Kawartha Pine Ridge District School Board

SPECIFICATIONS

For

Lydia Trull Public School
Air Handler Replacement
80 Avondale Drive
Courtice, Ontario L1E 3C2

Prepared by:

DEI Consulting Engineers
MECHANICAL | ELECTRICAL | AQUATIC
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November 2025
DEI Project No. 24300

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SPECIFICATIONS

DIVISION 07 - THERMAL & MOISTURE PROTECTION

MECHANICAL

Refer to Mechanical Division Sections

ELECTRICAL

Refer to Electrical Division Sections

DRAWINGS

MECHANICAL DRAWINGS

M101 LEGEND, SCHEDULES, & KEY PLAN
M201 GENERAL TRADES PLANS – DEMOLITION & RENOVATION
M202 GENERAL TRADES PLANS – DEMOLITION & RENOVATION
M301 SECOND FLOOR MECHANICAL ROOM PLAN – DEMOLITION
M302 SECOND FLOOR MECHANICAL ROOM PLAN – RENOVATION
M303 ROOF PLAN – DEMOLITION & RENOVATION
M401 SCHEMATICS & DETAILS

ELECTRICAL DRAWING LIST

E101 LEGEND, SCHEDULES, & KEY PLAN
E201 SECOND FLOOR MECHANICAL ROOM PLAN – DEMOLITION AND RENOVATION
E202 ROOF PLAN – DEMOLITION AND RENOVATION

END OF SECTION

PROJECT NAME

Lydia Trull Public School
Air Handler Replacement
80 Avondale Drive
Courtice, Ontario
L1E 3C2

PROJECT OWNER

Kawartha Pine Ridge District School Board
1994 Fisher Drive
Peterborough, Ontario
K9J 7A1

Contact: Simon M. Terry, Dipl. Arch. Tech.
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CONSULTANTS

PRIME CONSULTANT

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MECHANICAL CONSULTANT

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Lead Electrical Designer

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END OF SECTION

Part 1 General

1.1 GENERAL INSTRUCTIONS

.1 Comply with the General Conditions, Supplementary Conditions, and all of Division 1, General Requirements.

1.2 CASH ALLOWANCES FOR SERVICES

.1 Amount of each cash allowance includes:

.1 All costs related to the services, excluding *Value Added Taxes*.

.2 Amount of each cash allowance does not include *Contractor*'s overhead and profit, and other related costs, which shall be included in the *Contract Price* and not in the cash allowance.

.3 Allow the stipulated sum of $20,000.00 for lead remediation services.

1.3 EXPENDITURE OF CASH ALLOWANCES

.1 *Owne*r, through *Consultant*, will provide *Contractor* with documentation required to permit pricing of a cash allowance item.

.2 *Owner*, through *Consultant*, may request *Contractor* to identify potential *Suppliers* or *Subcontractors*, as applicable, and to obtain at least three competitive prices for each cash allowance item.

.3 *Owner*, through *Consultant*, may request the *Contractor* to disclose originals of all bids, quotations, and other price related information received from potential *Suppliers* or *Subcontractors*.

.4 *Owner,* through *Consultant*, will determine by whom and for what amount each cash allowance item will be performed. Obtain *Owner*'s prior written approval in the form of a *Change Order* before entering into a subcontract, amending an existing subcontract, or performing own forces work included in a cash allowance. Upon issuance of the *Change Order*, the *Contractor*'s responsibilities for a cash allowance item shall be the same as for other work of the *Contract*.

.5 Refer to CCDC 2 – 2020, GC4.1.4. Where the actual cost of the Work under any cash allowance exceeds the amount of the allowance, and unexpended amounts from other cash allowance shall be reallocated, at the Consultant's direction, to cover the shortfall, and, in that case, there shall be no additional amount added to the Contract Price for overhead and project. Only where the actual cost of the Work under all cash allowances exceeds the total amount of all cash allowances shall the Contractor be compensated for the excess incurred and substantiated, plus an amount for overhead and profit on the excess only, as set out in the Contract Documents.

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Part 1 General

1.1 ADMINISTRATIVE

.1 Submit specified submittals to *Consultant* for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in the *Work*. Failure to submit in ample time is not considered sufficient reason for an extension of *Contract Time* or for *Product* substitutions or other deviations from the *Drawings* and *Specifications*.

