Make corrections or changes to the submittals noted by the Consultant and resubmit.
- .2 Shop Drawings and Product Data:
 - .1 Revise drawings or data, and resubmit as noted on the initial submittal.
 - .2 Indicate any changes which have been made other than those noted by the Consultant.
- .3 Samples: Submit new samples as required for initial submittal as soon as possible after notification of the rejection of the original submission and mark "resubmitted samples".

1.07 DISTRIBUTION

- .1 Distribute reproductions of Shop Drawings and copies of Product Data which carry the Consultant's stamp to all parties as specified by Division One General Requirements.
 - .1 Job site file
 - .2 Project record document file
 - .3 Other affected contractors
 - .4 Subcontractors
 - .5 Supplier or fabricator (as applicable)
 - .6 Operations Manual

PART 2 - PRODUCTS

2.01 NIL

PART 3 - EXECUTION

3.01 NIL

END OF SECTION 26 05 01

SHOP DRAWING SUBMITTAL SHEET

Project: _____ Date: _____

Project No. _____ Submittal No. _____

Section: _____

Equipment
Description _____

Contractor: _____

Sub-Contractor: _____

Suppliers Name: _____

Manufacturer: _____

Catalogue No.: _____

Variations From
Tender Documents _____

Engineer: MCW Consultants Ltd.
207 Queen's Quay West, Suite 615
Toronto, Ontario
M5J 1A7

ELECTRICAL GENERAL REQUIREMENTS SECTION 26 05 01 – APPENDIX 'B' PROJECT: _____ PROJECT No: _____		SHOP DRAWING SUBMITTAL SCHEDULE DIVISION 26						Page 1 Date: _____	
SECTION	DESCRIPTION (List Equipment Example only Edit to Suit)	MANUFACTURER	SHOP DRAWING				DELIVERY		COMMENTS
			SUBMITTED		RETURNED		SCHED	ACTUAL	
			SCHED	ACTUAL	SCHED	ACTUAL			
26 05 14	Work in Existing Building								
26 05 31	Splitter Trough								
26 27 26	Wiring Devices								
26 28 13	Fuses								
26 28 23	Safety Switches								
26 50 00	Lighting Luminaires								
26 70 01	Fire Alarm System								

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- 3.09 SPRINKLER PROTECTION
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- 3.12 MOUNTING HEIGHTS

PART 1 - GENERAL

1.01 REFERENCES

- .1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.

1.02 WORK INCLUDED

- .1 Provide materials as specified herein to complete the work as required by the contract documents.

1.03 SUBMITTALS

- .1 Submit Shop drawings as required.

PART 2 - PRODUCTS

2.01 SLEEVES

- .1 In concrete slabs, except as noted below, sleeves shall be #24 gauge galvanized steel or factory fabricated plastic sleeves, each with an integral flange to secure the sleeve to form work construction.
- .2 In waterproof concrete slabs and in other slabs where waterproof sleeves are required, provide Schedule 40 mild galvanized steel.
- .3 40 mild galvanized steel or suitable rigid, factory fabricated plastic sleeves.

2.02 ESCUTCHEON PLATES

- .1 One-piece chrome plated steel sized to completely cover sleeves and complete with set screws to secure the plates to the conduit. Split plates will not be acceptable.

2.03 INSERTS AND BEAM CLAMPS

- .1 Inserts for concrete form work shall be Crane Canada Ltd., #4-M Unistrut Ltd., or approved equal cast iron inserts, multiple type where required.
- .2 Inserts for precast concrete and existing concrete shall be lead cinch anchors of "WEJ-IT" or self-drilling "STARR" or "PHILLIPS" anchors.
- .3 Beam clamps for hanging and support to structural steel shall be Crane Canada Ltd., or equal.

2.04 ACCESS DOORS

- .1 Minimum #12 gauge prime coat painted bonderized steel flush access doors, each complete with a heavy frame and anchor, heavy duty rust-resistant concealed hinges, a positive locking screwdriver lock, and mounting and finishing provisions to suit the particular construction in which it is installed. Access door sizes shall suit the concealed work for which they are supplied. Access doors in fire rated ceilings, walls, partitions, structures, etc., shall be ULC listed and labelled and of a rating to maintain the fire separation integrity.
- .2 Where access doors are located in surfaces where special finishes are required, they shall be of a recessed door type capable of accepting the finish in which they are to be installed so as to maintain the final building surface appearance throughout.

PART 3 - EXECUTION

3.01 INSTALLATION OF SLEEVES

- .1 Where conduits, raceways and conductors pass through structural poured concrete, supply sleeves, unless otherwise noted.
- .2 Size sleeves, unless otherwise noted, to leave 12mm clearance around the conduit, raceway, etc. Pack and seal the void between the sleeves and the conduit, raceway, conductor etc. for the length of the sleeves.
- .3 Pack all sleeves with a ULC and CSA approved one part intumescent elastomer as manufactured by 3M. The installation shall be formed for each specific application using the manufacturers recommended combination of the following:
 - .1 P25 caulk, Puty 303, penetration sealing system 7902 or 7904, composite sheet CS195 or wrap strip FS-195.
- .5 In poured concrete construction, accurately locate sleeves, and turn these sleeves over to the Division performing the concrete work for placement in the concrete form work. Sleeves shall be sufficiently rigid to prevent sleeve deformation when the concrete is poured, and shall be suitably plugged to prevent concrete from entering the sleeve.
- .6 Submit to the concrete reinforcement detailer at the proper times, drawings, indicating all required sleeves, recesses and formed openings in poured concrete work. Such drawings shall be completely and accurately dimensioned and shall relate sleeves, recesses and formed openings to suitable grid lines and elevation datum.
- .7 Supply sleeves of a water protecting type for installation in the following locations:
 - .1 In Mechanical and Fan Room floor slabs except where on grade;
 - .2 In slabs over Mechanical, Fan, Electrical and Telephone equipment rooms or closets;
 - .3 In all floors equipped with waterproof membranes;
 - .4 In the roof.
- .8 "Gang" type sleeving will be permitted only with the Consultant's approval.
- .9 Terminate sleeves for work which will be exposed so that the sleeve is flush at both ends with the wall, partition or slab surface so that the sleeves may be completely covered by escutcheon plates.
- .10 Openings for multiple conduit or conductor runs, etc., will be provided by the Division responsible for the particular construction in which the opening is required. Carefully co-ordinate the opening locations with the particular Division and ensure that openings are suitably sized and located. Seal the space between the opening and the conduit, conductors, etc., for the length of the opening as for sleeves above.
- .11 Where a round or formed opening is required, where placement of a sleeve has been missed, or where provision of an opening has not been properly co-ordinated with the Concrete Division, neatly cut a suitably sized hole or opening using proper tools to the approval of the Consultant. Prior to cutting any such holes or openings, determine whether or not any reinforcing steel or services, are concealed behind the surface where the hole or opening is to be cut and be responsible for all costs incurred for correcting any damage caused to the structure or services due to cutting holes or openings without prior study and approval.

3.02 INSTALLATION OF ESCUTCHEON PLATES

- .1 Provide escutcheon plates over all exposed conduit passing through walls, floors, ceilings, partitions, furrings, etc., in finished areas.

3.03 INSTALLATION OF INSERTS AND BEAM CLAMPS

- .1 Provide all inserts, beam clamps, fasteners, and similar hardware required for conduit, duct, raceway, conductor, etc., and equipment hanger and/or support materials unless otherwise noted.
- .2 Accurately and properly set concrete inserts in the concrete framework.
- .3 For runs of three (3) or more conduits, raceways, or conductors in concrete form work, use multiple type inserts used for the smallest conduit in the group.
- .4 Where inserts are required in pre-cast concrete and in concrete work where concrete inserts have not been installed, drill a neat hole of the proper diameter and depth in the concrete and insert an anchor to accept the hanger rod, bolt, etc. or where concrete mass permits, use self-drilling concrete anchors.
- .5 Fasten hangers and support provisions to brick or masonry with expansion shields and machine bolts, or for light loads, use plugs and screws.
- .6 In cavity walls and/or ceilings, use two (2) wing toggles and for heavy loads, provide steel anchor plates with two (2) or more toggles to spread the load.
- .7 Provide beam clamps for attaching, hanging and/or support provisions to structural steel, or where approved by the Consultant, weld the hanging and support provisions to the structural steel.
- .8 Explosive power actuated fasteners will not be permitted unless specific approval for their use has been obtained from the Consultant.
- .9 Use fibre or lead screw anchors for anchoring screws.

3.04 SUPPLY OF ACCESS DOORS

- .1 Supply access doors to give access to all junction boxes, pullboxes, conductor joints and other similar electrical work which may need maintenance or repair but which is concealed in inaccessible construction except as otherwise specified herein or on the drawings.
- .2 Before commencing installation of electrical work, prepare on a set of reflected ceiling plans with complete layouts of all ceiling access door which will be required. Submit these layouts to the Architect for approval and show the exact sizes and locations of such ceiling access doors. Locate access doors in walls and partitions to the Consultant's approval, and arrange electrical work to suit.
- .3 Supply the respective trade with panels, doors or the frames therefore complete with all pertinent information and pay their trade for installation.
- .4 Access doors shall be, wherever possible, of a standard size, for all applications. Confirm exact dimensions with the Consultant, prior to ordering.
- .5 Submit a sample of each proposed type of access door to the Consultant for approval.

3.05 PLYWOOD

- .1 Provide all plywood indicated on the drawings required for the work of Division 26. The backboards shall be 19mm thick, good both sides and shall be impregnated with white fire retardant paint on both sides.

3.06 EQUIPMENT CURBS, BASES AND SUPPORTS

- .1 Set all floor mounted equipment on 100mm high concrete housekeeping pads 100mm wider and longer than the equipment base dimensions.
- .2 Furnish dimensioned drawings, templates and anchor bolts for proper setting of equipment on bases and pads. Provide all structural steel frames, brackets, etc., for equipment bases and supports unless otherwise noted, and be responsible for all required levelling, alignment and grouting of the equipment.
- .3 Provide structural steel stands for equipment where indicated or specified. Flange bolt stands to housekeeping pads.
- .4 Where equipment is suspended above floor level it shall be, unless otherwise noted, supported on a suitable structural steel angles or channels bracketed to the wall or secured by hanger rods to slab construction, or where loading is excessive, from separate structural steel members carried to either the floor or ceiling, or both as required.

3.07 CUTTING AND PATCHING

- .1 Inform other trades in time concerning required openings. In work already finished, cutting and patching shall be done by the trades installing the affected work, at the expense of Division 26. Obtain the approval of the Consultant, before doing any cutting.

3.08 PROVISION FOR SERVICES CROSSING BUILDING EXPANSION JOINTS

- .1 Wherever services (conduit, cables etc.) cross building expansion joints, install the services in such a manner to permit free movement without imposing additional stress or loading upon the support system, and to prevent excessive movement at joints and connections.

3.09 SPRINKLER PROTECTION

- .1 Weatherproof equipment where noted in the specifications and/or drawings shall have EEMAC Type 3 enclosure in accordance with the requirements of CSA C22.2 No. 94 Standard.

3.10 FLASHING

- .1 Flash all electrical parts passing through or built into an outside wall, or a waterproof floor.
- .2 Provide copper flashing for sleeves passing through exterior walls or water proof floors.
- .3 Provide counter flashing on conduits passing through roofs to fit over flashing or curb. Supply flashing to appropriate division for installation.

3.11 METALS

- .1 Steel construction required solely for the work of electrical trades and not shown on architectural or structural drawings shall be provided by Division 26 to the acceptance of the Consultant.

3.12 MOUNTING HEIGHTS

- .1 Maximum mounting height of equipment is from finished floor to centre line of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not indicated verify before proceeding with installation.
- .3 Prior to rough-in, co-ordinate and have approved by the Consultant all mounting heights of devices.

- .4 Mounting heights shall meet the requirements of the "Barrier Free" section of OBC.
- | | | |
|-----|---|---|
| .1 | Local switches: | 1050mm |
| .2 | Local switches in suites: | 1050mm |
| .3 | Wall receptacles: | |
| .1 | General: | 400mm |
| .2 | Above top of continuous baseboard heater: | 200mm |
| .3 | Above top of counters or splash back: | 1100 |
| .4 | In mechanical room: | 1050mm |
| .4 | Panelboards (to top of panel trim): | 1850mm |
| .5 | Telephone and interphone outlets: | 400mm |
| .6 | Wall-mounted telephone and interphone outlets: | 1050mm |
| .7 | Wall-mounted A/V speakers: | 2100mm or as noted |
| .8 | Clocks: | 2100mm |
| .9 | Doorbell pushbuttons: | 1050mm |
| .10 | Pay Telephones: | 1050mm |
| .11 | Television outlets: | 400mm |
| .12 | All fire alarm devices shall be installed in accordance with CAN/ULC-S524-14 including: | |
| .1 | Manual stations: | 1150mm |
| .2 | Audible devices (not less than): | 2300mm or 150mm below ceiling |
| .3 | Visual devices: entire lens shall be not less than | 2000mm and not more than |
| | 2400mm above finished floor. | |
| .4 | Smoke detectors | 100 – 300mm from ceiling to top edge of device. |

END OF SECTION 26 05 05

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- 1.02 WORK INCLUDED
- 1.03 SUBMITTALS

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- 2.01 NIL

PART 3 - EXECUTION

- 3.01 STANDARD IDENTIFICATION
- 3.02 PAINTING AND FINISHES

PART 1 - GENERAL

1.01 REFERENCES

- .1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.

1.02 WORK INCLUDED

- .1 Provide lamacoid nameplates and other identification means for a complete installation.

1.03 SUBMITTALS

- .1 Submit a list of proposed labels for review prior to manufacturing.

PART 2 - PRODUCTS

2.01 NIL

PART 3 - EXECUTION

3.01 STANDARD IDENTIFICATION

- .1 Identify electrical work as specified herein:
 - .1 For each piece of electrical distribution equipment from the electrical source of supply up to and including panelboards and motor systems, for special control panels and cabinets, and for any other piece of equipment where specified in this Section, provide engraved lamacoid identification nameplates.
 - .2 Nameplates shall generally be black-white-black with bevelled edges, secured to apparatus with stainless steel screws. Generally lettering shall be 6mm high but equipment in the main electrical room shall be provided with lettering 13mm high.
 - .3 Warning signs, if and when required, shall be red with white lettering.
 - .4 Equip large multiple cell or component apparatus such as switchboards and distribution panels with main nameplates identifying the equipment, voltage characteristics and capacity and with sub-nameplates clearly identifying each cell or component and its service.
 - .5 Panelboard nameplates shall identify the panelboard numbers designated on the drawings, unless otherwise instructed. Nameplates for disconnect switches, control panels and cabinets shall outline their service.
 - .6 Motor starters, magnetic and manual, shall identify the piece of motorized equipment being serviced.
 - .7 Exact nameplate wording and sizes must be approved by and confirmed by the Consultant prior to manufacture.
 - .8 Directories for branch circuit panelboards shall be clearly and neatly typewritten, accurately identifying the type, location and wattage of the connected load for each circuit breaker. Directories shall be secured to the rear of the cabinet door under protective plastic. Incorporate copies of all panel board directories in each copy of operating and instruction manuals.
 - .9 Clearly identify each branch circuit breaker in a permanent manner to correspond with directories. Glued paper identification will not be acceptable.
 - .10 Clearly identify main pull or junction boxes (excluding obvious outlet boxes) by painting the outside of the covers. Paint colours shall be in accordance with the following schedule:
 - .1 Lighting - Yellow

- | | | | |
|----|-----------------------|---|--------|
| .2 | Power | - | Blue |
| .3 | Emergency Power | - | Orange |
| .4 | Fire Alarm | - | Red |
| .5 | Telephone | - | Cream |
| .6 | Miscellaneous Signals | - | Brown |
- .11 In addition to painting miscellaneous signal boxes clearly identify the specific system in which the box is installed.
- .12 Colour code empty conduit capped and terminated for future use as specified above and clearly identify its intended use by means of securely attached tags.
- .13 Colour code conductors throughout to identify phases, neutrals and grounds, by means of coloured conductor insulation. Colours shall be as follows:
- | | | | |
|----|---------|---|-------|
| .1 | Phase A | - | Red |
| .2 | Phase B | - | Black |
| .3 | Phase C | - | Blue |
| .4 | Ground | - | Green |
| .5 | Neutral | - | White |
- .14 Control conductors, in addition, shall be numbered with Brady Ltd., or Electrovert Ltd., Z-type markers. Colour code conductors, for special component per manufacturer's recommendations.
- .15 Use dymo tape to label each receptacle with its circuit number (e.g., UA-27).

3.02 PAINTING AND FINISHES

- .1 Painting of exposed electrical work will be done as part of the work of Division 9. Equipment to be located in finished areas shall be provided to site prime coated.
- .2 All exposed electrical fittings, supports, hangers, frames conduit, racks, boxes, raceways and similar material and apparatus shall be galvanized or finished with corrosion resistant primer ready to accept paint. Take special care when priming work exposed to the elements or in wet areas to prevent rust or corrosion from damaging adjacent surfaces.
- .3 All large switchgear, transformers, distribution centres, panelboard, starters, disconnects or similar apparatus shall be factory finished in gloss air dry enamel over corrosion resistant sealer primer. Unless specified to the contrary, this finish shall be ASA #61 grey.
- .4 Touch-up and/or repaint any factory finished equipment not scheduled to be painted by Division 9 that has been scratched or otherwise damaged during installation.

END OF SECTION 26 05 10

CONTENTS

PART 1 - GENERAL

- 1.01 REFERENCES
- 1.02 WORK INCLUDED
- 1.03 WORK IN EXISTING BUILDING

PART 2 - PRODUCTS

- 2.01 NIL

PART 3 - EXECUTION

- 3.01 NIL

PART 1 - GENERAL

1.01 REFERENCES

- .1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.

1.02 WORK INCLUDED

- .1 Demolition and restoration of areas as identified on the contract documents.

1.03 WORK IN EXISTING BUILDING

- .1 The building shall remain open and in operation during the construction period.
- .2 Where existing services such as electrical power, fire alarm system, television system etc., are required to be disrupted and/or shut-down, co-ordinate the shut-downs with the Owner and carry out the work at a time and in a manner acceptable to them. Carefully schedule all disruption and/or shut-downs and ensure that the duration of same is kept to the absolute minimum. Submit for approval a written, concise schedule of each disruption at least 72 hours in advance of performing work and obtain Owner's written consent prior to implementing.
- .3 Where disruption to life safety systems are required, comply with paragraph above and provide continuous monitoring during shut down period and ensure that all systems are reactivated prior to leaving site at the end of each working day.
- .4 Should any temporary connections be required to maintain services during work in the existing building, supply and install all necessary material and equipment and provide all labour at no extra cost. Should any existing system be damaged, make full repairs without extra cost, and to the satisfaction of the Consultant.
- .5 Refer to Division 1 for phasing and staging of work and adhere to that program. Comply with instructions regarding working hours necessary to maintain the building in operation].
- .6 The drawings indicating items of equipment to be deleted or relocated have been prepared as a guideline for this subcontractor, but shall not be construed as indicating every item of equipment or conduit. Be responsible for determining site conditions by personal examination.
- .7 Where existing services (conduits, receptacles, switches, etc.) presently mounted on and/or concealed behind existing finishes become exposed during the renovation work and where these services will not be concealed behind or mounted on new finishes, include for relocating the service so as to be concealed behind or on new or existing finishes. Co-ordinate new locations with the Consultant.

PART 2 - PRODUCTS

2.01 NIL

PART 3 - EXECUTION

3.01 NIL

END OF SECTION 26 05 14

CONTENTS

PART 1 - GENERAL

- 1.01 REFERENCES
- 1.02 WORK INCLUDED
- 1.03 SUBMITTALS
- 1.04 ACCEPTABLE MANUFACTURERS

PART 2 - PRODUCTS

- 2.01 BRANCH CIRCUIT CONDUCTORS
- 2.02 LOW VOLTAGE (24 VOLT) CONDUCTORS
- 2.03 MICC CABLE

PART 3 - EXECUTION

- 3.01 INSTALLATION OF BRANCH CIRCUIT CONDUCTORS
- 3.02 INSTALLATION OF LOW VOLTAGE (24) VOLT CONDUCTORS
- 3.03 INSTALLATION OF MICC CABLE

PART 1 - GENERAL

1.01 REFERENCES

- .1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.

1.02 WORK INCLUDED

- .1 Provide all wiring as specified herein for a complete installation, as required by the contract documents.

1.03 SUBMITTALS

- .1 Submit shop drawings of building wire and cables.
- .2 Submit a list of feeders used on the project, indicating cable type and size.

1.04 ACCEPTABLE MANUFACTURERS

- .1 Acceptable manufacturers are; Canada Wire and Pirelli.