.2 **Shop drawings are drawings, diagrams, illustrations, schedules, performance charts, brochures, Product, and other data, which the Contractor provides to illustrate details of a portion of the Work.**

.3 Identify details by reference to sheet and detail numbers shown on Contract Drawings.

.4 **Adjustments made on shop drawings by the Consultant are not intended to change the Contract Price.**

.5 Maximum sheet size 606 x 909 mm (2 ft. X 3 ft.).

.6 Where required by authorities having jurisdiction, provide submittals to such authorities for review and approval.

.7 Do not proceed with *Work* affected by a submittal until review is complete.

.8 Present *Shop Drawings*, *Product* data, and samples in SI metric imperial units. Where items or information is not produced in SI Metric imperial units, converted values are acceptable.

.9 Review submittals, provide verified field measurements where applicable, and affix *Contractor*'s review stamp prior to submission to *Consultant*. *Contractor*'s review stamp represents that necessary requirements have been determined and verified, and that the submittal has been checked and coordinated with requirements of the *Work* and *Contract Documents*.

.10 Verify field measurements and that affected adjacent work is coordinated.

.11 Submittals not meeting specified requirements will be returned with comments.

.12 Reproduction of construction *Drawings* to serve as background for *Shop Drawings* is not permitted. If construction *Drawings* are used for this purpose, remove references to *Consultant*.

.13 Do not propose Substitutions or deviations from *Contract Documents* via *Shop Drawing*, *Product* data and sample submittals.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Indicate *Products*, methods of construction, and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the *Work*.

.2 Where *Products* attach or connect to other *Products*, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross-references to *Drawings, Specifications* and other already reviewed *Shop Drawings*.

.3 Accompany submittals with a transmittal information including:

.1 Date.

.2 *Project* title and number.

.3 *Contractor*'s name and address.

.4 Identification of each submittal item and quantity.

.5 Other pertinent data.

.4 *Shop Drawing* submittals shall include:

.1 Date and revision dates.

.2 *Project* title and number.

.3 Name and address of:

.1 Subcontractor.

.2 Supplier.

.3 Manufacturer and contact person with contact information.

.4 *Contractor*'s stamp, date, and signature of *Contractor*'s authorized representative responsible for *Shop Drawing* review, indicating that each *Shop Drawing* has been reviewed for compliance with *Contract Documents* and, where applicable, that field measurements have been verified.

.5 Details of appropriate portions of the *Work* as applicable:

.1 Fabrication.

.2 Layout, showing dimensions, including identified field dimensions, and clearances.

.3 Setting or erection details.

.4 Capacities.

.5 Performance characteristics.

.6 Standards.

.7 Operating weight.

.8 Wiring diagrams.

.9 Single line and schematic diagrams.

.10 Relationships to other parts of the *Work*.

.5 Product manufacturers shall review, stamp, and initial shop drawings prior to the Consultant’s review.

.6 For sections of the work where products are specified by manufacturer’s name and product name or model number, shop drawing submissions shall be accompanied by a letter of certification prepared by the product manufacturer.

.7 The manufacturer's letter of certification shall be dated and include the following:

.1 Name of project and the Consultant's project number.

.2 Name of the Subcontractor.

.3 Name of the manufacturer's contact person with telephone number.

.4 A complete list of products, including series numbers, model numbers, and styles.

.5 Certification that the details shown on the shop drawings accurately depict the identified manufacturer's products.

.6 Certification that the Subcontractor has issued a purchase order, letter of intent, or otherwise entered into a contract with the product manufacturer.

.8 Above will only be accepted if they conform to following:

.1 Delete information, which is not applicable to project.

.2 Supplement standard information to provide additional information applicable to project.

.3 Show dimensions and clearances required.

.4 Show performance characteristics and capacities.

.5 Show wiring diagrams (when requested) and controls.

.9 *Product* data submittals shall include material safety data sheets (MSDS) for all controlled Products.

.10 Submit 2 hard copies and an electronic copy of *Shop Drawings* where specified in the technical *Specifications*.

.11 Submit 2 hard copies and an electronic copy of Product data sheets or brochures where specified in the technical *Specifications*.

.12 Where a submittal includes information not applicable to the *Work,* clearly identify applicable information and strike out non-applicable information.

.13 Supplement standard information to include details applicable to *Project*.

.14 Allow 10 *Working Days* for *Consultant*'s review of each submittal and incorporate in submittals schedule. Allow additional 2 *Working Days* where sub-*Consultant* or commissioning agent review is required.

.15 If upon *Consultant*'s review no errors or omissions are discovered, or if only minor corrections are required as indicated, submittal will be returned and fabrication or installation of *Work* may proceed.

.16 If upon *Consultant*'s review significant errors or omissions are discovered, a noted copy will be returned for correction and resubmission. Do not commence fabrication or installation. When resubmitting, notify the Consultant in writing of any other revisions other than those requested.

.17 *Consultant*'s notations on submittals are intended to ensure compliance with *Contract Documents* and are not intended to constitute a change in the *Work* requiring change to the *Contract Price* or *Contract Time*. If *Contractor* considers any *Consultant*'s notation to be a change in the *Work*, promptly notify *Consultant* in writing before proceeding with the *Work*. At not time or under any circumstances shall shop drawings be considered part of the contract documents.

.18 Resubmit corrected submittals through same procedure indicated above, before any fabrication or installation of the *Work* proceeds. When resubmitting, notify *Consultant* in writing of any revisions other than those requested by *Consultant*.

1.3 SAMPLES

.1 Submit samples for *Consultant*'s review in duplicate where specified in the technical *Specifications*. Label samples as to origin, *Project* name, and intended use.

.2 For sections of the work where shop drawings are also specified, samples shall be submitted at the same time as the shop drawings.

.3 Deliver samples prepaid to *Consultant*'s business address site office.

.4 Notify *Consultant* in writing of any deviations in samples from requirements of *Contract Documents*.

.5 Where a required colour, pattern or texture has not been specified, submit full range of available *Products* meeting other specified requirements.

.6 *Consultant* selection from samples is not intended to change the *Contract Price* or *Contract Time*. If a selection would affect the *Contract Price* or *Contract Time*, notify *Consultant* in writing prior to proceeding with the *Work*.

.7 Resubmit samples as required by *Consultant* to comply with *Contract Documents*.

.8 Reviewed and accepted samples will establish the standard against which installed *Work* will be reviewed.

1.4 COORDINATION OF SUBMISSIONS

.1 Review shop drawings, product data and samples prior to submission.

.2 Verify:

.1 Field measurements.

.2 Field construction criteria.

.3 Catalogue numbers and similar data.

.3 Coordinate each submission with requirement of work and Contract documents. Individual shop drawings will not be reviewed until all related drawings are available.

.4 Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.

.5 Contractor's responsibility for deviations in submission from requirements of Contract documents is not relieved by Consultant's review of submission, unless Consultant gives written acceptance of specified deviations.

.6 Notify Consultant, in writing at time of submission, of deviations from requirements of Contract documents.

.7 Shop drawing review:

.1 If upon review by the Consultant, no errors or omissions are discovered, the shop drawings will be marked “Reviewed”.

.2 upon review by the Consultant, only minor corrections are made, the shop drawings will be marked “Reviewed as Modified”.

.3 In both cases, described in .1 and .2 above, the copies of the shop drawings and/or product data sheets will be returned to the Contractor and fabrication and installation of the work may proceed, incorporation the Consultant’s review comments.

.4 If upon review by the Consultant, major corrections are deemed necessary or the submission is otherwise considered unsuitable, the shop drawings will be marked “Revise and Resubmit” and the submission shall be considered rejected.

.5 If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through the same procedure indicated above, shall be performed before fabrication and installation of the work may proceed.

.8 After Consultant's “final” review (as required), distribute copies. Keep one reviewed copy of each submission on site.

1.5 SUBMISSION REQUIREMENTS

.1 Submit all shop drawings for this project as a package. Partial submittals will not be accepted.

.2 Submissions shall be submitted electronically.

.1 State sizes, capacities, brand names, motor HP, accessories, materials, gauges, dimensions, and other pertinent information.

.2 List on catalog covers page numbers of submitted items.

.3 Underline applicable data.

.4 Electronic Submissions:

.1 Electronically submitted shop drawings shall be prepared as follows:

.1 Use latest software to generate PDF files of submission sheets.

.2 Scanned legible PDF sheets are acceptable. Image files are not acceptable.

.3 PDF format shall be of sufficient resolution to clearly show the finest detail.