PART 2 - PRODUCTS

2.01 BRANCH CIRCUIT CONDUCTORS

- .1 "RW90" single conductor to CSA C22.2 No. 38-95, colour coded 90°C rated, with approved manufactured connectors at joints.
- .2 "RWU90" (-40°C) single conductor to CSA C22.2 No. 38-95, colour coded, 90°C rated, with joints soldered and taped to the Consultant's approval.
- .3 Flexible armoured cable, CSA type "AC-90" to CSA C22.2 No. 51-95.
- .4 "TWH" single conductor to CSA C22.2 No. 75-M1983 (R1992), colour coded, 90°C, rated with approved manufactured connectors at joints.
- .5 Single conductor colour-coded, rubber insulated wire to CSA type "R90" 90°C rated.
- .6 Aluminum conductors where shown to be used, shall be provided with compression terminations, applied with corrosion preventing compound, and hydraulic or power activated tools shall be used for all connections.
- .7 Branch circuit conductors up to and including #12 AWG shall be solid. Branch circuit conductors in sizes larger than #12 AWG shall be stranded. All branch circuit conductors shall be constructed of 98% conductive copper, unless otherwise noted, and shall be approved for 600 volts.
- .8 Electric service, distribution and special conductors are specified in this Section and/or on the drawings.
- .9 Lubricant shall be Ideal "Yellow 77" or approved equal.

2.02 LOW VOLTAGE (24 VOLT) CONDUCTORS

- .1 Colour-coded #18 AWG TFF thermoplastic insulated wire for 600 volt service, complete with the number of copper conductors required.

2.03 MICC CABLE

- .1 Pyrotenax of Canada Ltd. two hour rated mineral insulated cables and accessories to CSA standard C22.2 No. 124.
- .2 Conductors shall be solid bare soft annealed copper.
- .3 Insulation shall be compressed powdered magnesium oxide to form compact homogeneous mass throughout the entire length of the cable.
- .4 The overall covering shall be an annealed seamless copper sheath type MI rated 600V, 250°C.
- .5 Terminations shall be factory pre-packaged kits.

PART 3 - EXECUTION

3.01 INSTALLATION OF BRANCH CIRCUIT CONDUCTORS

- .1 Provide all required branch circuit conductors.
- .2 Conductors for branch circuit work inside the building and above ground, except as noted below, shall be as specified in Article #2.01 Item .1 above.
- .3 Conductors for branch circuit work underground as specified in Article #2.01, Item .2 above.
- .4 Conductors for branch circuit lighting work (fixture tails) in accessible ceiling spaces, maximum length 1500mm, and branch circuit work in cavity wall construction from wiring devices to ceiling spaces, maximum length 6m, shall be as specified in Article #2.01, Item 3 above.
- .5 Conductors for branch circuit work to electric heating coils and/or units shall be as specified in Article #2.01, Items .4 and .5 above.
- .6 Branch circuit conductor sizes are scheduled and/or specified on the drawings. Such sizes are minimum requirements and must be increased, where required, to suit the length of run and voltage drop.
- .7 Do not use conductors smaller than #12 AWG in systems over 30 volts, unless otherwise noted.
- .8 Use lubricant when pulling wires into conduit. Ensure that wires are kept straight and are not twisted or abraded.
- .9 Neatly secure exposed wire in apparatus enclosures with approved supports or ties.
- .10 Splicing of all conductors shall be done with Ideal Wing nut #450 Series for conductors from #14 Awg to #8 Awg.
- .11 For all conductors larger than #8 AWG, splicing shall be done with Burndy Serut connectors wrapped with 3 m #33 scotch tape.
- .12 Provide a dedicated neutral for each branch circuit conductor unless noted otherwise.
- .13 Joints in all conductors shall be kept to a minimum and all conductors shall be installed in continuous unbroken runs.

3.02 INSTALLATION OF LOW VOLTAGE (24) VOLT CONDUCTORS

- .1 Install all low voltage wiring in conduit.
- .2 Refer to manufacturer's shop drawings for special requirements pertaining to low voltage wiring.
- .3 Refer to individual specification section and the drawings for additional wiring requirements.

3.03 INSTALLATION OF MICC CABLE

- .1 For feeders and branch circuit conductors which are used in connection with fire alarm systems and all life safety systems connected to a standby generator power source, and where such feeders and conductors are not embedded in concrete, or utilize Pyrotenax MICC cables as specified.
- .2 Cables shall be installed and terminations made as directed by the manufacturer.
- .3 MICC cables shall be clipped and fastened on maximum 12" centres and shall be fastened within 6" of each bend.
- .4 All MICC cables shall be meggered out using a 1000 volt megger upon completion of terminations.

END OF SECTION 26 05 21

CONTENTS

PART 1 - GENERAL

- 1.01 REFERENCES
- 1.02 WORK INCLUDED

PART 2 - PRODUCTS

- 2.01 MATERIALS

PART 3 - EXECUTION

- 3.01 INSTALLATION
- 3.02 TESTING

PART 1 - GENERAL

1.01 REFERENCES

- .1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.

1.02 WORK INCLUDED

- .1 Provide a complete system of electric service grounding as outlined herein and as specified and detailed on the drawings. Grounding shall comply with the requirements of all grounding work, which is required but not specified herein or shown on the drawings.

PART 2 - PRODUCTS

2.01 MATERIALS

- .1 All grounding conductors shall be stranded copper, bare or insulated as indicated on Drawings or in Specifications.
- .2 Use Cadweld or Burndy Thermoweld process for all weld connections. AMP of Canada Ltd. Wrench-Lok grounding connectors are an acceptable equivalent to welded connections.
- .3 All ground connectors to be designed and approved for grounding purposes.
- .4 Ground buses - 7 mm x 40 mm x 915 mm (1/4" x 1-1/2" x 36") solid copper.
- .5 Ground electrodes - 3050 mm x 20 mm (120" x 3/4") copper clad steel ground rods.

PART 3 - EXECUTION

3.01 INSTALLATION

- .1 Bond the electrical system ground to the main water supply pipe on the street side of the main water valve. Ground conductors shall be a minimum 3/0 copper wire connected with approved fittings.
- .2 Provide electrodes to code requirements. Ground electrode to comprise three 3050 mm x 20 mm (120" x 3/4") copper clad steel ground rods with their tops driven 300 mm (12") below grade. Space ground rods 3050 mm (120") apart. Where required provide additional ground rods.
- .3 Bond all interior non-electrical metallic piping systems to the electrical system ground including, but not limited to, water supply, waste water, and gas systems.
- .4 Ground all conduit, and all non-current carrying metal parts, equipment cases, frames, bases, brackets, frames of motors, duct systems, building steel, elevators, etc.
- .5 Where conduit systems are used for grounds, provide all necessary bushings, studs and jumpers as may be required to maintain effective continuity of ground. Provide separate ground conductors in all non-metallic conduits, concrete encased conduit, conduit below grade and EMT conduit. Bond the ground wire to all boxes and luminaries.
- .6 Ground each piece of fixed equipment back to the switchboard or panel feeding that equipment, by one of the following methods:

- .1 Where equipment is fed by a steel conduit, provided sizing is adequate, utilize conduit for the ground return conductor. At switchboard provide a grounding bushing, and strap such conduits to the ground bus (size per Code).
- .2 Where the size of the conduit is inadequate (per Code), or if the conduit is flexible, install a separate bare soft drawn copper ground inside the conduit. At the switchboard or distribution panel, provide a grounding bushing, loop the ground conductor through the bushing, and connect to the switchboard ground bus. At the fixed equipment, connect to an internal ground bus, or connect to the inside of the metal enclosure utilizing approved screws and connectors (remove all paint).
- .3 For branch circuits, the conduits may be used for grounding, provided seamless steel fittings are used on EMT and threaded fittings are used on rigid conduit. At each receptacle connect a stranded copper ground wire from the outlet box to the grounding terminal on the receptacle. Install a separate grounding conductor in all PVC conduits.
- .4 Where equipment is fed by a bus duct, provide a bare soft drawn copper ground bus inside the bus duct enclosure. Connect to the ground bus in the feeding switchboard, and to the equipment.
- .5 Where equipment is fed by a multi-conductor power cable, provide a ground conductor in the cable. At the switchboard or panel, connect to the ground bus. Use a grounding connector on the cable for positive grounding of the metallic sheath. Loop the ground wire to the grounding connector.
- .7 Where equipment is fed by single conductor flexible armoured cables, provide separate ground conductor and non-ferrous metallic plate and grounding connectors at the switchboard or panel for terminating cables. Run grounding conductor inside fixed equipment and terminate at the grounding connection. At the load end provide an insulating plate for terminating cables; the outer sheaths to be ungrounded.
- .8 Run a separate ground wire in all flexible conduits. Connect each end to ground bus or lug or connector.
- .9 Where mechanical protection is required for insulated grounding conductors install in rigid conduit. Use rigid PVC conduit in concrete or below grade slab and aluminum conduit in other locations.
- .10 Provide weld connection or wrench type grounding connectors for:
 - .1 All connections between grounding conductors.
 - .2 All connections to building steel.
 - .3 All connections between grounding conductors and cable lugs.
- .11 Arrange grounding to provide the minimum impedance paths for ground fault currents. Provide any additional grounding required for approval by the inspecting authorities.

3.02 TESTING

- .1 Test the resistance of the grounding system. Add additional ground wires and ground rods if required as directed by the Consultant and retest. Repeat this process until ground resistance is 2 ohms or less. Conduct all tests using Megger Null Balance or Megger Universal ground resistance test equipment.
- .2 Test all receptacles for proper connections with a neon lamp type polarity tester. Check that ground resistance is less than 0.2 ohms with an Edgecumbe Peebles Ltd., ground loop impedance tester.

END OF SECTION 26 05 27

CONTENTS

PART 1 - GENERAL

- 1.01 REFERENCES
- 1.02 WORK INCLUDED

PART 2 - PRODUCTS

- 2.01 SUPPORT CHANNELS

PART 3 - EXECUTION

- 3.01 INSTALLATION

PART 1 - GENERAL

1.01 REFERENCES

- .1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.

1.02 WORK INCLUDED

- .1 Provide all hangers and supports as required to provide a complete and operational system as required by the contract documents.

PART 2 - PRODUCTS

2.01 SUPPORT CHANNELS

- .1 U-shape, size 41 x 41 x 2.5mm thick, surface mounted, suspended or set in poured concrete walls and ceilings, as required for the specific application.

PART 3 - EXECUTION

3.01 INSTALLATION

- .1 Secure equipment to hollow or solid masonry, tile and plaster surfaces with nylon shields.
- .2 Secure equipment to poured concrete with expandable inserts.
- .3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.
- .4 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
- .5 Fasten exposed conduit or cables to building construction or support system using straps.
 - .1 One-hole steel straps to secure surface conduits and cables 50mm and smaller.
 - .2 Two-hole steel straps for conduits and cables larger than 50mm.
 - .3 Beam clamps to secure conduit to exposed steel work.
- .6 Suspended support systems
 - .1 Support individual cable or conduit runs with 6mm dia. threaded rods and spring clips.
 - .2 Support 2 or more cables or conduits on channels supported by 6mm dia. threaded rod hangers where direct fastening to building construction is impractical.
- .7 For surface-mounting of two or more conduits, use channels at 1.5m o.c. spacing.
- .8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

- .11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Consultant.
- .12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END OF SECTION 26 05 29

CONTENTS

PART 1 - GENERAL

- 1.01 REFERENCES
- 1.02 WORK INCLUDED

PART 2 - PRODUCTS

- 2.01 SPLITTER TROUGH

PART 3 - EXECUTION

- 3.01 INSTALLATION OF SPLITTER TROUGH

PART 1 - GENERAL

1.01 REFERENCES

- .1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.

1.02 WORK INCLUDED

- .1 Provide all splitter trough(s) for a complete installation, as required by the contract documents.

PART 2 - PRODUCTS

2.01 SPLITTER TROUGH

- .1 Provide CSA approved splitter boxes, each complete with a formed, primed and painted steel box with knock-outs, hinged coverplate, suitable mounting provisions, porcelain blocks complete with one (1) main conductor lug and six (6) branch conductor lugs per block, and a nameplate giving its rating.
- .2 Splitter boxes ratings shall be as specified on the drawings.
- .3 Splitter boxes mounted outside the building or exposed to weather shall be weatherproof.

PART 3 - EXECUTION

3.01 INSTALLATION OF SPLITTER TROUGH

- .1 Install splitter trough wherever shown, and/or specified on the drawings.

END OF SECTION 26 05 31

CONTENTS

PART 1 - GENERAL

- 1.01 REFERENCES
- 1.02 WORK INCLUDED

PART 2 - PRODUCTS

- 2.01 CONDUITS
- 2.02 STANDARD OUTLET BOXES
- 2.03 PULLBOXES AND JUNCTION BOXES

PART 3 - EXECUTION

- 3.01 INSTALLATION OF CONDUITS
- 3.02 INSTALLATION OF OUTLET BOXES
- 3.03 INSTALLATION OF PULLBOXES AND JUNCTION BOXES

PART 1 - GENERAL

1.01 REFERENCES

- .1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.

1.02 WORK INCLUDED

- .1 Provide all conduits, fastenings, fittings and boxes for a complete installation, as required by the contract documents.

PART 2 - PRODUCTS

2.01 CONDUITS

- .1 Rigid galvanized steel, CSA C22.2 No. 45, with exterior zinc and interior enamel coatings, galvanized threads where factory cut, red lead coated threads where site cut, factory made bends where site bending is not possible, factory made and threaded fittings and "tomic" joints and terminations made with rigid couplings, concrete tight where required.
- .2 EMT (Thinwall), to CSA C22.2 No. 83, complete with factory made bends where site bending is not possible and joints and terminations made with set screw type connectors, concrete tight where required, maximum allowable size shall be 50mm diameter.
- .3 Galvanized steel flexible liquid-tight metallic conduit, to CSA C22.2 No. 56, complete with proper and suitable liquid-tight flexible conduit connectors at terminations.
- .4 Galvanized steel flexible metallic conduit to CSA C22.2 No. 56, complete with suitable type connectors at terminations.
- .5 Rigid plastic (PVC) conduit to CSA C22.2 No. 211.1 complete with site made heat gun bends to 50mm diameter, factory made bends for conduit larger than 50mm, solvent weld joints with socket couplings and proper connectors and adaptors at terminations.
- .6 Electrical non-metallic tubing to CSA C22.2 No 211.0 complete with suitable type connections and couplings.
- .7 Conduit racks shall be Unistrut Ltd. Electrovert Ltd., "Cantruss", Burndy Ltd., "Flexible" or equivalent.

2.02 STANDARD OUTLET BOXES

- .1 Sheet Steel outlet boxes:
 - .1 Electro galvanized steel single and multi gang flush device boxes for flush installation.
 - .2 Electro galvanized steel utility boxes for outlets connected to surface mounted EMT conduit in interior application.
 - .3 102mm octagonal boxes for lighting fixture outlets
 - .4 102mm square outlet boxes with extension and plaster ring for flush mounting in finished plaster walls.
- .2 Masonry boxes: Electro galvanized steel masonry single and multi gang boxes for devices flush-mounted in exposed block walls.

- .3 Concrete boxes: Non-metallic concrete boxes with matching extension and plaster rings as required for flush-mounting in concrete.
- .4 Conduit boxes: Type FS and FD ferralloy boxes with factory threaded hubs and mounting feet for exterior surface wiring of switches and receptacles.
- .5 Each outlet box must be suitable in all respects for the application, and complete with securing lugs, knock-outs, and where necessary, suitable plaster rings, concrete rings, covers and any other required accessory.
- .6 Outlet boxes for special wiring devices, for special equipment and for special applications, if and where required, are specified hereinafter in this Section or on the drawings.
- .7 347 volt outlet boxes for 347 volt switching devices.
- .8 Provide blank cover plates for all boxes without wiring devices.

2.03 PULLBOXES AND JUNCTION BOXES

- .1 Pullboxes and junction boxes shall be constructed of galvanized or prime coated steel. Each shall be suitable in all respects for the applications, and complete with screw-on hinged covers as required.
- .2 The physical size of pullboxes shall be as required by the "Ontario Electrical Safety Code" to suit the number and size of conduits and conductors.

PART 3 - EXECUTION

3.01 INSTALLATION OF CONDUITS

- .1 Install conduit concealed in all finished areas, and concealed to the degree made possible by finishes in partially finished and unfinished areas. Conduit may be exposed in unfinished areas such as Electrical Rooms and Mechanical Rooms, unless otherwise noted on the drawings or specified herein. Refer to and examine the architectural drawings and on the drawings or specified herein. Refer to and examine the architectural drawings and room finish schedules to determine finished, partially finished and unfinished areas of the building.
- .2 Where conduits are exposed, arrange same to avoid interference with other work and parallel to the building lines. Where horizontal conduits are exposed, install as high as possible. Do not install conduit within 150mm of "hot" pipes or equipment unless the conduit is associated with the equipment.
- .3 Provide conduit for all electric service distribution and branch circuit conductors except armoured cable, and bus duct and except for applications where duct, cable tray and similar raceway material is provided.
- .4 Conduit for branch circuit and distribution conductors, except as noted hereinafter, shall be as specified in Article #2.01, Item .1 above.
- .5 From 1200mm above the ground floor slab.
 - .1 Conduit for branch circuit conductors concealed in masonry work in drywall, in shafts and furrings above ground and;
 - .2 For branch circuit conductors exposed inside the building shall be as specified in Article #2.01 Item .2 above.

- .6 For distribution and branch circuit conductors concealed in poured concrete work above ground (not on grade); shall be as specified in Article #2.01 Item .6 above.
- .7 Conduit for short branch circuit connections to motorized equipment (minimum length 450mm; maximum length 600mm with 180 degree loop where possible) shall be as specified in Article #2.01, Item .3 above.
- .8 Conduit for short branch circuit connections to electric heating units where 90°C rated conductors are required (minimum length 450mm - maximum length 600mm with 180 degree loop where possible) and at points where distribution and/or branch circuit conductors cross building expansion joints shall be as specified in Article #2.01, Item .4 above.
- .9 Conduit for distribution and branch circuit conductors underground and for distribution and branch circuit conductors in special corrosive areas as defined herein shall be as specified in Article #2.01, Item .5 above.
- .10 Conduit for branch circuit conductors where concealed in walls or encased in concrete shall be as specified in Article #2.01 Item 6 above.
- .11 Conduits supplying equipment classified as explosion proof (i.e., fuel pumps and associated and adjacent equipment) shall be rigid galvanized steel for their entire length from their power source. Provide all required seals as specified in CEC Section 20.
- .12 Provide a separate ground conductor in all plastic and EMT conduit.
- .13 Secure conduit located in poured concrete work in place in a manner such that conduit will not float or move when concrete is poured. Protect conduit from concrete and water penetration during the concrete pour.
- .14 Support and secure surface mounted and suspended single or double runs of metal conduit at support spacing in accordance with "Canadian Electrical Code" requirements by means of galvanized pipe straps, conduit clips, ring bolt type hangers, or by other manufactured devices. Support multiple mixed size metal conduit runs with conduit racks spaced to suit spacing requirements of the smallest conduit in the group.
- .15 Install conduit parallel or perpendicular to building lines.
- .16 Generally, conduit is sized on the drawings. Conduit not sized on the drawings shall be sized in accordance with the latest edition of the Canadian Electrical Code. Note that the sizes of branch circuit conductors scheduled and/or specified on the drawings are minimum sizes and must be increased as required to suit length of run and voltage drop in accordance with the Canadian Electrical Code. Where conductor sizes are increased to suit voltage drop requirements, increase the scheduled or specified conduit size to suit.
- .17 Increase conduit sizes for heavily insulated conductors (i.e., "TWU"), a minimum of one (1) conduit size, regardless of the size indicated or required.
- .18 The maximum allowable size of conduit for installation in poured concrete work must be determined in consultation with the Consultant prior to installation. The placement of reinforcing steel in structural concrete work will take precedence over the placement of conduit. Multiple runs of conduit in poured concrete work must be adequately spaced as directed by the Consultant.
- .19 Do not install horizontal runs of conduit in masonry walls.
- .20 Ensure that all conduit systems which are left empty are clean, clear, capped and properly identified. Provide suitable fish wires in all such conduit.

- .21 Provide a minimum of two (2) 25mm diameter conduits up to and into ceiling spaces from flush mounted panelboards located below and/or near a hung ceiling.
- .22 Support and secure surface mounted and suspended rigid PVC plastic conduit with hangers and supports as specified above for metal conduit but at support spacing in accordance with the conduit manufacturer's published recommendations.
- .23 Support all conduit installed underground on well tamped flat bed of earth, free from rocks or protrusions of any kind.
- .24 Conduit fittings shall be, unless otherwise noted, constructed of the same material as the conduit and suitable in all respects for the application.
- .25 Provide proper adaptors for joining conduits of different materials.
- .26 Ends of all site cut conduit must be square and properly reamed.
- .27 All conduits for high voltage cable installation shall be rigid galvanized steel.
- .28 Electrical conductors supplying all equipment connected to a source of emergency supply shall use Pyrotenax Mineral Insulated copper sheathed cables (MI).
- .29 As an alternate to the use of MI Cables, electrical conductors supplying equipment connected to a source of emergency supply may be installed in service spaces that do not contain other combustible material or shall be protected against exposure to fire as allowed by the Building Code. Provide fire rated enclosures or provide concrete enclosure as required to ensure continued operation for a minimum period of 2 hours from the source of power supply to the branch circuit supplying the equipment.