.4 PDF page size shall be standardized for printing to letter size (8.5"x11"), portrait with no additional formatting required by the consultant. Submissions requiring larger detail sheets shall not exceed 11"x17".

.5 Submissions shall contain multiple files according to section names as they appear in Specification.

.6 File names shall include consultant project number and description of shop drawing section submitted.

.7 Each submission shall contain an index sheet listing the products submitted, indexed in the same order as they appear in the Specification. Include associated PDF file name for each section.

.8 On the shop drawing use an "electronic mark" to indicate what is being provided.

.9 **Each file shall bear an electronic representation of the "company stamp" of the contractor. If not stamped the file submission will not be reviewed.**

.2 Email submissions shall include subject line to clearly identify the consultants project number and the description of the shop drawings submitted.

.3 Electronic attachments via email shall not exceed 10MB. For submissions larger than 10MB, multiple email messages shall be used. Denote related email messages by indicating "1 of 2" and "2 of 2" in email subject line for the case of two messages.

.4 Electronic attachments via web links (URL) shall directly reference PDF files. Provide necessary access credentials within link or as username/password clearly identified within body of email message.

.5 On site provide one copy of the "reviewed" shop drawings in a binder as noted above.

.6 Contractor to print **2** copies of "reviewed" shop drawings and compile into maintenance manuals.

.3 Submissions must include:

.1 Date and revision dates.

.2 Project title and number.

.3 Name of:

.1 Contractor.

.2 Subcontractor.

.3 Supplier.

.4 Manufacturer.

.5 Separate detailer when pertinent.

.4 Identification of product or material.

.1 Relation to adjacent structure or materials.

.2 Field dimensions, clearly identified as such.

.3 Specification Section number.

.4 Applicable standards, such as CSA or CGSB numbers.

.5 Contractor's stamp, initialed or signed, certifying review of submission, verification of field measurements and compliance with Contract documents.

END OF SECTION

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Part 1 General

1.1 CONSTRUCTION SAFETY

.1 Ensure that all work is carried out in strict accordance with the latest edition of "The Occupational Health and Safety Act", asbestos on Construction Projects and in Buildings and Repair Operations (O. Reg 278/05) the Canadian Construction Safety Code, Workplace Safety and Insurance Board requirements, Municipal statutes and authorities.

.2 The Contractor and all trades shall observe and enforce construction safety measures required by the Canadian Construction Safety Code, Workplace Safety and Insurance Board and Municipal statutes. In particular, the Ontario Construction Safety Act, the regulations of the Ontario Department of Labour and Ontario Hydro Safety Requirements shall be strictly enforced. In the event of a conflict between any provisions of the above authorities the most stringent provisions will apply.

.3 The Contractor is reminded that it is he who is responsible for Occupational Health and Safety on this Project. The items listed below are only guidelines of the Owner's expectations in this regard and are not to be construed to be comprehensive or total in nature.

.1 The Owner, in concert with the contractors, will endeavour to make every effort to ensure that the contractors provide a work site which is a safe and healthy work environment. The Owner insists that all contractors and their workers are dedicated to the continuing objective of reducing risk and injury. -

.2 The Contractor covenants and agrees to comply with all statutory and other obligations, including, without limitation, the provisions of the Occupational Health and Safety Act (Ontario) and all Regulations thereto, and all amending and successor legislation, including without limitation, Bill 208 (the "Act"), in connection with all work performed by either the Contractor, Subcontractors, or any other contractor on, or in connection with, the Project.

.3 Without limiting the foregoing, for the purposes of this Contract, the Contractor agrees that he shall be the "constructor" of the Project within the meaning of the Act, and as such, shall assume all the obligations and responsibilities, and observe all construction safety requirements and procedures, and duties of inspection imposed by the Act on the "constructor" as therein defined, for all work and services performed by the Contractor, Subcontractors and other contractors on or in connection with the Project.

.4 The Contractor further covenants and agrees that the Owner and its existing and former officers, trustees, employees and agents, and their respective heirs, executors, administrators, successors and assigns shall be released from *any* obligations or liabilities otherwise imposed on the Owner, or on any of them, pursuant to the Act in connection with the Project, and that the Contractor shall assume all liability and responsibility in connection with same.

.5 The Contractor agrees to save harmless and indemnify the Owner from any losses, damages, costs and expenses of any kind, or nature whatsoever, including all legal- expenses, and all defence costs and related expert or consulting fees, incurred by the Owner, or *any* of them, arising in connection with the failure, default, or inability of the Contractor or the Owner, or any of them, to comply with any of the aforementioned statutory, or other legal requirements, or arising in connection with any breach by the Contractor of any of its covenants, agreements and obligations under this Contract.

.6 The Contractor shall inform and instruct other contractors that they, while performing work on this project, are under the authority of the Contractor. Other contractors are to discuss and co-ordinate with, and follow instructions from, the Contractor on all matters of site access, vehicles, deliveries, storage, temporary facilities, coordination with the work of other Subcontractors, work methods, scheduling, labour conditions, construction safety, environmental protection, security and all other matters which relate to the safe and proper execution of construction work.

.7 The Contractor shall ensure that all supervisory personnel on the job site are fully aware of the procedures and requirements outlined above and comply with all requirements specified.

.8 All contractors are responsible to ensure that all machinery and equipment is safe and that the workers perform their tasks in compliance with established safe work practices or procedures. Workers must receive adequate training in their specific work tasks to protect their health and safety.

.9 The Contractor shall be responsible for all persons and companies performing work, including other contractors, on this project, at all times, up to and including, the date of Substantial Performance of the Work. Authority for coordination and instruction relating to all matters which relate to the safe and proper execution of construction work shall rest with the Contractor. The Contract Price must include the Contractor's fees for the coordination and supervision of the work of all other contractors.

.10 In addition to the responsibility of all contractors as outlined above, Subcontractors will be held accountable for the health and safety of workers under their supervision.

.11 Workers shall protect their own health and safety by working in compliance with the law and with safe work practices and procedures established by the authorities having jurisdiction.

.12 All sections of the Occupational Health and Safety Act for Industrial Establishments, latest edition, and the Occupational Health and Safety Act for Construction Projects, latest edition, shall be enforced, by the Contractor, in their entirety, throughout the duration of the construction project.

.13 The Contractor shall provide the Consultant with the telephone number where the Contractor or his representative can be reached at any time, day or night, for the duration of the Contract.

.14 Where an accident, explosion, or fire causes a personal injury at the work place, and the worker is disabled from performing the usual task, the Contractor shall prepare a written notice and shall forward same to the Ministry of Labour within four days of the occurrence with a copy to the Owner's Representative.

.15 Where a person is killed or critically injured from any cause at the work place, the Contractor shall immediately call the Ministry of Labour. A written notice from the Contractor shall be given to the Ministry of Labour within forty-eight hours after the occurrence, containing such information and particulars as may be prescribed, with copies to the Consultant and the Owner's Representative.

.16 Following the call to the Ministry of Labour, promptly inform the Consultant.

.17 The Contractor is advised that the accident scene is under the jurisdiction of the Ministry of Labour and no wreckage, articles, etc., shall be interfered with, disturbed, destroyed, altered or carried away at the scene, or connected with the occurrence, until the Ministry of Labour has given permission.

.4 The Consultant shall have the authority to halt work if, in his opinion, it is not being performed safely. His specific approval must be obtained before starting the following types of work:

.1 The use of explosive powered tools - these will not be permitted under any circumstance unless equipped with a device which positively prevents free flight of the stud.

.2 The use of a portable crane, derrick, power shovel or similar equipment which might possibly involve hazard due to overhead services, particularly power lines.

.3 Excavation, or piercing the ground by stakes, posts, hammer points or other equipment which might involve disturbance to underground services.

1.2 REPORTING REQUIREMENTS

.1 If any claim is made by anyone against the Contractor or Subcontractor on account of any accident, the Contractor shall promptly report the facts in writing to the Consultant giving full details of the claim.

1.3 FIRST AID FACILITIES

.1 Provide at the site the equipment and medical facilities necessary to supply first-aid service to anyone who may be injured in connection with the Work, and to conform to the requirements of the authorities having jurisdiction over the Work.

1.4 FIRE SAFETY REQUIREMENTS

.1 Comply with requirements of standard for Building Construction Operations FCC No.301, issued by Fire Commissioner of Canada.

.2 This standard may be viewed at Regional Engineer's office and copies may be obtained from:

Ontario Fire Marshall
5775 Yonge Street, 7th Floor
North York , ON M2M 4J1
Tel: 416-325-3100

.3 The appropriate clauses of the National Building Code relating to fire protection shall be strictly followed - refer to Part 8.