3.02 INSTALLATION OF OUTLET BOXES

- .1 Provide an outlet box for each lighting fixture, wiring device, telephone outlet and any other outlet specified herein or shown or specified on the drawings, unless otherwise noted.
- .2 Generally, mounting heights and locations for outlets are shown on the drawings and/or specified herein, however, confirm the exact location and arrangement of all outlets with the Consultant prior to roughing-in. Architectural drawings and the Consultant's instructions have precedence over electrical drawing diagrammatic layouts and specified mounting heights and locations.
- .3 Do not install outlet boxes "back-to-back" in walls and partitions. Such outlets must be staggered and sealed against noise transmission. "Thru-Wall" type outlet boxes will not be permitted for any application.
- .4 Support and secure boxes independent of the conduit or cable connected thereto.
- .5 All recessed outlet boxes for surface mounted devices or lighting fixtures must be totally concealed by the device or fixture.

3.03 INSTALLATION OF PULLBOXES AND JUNCTION BOXES

- .1 Provide pullboxes in conduit systems wherever necessary to facilitate conductor installations. Generally, conduit runs exceeding 30m in length, or with more than two (2) 90 degree bends shall be equipped with a pullbox installed at a convenient and suitable intermediate location.
- .2 Provide a junction box wherever required and where shown and/or specified on the drawings.
- .3 All pullboxes and junction boxes must be accessible after the building is completed.

- .4 Accurately locate and identify all concealed pullboxes and junction boxes on "as-built" record drawings.
- .5 Support and secure all boxes independent of the conduit or cable connected thereto.
- .6 Install identification labels indicating system name on all pullboxes and junction boxes.

END OF SECTION 26 05 33

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PART 1 - GENERAL

1.01 REFERENCES

- .1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.

1.02 WORK INCLUDED

- .1 Provide all wiring devices and coverplates for a complete installation as required by the contract requirements.

1.03 SUBMITTALS

- .1 Submit shop drawings of all wiring devices.
- .2 Submit samples of receptacles, switches, dimmers and plates.

1.04 ACCEPTABLE MANUFACTURERS

- .1 The specifications are based on Hubbell wiring devices, unless noted otherwise. Acceptable alternates are Pass and Seymour, Leviton, Arrow Hart and Bryant.
- .2 Dimmer specifications are based on Lutron.

PART 2 - PRODUCTS

2.01 STANDARD LINE VOLTAGE SWITCHES, RECEPTACLES AND PLATES

- .1 Provide specification grade switches and receptacles as specified below:
 - .1 Provide CSA approved, specification grade switches and receptacles in all public areas to suit the intended function. Provide Hubbell "Style Line" or approved equal devices with white finish.
 - .2 Provide CSA approved, residential grade switches and tamper resistant receptacles in all residential suites. Provide Hubbell "homeSELECT" RRD15SxTR or approved equal devices with white finish.
 - .3 Provide CSA approved, residential grade tamper resistant 20 amp GFCI protected receptacles in residential suite kitchens as shown on plan. Provide Hubbell "homeSELECT" GFTR20x or approved equal devices with white finish.
- .2 Generally, faceplates for flush-mounted toggle switches and receptacles shall be in finished areas except residential suites; 0.04 inch thick type 302/304 non-magnetic stainless steel, smooth satin finish each supplied individually wrapped in a sealed protective envelope.
- .3 Unfinished areas - 0.06 inch thick impact resistant smooth ivory coloured nylon finish with captive screw feature for quick and easy installation.
- .4 Faceplates for surface-mounted switches and receptacles unless otherwise noted, shall be galvanised steel.
- .5 The colour of all devices must be approved by and confirmed with the Consultant prior to installation.

- .6 Receptacles located in all rooms, containing personal washing facilities such as washbasins bath tubs, showers, or similar devices and located within 3 metres of such devices shall provide GFCI protection (Hubbell Cat. No. GF5252IA).
- .7 All receptacles designated 'WP' (weatherproof) on the drawings shall be Hubbell GF5252IA receptacles with Hubbell non-metallic in use covers (MM or ML series – to be confirmed prior to order).
- .8 Special switches and/or receptacles are specified on the drawings and shall be complete with proper faceplates conforming to requirements specified herein before.
- .9 Dryer and range receptacles shall be supplied complete with suitable plug and cord connection.

2.02 DIMMER SWITCHES

- .1 Dimmers shall be UL listed for a broad range of dimmable CFL's, LED, halogen and incandescent sources.
- .2 The dimmers shall have adjustable low end trim to suit various dimmable sources.
- .3 Dimmers shall be provided with built in switch to turn off positively as dimmer is set to zero.
- .4 Dimmers shall be Lutron Maestro C L Series, rated for load and source based on proposed LED sources.

PART 3 - EXECUTION

3.01 INSTALLATION OF STANDARD LINE VOLTAGE SWITCHES, RECEPTACLES AND PLATES

- .1 Provide standard switches and receptacles in locations shown and/or specified on the drawings.
- .2 Equip each switch and receptacle with a faceplate with an opening or openings suitable for the device it conceals. Secure faceplates to the device frames with metal screws finished to match the faceplate.
- .3 The exact colour of switches and receptacles, and associated faceplates in any area must be approved by and confirmed by the Consultant prior to installation.
- .4 Furnish and turn over to the Owner, a sufficient quantity of keys for key lock switches.
- .5 Change location of outlets at no extra cost or credit providing distance does not exceed 3 m and information is given before installation.

3.02 INSTALLATION OF DIMMER SWITCHES

- .1 Provide dimmer switches in single and multiple ganged 3" deep outlet boxes as required for the application, shown on the drawings.
- .2 When grouping dimmers, refer to manufacturer's requirements regarding derating of dimming switches.
- .3 Provide matching line voltage switches, as specified, in rooms where dimmers and line voltage switches are shown.
- .4 Provide multi-gang coverplates where multiple dimmers/switches are used within the same area. Provide coverplates to suit dimmer line-up requirements.

- .5 Provide engraved identification for all slide controls. Exact description of zone designations to Consultant's approval.
- .6 The exact colour of dimmers and associated face plates shall be approved by and confirmed by the Consultant and Interior Designer prior to installation.

END OF SECTION 26 27 26

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PART 1 - GENERAL

1.01 REFERENCES

- .1 Comply with Section 26 05 00, Electrical General Requirements and all documents referred to therein.
- .2 Underwriters' Laboratories of Canada (ULC)
- .3 CAN/ULC-S524 Installation of Fire Alarm Systems.
- .4 CAN/ULC S525 Audible Signal Devices for Fire Alarm.
- .5 CAN/ULC S526 Visual Signal Appliances.
- .6 CAN/ULC S527 Control Units.
- .7 CAN/ULC S528 Manual Stations.
- .8 CAN/ULC S529 Smoke Detectors.
- .9 CAN/ULC S530 Heat Actuated Fire Detectors.
- .10 CAN/ULC S531 Smoke Alarms (120V Non-System Device).
- .11 CAN/ULC S536 Inspection and Testing of Fire Alarm Systems.
- .12 CAN/ULC S537 Verification of Fire Alarm Systems.
- .13 CAN/ULC S541 Speakers for Fire Alarm Systems.
- .14 Integrated Systems Testing of Fire Protection and Life Safety Systems.
- .15 CAN/ULC-S1001-11 Integrated Systems Testing of Fire Protection and Life Safety Systems.
- .16 NBC: National Building Code of Canada or Applicable Provincial Building Code.
- .17 CAN/ULC-S524-06 Installation of Fire Alarm Systems.
- .18 2009 CEC Canadian Electrical Code (or Provincial Equivalent).
- .19 CAN/ULC-S537-04 Verification of Fire Alarm Systems.
- .20 2006 Ontario Building Code as Amended.
- .21 2007 Ontario Fire Code as Amended.

1.02 RELATED SECTIONS

- .1 Section **[01 33 00 Submittal Procedures]**.
- .2 Section **[01 74 21 - Construction/Demolition Waste Management and Disposal]**.
- .3 Section **[01 78 00 Closeout Submittals]**.
- .4 Section **[21 05 00 - Common Work Results for Fire Suppression]**

- .5 Section **[25 05 00 - Common Work Results for HVAC]**
- .6 Section **[25 01 01 - Common Work Results - Energy Monitoring and Control System (EMCS)]**
- .7 Section **[26 05 05 - Common Work Results - Electrical]**
- .8 Section **[27 05 13- Common Work Results – Communication Services].**
- .9 Section **[28 13 00- Common Work Results – Access Control].**

1.03 SYSTEM DESCRIPTION

- .1 System to carry out fire alarm and protection functions; including receiving alarm signals; initiating **[general] [two stage] [modified two stage]** alarm; supervising components and wiring; actuating Display and control centres, remote annunciators and auxiliary functions; initiating supervisory and off-normal trouble signals and signalling to **[monitoring agency] [Central station]**.
- .2 System to include:
 - .1 Initiating/input circuits.
 - .2 Wiring.
 - .3 System compatible manual and automatic initiating devices.
- .3 The System and all of its component parts and devices shall comply with the individual ULC Standards listed in a subsequent section. The installation materials and methods shall comply with CAN/ULC-S524 Installation of Fire Alarm Systems and the referenced Canadian Electrical Code (or mandated Provincial/Local Electrical Code). The system shall be fully supervised and shall monitor the integrity of all field wiring circuits and conductors and device placements.

1.04 SCOPE OF WORK OVERVIEW

- .1 The system shall include, but not be limited to; all system compatible alarm and supervisory initiating field devices, and all system wiring types as prescribed by the manufacturer requirements.

1.05 QUALIFICATIONS

- .1 The Installing Contractor shall supply all electrical materials and components. Installation activities shall be performed by an Electrician(s) holding a current license.
- .2 The Verification shall be performed by a Registered Fire Alarm Technician certified/recognized by an educational course and/or program that is acceptable to the local Authority Having Jurisdiction (AHJ).
- .3 Evidence of completion of such a program (example: CFAA Canadian Fire Alarm Association) or similar body may be requested.
- .4 The Lead Technician must have completed an authorized Mircom factory training program on the equipment installed under this contract.
- .5 Acceptance of the system shall be performed by the Engineer of Record, and shall be witness-tested by the Authority Having Jurisdiction, all after acceptance by both parties of the successfully completed Verification Report.
- .6 Warranty provisions shall be by Mircom as specified in the warranty section of this specification.

1.06 SHOP DRAWINGS

- .1 Submit shop drawings in context of the general electrical provisions.

- .2 Provide a complete description of each system component including dimensions.

1.07 APPROVALS & LISTINGS

- .1 The system shall have proper listing and/or approval from the following nationally recognized agencies:
 - .1 ULC: Underwriters Laboratories of Canada for all compatible to Mircom system components and devices.
 - .2 The Fire Alarm Control Unit and all Transponders shall meet the modular listing requirements of ULC and UL. Each subassembly, including all printed circuits, shall include the appropriate UL/ULC modular label. This includes all printed circuit board assemblies, power supplies, and enclosure parts

1.08 INSTALLATION WARRANTY

- .1 All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of substantial completion.

PART 2 - PRODUCTS

2.01 MATERIALS

- .1 Equipment and devices: ULC listed and labelled and supplied by Mircom.
- .2 Power supply: to CAN/ULC S524.
- .3 Audible signal devices: to CAN/ULC S525.
- .4 Speakers: to CAN/ULC S541.
- .5 Control unit: to CAN/ULC S527.
- .6 Manual stations: to CAN/ULC S528.
- .7 Thermal detectors: to CAN/ULC S530.
- .8 Smoke detectors: to CAN/ULC S529.

2.02 GENERAL EQUIPMENT & MATERIALS

- .1 All equipment and components shall be new, and the manufacturer's current model. The materials, equipment and devices shall have been tested and listed by a nationally recognized approvals agency for use as part of a protected premises protective signaling Fire Alarm System.
- .2 All equipment and components shall be installed in strict compliance with the manufacturer's recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc. before beginning system installation. Refer to the riser/connection diagram for all specific system installation, termination and wiring data.
- .3 All equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. Fasteners and supports shall be adequate to support the required load.
- .4 All active field devices connected to the control unit or transponder shall be manufacturer listed as compatible with the control unit as per CAN/ULC-S527 requirements.

- .5 The following is a list of devices that are required to be compatible with the control unit and/or transponder and include but not limited to:

- .1 Spot type smoke detectors – Photo-electronic and/or Ionization; and/or laser;

2.03 HEATING, VENTILATING AND AIR-CONDITIONING (HVAC) SYSTEM FOR SUPPLY FAN SHUT DOWN AND/OR SMOKE MANAGEMENT SYSTEM INTEROPERABILITY

- .1 Fire alarm relays shall be installed in a separate box adjacent to the motor control centers for fan control. Acceptable methods include:
 - .1 Method one is to power these relays from the Transponders or control unit to provide 24 Volt DC appliance circuits.
 - .2 Method two is to provide an addressable relay at the existing Motor Control Centre and connect to a Dual Voltage Relay.
 - .3 Method Three is to provide an addressable relay at an existing master relay location. The Master relay operates a series of MCC Dual Voltage Relays (DVR's) for the purpose of Fan shut down for the equipment.
- .2 Duct smoke detectors installed on the supply fan system downstream from the filter and mixing box shall be provided with a local relay to interrupt the supply fan following duct smoke detection activation.

2.04 SYSTEM SPECIFIC NETWORK WIRING & TOPOLOGY REQUIREMENTS

- .1 Fire alarm network wiring shall include but not limited to:
 - .1 4000 feet MAX wiring distance with 18 AWG twisted pair unshielded.
 - .2 Maximum line loss 25 ohms.
 - .3 Applied network voltage 9 volts maximum.
 - .4 Applied network current 800mA.
 - .5 Network cabling shall be installed via two separate paths, primary and alternate, to ensure system structure provides DCL-C performance as per Table 1 of CAN/ULC-S524-06.

2.05 PHOTOELECTRIC SPOT TYPE SMOKE DETECTOR CONVENTIONAL

- .1 Photoelectric smoke detectors shall be provided with a dust cap to protect the detector after installed but prior to placing in service.
- .2 Photoelectric smoke detectors shall be a 24 VDC, two wire, and ceiling-mounted, light scattering type using an LED light source.
- .3 Each detector shall contain a remote LED output and a built-in test switch.
- .4 Detector shall be provided on a twist-lock base.
- .5 It shall be possible to perform a calibrated sensitivity and performance test on the detector without the need for the generation of smoke. The test method shall test all detector circuits.
- .6 A visual indication of an alarm shall be provided by dual latching Light Emitting Diodes (LEDs), on the detector, which may be seen from ground level over 360 degrees. These LEDs shall flash at least every 10 seconds, indicating that power is applied to the detector.
- .7 All field wire connections shall be made to the base through the use of a clamping plate and screw.
- .8 Where photoelectric smoke detectors are mounted below 8'-0" from floor and located in areas accessible to the general public, provide a tamper resistant mounting to base.

- .9 As a photoelectric smoke detector gets dirty and the initial sensitivity changes, automatically adjust the sensitivity to compensate for the change and maintain the sensor at the same sensitivity level as the initial setting.
- .10 If a photoelectric smoke detector becomes dirty to a point where it becomes too sensitive or unstable and service is required, the removal of the device from service shall trigger an appropriate system fault indication at the DCC.
- .11 As the photoelectric smoke detector nears the point where the compensation feature can no longer maintain the set sensitivity, initiate a pre-warning indication at the DCC. The pre-warning indication shall identify the device requiring service.

2.06 DUCT SMOKE DETECTORS CONVENTIONAL

- .1 Provide a new sampling tube for each replacement or new duct smoke detector installation.
 - .1 The sampling tube to contain evenly spaced sample holes mounted across the air duct to obtain a representative sample from the air flow. The Contractor shall ensure sample tube is installed with the end extending through duct for testing purposes.
- .2 The duct smoke assembly shall utilize a photoelectric plug in sensor.
- .3 The duct detector assemblies to detect the presence of smoke being circulated by the associated supply fan system.
 - .1 The duct smoke detector is to be mounted to obtain a representative sample of the air flow within a section of the duct work as identified in CAN/ULC-S524-06.
- .4 The duct detector housing shall be mounted to the exterior of duct and be sealed from surrounding exterior conditions.
 - .1 Provide an indicator on the duct housing to indicate activation and to verify normal operation.
- .5 Where the duct detector is hidden from view within the room, install a Remote Indicating Lamp to show alarm activation. Install the remote lamp in a location to the Owners' approval.
- .6 Provide an addressable relay Form C contact with each duct smoke rated appropriately to control dampers or fans for shutdowns following activation of the duct detector.
- .7 Connect the electrical contact in a manner that overrides all control conditions including "Hand" and "Auto" for the purpose of shutting down the fan system.
 - .1 Confirm via testing with Mircom that the fan system will shut down in the hand position.
- .8 Allow for a maximum ten (10) foot sampling tube for each duct smoke detector or smaller length size according to duct smoke installation requirements and position of the duct smoke on the duct work.
- .9 Duct smoke detectors shall be a 24 VDC type with visual alarm and power indicators, and a reset switch.
- .10 Each detector shall be installed upon the composite supply/return air ducts(s), with properly sized air sampling tubes.

2.07 ADDRESSABLE DEVICES – GENERAL

- .1 Addressable devices shall provide an address-setting means using rotary decimal switches.
- .2 Addressable devices shall use simple to install and maintain decade (numbered 0 to 9) type address switches.
- .3 Devices which use a binary address or special tools for setting the device address, such as a dip switch are not an allowable substitute.
- .4 Detectors shall be Analog and Addressable, and shall connect to the fire alarm control units DCL Circuits.
- .5 Addressable smoke and thermal detectors shall contain dual (2) status LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the system, and both LEDs shall be placed into steady illumination by the system, indicating that an alarm condition has been detected.
 - .1 If required, the flashing mode operation of the detector LEDs can be programmed off via the fire system program.
- .6 The fire alarm system shall permit detector sensitivity adjustment through field programming of the system. Sensitivity can be automatically adjusted by the panel on a time-of-day basis.
- .7 Using software in the system, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance.
- .8 The detectors shall be ceiling-mount and shall include a separate twist-lock base which includes a tamper proof feature.

2.08 BASES AND ANCILLARY FUNCTIONS

- .1 The following bases and ancillary functions shall be provided:
 - .1 Sounder base rated at 85 dBA minimum.
 - .2 Form-C Relay base rated 30VDC, 2.0A.
 - .3 Isolator base.
- .2 The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the system. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the system.
- .3 Detectors shall also store an internal identifying type code that the control unit shall use to identify the type of device (example: PHOTO, THERMAL).

PART 3 - EXECUTION

3.01 INSTALLATION OVERVIEW

- .1 Install systems to CAN/ULC-S524 and the Building Code applicable to the Project jurisdiction.
- .2 Install Transponders/control units, Display and Control Centres and connect to ac power supply, standby power.
- .3 Install remote annunciator DCC and LCD annunciators and connect to annunciator DCL-C circuit wiring.
- .4 Install manual stations and connect to alarm circuit wiring.

- .5 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
- .6 Connect alarm circuits to transponders/control units.
- .7 Install alarm signalling devices and connect to transponders/control unit signaling circuits.
- .8 Install end of line devices as required.
- .9 Install ancillary door releasing devices.
- .10 Install ancillary remote relay units to control fan systems.
- .11 Sprinkler system: wire alarm, low pressure supervisory and valve supervisory switches and connect to transponders/control units.
- .12 Connect fire suppression systems to transponders/control units
- .13 Provide raceways, cable and wiring to make interconnections to terminal boxes, annunciator equipment and transponders/control units, as required by equipment manufacturer.
- .14 Ensure that wiring is free of opens, shorts and/or grounds, before system testing.
- .15 Identify circuits and other related wiring at transponders/control units and terminal panels.

3.02 CABLE AND RACEWAY INSTALLATION

- .1 Installation shall be in accordance with CAN/ULC-S524 Installation of Fire Alarm Systems and the Canadian Electrical Code as shown on the drawings, and as required by the equipment manufacturer.
- .2 All raceway, junction boxes, raceway supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas.
- .3 Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.
- .4 All fire detection and alarm system devices, control units and remote annunciators shall be flush mounted when located in finished areas and may be surface mounted when located in unfinished areas.
- .5 Manual Stations shall be suitable for surface mounting or semi flush mounting as shown on the plans, and shall be installed not less than 1200 mm, nor more than 1400 mm above the finished floor.
- .6 Raceway shall be in accordance with the Canadian Electrical Code (CEC), and all provincial and local Electrical Authority requirements.
- .7 Where possible, all wiring shall be installed in raceways. . Raceway fill shall not exceed 40 percent of interior cross sectional area where three or more cables are contained within a single raceway.
- .8 Cable must be separated from any open conductors of Power, or Class 1 circuits, and shall not be placed in any junction box or raceway containing these conductors.

- .9 Wiring for 24 volt control, alarm signalling, emergency communication and similar power-limited auxiliary functions may be run in the same raceway as initiating and signaling line circuits-as approved and permitted by the manufacturer.
- .10 All circuits shall be provided with transient suppression devices and the system shall be designed to permit simultaneous operation of all circuits without interference or loss of signals.
- .11 Raceway shall not enter the fire alarm system, or any other remotely mounted system equipment or back boxes, except where raceway entry is specified by the manufacturer.
- .12 All fire alarm system wiring must copper and be new.
- .13 Wiring shall be in accordance with local, provincial and national codes and as recommended by the manufacturer of the fire alarm system.
- .14 The number and size of conductors shall be as recommended by the fire alarm system manufacturer, but not less than 18 AWG (1.02 mm) for initiating device circuits and signaling line circuits, and 12 AWG (1.63 mm) for alarm signalling circuits
- .15 All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signalling system.
- .16 Wire and cable not installed in raceways shall have a fire resistance rating suitable for the installation as indicated.
- .17 The system shall permit the use of initiating and signalling circuit wiring in the same raceway with the multiplex communication link and shall be suitable for use with fiber optic cabling.
- .18 All field wiring shall be completely supervised. In the event of a primary power failure, disconnected standby battery, removal of any internal modules, or any open circuits in the field wiring; a trouble signal will be activated until the system and its associated field wiring are restored to normal condition.
- .19 All analog voice speaker and analog telephone circuits shall use twisted/shielded pair to eliminate electrical interference.