.4 Provide sufficient temporary standpipes and connections, fire hose, valves, temporary cabinets, extinguishers, etc. to comply with the requirements of the governing Municipal and Provincial authorities.

.5 Make necessary adjustments and modifications to temporary fire protection as required during progress of the work. Remove such temporary work when permanent system is installed and operating.

.6 Provide and maintain free access to any temporary or permanent fire hydrants, acceptable to local fire department. Provide and maintain adequate portable fire extinguishers in the building until sprinkler system is in operation.

.7 Keep all designated fire routes clear of construction materials, debris and vehicles.

.8 Maintain fire protection continuously. Store paints and volatile substances in a separate and controlled location and inspect frequently. Inspect temporary wiring, drop cords and extension cables for defective insulation or connections frequently. Remove combustible wastes frequently. Prohibit smoking in areas where volatile and flammable substances are used.

1.5 OVERLOADING

.1 Ensure no part of Work is subjected to a load, which exceeds the design live loads shown on the structural drawings. Ensure that scaffolding and false work are not overloaded. Do not cut load bearing members without approval of Consultant.

1.6 FALSEWORK

.1 Design and construct falsework in accordance with CSA S269.1, latest version.

1.7 VISITORS

.1 Ensure that all visitors are aware of the hazards on site prior to entering the work area and where necessary ensure that all visitors are "Working At Heights” Certified".

1.8 SIGNAGE

.1 Provide signage indicating " Danger - Keep Out", "Hard Hats must be worn at all times", "Safety Shoes must be worn at all times", "No Trespassing", etc., mounted on all sides of work areas and additional signs as necessary to adequately warn the public and workmen of the inherent dangers of the site and requirements to maintain personal safety.

1.9 JOINT HEALTH AND SAFETY COMMITTEE & "COMPETENT SAFETY PERSON"

.1 The Contractor shall be responsible for the establishment and operation of the Joint Health and Safety Committee as required by the Occupation Health and Safety Act.

.2 The Contractor shall assign a "Competent Safety Person" to assist the site superintendent in the discharging of safety responsibility. A "Competent Safety Person" shall be defined as a person who is knowledgeable in all aspects of documents identified in Item 1.1.1 above.

.3 The "Competent Safety Person" will be responsible for liaison with Board Staff and Trades to ensure occupant safety is maintained at all times.

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Part 1 General

1.1 RELATED WORK

.1 These specifications apply to all 16 divisions of the project specification. It is the responsibility of the contractor to apply these provisions wherever practical within specification limits to all products and services used on this project.

.2 Recognized that currently specified materials and methods may conflict with the basic intention of this section. Where reasonable alternate materials and methods exist that are not specified here, and that do not compromise quality or create additional cost for the owner, notify the Consultant of such alternate materials or methods. Do not proceed to use alternate materials or methods to those specified without the express approval of the Consultant.

.3 Elsewhere, apply the provisions of this section to all work. Exceptions can only be made when signed off by the Consultant. Suitability of all products used is the responsibility of the contractor.

1.2 COMPLIANCE SPECIFICATION

.1 The contractor must comply with all applicable health, safety and environmental regulations.

1.3 BEYOND COMPLIANCE SPECIFICATIONS

.1 These specifications apply in addition to all applicable health, safety and environmental compliance regulations. They are incorporated here to reflect the Owner's intention to develop a specification, which maximizes environmentally "friendly" materials and methods wherever possible within current technical and budget limitations.

.2 Beyond compliance specifications recognize that performance well beyond the minimum regulatory standard is often desirable, possible and affordable, often with no cost or low cost options. It also recognizes that application methods or protocols may be as important as the material specified. Therefore these specifications cover both material and methods.

.3 The primary goal of beyond compliance specification is to reduce the use of products or methods, which have negative health and environmental impacts both during and after construction. These considerations may include full life cycle impacts, associated with raw materials, manufacturing, transport, deconstruction and their eventual fate.

.4 These specifications will specifically address primary categories of readily identifiable products, ingredients and methods.

.5 These provisions apply to both indoor and outdoor applications equally.

1.4 EXCEPTIONS

.1 These specifications recognize that not all substitutes are equal and therefore exceptions can be made based on substantive evidence of necessary and superior performance. Special considerations may be given to restricted substances when secondary provisions are made such as sealed in place (contained) applications. All such exceptions must be approved in writing by the Consultant.