3.03 TERMINAL BOXES, JUNCTION BOXES AND CABINETS

- .1 All boxes and cabinets shall be listed for their intended purpose.
- .2 Initiating circuits shall be arranged to serve like categories (manual, smoke, water flow). Mixed category circuitry shall not be permitted except on signalling line circuits connected to intelligent reporting devices.
- .3 The fire alarm control units shall be connected to a separate dedicated branch circuit, maximum 15 amperes.
- .4 This circuit shall be labelled at the main power distribution panel as FIRE ALARM. Fire alarm system primary power wiring shall be 12 AWG. The system cabinet shall be grounded securely to either a cold water pipe or grounding rod

3.04 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results - Electrical and to CAN/ULC S537-04.

- .2 Provide a schedule for testing that includes an alternate area to test in case of any unforeseen operational issues. The Sub-contractors shall abide with the schedule following owner approval of the test schedules.
- .3 Submit to the Consultant, upon completion of Verification for each section of the installation, a point-by-point checklist indicating the date each item tested, the test conducted, and the respective DCC audible and visual signals activated.
- .4 The checklist shall be as provided in Appendix A of CAN/ULC-S537-04 or other similar format approved by the Owner.
- .5 Fire alarm system:
 - .1 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors, and sprinkler system monitoring devices transmit alarm to DCC and transponder/control unit for each of the prescribed sequences of operation.
 - .2 Check annunciator panels to ensure zones are shown correctly.
 - .3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.
- .6 Addressable circuits system style DCLA and DCLC
 - .1 Test each conductor on all DCLA and DCLC addressable links for capability of providing 3 or more subsequent alarm signals on each side of single open circuit fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
 - .2 Test each conductor on all DCLA and DCLC addressable links for capability of providing 3 or more subsequent alarm signals during ground fault condition imposed near midmost point of each link.
 - .3 Operate Acknowledge/Silence switch after reception of each of the 3 signals.
 - .4 Remove imposed fault after completion of each series of tests.
- .7 Addressable circuits system style DCLB:
 - .1 Test each conductor on all DCLB addressable links for capability of providing 3 or more subsequent alarm signals on line side of single open circuit fault condition imposed near electrically most remote device on each link.
 - .2 Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
 - .3 Test each conductor on all DCLB addressable links for capability of providing 3 or more subsequent alarm signals during ground fault condition imposed near electrically most remote device on each link.
 - .4 Operate Acknowledge/Silence switch after reception of each of the 3 signals. Remove imposed fault after completion of each series of tests

3.05 WITNESS TESTING FOR CONSULTANT AND OWNER

- .1 Provide the service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests of the system.
- .2 Before energizing the cables and wires, check for correct connections and test for short circuits, ground faults, continuity, and insulation.
- .3 Close each sprinkler system control valve and verify proper supervisory alarm at the DCC and remote annunciators.

- .4 Verify activation of all flow switches.
- .5 Open initiating device circuits and verify that the trouble signal actuates.
- .6 Open and short signalling device circuits and verify that trouble signal actuates.
- .7 Ground initiating device circuits and verify response of trouble signals.
- .8 Ground signalling line circuits and verify response of trouble signals.
- .9 Ground notification appliance circuits and verify response of trouble signals.
- .10 Check presence and audibility of tone at all alarm signalling devices.
- .11 Check installation, supervision, and operation of all intelligent smoke detectors during a walk test.
- .12 Each of the alarm conditions that the system is required to detect shall be introduced on the system. Verify the proper receipt and the proper processing of the signal at the DCC and remote annunciators and the correct activation of the control points.
- .13 When the system is equipped with optional features, the manufacturer's manual should be consulted to determine the proper testing procedures.
 - .1 This is intended to address such items as verifying controls performed by individually addressed or grouped devices, sensitivity monitoring, and verification functionality.

3.06 FINAL AHJ WITNESS TESTING

- .1 At the final witness testing phase of the project provide a factory trained manufacturer representative technician of the equipment.
- .2 The representative shall demonstrate that the system functions properly in every respect in accordance with specifications and code requirements
- .3 Factory trained manufacturer representative technician shall provide a completed Verification Report as per CAN/ULC-S537-04 acceptable to the local AHJ

3.07 INSTALLATION VERIFICATION DOCUMENT REVIEW

- .1 Prior to testing, check installation in each room.
- .2 Check that the installation by the qualified electrician conforms with CAN/ULC-S524 and the Canadian Electrical Code and has been verified by the fire alarm technician to comply with CAN/ULC-S537-04 Verification requirements as noted in the CAN/ULC-S537-04 Report
- .3 Review CAN/ULC-S537-04 Appendix C.6 Field Device Record Document for report on each specific active field device.
- .4 Ensure that the CAN/ULC-S537-04 is signed by a registered fire alarm technician who is qualified to perform the Verification in accordance with the local building and fire codes.

3.08 DEMONSTRATION

- .1 Provide instruction as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

- .2 The contractor and/or the systems manufacturer's representatives shall provide a "Operators Manual" to the end user's representative.

3.09 TRAINING MANUALS

- .1 Provide onsite lectures and demonstration by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.
- .2 Submit simultaneously with the shop drawings, complete operating and maintenance manuals listing the manufacturer's name(s), including technical data sheets.
- .3 Wiring diagrams shall indicate internal wiring for each device and the interconnections between the items of equipment.
- .4 Provide a clear and concise description of operation (System Operation) that gives in detail, the overall operation of the system as prescribed in these specifications.
- .5 Approvals will be based on complete submissions of manuals together with shop drawings.

3.10 FUTURE SOFTWARE MODIFICATIONS DURING WARRANTY PERIOD

- .1 Provide the services of a factory trained and authorized fire alarm system technician to perform all system software modifications, upgrades or changes.
- .2 Response time of the technician to the site shall not exceed the time period as stipulated in the Contract documents.
- .3 Provide all hardware, software, programming tools and documentation necessary to modify the fire alarm system on site.
- .4 Modification includes addition and deletion of devices, circuits, zones and changes to system operation and custom label changes for devices or zones.
- .5 The system structure and software shall place no limit on the type or extent of software modifications on-site.

END OF SECTION 26 70 01

**Hazardous Building Materials Assessment, Ventilation Upgrade
University Hall ,1280 Main Street West**

PART 1 GENERAL

1.1 General and Related Work

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of the General Conditions of the Contract.
- .2 Related work specified elsewhere:
 - Section 02 82 00.01 Asbestos Abatement – Type 1 Procedures
 - Section 02 82 00.02 Asbestos Abatement – Type 2 Procedures
 - Section 02 82 00.04 Asbestos Abatement – Type 2 Glove Bag Method
 - Section 02 83 11 Lead Abatement – Class 2 Procedures
- .3 Site Conditions identifies all known hazardous building materials within the Project Area. The information provided is for general reference only. Each Contractor must confirm existing conditions on site prior to tender close.
 - .1 The specification fulfils the requirements of Section 30 of the Ontario Occupational Health and Safety Act.
 - .2 The specification fulfils the requirements of the Section 10 of Ontario Regulation 278/05.
- .4 The Outline of Work identifies the location, condition and quantities of hazardous building materials to be removed as part of this project.
 - .1 It is the intent that work prescribed this Section will result in the removal of hazardous materials where impacted by the renovation scope of work as outlined by others and the decontamination of all surfaces or materials which may have been or become contaminated by hazardous materials either during or prior to work of this Contract.

1.2 Site Conditions

- .1 Refer to the report entitled ““*Hazardous Building Materials Assessment, Ventilation Upgrade – University Hall 1280 Main Street West*”, dated April 3, 2024, prepared by Pinchin Ltd., file number 336567.004 and the attached HMIS All Data for Locations 2, 33, 34, 46, 81, 82, 101, 129, and 172
 - .1 Lead is presumed present in all paints and coatings not sampled.
 - .2 Additionally, the following are site conditions in B111 (Location 2)
 - .1 Asbestos-containing parging cement is present on pipe fittings.
 - .3 Additionally, the following are site conditions in B180 (Location 44)
 - .1 Asbestos-containing texture coat is present on walls and ceilings.

- .2 Asbestos-containing parging cement is present on pipe fittings.
- .4 Additionally, the following are site conditions in B131 (Location 33), B182 (Location 38), B107 (Location 55), and 128 (Location 101):
 - .1 Vinyl floor tiles are presumed asbestos-containing.
- .5 Additionally, the following are site conditions in Corridor 381 (Location 172):
 - .1 Asbestos-containing texture coat is present on walls and ceilings.

1.3 Outline of Work

- .1 Coordinate the following items with the Owner's Project Manager and the Construction Manager, including but not limited to: electrical isolations, GFI connection, water connections, HVAC and exhaust ventilation system isolation, bin placement, schedule, disconnects, etc.
- .2 Refer to the Contract Drawings prepared by MCW Consultants Ltd. for the extent of construction work and the Work Areas.
- .3 Using procedures prescribed in the Sections identified in Related Work, complete the following, where required to accommodate the ventilation upgrade work:
 - .1 Remove asbestos-containing spray-applied texture coat as required to create new penetrations, at mounting points and or where it may be disturbed by the work.
 - .1 Seal exposed edges of texture with lagging.
 - .2 Perform drilling/cutting of asbestos-containing spray-applied texture coat or drywall finished with asbestos-containing joint compound using power tools equipped with a HEPA filtered dust collection device, as required to create new penetrations and or at mounting points.
 - .1 Seal exposed edges of texture with lagging.
 - .3 Remove and dispose of Transite bulkheads as required.
 - .4 Remove and dispose of asbestos-containing pipe insulation scheduled for demolition and or at tie in locations. All pipe insulation inside bulkheads and pipe chases is to be treated as asbestos-containing.
 - .1 If for reasons of pipe geometry or access, Glove Bag procedures cannot be used, remove and dispose of asbestos-containing insulations as per Section 02 82 11 for less than 1 square meter, or following Type 3 procedures in accordance with Ontario Regulation 278/05 for greater than 1 square meter.
 - .5 Remove and dispose of asbestos-containing lay-in ceiling tiles (24" x 48" with large and small pinhole pattern) from Room 203 and Room 203A (Location 114 and 115) as required to accommodate the ventilation upgrades.
 - .6 Remove and dispose of presumed asbestos-containing vinyl floor tiles and associated mastic as required to accommodate the ventilation upgrades.

- .7 Complete welding/cutting/modification of structural members with presumed lead-containing coatings. Alternatively, remove paint/coating from structural members where it will be affected/disturbed.
- .4 Refer to Specification Sections identified in the Related Work for specified personnel protective measures for the safe handling, removal, clean-up, enclosure, or repair of hazardous materials in each phase or work area.
- .5 Follow lead procedures prescribed in EACC Lead Guideline when disturbing lead-containing materials.
- .6 Follow silica procedures prescribed in MOL Silica guidelines when disturbing silica-containing materials.
- .7 Visit the site prior to tender close to confirm the location and extent of any hazardous building materials or materials contaminated by hazardous materials.
- .8 Protect surfaces, building fabrics and items remaining within the Abatement Work Area.
- .9 Without disturbing hazardous materials, perform removals where required, prior to abatement work.
- .1 Maximize waste diversion by use of resale of building materials, or recycling.
- .10 Isolate the Abatement Work Area from adjoining Occupied and Non-Occupied Areas whether present at an interior or exterior location.
- .11 Maintain emergency and fire exits from Abatement Work Area, or establish alternative exits satisfactory to Provincial Fire Marshall and local authorities having jurisdiction. Maintain extra routes from occupied areas. Place emergency exit signs at locations to clearly mark exit route. Seal emergency exit doors so as not to impede use of door during emergency evacuation.
- .12 Remove, clean, store and replace at completion of work, non-operating mechanical and electrical equipment, ducts, building components, materials or items removed to accommodate asbestos removal.
- .13 Perform selective demolition of mechanical and electrical equipment, building components, materials and items scheduled for demolition at locations required to facilitate asbestos removal. Refer to all Contract Documents for responsibility of demolition work and disposal.
- .14 Remove and dispose of as appropriate waste, building components, materials and items contaminated by hazardous materials that cannot be effectively cleaned.
- .15 Encapsulate remaining hazardous materials at locations where removal is deemed impractical by the Abatement Consultant.
- .16 Encapsulation will not be permitted where removal of building materials or structures scheduled for demolition will facilitate access to the asbestos materials in question.

- .17 Final clean work area to remove visible signs of asbestos and other hazardous materials, other debris or settled dust.
- .18 Apply lock-down agent to exposed surfaces throughout the work area and to surfaces from which any hazardous materials have been removed.
 - .1 Do not apply lock-down to materials which would be damaged by its application.
- .19 Unless otherwise specified, the handling, removal, clean-up or repair of hazardous materials or surfaces contaminated with hazardous materials is to be performed following wet removal techniques.

1.4 Schedule

- .1 Provide necessary manpower, supervision, equipment and materials to maintain and complete the project on schedule.
- .2 Work Hours:
 - .1 Coordinate all work, scheduling and phasing with the Owner.
 - .2 Duration for which HVAC systems may remain shutdown to accommodate quiet hours work will vary in accordance with outside weather conditions and internal demand. Duration of quiet hours work will have to be scheduled accordingly and in consultation with the Abatement Consultant and Owner.
- .3 Provide 48 hours written notice to the Abatement Consultant of any request to work outside normal working hours. Obtain written approval before proceeding.

1.5 Definitions

- .1 Abatement Consultant: Owner's Representative providing inspection and air monitoring.
- .2 Abatement Contractor: Contractor or sub-contractor performing work of this section.
- .3 Abatement Work Area: Area where work takes place which will, or may, disturb hazardous materials.
- .4 Amended Water: Water with wetting agent added for the purpose of reducing surface tension to allow thorough wetting of materials.
- .5 Asbestos: Any of the fibrous silicates defined in Regulation 278/05 including: actinolite, amosite, anthophyllite, chrysotile, crocidolite and tremolite.
- .6 Asbestos-Containing Material (ACM): Material identified under Site Conditions including any debris, overspray, fallen material and settled dust.
- .7 Authorized Visitors: Building Owner, Abatement Consultant, or designated representative, and persons representing regulatory agencies.

- .8 Competent Worker: A worker who is qualified because of knowledge, training and experience to perform the work, is familiar with Regulation 278/05 and the Occupational Health and Safety Act and has knowledge of the potential or actual danger to health and safety in the work.
- .9 Contaminated Waste: Material identified under Site Conditions, including fallen material, settled dust, other debris and materials or equipment deemed to be contaminated by the Abatement Consultant.
- .10 Curtained Doorway: Doorway consisting of two (2) overlapping flaps of rip-proof polyethylene arranged to permit ingress and egress from one room to another while permitting minimal air movement between rooms.
- .11 DOP Test: A testing method used to determine the integrity of the Negative Pressure unit or vacuum using a Dispersed Oil Particulate (DOP) or Poly Alpha Olefin (PAO) HEPA filter leak test. This test is to be conducted on site where units are to be installed. Refer to the Environmental Abatement Council of Canada (EACC) DOP/PAO Testing Guideline 2013 or ANSI/ASME N510-2007.
- .12 Fitting: Individual segments or pieces of a mechanical service line which may include but is not limited to the hangers, tees, elbows, joints, valves, unions, etc.
- .13 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.
- .14 HEPA: High Efficiency Particulate Aerosol filter that is at least 99.97 percent efficient in collecting a 0.3 micrometre aerosol.
- .15 Lead-Containing: The Ontario Ministry of Labour (MOL) has not established a lower limit for concentrations of lead in paint, below which precautions do not need to be considered during construction projects. Pinchin follows the recommendations of the Environmental Abatement Council of Canada (EACC) Lead Guideline for Construction, Renovation, Maintenance or Repair. The Guideline suggests that 0.1% (1,000 ppm) lead in paint represents a de minimis concentration of lead in paint for construction hygiene purposes, that is a concentration below which the lead content is not the limiting hazard in any disturbance of leaded paint for non-aggressive disturbance of painted finishes, (hand powered demolition, chipping, scraping, light sanding, etc.).
- .16 Lead Waste: Waste generated from removal of lead-containing materials, or the substrate and paint finish where left intact.
- .17 Mercury Waste: Equipment, materials or items containing mercury or contaminated with mercury.
- .18 Milestone Site Review: Review of the Abatement Work Area at a defined point in the abatement operation.
- .19 Negative Pressure: A reduced pressure within the Abatement Work Area (> 0.02 inches of water column) established by extracting air directly from Abatement Work Area and discharging it to exterior of building.

- .20 Non-Friable Material: Material that when dry cannot be crumbled, pulverized or powdered by hand pressure.
- .21 Occupied Area: Any area of the building or adjoining space outside the Abatement Work Area.
- .22 Personnel: All Contractor's employees, sub-contractors' employees, supervisors.
- .23 PCBs: Monochlorinated or Polychlorinated Biphenyls (or any mixture of both).
- .24 PCB Material: means solid material containing PCBs at a concentration of more than fifty milligrams per kilogram (mg/kg) or 50 parts per million (ppm), or liquid with greater than 2 mg/kg or ppm.
- .25 PCB Waste: PCB Equipment, PCB Material, PCB Liquids and materials or items contaminated with PCBs.
- .26 PCM: Phase Contrast Microscopy.
- .27 Remove: Remove means remove and dispose of (as applicable type of waste) unless followed by other instruction (e.g. remove and turn over to Owner).
- .28 Toxicity Characteristic Leachate Procedure (TCLP): Laboratory analysis to determine leachable parameters in lead waste.
- .29 TEM: Transmission Electron Microscopy.

1.6 Regulations and Guidelines

- .1 Comply with Federal, Provincial, and local requirements, provided that in any case of conflict among those requirements or with these Specifications, the more stringent requirements shall apply. Work shall be performed under regulations in effect at the time work is performed.
- .2 Where regulations are not present, follow accepted industry standards and applicable Guideline documents.
- .3 Regulations and Guidelines include but are not limited to the following:
 - .1 Ministry of Labour Occupational Health and Safety Act Regulations for Construction Projects including Revised Statutes of Ontario 1990, Chapter 0.1 and Ontario Regulation 278/05.
 - .2 Ministry of the Environment and Climate Change Regulation for the disposal of waste, including R.R.O. 1990, Reg. 347 as amended.
 - .3 PCB Regulations, SOR 2008-273 and R.R.O. 1990, Reg 362.
 - .4 Regulation 490/09 Designated Substances.

.5 Environmental Abatement Council of Ontario (EACO), Lead Guideline For Construction, Renovation, Maintenance or Repair, October 2014.

.6 Ministry of Labour, Guideline, Silica on Construction Projects, 2011.

1.7 Quality Assurance

- .1 Removal and handling of hazardous materials is to be performed by persons trained in the methods, procedures and industry practices for Abatement.
- .2 Ensure work proceeds to schedule, meeting all requirements of this Specification.
- .3 Complete work so that at no time airborne dust, visible debris, or water runoff contaminate areas outside the Abatement Work Area.
- .4 Any contamination of surrounding area (indicated by visual inspection or air monitoring) shall necessitate the clean-up of affected area, and in the same manner applicable to an Abatement Work Area at no cost to the Owner.
- .5 All work involving electrical, mechanical, carpentry, glazing, etc., shall be performed by licensed persons experienced and qualified for the work required.

1.8 Supervision

- .1 Provide on site for each work shift, a Shift Superintendent(s), who has authority regarding all aspects related to manpower, equipment and production.
- .2 At all times during work, the Overall or Shift Superintendent(s) must be on site. Failure to comply with this requirement will result in a stoppage of all work, at no cost to the Owner.
- .3 Replace supervisory personnel, with approved replacements, within three (3) working days of a written request from the Owner. Owner reserves the right to request replacement of supervisory personnel without explanation.
- .4 Do not replace supervisory personnel without written approval from the Owner.

1.9 Instruction and Training

- .1 Instruction and training must be provided by a competent person.
- .2 All workers completing Type 1, 2 or 3 asbestos abatement must be trained in compliance with Section 19 of O.Reg. 278/05.
 - .1 For Type 3 asbestos abatement, workers must be trained and certified per Section 20 of O.Reg. 278/05.

1.10 Notification

- .1 Before commencing work, notify orally and in writing, an inspector at the office of the Ontario Ministry of Labour nearest the project site, where required.

- .2 Inform all trades on site of the presence and location of hazardous materials identified in the Contract documents.
- .3 Notify the Owner or Owner's Representative, the Joint Occupational Health and Safety Committee and the Provincial Ministry of Labour, if suspected asbestos-containing materials not identified in the contract documents are discovered during the course of the work. Stop work in these areas immediately.
- .4 Notify Sanitary Landfill site as per O.Reg. 347/90 as amended.

1.11 Submittals

- .1 Submit prior to starting work:
 - .1 Provincial Workers' Compensation Board Clearance Certificate.
 - .2 Insurance certificates.
 - .3 Copy of Company Health and Safety Policy and applicable programs.
 - .4 Ministry of Labour Notice of Asbestos Removal Work form.
 - .5 Copy of Certificate of Approval for disposal of hazardous materials waste and location of landfill.
 - .6 Pre-removal damage survey of the Abatement Work Area(s), waste transport routes, and bin storage areas
- .2 Submit the following information regarding personnel prior to starting work:
 - .1 Written statement that personnel have had instruction on hazards of exposure to hazardous materials identified within this scope, the use of respirator, protective clothing, worker and waste decontamination procedures, and all aspects of work procedures and protective measures.
 - .2 WHMIS training certificates for all personnel.
 - .3 Certificate proving that each worker on site has been fit tested for the respirator appropriate for the work being performed.
- .3 Submit the following information regarding HEPA filtered devices prior to construction of enclosure or asbestos abatement:
 - .1 Performance data on HEPA filtered vacuums including DOP tests no more than 3 months old.
 - .2 Performance data on negative air units including DOP tests which must be no more than 3 months old if the unit is vented outdoors or which must be performed on site immediately prior to initial usage and when HEPA filters are changed if the unit is vented indoors.

- .3 DOP tests to be performed by an independent testing company.
 - .1 DOP testing company is required to submit a detailed technical report of testing protocol, including Introduction, Methodology, Results, Conclusions, and Recommendations, including results of the Air-Aerosol Mixing Uniformity test as per ASME N510-1989 (1995).
 - .2 DOP testing company must also provide calibration certificates from an independent calibration firm or from the manufacturer of the testing equipment for both the aerosol photometer and the pressure gauge on the aerosol generator dated within 1 calendar year from the on-site testing date.
 - .3 DOP testing company must also provide the National Sanitation Foundation (NSF) certification name and number of the on-site technician performing the testing.
- .4 Proof of calibration of DOP testing equipment.
- .4 Submit the following prior to isolating the work area:
 - .1 Safety Data Sheets for chemicals or material used in the course of the Abatement Project.
- .5 Submit the following upon completion of the work.
 - .1 Manifests, waybills, bills of lading etc. as applicable for each type of waste.

1.12 Insurance

- .1 Maintain a Commercial General Liability Policy with an insurance company acceptable to McMaster University and the Construction Manager. The intent of this policy is to hold McMaster University and the Construction Manager harmless as it relates to claims for Bodily Injury or Property Damage or both, relating to the contract. Commercial General Liability insurance shall be provided on an “occurrence” basis to cover injury or damage (whether detected or not during the policy period) which happens during the policy period.
- .2 Maintain an Automobile or Fleet Policy, and Non-owned Automobile Policy with an insurance company acceptable to McMaster University and the Construction Manager. The intent of these policies is to hold McMaster University and the Construction Manager harmless as it relates to claims for Bodily Injury or Property Damage or both, relating to the contract.

- .3 Maintain a Pollution Liability Policy (or asbestos/lead liability policy or specific coverage under the CGL for asbestos/lead abatement) with an insurance company acceptable to McMaster University and the Construction Manager. The intent of this policy is to hold McMaster University and the Construction Manager harmless as it relates to claims for Bodily Injury or Property Damage or both, relating to the contract. Pollution Liability shall be provided on an “occurrence” basis to cover injury or damage (whether detected or not during the policy period) which happens during the policy period. Without limiting the generality of the foregoing, the policy shall insure the operations of abatement and shall not contain any environmental and/or health hazard exclusions relating to remediation operations.
- .4 Forward all certificates to McMaster University and the Construction Manager before work is commenced, showing McMaster University and the Construction Manager as additional insured as their interest may appear.
- .5 McMaster University and the Construction Manager may request a certified true copy of the policies.
- .6 The limits will not be less than:
 - .1 Commercial General Liability \$5,000,000.00
 - .2 Automobile \$2,000,000.00
 - .3 Pollution Policy \$5,000,000.00

1.13 Site Review

- .1 From commencement of work until completion of clean-up operations, the Abatement Consultant is empowered by the Owner to review for compliance with the requirements of governing authorities, adherence to specified procedures and materials, and to review for final cleanliness and completion.
- .2 The Abatement Consultant is empowered by the Owner to order a shutdown of work when leakage of asbestos from the controlled work area has occurred or is likely to occur.
- .3 Any deviation from the requirements of the Specifications or governing authorities that is not approved in writing may result in a stoppage of work, at no cost to the Owner.
- .4 Additional labour or materials expended by the Contractor to rectify unsatisfactory conditions and to provide performance to the level specified shall be at no additional cost to the Owner.
- .5 Site review and air monitoring performed as a result of Contractor's failure to perform satisfactorily regarding quality, safety, or schedule, shall be back-charged to the Contractor.
- .6 Facilitate site review and provide access as necessary. Make good work disturbed by review and testing at no cost to the Owner.

- .7 Refer to the Sections identified in Related Work for specified milestone site reviews which are to take place at defined points throughout the abatement operation specific to each phase or work area.
- .8 Provide 24 hours written notice to the Abatement Consultant of any request for scheduling of milestone site reviews or transportation of waste through Occupied Areas.
- .9 The following Milestone Site Reviews may take place, at the Owner's cost, as outlined in each related specification section:
 - .1 Milestone Site Review - Clean Site Preparation
 - .1 Review of preparations and set-up prior to contaminated work in the Abatement Work Area.
 - .2 Milestone Site Review – Bulk Removal Site Review
 - .1 Review during asbestos removal, monitoring removal methods, site deficiencies, performing occupied air monitoring, etc.
 - .3 Milestone Site Review - Visual Clearance
 - .1 Review of Abatement Work Area after completion of all abatement, but prior to application of lock-down agents or dismantling of enclosure.
- .10 Refer to the Sections identified in Related Work for specified milestone inspections which are to take place at defined points throughout the abatement operation specific to each phase or work area.
- .11 Do not proceed with next phase of work until written approval of each milestone is received from the Abatement Consultant.

1.14 Air Monitoring - Asbestos

- .1 Air monitoring will be performed using Phase Contrast Microscopy (PCM) following the National Institute for Occupational Safety and Health Method 7400.
- .2 Co-operate in the collection of air samples, including providing workers to wear sample pumps for up to full-shift periods. Contractor will be responsible for the cost of testing equipment repairs or resampling resulting from the actions of the Contractor's forces.
- .3 Results of PCM samples at or exceeding 0.05 fibres per cubic centimeter of air (fibre/cc) or greater, outside an Abatement Work Area, or from within the Abatement Work Area during or following Glove Bag Work, will indicate asbestos contamination of these areas. Respond as follows:
 - .1 Suspend work within the adjoining Abatement Work Area until written authorization to resume work has been received from the Abatement Consultant.
 - .2 Isolate and clean area in the same manner applicable to the Abatement Work Area.

- .3 Maintain work area isolation, and repeat clean-up operations until visual inspection and air monitoring results are at a level equal to that specified.
- .4 At the discretion of the Abatement Consultant provide additional negative air units at locations specified in response to elevated fibre levels being detected in the Clean Change Room or Occupied Areas.
- .4 Results of PCM samples at or greater than 0.01 fibres per cubic centimeter of air (fibre/cc), collected within the Abatement Work Area enclosure after the site has passed a visual inspection, and an acceptable coat of lock-down agent has been applied, will indicate asbestos contamination of these areas. Respond as follows:
 - .1 Maintain work area isolation and re-clean entire work area. Then apply another acceptable coat of lock-down agent to exposed surfaces throughout the work area.
 - .2 Repeat above measures until visually inspected and air monitoring results are at a level equal to that specified
 - .3 Alternate to items above, the Asbestos Abatement Contractor can pay for analysis of PCM samples by Transmission Electron Microscopy (TEM) at NVLAP accredited laboratory.
 - .1 Enclosure to remain sealed, with negative pressure maintained, and subject to required daily inspections until TEM results are received.
- .5 Additional labour or materials expended by the Contractor to rectify unsatisfactory conditions and to provide performance to the level specified shall be at no additional cost to the Owner.
- .6 Cost of additional site review and sampling performed as a result of elevated fibre levels in areas outside the Abatement Work Area or from within the work area following completion of work, will be back-charged to the Contractor.

1.15 Worker Protection

- .1 Instruct workers before allowing entry to the Abatement Work Area. Instruction shall include training in use of respirators, dress, showering, entry and exiting from an Abatement Work Area, and all other aspects of work procedures and protective measures.
- .2 Workers shall not eat, drink, chew gum or tobacco, vape or smoke in the Abatement Work Area.
- .3 Workers shall be fully protected at all times when possibility of disturbance of hazardous materials exists.
- .4 Provide soap, towels and facilities for washing of hands and face, which shall be used by all personnel when leaving the Abatement Work Area.
- .5 Respiratory Protection

- .1 Refer to each particular Section of the Specification for specified type of respiratory equipment specific to each phase or work area.
- .2 Respirators shall be:
 - .1 Certified by the National Institute of Occupational Safety and Health (NIOSH) or other testing agency acceptable to the Ministry of Labour.
 - .2 Fitted so that there is an effective seal between the respirator and the worker's face. Ensure that no person required to enter an Abatement Work Area has facial hair which affects the seal between respirator and face.
 - .3 Assigned to a worker for their exclusive use.
 - .4 Maintained in accordance with manufacturer's specifications.
 - .5 Cleaned, disinfected and inspected by a competent person after use on each shift, or more often if required.
 - .6 Repaired or have damaged or deteriorated parts replaced.
 - .7 Stored in a clean and sanitary location.
 - .8 Provided with new filters as necessary, according to manufacturer's instructions.
 - .9 Worn by personnel who have been fit checked by qualitative or quantitative fit-testing.
 - .10 Instruction on proper use of respirators must be provided by a competent person as defined by the Occupational Health and Safety Act.
- .3 Provide protective clothing, to all personnel which:
 - .1 Is made of a material that does not readily retain nor permit penetration of asbestos fibres or lead/silica dust.
 - .2 Consists of head covering and full body covering that fits snugly at the ankles, wrists and neck.
 - .3 Once coveralls are worn, treat and dispose of as contaminated waste.
 - .4 Is replaced or repaired if torn or ripped.
- .4 Use hard hats, safety footwear and other protective equipment and apparel required by applicable construction safety regulations.

1.16 Visitor Protection

- .1 Provide clean protective clothing and equipment to Authorized Visitors.
- .2 Instruct Authorized Visitors in the use of protective clothing and Abatement Work Area entry and exit procedures.
- .3 Authorized visitors are required to be fit tested on respirators, prior to entering Abatement Work Area.
 - .1 Respirator worn must be compliant with Section 13 and Table 2 of O.Reg. 278/05.

1.17 Signage

- .1 Asbestos Abatement Signs: Post signs at access points to the Abatement Work Area, stating at minimum, the following:

- .1 There is an asbestos dust hazard.
- .2 Access to the work area is restricted to persons wearing protective clothing and equipment.
- .2 Lead Abatement Signs: Post signs at access points to the Abatement Work Area, stating at minimum, the following:
 - .1 There is a 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.
- .3 Silica Warning Signs: Post signs at access points to the Abatement Work Area, stating at minimum, the following:
 - .1 There is a silica dust hazard.
 - .2 Access to the work area is restricted to authorized persons.
 - .3 Respirators must be worn in the work area.
- .4 Vehicles, Bins and Asbestos Waste Containers: Post signs on both sides of every vehicle used for the transportation of asbestos waste and on every asbestos waste container. Signs must display thereon in large, easily legible letters that contrast in colour with the background the word “CAUTION” in letters not less than ten centimetres in height and the words:
 - .1 CONTAINS ASBESTOS FIBRES
 - .2 Avoid Creating Dust and Spillage
 - .3 Asbestos May be Harmful To Your Health
 - .4 Wear Approved Protective Equipment.
- .5 Place placards in accordance with Transportation of Dangerous Goods Act.

1.18 Differential Pressure Monitoring

- .1 Provide and install differential pressure monitors as specified in each section.
- .2 Replace damaged or non-functional equipment at the request of the Abatement Consultant.
- .3 Record at minimum twice daily, and when damage to the enclosure is identified and repaired, the following information:
 - .1 Name of inspector.
 - .2 Date and time.

- .3 Pressure reading.
- .4 Repairs completed, if applicable.
- .4 Maintain specified differential pressure.
- .5 Stop contaminated work and take corrective action if pressure differential drops below the specified level. Notify the Abatement Consultant immediately.

1.19 Waste and Material Handling

- .1 Waste bins must be placed on grade or in receiving.
- .2 All bins for hazardous materials must be covered and locked when waste transfer is not being performed.
- .3 Ensure redundant non-ACM, rubble, debris, etc. removed during contaminated work are treated, packaged, transported and disposed of as appropriate waste.
- .4 Clean, wash and apply Post Removal Sealant to metal waste prior to removal from Abatement Work Area. Recycle metals.
- .5 Clean, wash and apply Post Removal Sealant to non-porous materials prior to disposal as clean waste. Obtain prior written approval from the Abatement Consultant for each individual type of material.
- .6 Clean and wash equipment prior to removal from Abatement Work Area if removed prior to completion.
- .7 Place all equipment, tools and unused materials that cannot be cleaned in Abatement Waste Containers.
- .8 As work progresses, and at regular intervals, transport the sealed and labelled waste containers from the Abatement Work Area to waste bin.
- .9 Place items in bins according to waste classification. Place asbestos waste, lead waste, metals, non-asbestos waste, etc. in separate bins.
- .10 Removal of waste containers and decontaminated tools and materials from the Abatement Work Area shall be performed as follows:
 - .1 Remove any visible contamination from the surface of non-porous or cleanable waste being removed from the Abatement Work Area. If the item can be cleaned, remove it from the site as clean waste.
 - .2 Place waste or item in Waste Container and seal closed.
 - .3 Wet wipe outside of Waste Container.
 - .4 Within Decontamination Facility, Transfer Room or at the perimeter of the Abatement Work Area, place in second Waste Container. Seal closed.

- .5 Remove waste containers and transport to appropriate bin.
- .11 Transport waste and materials via the predetermined routes and exits. Arrange waste transfer route with Owner. Use a closed, covered cart to transport through Occupied Areas.
- .12 Provide workers transporting waste with means to access full personal protective equipment and all tools required to properly clean up spilled material in the case of a rupture of a Waste Container.
- .13 Pick-up and drop off of garbage bin shall be at pre-approved times and must not interfere with the Owners operations.
- .14 Transport hazardous waste to landfill or waste transfer station licensed by the provincial Ministry of the Environment.
- .15 Cooperate with the provincial Ministry of the Environment inspectors and immediately carry out instructions for remedial work at dump to maintain environment, at no additional cost to the Owner.

1.20 Re-establishment of Objects and Systems

- .1 Re-establish objects and items relocated by the Contractor's workforce to facilitate work.
- .2 Re-establish electrical, communication, HVAC and other services previously disconnected or otherwise isolated to accommodate work by this Section.
- .3 Make good at completion of work, all damage not identified in pre-removal survey.

PART 2 PRODUCTS AND FACILITIES

2.1 Materials and Equipment

- .1 Refer to the Sections identified in Related Work for specified materials, equipment or facilities specific to each phase or work area.
- .2 Materials and equipment must be in good condition and free of debris and fibrous materials. Disposable items must be of new materials only.
- .3 Airless Sprayer: AC powered pressure washer that allows wetting agent to mix with water, uses no air or compressed air, and has a nozzle to regulate power and pressure.
- .4 Amended Water: Water with wetting agent added for purpose of reducing surface tension to allow thorough wetting of materials.
- .5 Asbestos Waste Container: A container acceptable to disposal site, Ministry of the Environment, and Ministry of Labour, comprised of the following:
 - .1 Dust tight.
 - .2 Suitable for the type of waste.

- .3 Impervious to asbestos.
- .4 Identified as asbestos waste.
- .6 Differential Pressure Monitor: a high precision instrument for measuring and controlling pressure differences in the low range, between the Abatement Work Area and Occupied Area. Calibrate regularly to manufacturer's instructions.
- .7 Discharge Ducting: Polyethylene Tubing. Reinforced with wire. Diameter to equal negative pressure machine discharge. Not to be longer than required, or so long that negative pressure is compromised.
- .8 Ground Fault Panel: Electrical panel as follows:
 - .1 Ground fault circuit interrupters of sufficient capacity to power temporary electrical equipment and lights in Asbestos Work Area.
 - .2 Interrupters to have a 5 mA ground fault protection.
 - .3 Necessary accessories including main switch disconnect, ground fault interrupter lights, test switch to ensure unit is working, and reset switch.
 - .4 Openings sealed to prevent moisture or dust penetration.
 - .5 Inspected by the Electrical Safety Authority.
 - .6 Panel uses CSA approved parts and been constructed, inspected and installed by a licensed electrician.
 - .7 Provide one Ground Fault Panel for each 5,000 square feet (500 square metres) of Abatement Work Area.
- .9 HEPA Filtered Negative Pressure Machine: Portable air handling system which extracts air directly from the Abatement Work Area and discharges the air to the exterior of the building. Equipped as follows:
 - .1 Prefilter and HEPA filter. Air must pass HEPA filter before discharge.
 - .2 Pressure differential gauge to monitor filter loading.
 - .3 Auto shut off and warning system for HEPA filter failure.
 - .4 Separate hold down clamps to retain HEPA filter in place during change of prefilter.
- .10 HEPA Vacuum: Vacuum with necessary fittings, tools and attachments. Discharged air must pass through a HEPA filter.
- .11 Hose: Leak-proof, minimum bursting strength of 500 PSI or greater if required, abrasion resistant covering, reinforcing, and machined-brass couplings. Maintained and tested. Hose to be temperature resistant if it is to carry domestic hot water.

- .12 OSB: Oriented Strand Board.
- .13 Polyethylene Sheeting: 6 mil (0.15 mm) minimum thickness unless otherwise specified, in sheet size to minimize joints.: 6 mil (0.15 mm) minimum thickness unless otherwise specified, in sheet size to minimize joints.
- .14 Post Removal Sealant (or Lockdown): Sealant that when applied to surfaces serves the function of trapping residual asbestos fibres or other dust. Product must have flame spread and smoke development ratings both less than 50. Product shall leave no stain when dry. Post Removal Sealant shall be compatible with replacement insulation or fireproofing where required and capable of withstanding service temperature of substrate. Apply to manufacturer's instructions.
- .15 Protective Clothing: Disposable coveralls complete with head covering and full body covering that fits snugly at the ankles, wrists and neck.
- .16 Rip-Proof Polyethylene Sheeting: 8 mil (0.20 mm) fabric made up from 5 mil (0.13 mm) weave and two (2) layers of 1.5 mil (0.05 mm) poly laminate or approved equal. In sheet size to minimize on-site seams and overlaps.
- .17 Shower Hose: Water lines for supply of hot & cold water to shower facilities to be rated for use at 200 PSI (1380 kPa) or twice the working pressure whichever is greater. Supply lines to be continuous and free of fittings, joints or couplings.
- .18 Sprayer: Garden type portable manual sprayer or water hose with spray attachment if suitable.
- .19 Tape: Duct tape or tape suitable for sealing polyethylene to surfaces under both dry and wet conditions in the presence of Amended Water.
- .20 Wetting Agent: Non-sudsing surfactant added to water to reduce surface tension and increase wetting ability.

PART 3 EXECUTION

- .1 Refer to the Sections identified in Related Work for specified procedures for work area preparation, maintenance, site dismantlement, application of lock-down agent and all other procedures for the safe handling, removal and clean-up of hazardous materials specific to each phase or work area.

END OF SECTION

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PART 1 GENERAL

1.1 General and Related Work

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of the General Conditions of the Contract.
- .2 Requirements specified elsewhere:
 - .1 Section 02 81 00 Hazardous Materials – General Provisions

1.2 Outline of Work

- .1 Refer to Section 02 81 00 Hazardous Materials – General Provisions for the Outline of Work.
- .2 The intent of this Section is to provide safe work practices and procedures to govern the handling, removal, clean-up and disposal of asbestos-containing materials following Type 1 or Low Risk procedures, and Pinchin and Owner specific requirements.

1.3 Personal Protection

- .1 Protect all personnel at all times when possibility of disturbance of ACM exists.
 - .1 Provide non-powered half-face respirators with P100 high efficiency (HEPA) cartridge filters when requested by personnel.
 - .2 When requested by personnel, provide protective clothing.
- .2 Provide protective clothing, to all personnel entering the Abatement Work Area.
- .3 Wear hard hats, safety shoes and other personal protective equipment required by applicable construction safety regulations.

1.4 Site Reviews

- .1 Refer to Section 02 81 00 – General Provisions.
- .2 The following Milestone Site Reviews are to be scheduled:
 - .1 Milestone Site Review - Visual Clearance

PART 2 PRODUCTS AND FACILITIES

- .1 Refer to Section 02 81 00.

PART 3 EXECUTION

3.1 Site Preparation

- .1 Remove stored or non-fixed items from the Abatement Work Area including but not limited to equipment, furniture, waste etc. Store in area provided by Owner.
- .2 Remove visible dust and friable material from all surfaces in the work area including those to be worked on, using HEPA Vacuums or wet wiping.
- .3 Install polyethylene drop sheets below areas of work.
- .4 Install signage in clearly visible locations and in sufficient numbers to adequately warn of an asbestos dust hazard.
- .5 Provide power from ground fault interrupt circuits.
- .6 Shut down HVAC systems serving the Abatement Work Area.
 - .1 Install polyethylene sheeting over openings in ducts and diffusers and seal.