Part 2 Materials

2.1 PRODUCTS OR SUBSTANCES TO BE AVOIDED OR LIMITED IN USE

.1 No product containing the following substances may be used on this project when an equivalent product without or with a lower concentration of this substance is suitable and available. All products containing substances which are known to cause health effects including but not limited to cancer, mutagenic, neurological, or behavioral effects should be avoided if suitable substitutes not containing or containing lower concentrations are available. This provision shall be limited to information contained on Material Safety Data Sheets, therefore MSDS sheets must be reviewed for all products for which such sheets are required. Applications for exceptions must be accompanied by related MSDS and product application and performance sheets, clearly showing a need for the exception.

2.2 PLASTICIZERS

.1 Plasticizers which off-gas (low molecular weight) should be avoided.

2.3 MAN MADE MINERAL FIBRES

.1 Products containing mineral fibres, which can be emitted or abraded should be avoided.

Examples: duct liner, mineral fibre ceiling tiles, etc.

2.4 RADIATION

.1 Products or methods which result in the lowest emission of Electro Magnetic Fields are preferred.

2.5 HEAVY METALS

.1 Heavy metals such as lead, cadmium, mercury etc, should be avoided.

2.6 ALUMINUM

.1 Raw aluminum should be avoided, anodized or factory painted aluminum is acceptable. This is particularly applicable to surfaces which people can touch.

2.7 OZONE DEPLETING SUBSTANCES

.1 Products which contain or which use Ozone Depleting Substances such as Bromide, Chlorofluorocarbons (CFC) or Hydrofluorocarbons (HFC) etc. should be avoided if suitable substitutes are available.

2.8 GREENHOUSE GASES

.1 Products which contain, use or generate Greenhouse gasses such as CO2 should be avoided if suitable substitutes are available.

2.9 BITUMINOUS (tar) PRODUCTS

.1 Products containing tar compounds should not be used if suitable substitutes are available.

2.10 CHEMICAL COMPOUNDS

.1 Products containing the following chemical compounds should not be used if suitable substitutes are available: Neoprene, Latex, Butyl, ABS, Formaldehyde.

2.11 ADHESIVES

.1 Adhesives containing solvents or other non preferred ingredients should be avoided if suitable substitutes are available, including systems designs which do not need adhesives or can use mechanical etc. fastening alternatives

2.12 COMPOSITE PRODUCTS

.1 Some composite products contain adhesives such as formaldehyde, which are not preferred, and some composites such as Fibre Reinforced Plastics are not practical for recycling. These products should be avoided if suitable substitutes are available.

2.13 CLEANERS AND SOLVENTS

.1 Products, equipment, and methods, which require the use of cleaners and solvents, are not preferred if suitable substitutes are available. Examples of preferred products would include No Wax floors, or primerless caulks and adhesives, or products not requiring caulks and adhesives.

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Part 1 General

1.1 SUMMARY

.1 Except where otherwise specified in technical *Specifications* or otherwise indicated on *Drawings*, comply with requirements of this Section.

1.2 MANUFACTURER'S INSTRUCTIONS

.1 Install, erect, or apply *Products* in strict accordance with manufacturer's instructions.

.2 Notify *Consultant*, in writing, of conflicts between *Contract Documents* and manufacturer's instructions where, in *Contractor*'s opinion, conformance with *Contract Documents* instead of the manufacturer's instructions may be detrimental to the *Work* or may jeopardize the manufacturer's warranty.

.3 Do not rely on labels or enclosures provided with *Products*. Obtain written instructions directly from manufacturers.

.4 Provide manufacturer's representatives with access to the *Work* at all times. Render assistance and facilities for such access so that manufacturer's representatives may properly perform their responsibilities.

1.3 CONCEALMENT

.1 Conceal pipes, ducts, and wiring in floors, walls and ceilings in finished areas:

.1 after review by *Consultant* and authority having jurisdiction, and

.2 where locations differ from those shown on *Drawings*, after recording actual locations on as-built drawings.

.2 Provide incidental furring or other enclosures as required.

.3 Notify *Consultant* in writing of interferences before installation.

1.4 FASTENINGS - GENERAL

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

.2 Prevent electrolytic action and corrosion between dissimilar metals and materials by using suitable non-metallic strips, washers, sleeves, or other permanent separators to avoid direct contact.