- .2 HVAC to remaining areas of building must not be disrupted during work of this section.
- .3 System shall remain inoperative until completion of work, unless ducts can be effectively capped.
- .4 Perform work at scheduled times after shutting down HVAC systems affecting the Abatement Work Area.
- .7 Provide amended water for wetting ACM, and adequate method of wetting (garden sprayers, airless sprayers, etc.).

3.2 Maintenance of Abatement Work Area

- .1 Inspect polyethylene sheeting and ensure it is effectively sealed and taped. Repair damage and remedy defects immediately.
- .2 Maintain Abatement Work Area in tidy condition.
- .3 Remove any standing water on polyethylene/floor at the end of every shift.
- .4 Turn off water supply to any hoses and reduce pressure in hose, prior to leaving the Abatement Work Area at end of shift.

3.3 Asbestos Removal - General

- .1 Do not use powered tools or non-hand held tools.
- .2 Do not use compressed air to clean or remove dust or debris.
- .3 Do not break, cut, drill, abrade, grind, sand or vibrate ACM if it cannot be wetted. Type 2 procedures would be required if the material cannot be wetted due to hazard or damage.
- .4 Wet ACM prior to work and keep ACM wet throughout the removal process.
- .5 Frequently and at regular intervals during the work, clean up dust and waste using HEPA vacuums and/or wet sweeping or mopping.
- .6 Frequently and at regular intervals, place all waste in asbestos waste containers.
- .7 Immediately upon completion of work, clean area with HEPA vacuum and/or wet sweeping or mopping.

3.4 Asbestos Removal - Vinyl Asbestos Tile

- .1 Wedge a heavy duty scraper in seam of two adjoining tiles and gradually force edge of one tile up and away from floor. Do not break off pieces of tile, but continue to force balance of tile up.
- .2 Place tile, without breaking into smaller pieces, into Asbestos Waste Container.
- .3 Force scraper through tightly adhered areas by striking scraper handle with a hammer.
- .4 Heat tile thoroughly with a hot air gun until heat penetrates through tile and softens adhesive in areas where scraper will not remove tile.
- .5 Scrape up adhesive remaining on floor with a hand scraper until only a thin smooth film remains.
- .6 Use a hot air gun where deposits are heavy or difficult to scrape.
- .7 Deposit scrapings into asbestos waste disposal bag.
- .8 HEPA vacuum floor on completion of work in area.

3.5 Asbestos Removal - Ceiling tiles (less than 7.5 square metres)

- .1 Slightly lift first tile, HEPA vacuum the ceiling grid the perimeter of tile.
- .2 Lift tile vertically, and while keeping level, slide tile over to adjacent tile.
- .3 HEPA vacuum back of all tiles within reach.
- .4 Mist surface of ceiling tiles with amended water.
- .5 Remove ceiling tiles intact. Do not break or pulverize.
- .6 Place directly into asbestos waste container.
- .7 HEPA vacuum grid and area below ceiling.

3.6 Asbestos Removal - Drywall with Asbestos Drywall Joint Compound (less than 1 square metre)

- .1 Protect drywall around area to be removed by covering with polyethylene and taping seams to wall.
- .2 Mist surface of drywall and drywall joint compound.
- .3 Cut drywall and remove using non-powered hand-held tools. Place directly into a 6 mil polyethylene bag.
- .4 HEPA vacuum floor and Abatement Work Area.

3.7 Asbestos Removal - Removal of Other Non-Friable Asbestos Materials (Transite)

- .1 Wet all material to be disturbed.
- .2 Undo fasteners if necessary to remove material.
- .3 Break material only if unavoidable, and wet material if broken during work.
- .4 Use only non-powered hand-held tools to remove ACM.
- .5 Scrape to remove material adhered to substrate.
- .6 Place removed ACM directly into an asbestos waste container.

3.8 Abatement Work Area Dismantling

- .1 Wash or HEPA vacuum equipment and tools used in contaminated Abatement Work Area to remove all asbestos contamination, or place in Asbestos Waste Containers prior to being removed from Abatement Work Area.
- .2 Place tools and equipment used in contaminated work site but not cleaned in polyethylene bags prior to removal from Abatement Work Area.
- .3 Clean polyethylene sheeting and drop sheets which with HEPA vacuum or wet cleaning methods at completion of work.
- .4 Wet drop sheets and polyethylene sheeting.
- .5 Carefully roll polyethylene sheeting and drop sheets toward the centre. As polyethylene is rolled away, immediately remove visible debris beneath with a HEPA vacuum.
- .6 Remove remaining polyethylene sheeting and tape.
- .7 Place polyethylene sheeting, drop sheets, tape, disposal clothing and other contaminated waste in asbestos waste containers, wet wipe and place in second asbestos waste container.

3.9 Waste and Material Handling

- .1 Refer to Section 02 81 00.

END OF SECTION

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Type 1 Precautions UH McMaster.docx

PART 1 GENERAL

1.1 General and Related Work

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of the General Conditions of the Contract.
- .2 Requirements specified elsewhere:
 - .1 Section 02 81 00 Hazardous Materials – General Provisions

1.2 Outline of Work

- .1 Refer to Section 02 81 00 Hazardous Materials – General Provisions for the Outline of Work.
- .2 The intent of this Section is to provide safe work practices and procedures to govern the handling, removal, clean-up and disposal of asbestos-containing materials following Type 2 or Moderate Risk procedures, and Pinchin and Owner specific requirements.

1.3 Personal Protection

- .1 Protect all personnel at all times when possibility of disturbance of ACM exists.
- .2 Provide the following minimum respiratory protection to all personnel:
 - .1 Full face respirators with P100 high efficiency (HEPA) cartridge filters, for:
 - .1 Removal of all or part of a ceiling if asbestos is likely lying on the surface.
 - .2 Use of a HEPA filtered power tool on non-friable ACM if the material is not wetted.
 - .2 Non-powered half-face respirators with P100 high efficiency (HEPA) cartridge filters.
- .3 Provide protective clothing, to all personnel entering the Abatement Work Area.
- .4 Wear hard hats, safety shoes and other personal protective equipment required by applicable construction safety regulations.

1.4 Site Reviews

- .1 Refer to Section 02 81 00 – General Provisions.
- .2 The following Milestone Inspections are to be scheduled:
 - .1 Milestone Site Review - Clean Site Preparation
 - .2 Milestone Site Review - Visual Clearance

PART 2 PRODUCTS AND FACILITIES

- .1 Refer to Section 02 81 00.

2.2 Hoarding Walls

- .1 Type A Hoarding Wall: One layer of rip-proof polyethylene sheeting installed floor to ceiling, secured with telescopic poles, clips, or other suitable methods.
- .2 Windows: Install sufficient transparent windows area in hoarding walls to allow observation of entire work area from outside the enclosure where existing solid walls do not make up the perimeter.

2.3 Transfer Room

- .1 Transfer Room to be generally 2000 mm x 2000 mm x 2200 mm high. Increase size accordingly to accommodate number of workers.
- .2 Install walls as follows:
 - .1 Install 38 x 89 mm wood framing at 610 mm o/c with continuous top and sill plates.
 - .2 Install one layer rip-proof polyethylene sheeting on interior walls of Transfer Room.
- .3 Install one layer of rip-proof polyethylene sheeting over two layers of 6 mil polyethylene sheeting beneath entire Transfer Room.
- .4 Install one layer rip-proof polyethylene sheeting over roof.
- .5 Turn 600 mm of polyethylene down the sides over polyethylene on the perimeter walls.
- .6 Install a fire extinguisher, mount to wall.

2.4 Curtained Doorways

- .1 Construct as follows:
 - .1 Install two flap doors, full width and height of door opening at all doors to Abatement Work Area and both ends of Transfer Room.
 - .2 Construct each flap door of two layers of polyethylene sheeting with all edges reinforced with tape. Use wood strapping to securely fasten flap doors to head and alternate jambs.
 - .3 Install weights attached to bottom edge of each door flap.
 - .4 Provide direction arrows on flaps to indicate opening.

PART 3 EXECUTION

3.1 Site Preparation - General

- .1 Moving of equipment, tools, supplies, and stored materials that can be performed without disturbing ACM will be performed by others.
- .2 Remove visible dust and friable material from all surfaces in the work area including those to be worked on, using HEPA Vacuums or wet wiping.
- .3 Isolate, at panel, and disconnect existing power supply to Abatement Work Area. Power supply to remaining areas of building must not be disrupted during work of this section.
 - .1 Lock-out/tag-out power at electrical panels.
 - .2 Mark/tag any items within or passing through the Abatement Work Area that are to remain live including but not limited to cable, conduit, wire, fixtures, equipment panels, etc.
- .4 Provide power from ground fault interrupt circuits.
- .5 Shut down HVAC systems serving the Abatement Work Area.
 - .1 Install polyethylene sheeting over openings in ducts and diffusers and seal.
 - .2 HVAC to remaining areas of building must not be disrupted during work of this section.
 - .3 System shall remain inoperative until completion of work, unless ducts can be effectively capped.

- .4 Perform work at scheduled times after shutting down HVAC systems affecting the Abatement Work Area.

- .6 Provide amended water for wetting ACM, and adequate method of wetting (garden sprayers, airless sprayers, etc.).

3.2 Site Preparation – Enclosure Required

- .1 Install polyethylene enclosure complete with Windows at Abatement Work Areas for the following work:
 - .1 Removal of friable asbestos-containing materials (less than 1 square metre).
 - .2 Removal of a false ceiling (or part of) where asbestos-containing material is presumed or known to be present on the surface.
- .2 Install Transfer Room where duration of work is to last longer than one 8 hour shift.
- .3 Seal openings in floor using tape, caulking, polyethylene, etc. Floor openings are to be sealed independently prior to installation of floor polyethylene.
- .4 Install polyethylene sheeting on floors of Abatement Work Area. Use sufficient layers to provide adequate protection for carpeting and equipment.
 - .1 Minimum requirement over carpet is one layer of 6 mil polyethylene under one layer of rip-proof polyethylene.
 - .2 Cover floors first so that polyethylene on walls is overlapped by at least 305 mm.
- .5 Construct Hoarding Walls between Abatement Work Area perimeter and occupied areas.
- .6 Install polyethylene sheeting at openings in walls (as required) and seal.
- .7 Install 6 mil polyethylene sheeting on walls within the Abatement Work Area., including existing walls that make up, or are within, the Abatement Work Area.
- .8 Provide a completely sealed polyethylene top for free standing enclosures.
- .9 Extend to underside of ceiling system, enclosures for access into ceilings. Enclosure may be supported from the ceiling system if ceiling can support the polyethylene.
- .10 Install Curtained Doorways.
- .11 Install one layer of 6 mil polyethylene sheeting so as to protect all equipment and finishes in the Abatement Work Area that may be damaged. Items to remain include but are not limited to:
 - .1 Millwork.
 - .2 Doors.
 - .3 Bulkheads.
 - .4 Plumbing fixtures.
 - .5 Electrical Equipment.
 - .6 Mechanical Equipment.
- .12 Install temporary lighting in enclosure to a level that will provide for safe and efficient use of work area - minimum 550 LUX.
- .13 Establish negative pressure in Abatement Work Areas as follows:
 - .1 Provide sufficient HEPA filtered negative pressure machines to exchange a volume of air equivalent to that of the Abatement Work Area a minimum of every 20 minutes.

- .2 Provide additional HEPA filtered negative pressure machines as required to ensure air flow from Occupied Area into Abatement Work Area.
- .3 Arrange negative air units to maximize the distance between units and decontamination facilities.
- .4 Provide weighted flaps in perimeter Hoarding Walls as necessary to provide make-up air.
- .5 Operate HEPA filtered negative pressure machines continuously from first disturbance of ACM until completion of dismantling.
- .6 Replace prefilters to maintain specified flow rate.
- .7 Replace HEPA filter as required to maintain flow rate and integrity of unit.
- .8 Discharge HEPA filtered negative air machines as follows:
 - .1 To building exterior.
- .14 Place required tools to complete the abatement with the Abatement Work Area.
- .15 Install Signage in clearly visible locations and in sufficient numbers to adequately warn of an asbestos dust hazard.

3.3 Site Preparation – No Enclosure Required

- .1 Install caution tape around work area where existing walls are not present.
- .2 Cover walls, floors, finishes, millwork, equipment and furnishings remaining in the Abatement Work Area with polyethylene sheeting before disturbing ACM to control the spread of dust.
- .3 Install one layer of 6 mil polyethylene sheeting so as to protect all equipment and finishes in the Abatement Work Area that may be damaged. Items to remain include but are not limited to:
 - .1 Millwork.
 - .2 Doors.
 - .3 Bulkheads.
 - .4 Plumbing fixtures.
 - .5 Electrical Equipment.
 - .6 Mechanical Equipment.
- .4 Install Signage in clearly visible locations and in sufficient numbers to adequately warn of an asbestos dust hazard.
- .5 Install temporary lighting in enclosure to a level that will provide for safe and efficient use of work area - minimum 550 LUX.
- .6 Place HEPA vacuum in Abatement Work Area.
- .7 Place required tools to complete the abatement with the Abatement Work Area.

3.4 Maintenance of Abatement Work Area

- .1 Inspect polyethylene sheeting and ensure it is effectively sealed and taped. Repair damage and remedy defects immediately.
- .2 Inspect electrical panels and ensure locks and tags are on panels prior to entering the Abatement Work Area.
- .3 Inspect HEPA filtered negative pressure machines including discharge ducting at the beginning and end of each working period. Inspection must be performed by competent

person.

- .4 Maintain Abatement Work Area in tidy condition.
- .5 Remove standing water on polyethylene/floor at the end of every shift.
- .6 Turn off water supply to any hoses and reduce pressure in hose, prior to leaving the Abatement Work Area at end of shift.

3.5 Asbestos Removal - General

- .1 Do not use compressed air to clean or remove dust or debris.
- .2 Frequently and at regular intervals during the work, clean up dust and waste using HEPA vacuums and/or wet sweeping or mopping.
- .3 Frequently and at regular intervals, place all waste in asbestos waste containers.
- .4 Immediately upon completion of work, clean area with HEPA vacuum and/or wet sweeping or mopping.

3.6 Asbestos Removal – Thermal Systems Insulation (less than 1 Square Metre)

- .1 Construct an enclosure around Abatement Work Area and use the procedures described above under *Site Preparation – Enclosure Required*.
- .2 Adequately wet exterior of the ACM with amended water to suppress dust.
- .3 Remove asbestos-containing mechanical insulations in layers, maintaining all exposed surfaces of insulation in a wet condition.
- .4 Remove wetted ACM directly into waste containers. Do not allow ACM to fall to the floor of the Abatement Work Area.
- .5 Clean all surfaces from which ACM has been removed with scouring pads, vacuuming or wet-sponging to remove all visible material after completion of removal of ACM.
- .6 Remove visible dust and debris.
- .7 Seal exposed ends of asbestos-containing insulation to remain, with canvas and lagging.
- .8 HEPA vacuum or wet clean entire Abatement Work Area, including any surfaces not covered with polyethylene sheeting. Any materials removed to access ACM that are to be re-used, and any abatement equipment, must be wet cleaned or HEPA vacuumed prior to completion.
- .9 Apply Post Removal Sealant to all surfaces within the Abatement Work Area including those from which ACM has been removed.

3.7 Ceiling Entry where Asbestos-Containing Debris is Present

- .1 Construct an enclosure around Abatement Work Area and use the procedures described above under *Site Preparation – Enclosure Required*.
- .2 Slightly lift first tile, HEPA vacuum the ceiling grid the perimeter of tile.
- .3 Lift tile vertically, and while keeping level, slide tile over to adjacent tile.
- .4 HEPA vacuum back of all tiles within reach.
- .5 Mist surface of ceiling tiles with amended water.
- .6 Carefully remove HEPA vacuumed ceiling tiles from grid. Do not break tiles or allow to fall to floor.

- .7 Repeat Items .4 to .6 until all required ceiling tiles have been cleaned and removed.
- .8 Remove visible dust and debris including on grid, ceiling tiles and accessible items within reach.
- .9 Wet clean or HEPA vacuum Abatement Work Area, including any surfaces not covered with polyethylene sheeting. Any materials or equipment removed to access ACM that are to be reused, must be vacuumed prior to reinstatement.
- .10 Re-establish ceiling systems and reinstall tiles.

3.8 Asbestos Removal – More than 7.5 square metres of Ceiling Tiles

- .1 Use the procedures described above under *Site Preparation –No Enclosure Required*.
- .1 Slightly lift first tile, HEPA vacuum the ceiling grid the perimeter of tile.
- .2 Lift tile vertically, and while keeping level, slide tile over to adjacent tile.
- .3 HEPA vacuum back of all tiles within reach.
- .4 Mist surface of ceiling tiles with amended water.
- .5 Remove ceiling tiles intact. Do not break or pulverize.
- .6 Carefully remove laminated tiles by prying tile from substrate. Do not break tiles or allow to fall to floor.
- .7 Remove all glue from substrate.
- .8 Place directly into asbestos waste container.
- .9 Repeat items .3 to .6, until all required ceiling tiles are removed.
- .10 Place ACM directly into waste containers.
- .11 Remove visible dust and debris including at grid.
- .12 Do not damage or remove grid.
- .13 Remove ceiling grid and support system and dispose of as clean waste where specified to be removed.
- .14 Wet clean or HEPA vacuum the entire Abatement Work Area, including surfaces not covered with polyethylene sheeting (i.e. ceiling grid).
- .15 Any materials or equipment removed to access ACM that are to be reused, must be wet cleaned or vacuumed prior to reinstatement.

3.9 Asbestos Removal - Drywall with Asbestos Drywall Joint Compound (greater than 1 square metre)

- .1 Use the procedures described above under *Site Preparation –Enclosure Required*.
- .2 Protect drywall around area to be removed by covering with polyethylene and taping seams to wall.
- .3 Cut drywall and remove using non-powered hand-held tools. Place directly into polyethylene waste bag, or sealed container until at waste bin.
- .4 Remove all screws and fasteners in studs or strapping.
- .5 Remove studs and strapping where specified. Clean metal studs and remove from Abatement Work Area.
- .6 Wet clean or HEPA vacuum the entire Abatement Work Area, including surfaces not

covered with polyethylene sheeting. Any materials or equipment removed to access ACM that are to be reused, must be wet cleaned or vacuumed prior to reinstatement.

3.10 Asbestos Removal - Asbestos Materials with HEPA Filtered Power Tools (Texture Coat, Flooring Mastic and Drywall)

- .1 Use the procedures described above under *Site Preparation –No Enclosure Required*.
- .2 Wet all material to be disturbed.
- .3 Turn on HEPA vacuum. Vacuum to remain operation throughout work.
- .4 Place removed ACM directly into an asbestos waste container.
- .5 Apply lagging to any exposed edges created by removal.
- .6 If power tool can disconnect from HEPA vacuum, remove tool, and HEPA vacuum tool and bit, blade, etc., and shrouds.
- .7 Wet clean or HEPA vacuum the entire Abatement Work Area, including surfaces not covered with polyethylene sheeting. Any materials or equipment removed to access ACM that are to be reused, must be wet cleaned or vacuumed prior to reinstatement.

3.11 Asbestos Removal – Non-Friable Materials with a Machine (Flooring Mastic)

- .1 Use the procedures described above under *Site Preparation –Enclosure Required*.
- .2 Wet all materials to be disturbed.
- .3 Using only a self-propelled machine (i.e. excavator or similar) to complete the required removal work.
- .4 Maintain removed material wet, until packaged.
- .5 Place removed ACM into asbestos waste container.
- .6 Wet clean or HEPA vacuum the entire Abatement Work Area, including surfaces not covered with polyethylene sheeting and the machinery used during the work.

3.12 Asbestos Removal - Dust and Debris

- .1 Use the procedures described above under *Site Preparation –No Enclosure Required*.
- .2 Remove visible dust and debris from Abatement Work Area using HEPA vacuums or wet cleaning methods.

3.13 Application of Post Removal Sealant

- .1 Apply one coat of Post Removal Sealant with an airless sprayer, in accordance with Manufacturer's Instructions, to cover all surfaces on all items in the Abatement Work Area, including but not limited to polyethylene, ACM substrate, structural steel, and surfaces scheduled for demolition.
- .2 Do not apply post removal sealant to materials that will be damaged by its application.

3.14 Abatement Work Area Dismantling

- .1 Wash or HEPA vacuum equipment and tools used in contaminated Abatement Work Area to remove all asbestos contamination, or place in Asbestos Waste Containers prior to being removed from Abatement Work Area.
- .2 Place tools and equipment used in contaminated work site but not cleaned in polyethylene bags prior to removal from Abatement Work Area.
- .3 Clean polyethylene sheeting and drop sheets which with HEPA vacuum or wet cleaning

methods at completion of work.

- .4 Wet drop sheets and polyethylene sheeting.
- .5 Carefully roll polyethylene sheeting and drop sheets toward the centre of enclosure. As polyethylene is rolled away, immediately remove visible debris beneath with a HEPA vacuum.
- .6 Remove remaining polyethylene sheeting and tape, and dispose of as asbestos waste.
- .7 Place polyethylene sheeting, drop sheets, tape, disposal clothing and other contaminated waste in asbestos waste containers, wet wipe and place in second asbestos waste container.
- .8 Remove remaining site isolation, seals, tape, etc.
- .9 Remove Transfer Room.
- .10 Remove seals, tape, Signage etc.
- .11 Immediately upon shutting down negative air units, seal air inlet grill and exhaust vent with polyethylene and tape.
- .12 Seal openings in HEPA vacuums.
- .13 Remove and dispose of the pre-filters from HEPA filtered negative pressure machines as asbestos waste.
- .14 Remove HEPA filtered negative pressure machines and discharge ducting or HEPA vacuums.
- .15 Remove temporary lights.
- .16 Remove ground fault panels.
- .17 Place contaminated materials including polyethylene sheeting, drop sheets, seals, tape, disposable coveralls, and other contaminated waste in asbestos waste containers.

3.15 Waste and Material Handling

- .1 Refer to Section 02 81 00.

3.16 Re-Establishment of Items

- .1 Upon completion of work:
 - .1 Move items that were removed from Abatement Work Area prior to work, back into same location within Abatement Work Area.
 - .2 Remove and disconnect Ground fault Panel, tags and locks from electrical panels and re-energize equipment and items.
 - .3 Remove hose bibs installed and repair pipe.
 - .4 Reinstall ducts removed to perform cleaning of ducts or to access ACM.
 - .5 Clean, mop and vacuum Abatement Work Area and area beneath any tunnels, platform and Decontamination Facilities.
 - .6 Enable building air handling systems.

END OF SECTION

PART 1 GENERAL

1.1 General and Related Work

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of the General Conditions of the Contract.
- .2 Requirements specified elsewhere:
 - .1 Section 02 81 00 Hazardous Materials – General Provisions

1.2 Outline of Work

- .1 Refer to Section 02 81 00 Hazardous Materials – General Provisions for the Outline of Work.
- .2 The intent of this Section is to provide safe work practices and procedures to govern the handling, removal, clean-up and disposal of asbestos-containing materials following Glove Bag procedures, and Pinchin and Owner specific requirements.
- .3 If for reasons of pipe temperature, geometry or access, Glove Bag procedures cannot be used, remove and dispose of asbestos-containing insulations as per Section 02 82 11 for less than 1 square meter, or Section 02 82 13 for greater than 1 square meter.

1.3 Personal Protection

- .1 Protect all personnel at all times when possibility of disturbance of ACM exists.
- .2 Provide the following minimum respiratory protection to all personnel:
 - .1 Non-powered half-face respirators with P100 high efficiency (HEPA) cartridge filters.
- .3 Provide protective clothing, to all personnel entering the Abatement Work Area.
- .4 Wear hard hats, safety shoes and other personal protective equipment required by applicable construction safety regulations.

1.4 Site Reviews

- .1 Refer to Section 02 81 00 – General Provisions.
- .2 The following Milestone Site Reviews are to be scheduled:
 - .1 Milestone Site Review - Clean Site Preparation
 - .2 Milestone Site Review – Bulk Removal Inspection
 - .3 Milestone Site Review - Visual Clearance

PART 2 PRODUCTS AND FACILITIES

2.1 Materials and Equipment

- .1 Refer to Section 02 81 00.
- .2 Glove Bag: Prefabricated bag which provides a completely sealed envelope surrounding a given section of piping to permit the removal of asbestos-containing insulation from within the bag while maintaining the integrity of the bag and preventing the spread of airborne asbestos fibres. The glove bag shall be equipped with,
 - .1 sleeves and gloves that are permanently sealed to the body of the bag to allow the worker to access and deal with the insulation and maintain a sealed enclosure throughout the work period,

- .2 valves or openings to allow insertion of a vacuum hose and the nozzle of a water sprayer while maintaining the seal to the pipe, duct or similar structure,
 - .3 a tool pouch with a drain,
 - .4 a seamless bottom and a means of sealing off the lower portion of the bag, and
 - .5 a high strength double throw zipper and removable straps, if the bag is to be moved during the removal operation.
- .3 Securing Straps: For some types of Glove Bag, reusable nylon straps at least 25mm wide with metal tightening buckle for sealing ends of bags around pipe and/or insulation.

PART 3 EXECUTION

3.1 Site Preparation - General

- .1 Remove to the extent necessary to access piping, stored or non-fixed items from the Abatement Work Area including but not limited to equipment, furniture, waste etc. Store in area provided by Owner.
- .2 Shut down HVAC systems serving the Abatement Work Area.
 - .1 Install polyethylene sheeting over openings in ducts and at diffusers and seal.
 - .2 HVAC to remaining areas of building must not be disrupted during work of this section.
 - .3 System shall remain inoperative until completion of work, unless ducts can be effectively capped.
 - .4 Perform work at scheduled times after shutting down HVAC systems affecting the Abatement Work Area.
- .3 Install caution tape around work area where existing walls are not present.
- .4 Install Signage in clearly visible locations and in sufficient numbers to adequately warn of an asbestos dust hazard.
- .5 Remove visible dust and friable material from all surfaces in the work area including those to be worked on, using HEPA Vacuums or wet wiping.
- .6 Cover walls, floors, finishes, millwork, equipment and furnishings below the pipe to be worked on in the Abatement Work Area with polyethylene sheets before disturbing ACM. Drop sheets shall extend a minimum of 1,800 mm from pipe.
- .7 Use existing lighting or install temporary lighting to a level that will provide for safe and efficient use of work area - minimum 550 LUX.
- .8 Provide Amended Water for wetting ACM, in garden sprayers. Provide one garden sprayer for each worker.
- .9 Do not use compressed air to clean or remove dust or debris when completing work of this section.
- .10 Place HEPA Vacuum in Abatement Work Area for each worker.
- .11 Place required tools to complete the abatement within the Abatement Work Area.
- .12 Post Notice of Asbestos Removal Work, where required by O.Reg. 278/05.

3.2 Maintenance of Abatement Work Area

- .1 Maintain Abatement Work Area in tidy condition.

3.3 Glove Bag Removal

- .1 Do not use Glove Bags on hot pipes that may damage Glove Bag. Refer to manufacturer's limitations.
- .2 Prior to use of Glove Bag on damaged orunjacketed insulation:
 - .1 Spray any areas of damaged insulation jacketing with mist of Amended Water.
 - .2 Tape over damaged insulation to provide temporary repair.
 - .3 Mist areas of insulation with no jacketing and wrap with polyethylene sheeting and seal with tape.
- .3 Place any tools necessary to remove insulation in tool pouch built into Glove Bag.
- .4 Inspect the Glove Bag for damage and defects immediately before it is attached to the pipe or duct.
 - .1 If damage or defects are observed, dispose of Glove Bag.
- .5 Install Glove Bag as per manufacturer's instructions.
- .6 Remove metal jacketing or banding carefully. Do not damage the Glove Bag.
- .7 Remove insulation from pipe as per manufacturer's directions.
 - .1 Volume and weight of insulation must not exceed capacity of the Glove Bag or supports.
 - .2 Arrange insulation in the Glove Bag to maximize use of the Glove Bag.
- .8 Only glove bags designed to be moved may be re-used on other sections of pipe or moved down same section of pipe (e.g. Safe-T-Strip).
- .9 At regular intervals during its use, if damage or defects are observed during the use of the Glove Bag, which cannot be readily repaired with tape and not affect the integrity or strength of the glove bag.
 - .1 Discontinue use of Glove Bag.
 - .2 Wash inner surface of Glove Bag.
 - .3 Wet insulation.
 - .4 Pull an Asbestos Waste Container over Glove Bag before removing from pipe.
 - .5 Remove Glove Bag and Asbestos Waste Container, seal with tape.
 - .6 Place in a second Asbestos Waste Container and seal with tape.
 - .7 Clean immediate area with a HEPA Vacuum prior to resuming work.
- .10 If bag is to be moved along pipe for use on adjacent section of insulation:
 - .1 Wash inner surface of Glove Bag.
 - .2 Wash tools and place tools in pouch.
 - .3 Wet surface of insulation in lower section of bag and any exposed end of asbestos insulation remaining on pipe with Amended Water.
 - .4 Insert nozzle of HEPA filtered vacuum cleaner into bag through valve and evacuate air from bag.
 - .5 Seal closure strip.
 - .6 Loosen securing straps to maintain a loose seal of Glove Bag to insulation or pipe.

- .7 Use double throw zipper as necessary to pass hangers.
- .8 Tighten straps once bag is in new position and continue insulation removal until Glove Bag is full, work is completed on the pipe or an obstruction prevents further movement of the bag.
- .11 If bag is to be removed from a pipe for use on a new section of pipe, perform the following:
 - .1 Wash inner surface of Glove Bag.
 - .2 Wash tools and place tools in pouch.
 - .3 Wet surface of insulation in lower section of bag and any exposed end of asbestos insulation remaining on pipe with Amended Water.
 - .4 Insert nozzle of HEPA filtered vacuum cleaner into bag through valve and evacuate air from bag.
 - .5 Seal valve cover on valve Glove Bags.
 - .6 Seal closure strip.
 - .7 Wash top section of Glove Bag and tool pouch thoroughly.
 - .8 Undo securing straps, unfasten zipper and carefully move bag to new section of pipe.
- .12 To remove bag after completion of insulation removal operation:
 - .1 Wash inner surface of Glove Bag.
 - .2 Wash and place all tools in one hand (glove), pull hand out inverted, twist to create a separate pouch, tape inverted hand at two separate locations 25 mm apart so as to seal pouch.
 - .1 Remove inverted hand and tools by cutting between the two tape seals.
 - .2 Place inverted hand pouch and tools into the next clean Glove Bag to be used or into a water bucket, open pouch underwater and clean tools.
 - .3 Wet surface of insulation in lower section of bag and any exposed end of asbestos insulation remaining on pipe with Amended Water.
 - .4 Insert nozzle of HEPA filtered vacuum cleaner into bag through valve and evacuate air from bag.
 - .5 Seal valve cover on valve Glove Bags.
 - .6 Seal closure strip if equipped with one. Twist bag at tapered point and secure with tape.
 - .7 Pull an Asbestos Waste Container over Glove Bag before removing from pipe.
 - .1 Undo straps and unzipper, or cut upper portion of single-use Glove Bag.
 - .2 Seal Asbestos Waste Container with tape.
 - .8 Ensure pipe is clean of all residue after removal of Glove Bag. If necessary, after removal of each section of asbestos, vacuum all surfaces of pipe, using HEPA vacuum or wipe with wet cloth.
- .13 Seal all surfaces of freshly-exposed pipe with Post Removal Sealer.
- .14 Cover exposed ends of any remaining asbestos insulation with canvas and lagging using Type 2 Procedures.

3.4 Clean-Up and Dismantling

- .1 Clean and remove from Abatement Work Area:

- .1 Equipment and tools.
- .2 Temporary lighting if used.
- .3 Polyethylene seals from HVAC systems.
- .2 Place polyethylene sheeting, drop sheets, seals, tape, clothing and other contaminated waste in asbestos waste containers, wet wipe and place in second asbestos waste container.
- .3 Clean Abatement Work Area with HEPA vacuums or wet wiping/mopping.
- .4 Seal openings in HEPA vacuums.
- .5 Proceed with the dismantlement of all barricades, etc. following receipt of authorization to proceed from the Asbestos Abatement Consultant.
- .6 Remove barricades, fencing, caution tape, signs, etc.

3.5 Waste and Material Handling

- .1 Refer to Section 02 81 00.

3.6 Re-Establishment of Items

- .1 Upon completion of work:
 - .1 Move all items that were removed from Abatement Work Area prior to work, back into same location within Abatement Work Area.
 - .2 Remove tags and locks from electrical panels and re-energize equipment and items.
 - .3 Enable building air handling systems.
 - .4 Clean and vacuum Abatement Work Area.

END OF SECTION

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PART 1 GENERAL

- .1 Read this Section in conjunction with all drawings and all other Sections so as to comply with the requirements of the General Conditions of the Contract.
- .2 Requirements specified elsewhere:
 - .1 Section 02 81 00 Hazardous Materials – General Provisions

1.2 Outline of Work

- .1 Refer to Section 02 81 00 Hazardous Materials – General Provisions for the Outline of Work.
- .2 The intent of this Section is to provide safe work practices and procedures to govern the handling, removal, clean-up and disposal of lead-containing materials following Class 2 or Moderate Risk procedures, and Pinchin and Owner specific requirements.
- .3 Comply with requirements of this Section when performing following Work:
 - .1 Removal of lead-containing paint using power tools with an effective dust collection system equipped with HEPA filter.
 - .2 Welding, torching or high temperature cutting of lead-containing surface coatings or materials indoors, with use of an effective fume collector or smoke eater.
 - .3 Welding, torching or high temperature cutting of lead-containing surface coatings materials outdoors.
 - .4 Removal of lead-containing surface coatings or materials by scraping or sanding (including wet sanding) using non-powered hand tools.
 - .5 Demolition of plaster or other building components that crumble, pulverize or powder and are covered with lead-containing surface coating.

1.3 Instruction and Training

- .1 Provide instruction and training to all workers including the following:
 - .1 Hazards of lead.
 - .2 Use, care and disposal of protective equipment (including but not limited to respirators and filters) and clothing that would be used and worn during abatement work, including:
 - .1 Limitations of equipment.
 - .2 Inspection and maintenance of equipment.
 - .3 Proper fitting of equipment.
 - .4 Disinfecting and cleaning of equipment.
 - .3 Personal hygiene to be observed when performing the work.
 - .4 The measures and procedures prescribed by this section including decontamination of the worker.
 - .5 Instruction and training must be provided by a competent person.

1.4 Personal Protection

- .1 Provide the following respiratory protection to all personnel, at minimum:
 - .1 Non-powered half-face respirators with P100 high efficiency cartridge filters.

- .2 Provide protective clothing, to all personnel entering the Abatement Work Area, including:
 - .1 Dust impermeable gloves appropriate for the work being completed.
 - .2 Disposable protective clothing that does not readily retain or permit skin contamination, consisting of full body covering including head covering with snug fitting cuffs at wrists, ankles, and neck.
- .3 Provide protective clothing, to all personnel entering the Abatement Work Area.
- .4 Wear hard hats, safety shoes and other personal protective equipment required by applicable construction safety regulations.
- .5 Lead-specific soaps and hygiene indicators are recommended to be provided for hand-wash stations.

1.5 Site Reviews

- .1 Refer to Section 02 81 00 – General Provisions.
- .2 The following Milestone Site Reviews are to be scheduled:
 - .1 Milestone Site Review - Visual Clearance

PART 2 PRODUCTS AND FACILITIES

- .1 Refer to Section 02 81 00.

2.2 Hoarding Walls

- .1 Type A Hoarding Wall: One layer of rip-proof polyethylene sheeting installed floor to ceiling, secured with telescopic poles, clips, or other suitable methods.
- .2 Type B Hoarding Wall: 38 mm x 89 mm wood or metal studs at 400 mm o/c with continuous sill and top plate, covered with one layer of rip-proof polyethylene sheeting on each side of wall.
- .3 Windows: Install sufficient transparent windows area in hoarding walls to allow observation of entire work area from outside the enclosure where existing solid walls do not make up the perimeter.

2.3 Transfer Room

- .1 Transfer Room to be generally 2000 mm x 2000 mm x 2200 mm high. Increase size accordingly to accommodate number of workers.
- .2 Install walls as follows:
 - .1 Install 38 x 89 mm wood framing at 610 mm o/c with continuous top and sill plates.
 - .2 Install one layer rip-proof polyethylene sheeting on interior walls of Transfer Room.
- .3 Install one layer of rip-proof polyethylene sheeting over two layers of 6 mil polyethylene sheeting beneath entire Transfer Room.
- .4 Install one layer rip-proof polyethylene sheeting over roof.
- .5 Turn 600 mm of polyethylene down the sides over polyethylene on the perimeter walls.
- .6 Install a fire extinguisher, mount to wall.

2.4 Curtained Doorways

- .1 Construct as follows:
 - .1 Install two flap doors, full width and height of door opening at all doors to Abatement Work Area and both ends of Transfer Room.
 - .2 Construct each flap door of two layers of polyethylene sheeting with all edges reinforced with tape. Use wood strapping to securely fasten flap doors to head and alternate jambs.
 - .3 Install weights attached to bottom edge of each door flap.
 - .4 Provide direction arrows on flaps to indicate opening.

PART 3 EXECUTION

3.1 Site Preparation - General

- .1 Provide washing facilities consisting of a wash basin, clean water, soap and towels.
 - .1 Workers are to use washing facilities each time leaving the Abatement Work Area.
- .2 Stored or non-fixed items, including but not limited to equipment, furniture, waste etc., shall be removed from the Abatement Work Area prior to abatement work.
- .3 Isolate, at panel, and disconnect existing power supply to Abatement Work Area. Power supply to remaining areas of building must not be disrupted during work of this section.
 - .1 Lock-out/tag-out power at electrical panels.
 - .2 Mark/tag any items within or passing through the Abatement Work Area that are to remain live including but not limited to cable, conduit, wire, fixtures, equipment panels, etc.
- .4 Shut down HVAC systems serving the Abatement Work Area.
 - .1 Install polyethylene sheeting over openings in ducts and diffusers and seal.
 - .2 HVAC to remaining areas of building must not be disrupted during work of this section.
 - .3 System shall remain inoperative until completion of work, unless ducts can be effectively capped.
 - .4 Perform work at scheduled times after shutting down HVAC systems affecting the Abatement Work Area.
- .5 Remove visible dust from all surfaces in the work area including those to be worked on, using HEPA Vacuums or wet wiping.
- .6 Provide amended water for wetting materials, and adequate method of wetting (garden sprayers, airless sprayers, etc.).
- .7 Provide electrical power and shut off for operation of powered tools and equipment. Provide ground fault interrupter circuits on power source for electrical tools, in accordance with applicable CSA Standard.
 - .1 Ensure safe installation of electrical lines and equipment.

- .8 Do not use compressed air to clean or remove dust or debris.
- .9 Frequently and at regular intervals during the work, clean up dust and waste using HEPA vacuums and/or wet sweeping or mopping.
- .10 Frequently and at regular intervals, place all waste in waste containers.
- .11 Immediately upon completion of work, clean area with HEPA vacuum and/or wet sweeping or mopping.

3.2 Site Preparation – Enclosure Required

- .1 Install Transfer Room where duration of work is to last longer than one 8 hour shift.
- .2 Install Curtained Doorways.
- .3 Install polyethylene sheeting at openings in walls (as required) and seal.
- .4 Seal openings in floor using tape, caulking, polyethylene, etc. Floor openings are to be sealed independently prior to installation of floor polyethylene.
- .5 Install polyethylene sheeting on floors of Abatement Work Area. Use sufficient layers to provide adequate protection for carpeting and equipment.
 - .1 Cover floors first so that polyethylene on walls is overlapped by at least 305 mm.
- .6 Install 6 mil polyethylene sheeting on walls to remain, within the Abatement Work Area., including existing walls that make up, or are within, the Abatement Work Area.
- .7 Install one layer of 6 mil polyethylene sheeting so as to protect all equipment and finishes in the Abatement Work Area that may be damaged.
- .8 Place required tools to complete the abatement with the Abatement Work Area.
- .9 Install temporary lighting in enclosure to a level that will provide for safe and efficient use of work area - minimum 550 LUX.
- .10 Establish negative pressure in Abatement Work Areas as follows:
 - .1 Provide sufficient HEPA filtered negative pressure machines to exchange a volume of air equivalent to that of the Abatement Work Area a minimum of every 20 minutes.
 - .2 Provide additional HEPA filtered negative pressure machines as required to ensure air flow from Occupied Area into Abatement Work Area.
 - .3 Operate HEPA filtered negative pressure machines continuously from first disturbance of ACM until completion of dismantling.
 - .4 Replace prefilters to maintain specified flow rate.
 - .5 Replace HEPA filter as required to maintain flow rate and integrity of unit.
 - .6 Discharge HEPA filtered negative air machines to building exterior, where possible.
 - .1 Direct discharge away from building access points.
- .11 Install Signage in clearly visible locations and in sufficient numbers to adequately warn of lead hazard, and lead hazard where appropriate.

3.3 Site Preparation – No Enclosure Required

- .1 Cover materials to remain in the Abatement Work Area with polyethylene sheeting before disturbing ACM to control the spread of dust.
- .2 Install caution tape around work area where existing walls are not present.
- .3 Install temporary lighting in enclosure to a level that will provide for safe and efficient use of work area - minimum 550 LUX.
- .4 Place HEPA vacuum in Abatement Work Area.
- .5 Place required tools to complete the abatement with the Abatement Work Area.
- .6 Install Signage in clearly visible locations and in sufficient numbers to adequately warn of a lead dust hazard.

3.4 Maintenance of Abatement Work Area

- .1 Inspect polyethylene sheeting and ensure it is effectively sealed and taped. Repair damage and remedy defects immediately.
- .2 Inspect electrical panels and ensure locks and tags are on panels prior to entering the Abatement Work Area.
- .3 Inspect HEPA filtered negative pressure machines including discharge ducting at the beginning and end of each working period. Inspection must be performed by competent person.
- .4 Maintain Abatement Work Area in tidy condition.
- .5 Remove standing water on polyethylene/floor at the end of every shift.
- .6 Turn off water supply to any hoses and reduce pressure in hose, prior to leaving the Abatement Work Area at end of shift.

3.5 Lead Abatement

- .1 Use the procedures described above under *Site Preparation – Enclosure Required*.
 - .1 Removal of lead-containing surface coatings or materials by scraping or sanding (including wet sanding) using non-powered hand tools.
 - .2 Demolition of plaster or other building components that crumble, pulverize or powder and are covered with lead-containing surface coating.
- .2 Use the procedures described above under *Site Preparation – No Enclosure Required*.
 - .1 Removal of lead-containing paint using power tools with an effective dust collection system equipped with HEPA filter.
 - .2 Welding, torching or high temperature cutting of lead-containing surface coatings or materials indoors, with use of an effective fume collector or smoke eater.
 - .3 Welding, torching or high temperature cutting of lead-containing surface coatings materials outdoors.
- .3 Provide washing facilities consisting of a wash basin, clean water, soap and towels.
 - .1 Workers are to use washing facilities each time leaving the Abatement Work Area.
- .4 Removal methods minimizing dust generation should be used wherever possible.

- .1 Wet methods are to be used to reduce dust generation.
 - .1 Wetting agents should be used where possible.
 - .2 Wet method not be used if it creates a hazard or cause damage to equipment or to project.
- .5 Provide drop sheets below all lead operations that may produce dust, chips or debris containing lead.
- .6 Waste water from cleaning or removal operations must be contained, for treatment or disposal.
- .7 Remove lead-containing paint in small sections and pack as it is being removed in sealable waste containers.
- .8 Waste generated should be maintained wet until cleaned and packaged.
- .9 After completion of stripping work, wire brush and wet sponge surface from which lead based paint has been removed to remove visible material. During this work keep surfaces wet.
- .10 After wire brushing and wet sponging to remove visible lead containing paint, wet clean entire work area, and equipment used in process.
 - .1 Compressed air or dry sweeping not be used to clean up lead-containing dust or waste.
 - .2 Ensure all waste is cleaned and packaged.
- .11 Seal filled containers. Clean external surfaces thoroughly by wet sponging. Remove from immediate working area to staging area. Clean external surfaces thoroughly again by wet sponging. Wash containers thoroughly pending removal to outside. Ensure containers are removed by workers who have entered from uncontaminated areas dressed in clean coveralls.

3.6 Waste Management and Disposal

- .1 Per Section 02 82 00.

3.7 Final Cleaning

- .1 Following specified cleaning procedures, and when visual site review is acceptable, proceed with final cleanup.
- .2 Remove polyethylene sheet by rolling it away from walls to centre of work area. Clean visible lead-containing particles observed during cleanup, immediately, using HEPA vacuum.
- .3 Place polyethylene sheets, tape, cleaning material, clothing, and contaminated waste in plastic bags and seal. Dispose of in accordance with waste materials generated.
- .4 Clean Work areas and Transfer Room, where present.
- .5 Remove sealed waste containers and equipment used in Work and remove from work areas at appropriate time in cleaning sequence.
- .6 Conduct final check to ensure no dust or debris remain on surfaces as result of dismantling operations.

END OF SECTION

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Precautions UH McMaster.docx

ALL DATA REPORT

Client: McMaster University
Location: #2 : STORAGE
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 111
Last Re-Assessment: 2024-11-19

Area (sqft): 90

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	N/a	Plaster	Not Applicable		C	Y		100			LF	V0013	None Detected	N.D.	None	
Duct		None Found														
Floor	N/a	Concrete (poured)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Mechanical Equipment		None Found														
Piping	Unidentified Pipe One	Fibreglass	Straight	Polyvinyl chloride (PVC)	A	Y					LF	V0000	Non-Asbestos		None	
Piping	Unidentified Pipe One	Parging Cement	Fitting	Canvas	A	Y		6(5)			EA	V0001	Chrysotile	50-75%	Confirmed Asbestos	F
Piping	Unidentified Pipe Two	Fibreglass	Fitting	Polyvinyl chloride (PVC)	A	Y					EA	V0000	Non-Asbestos		None	
Piping	Unidentified Pipe Two	Sweatwrap	Straight	Canvas	A	Y		20			LF	V0006	None Detected	N.D.	None	
Structure		Concrete (poured)										V0000	Non-Asbestos		None	
Wall		Plaster			B	Y		100			%	S0013	None Detected	N.D.	None	

Client: McMaster University
Location: #2 : STORAGE
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 111
Last Re-Assessment: 2024-11-19

Area (sqft): 90

PAINT								
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard
Wall	Plaster	100		%	V9500			Presumed Lead
Structure	Steel	100		%	V9500			Presumed Lead

Client: McMaster University
Location: #2 : STORAGE
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 111
Last Re-Assessment: 2024-11-19

Area (sqft): 90

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	100	%	V9500	Presumed

ALL DATA REPORT

Client: McMaster University
Location: #33 : OFFICE
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 131
Last Re-Assessment: 2024-11-19

Area (sqft): 100

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	N/a	Plaster	Not Applicable	N/A	C	Y		100			%	V0013	None Detected	N.D.	None	
Duct	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Floor	N/a	Vinyl Floor Tile and Mastic		Carpet	D	N		170(0)			SF	V9500	Presumed Asbestos		Presumed Asbestos	NF
Mechanical Equipment	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Piping	Chilled Water Return	Fibreglass	Fitting	Polyvinyl chloride (PVC)	A	Y										
Piping	Chilled Water Return	Styrofoam	Straight	Canvas	A	Y						V0000	Non-Asbestos		None	
Piping	Heating Water Return	Fibreglass	Straight	Canvas	A	Y						V0000	Non-Asbestos		None	
Piping	Heating Water Return	Fibreglass	Fitting	Polyvinyl chloride (PVC)	A	Y										
Structure	Beam, Deck	Concrete (poured)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Wall	N/a	Plaster	Not Applicable	N/A	A	Y		100			%	V0013	None Detected	N.D.	None	

Client: McMaster University
Location: #33 : OFFICE
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 131
Last Re-Assessment: 2024-11-19

Area (sqft): 100

PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard	
Structure	Steel	100		%	V9500			Presumed Lead	
Wall	Plaster	100		%	V9500			Presumed Lead	

Client: McMaster University
Location: #33 : OFFICE
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 131
Last Re-Assessment: 2024-11-19

Area (sqft): 100

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	100	%	V9500	Presumed

ALL DATA REPORT

Client: McMaster University
Location: #34 : JANITOR ROOM
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 132
Last Re-Assessment: 2024-11-19

Area (sqft): 150

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	N/a	Plaster	Not Applicable	N/A	C	Y		100			%	V0013	None Detected	N.D.	None	
Duct	N/a	Fibreglass	Not Applicable	N/A								V0000	Non-Asbestos		None	
Floor	N/a	Concrete (poured)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Mechanical Equipment	Fan Unit	Not Insulated	Not Applicable	N/A								V0000	Non-Asbestos		None	
Piping		Fibreglass	Elbow	Polyvinyl chloride (PVC)	B	Y						V0000	Non-Asbestos		None	
Piping	Chilled Water Return	Fibreglass	Elbow	Polyvinyl chloride (PVC)	B	Y										
Piping	Chilled Water Return	Styrofoam	Straight	Canvas	B	Y						V0000	Non-Asbestos		None	
Piping	Domestic Hot Water	Fibreglass	Straight	Canvas	B	Y						V0000	Non-Asbestos		None	
Piping	Domestic Hot Water	Fibreglass	Elbow	Polyvinyl chloride (PVC)	B	Y										
Piping	Unidentified Pipe One	Fibreglass	Straight	Canvas	B	Y						V0000	Non-Asbestos		None	
Piping	Unidentified Pipe One	Fibreglass	Elbow	Canvas	B	Y						V0000	Non-Asbestos		None	
Structure	Beam, Deck	Concrete (poured)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Wall	N/a	Plaster	Not Applicable	N/A	A	Y		100			%	V0013	None Detected	N.D.	None	

Client: McMaster University
Location: #34 : JANITOR ROOM
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 132
Last Re-Assessment: 2024-11-19

Area (sqft): 150

PAINT								
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard
Structure	Steel	100		%	V9500			Presumed Lead
Wall	Plaster	100		%	V9500			Presumed Lead

Client: McMaster University
Location: #34 : JANITOR ROOM
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 132
Last Re-Assessment: 2024-11-19

Area (sqft): 150

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	100	%	V9500	Presumed

ALL DATA REPORT

Client: McMaster University
Location: #46 : STORAGE
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 101
Last Re-Assessment: 2024-11-19

Area (sqft): 45

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Duct	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Floor	N/a	Concrete (poured)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Mechanical Equipment	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Piping	Domestic Hot Water	Fibreglass	Straight	Canvas	B	Y						V0000	Non-Asbestos		None	
Piping	Domestic Hot Water	Fibreglass	Fitting	Polyvinyl chloride (PVC)	B	Y										
Structure	Beam, Deck	Concrete (poured)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Wall	N/a	Concrete (poured)	Not Applicable	N/A								V0000	Non-Asbestos		None	

Client: McMaster University
Location: #46 : STORAGE
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 101
Last Re-Assessment: 2024-11-19

Area (sqft): 45

PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard	
Structure	Steel	100		%	V9500			Presumed Lead	
Wall	Concrete (poured)	100		%	V9500			Presumed Lead	

Client: McMaster University
Location: #46 : STORAGE
Survey Date: 2022-01-11

Site: McMaster
Floor: B

Building Name: 1 : UNIVERSITY HALL
Room #: 101
Last Re-Assessment: 2024-11-19

Area (sqft): 45

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	100	%	V9500	Presumed

ALL DATA REPORT

Client: McMaster University
Location: #81 : OFFICE
Survey Date: 2022-01-11

Site: McMaster
Floor: 1

Building Name: 1 : UNIVERSITY HALL
Room #: 113
Last Re-Assessment: 2024-11-19

Area (sqft): 140

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling		Ceiling tiles (glue-on)			C	N		20			SF	V0011	None Detected	N.D.	None	
Ceiling		Mastic, Black			C	N		20(7)			SF	V0015	Chrysotile	0.5-5%	Confirmed Asbestos	NF
Ceiling ¹	Acoustic Tile	Ceiling Tiles (lay-in), 24x24 pinhole and fleck			C	Y		140			SF	V0000	Non-Asbestos		None	
Ceiling	Bulkhead	Cement Product			C	Y		20(7)			SF	V9000	Confirmed Asbestos		Confirmed Asbestos	NF
Ceiling	N/a	Plaster	Not Applicable	N/A	C	Y		135	5		SF	V0013	None Detected	N.D.	None	
Duct	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Floor	N/a	Wood	Not Applicable	N/A								V0000	Non-Asbestos		None	
Mechanical Equipment	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Other		Ceiling tiles (glue-on)			C	N		100			SF	V0011	None Detected	N.D.	None	
Piping	N/a	N/A	Not Applicable	N/A	D	N						V0000	Non-Asbestos		None	
Structure	Beam, Deck	Concrete (precast)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Wall	N/a	Plaster	Not Applicable	N/A	C	Y		100			%	V0013	None Detected	N.D.	None	

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Client: McMaster University
Location: #81 : OFFICE
Survey Date: 2022-01-11

Site: McMaster
Floor: 1

Building Name: 1 : UNIVERSITY HALL
Room #: 113
Last Re-Assessment: 2024-11-19

Area (sqft): 140

PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard	
Structure	Steel	100		%	V9500			Presumed Lead	
Wall	Plaster	100		%	V9500			Presumed Lead	

Client: McMaster University
Location: #81 : OFFICE
Survey Date: 2022-01-11

Site: McMaster
Floor: 1

Building Name: 1 : UNIVERSITY HALL
Room #: 113
Last Re-Assessment: 2024-11-19

Area (sqft): 140

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	100	%	V9500	Presumed

ALL DATA REPORT

Client: McMaster University
Location: #82 : OFFICE
Survey Date: 2022-01-11

Site: McMaster
Floor: 1

Building Name: 1 : UNIVERSITY HALL
Room #: 114
Last Re-Assessment: 2024-11-19

Area (sqft): 200

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	Bulkhead	Cement Product			C	Y		60(7)			SF	V9000	Confirmed Asbestos		Confirmed Asbestos	NF
Ceiling	N/a	Plaster	Not Applicable	N/A	C	Y		100			%	V0013	None Detected	N.D.	None	
Duct	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Floor	N/a	Wood	Not Applicable	N/A								V0000	Non-Asbestos		None	
Mechanical Equipment	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Piping	N/a	N/A	Not Applicable	N/A	D	N						V0000	Non-Asbestos		None	
Structure	Beam, Deck	Concrete (precast)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Wall	N/a	Plaster	Not Applicable	N/A	C	Y		100			%	V0013	None Detected	N.D.	None	

Client: McMaster University
Location: #82 : OFFICE
Survey Date: 2022-01-11

Site: McMaster
Floor: 1

Building Name: 1 : UNIVERSITY HALL
Room #: 114
Last Re-Assessment: 2024-11-19

Area (sqft): 200

PAINT									
System	Item	Good	Poor	Unit	Sample	Sample Description			Hazard
Structure	Steel	100		%	V9500				Presumed Lead
Wall	Plaster	100		%	V9500				Presumed Lead

Client: McMaster University
Location: #82 : OFFICE
Survey Date: 2022-01-11

Site: McMaster
Floor: 1

Building Name: 1 : UNIVERSITY HALL
Room #: 114
Last Re-Assessment: 2024-11-19

Area (sqft): 200

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	100	%	V9500	Presumed

ALL DATA REPORT

Client: McMaster University
Location: #101 : JANITOR ROOM
Survey Date: 2022-01-11

Site: McMaster
Floor: 1

Building Name: 1 : UNIVERSITY HALL
Room #: 128
Last Re-Assessment: 2024-11-19

Area (sqft): 80

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	N/a	Plaster	Not Applicable	N/A	C	Y		100			%	V0013	None Detected	N.D.	None	
Duct	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Floor	N/a	Vinyl Floor Tile and Mastic	Not Applicable	N/A	A	Y		80(7)			SF	V9500	Presumed Asbestos		Presumed Asbestos	NF
Mechanical Equipment	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Piping	N/a	N/A	Not Applicable	N/A	D	N						V0000	Non-Asbestos		None	
Structure	Beam, Deck	Concrete (precast)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Wall	N/a	Plaster	Not Applicable	N/A	C	Y		100			%	V0013	None Detected	N.D.	None	

Client: McMaster University
Location: #101 : JANITOR ROOM
Survey Date: 2022-01-11

Site: McMaster
Floor: 1

Building Name: 1 : UNIVERSITY HALL
Room #: 128
Last Re-Assessment: 2024-11-19

Area (sqft): 80

PAINT								
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard
Structure	Steel	100		%	V9500			Presumed Lead
Wall	Plaster	100		%	V9500			Presumed Lead

Client: McMaster University
Location: #101 : JANITOR ROOM
Survey Date: 2022-01-11

Site: McMaster
Floor: 1

Building Name: 1 : UNIVERSITY HALL
Room #: 128
Last Re-Assessment: 2024-11-19

Area (sqft): 80

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	100	%	V9500	Presumed

ALL DATA REPORT

Client: McMaster University
Location: #129 : CORRIDOR
Survey Date: 2022-01-11

Site: McMaster
Floor: 2

Building Name: 1 : UNIVERSITY HALL
Room #: 281
Last Re-Assessment: 2024-11-19

Area (sqft): 1000

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	N/a	Fireproofing (Fibrous)	Not Applicable	N/A	C	Y		150			SF	V0007	None Detected	N.D.	None	
Ceiling	N/a	Texture Coat	Not Applicable		C	Y		850(7)			SF	V0005	Chrysotile	50-75%	Confirmed Asbestos	F
Duct	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Floor	N/a	Terrazzo	Not Applicable	N/A								V0000	Non-Asbestos		None	
Mechanical Equipment	N/a	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Piping	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Structure	Deck	Concrete (poured)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Wall	N/a	Fireproofing (Fibrous)	Not Applicable	N/A	C	Y		800	2		SF	V0007	None Detected	N.D.	None	
Wall	N/a	Texture Coat	Not Applicable		C	Y		2000(7)			SF	V0005	Chrysotile	50-75%	Confirmed Asbestos	F

Client: McMaster University
Location: #129 : CORRIDOR
Survey Date: 2022-01-11

Site: McMaster
Floor: 2

Building Name: 1 : UNIVERSITY HALL
Room #: 281
Last Re-Assessment: 2024-11-19

Area (sqft): 1000

PAINT								
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard
Structure	Steel	100		%	V9500			Presumed Lead
Wall	Texture Coat	100		%	V9500			Presumed Lead

Client: McMaster University
Location: #129 : CORRIDOR
Survey Date: 2022-01-11

Site: McMaster
Floor: 2

Building Name: 1 : UNIVERSITY HALL
Room #: 281
Last Re-Assessment: 2024-11-19

Area (sqft): 1000

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	100	%	V9500	Presumed

ALL DATA REPORT

Client: McMaster University
Location: #172 : CORRIDOR
Survey Date: 2022-01-11

Site: McMaster
Floor: 3

Building Name: 1 : UNIVERSITY HALL
Room #: 381
Last Re-Assessment: 2024-11-19

Area (sqft): 1000

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	N/a	Fireproofing (Fibrous)	Not Applicable	N/A	C	Y		150			SF	V0007	None Detected	N.D.	None	
Ceiling	N/a	Texture Coat	Not Applicable		C	Y		850(7)	4(6)		SF	V0005	Chrysotile	50-75%	Confirmed Asbestos	F
Duct	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Floor	N/a	Terrazzo	Not Applicable	N/A								V0000	Non-Asbestos		None	
Mechanical Equipment	N/a	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Piping	Not Found	N/A	Not Applicable	N/A								V0000	Non-Asbestos		None	
Structure	Deck	Concrete (poured)	Not Applicable	N/A								V0000	Non-Asbestos		None	
Wall	N/a	Fireproofing (Fibrous)	Not Applicable	N/A	C	Y		800			SF	V0007	None Detected	N.D.	None	
Wall	N/a	Texture Coat	Not Applicable		C	Y		2000(7)			SF	V0005	Chrysotile	50-75%	Confirmed Asbestos	F

Client: McMaster University
Location: #172 : CORRIDOR
Survey Date: 2022-01-11

Site: McMaster
Floor: 3

Building Name: 1 : UNIVERSITY HALL
Room #: 381
Last Re-Assessment: 2024-11-19

Area (sqft): 1000

PAINT								
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard
Structure	Steel	100		%	V9500			Presumed Lead
Wall	Texture Coat	100		%	V9500			Presumed Lead

Client: McMaster University
Location: #172 : CORRIDOR
Survey Date: 2022-01-11

Site: McMaster
Floor: 3

Building Name: 1 : UNIVERSITY HALL
Room #: 381
Last Re-Assessment: 2024-11-19

Area (sqft): 1000

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	100	%	V9500	Presumed

Legend:

Sample number	Units	Other
S#### Asbestos sample collected	SF Square feet	A Access
L#### Paint sample collected	LF Linear feet	V Visible
P#### PCB sample collected	EA Each	AP Air Plenum
M#### Mould sample collected	% Percentage	F Friable material
V#### Material is visually identified to be identical to S####	LF Linear feet	NF Non Friable material
V0000 Known non hazardous material		PF Potentially Friable material
V9000 Material visually identified as a Hazardous Material		Pb Lead
V9500 Material is presumed to be a hazardous material		Hg Mercury
		As Arsenic
		Cr Chromium

Access
A Accessible to all building occupants
B Accessible to maintenance and operations staff without a ladder
C Accessible to maintenance and operations staff with a ladder. Also rarely entered, locked areas
D Not normally accessible

Condition
Good No visible damage or deterioration
Fair Minor, repairable damage, cracking, delamination or deterioration
Poor Irreparable damage or deterioration with exposed and missing material

Visible
Y The material is visible when standing on the floor of the room, without the removal or opening of other building components (e.g. ceiling tiles or access panels).
N The material is not visible to view when standing on the floor of the room and requires the removal of a building component (e.g. ceilings tiles or access panels) to view and access. Includes rarely entered crawlspaces, attic spaces, etc. Observations will be limited to the extent visible from the access points.
L The material is partially visible to view when standing on the floor of the room and requires the removal of a building component (e.g. ceiling system or access panels) to view completely and access. Includes partially viewed access points to crawlspaces, attic spaces, etc. without entering. Observations are limited to the extent visible from the access points.

Air Plenum
Yes or No The material is in a return air plenum or in a direct airstream or there is evidence of air erosion (e.g. duct for heating or cooling blowing directly on or across an ACM). This field is only completed where Air Plenum consideration is required by regulation.

Colour Coding
The material is a hazardous material, either by analytical results or by visible identification.
The material is presumed to be a hazardous material, based on visual appearance, and was not sampled due to limited access or the non-destructive nature of sampling.

Action					
(1)	Clean up of ACM Debris	(2)	Precautions for Access Which may Disturb ACM Debris	(3)	ACM removal
(4)	Precautions for Work Which may Disturb ACM in Poor Condition	(5)	Proactive ACM removal (Minimum repair required for fair condition)	(6)	ACM repair

(7) Management program and surveillance