.3 Use non-corrosive fasteners and anchors for securing exterior work and in spaces where high humidity levels are anticipated.

.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage.

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

.6 Do not use fastenings or fastening methods that may cause spalling or cracking of material to which anchorage is made.

1.5 FASTENINGS - EQUIPMENT

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

.2 Bolts shall not project more than one diameter beyond nuts.

1.6 FIRE RATED ASSEMBLIES

.1 When penetrating fire rated walls, ceiling, or floor assemblies, completely seal voids with fire-stopping materials, smoke seals, or both, in full thickness of the construction element as required to maintain the integrity of the fire rated assembly.

1.7 LOCATION OF FIXTURES, OUTLETS AND DEVICES

.1 Consider location of fixtures, outlets, and devices indicated on *Drawings* as approximate.

.2 Locate fixtures, outlets, and devices to provide minimum interference, maximum usable space, and as required to meet safety, access, maintenance, acoustic, and regulatory, including barrier free, requirements.

.3 Promptly notify *Consultant* in writing of conflicting installation requirements for fixtures, outlets, and devices. If requested, indicate proposed locations and obtain approval for actual locations.

1.8 PROTECTION OF COMPLETED WORK AND WORK IN PROGRESS

.1 Adequately protect parts of the *Work* completed and in progress from any kind of damage.

.2 Promptly remove, replace, clean, or repair, as directed by *Consultant,* work damaged as a result of inadequate protection.

.3 Do not load or permit to be loaded any part of the *Work* with a weight or force that will endanger the safety or integrity of the *Work*.

1.9 REMEDIAL WORK

.1 Notify *Consultant* of, and perform remedial work required to, repair or replace defective or unacceptable work. Ensure that properly qualified workers perform remedial work. Coordinate adjacent affected work as required.

END OF SECTION

Part 1 General

1.1 CONTRACT REQUIREMENTS

.1 This Section contains Articles prepared which represent the Owner's standards and policies. In all cases this Section is intended to be read in conjunction with and to coordinate with all other Sections. In the case of discrepancy between this Section and other Sections to more stringent Articles of any applicable Section shall apply.

1.2 SUPERVISION

.1 Employ an experienced and qualified supervisor who shall be in complete charge of the Work from commencement to final completion of the Work and who shall be present at the site whenever work is being carried out. A working foreperson will not be acceptable. The supervisor shall not be changed after commencement of work without the Consultant's approval.

.2 Supervise, direct, manage and control the work of all forces carrying out the Work, including subcontractors and suppliers. Carry out daily inspections to ensure compliance with the Contract Documents and the maintenance of quality standards. Ensure that the supervisory staff includes personnel competent in supervising all Sections of Work required.

.3 Arrange for sufficient number of qualified assistants to the supervisor as required for the proper and efficient execution of the Work.

.4 The owner reserves the right and option to have the contractor remove and replace any supervisor, at no additional cost to the owner, whom the owner feels is not qualified to perform the duties required under this contract.

1.3 CRIMINAL BACKGROUND CHECK

.1 If requested, the prime contractor and associated sub-contractors shall provide the owner with a criminal background check covering offences under the Criminal Code, the Narcotics Control Act and any other offences which would be revealed by search of the automated Criminal Records Retrieval System maintained by the RCMP ("Criminal Background Check"), together with an Offence Declaration in an Owner's approved form for every individual, or employee of the contractor's who will be on site. For the purposes of this contract, the Owner shall determine in its sole and unfettered discretion whether an individual or employee of the Contractor may come into contact with occupants. All fees for these checks shall be borne by the contractor.

1.4 GENERAL INSTRUCTIONS

.1 The Mechanical Contractor shall be the prime Contractor for this project.

.2 Construct the Work under a single, lump sum, Stipulated Contract.

.3 The term Contractor in this section refers to the prime Contractor for this project.

1.5 ADMINISTRATION

.1 Contractor to arrange and schedule a pre-construction meeting four weeks prior to commencement of work. Present at meeting shall be:

.1 Prime contractor.

.2 Owner representative.

.3 Staff.

.4 Consultants.

.5 All trades.

.2 Schedule and administer project meetings throughout the progress of the Work. Such meetings shall be held every two weeks, or more frequently if required to maintain project schedule.

.3 Distribute written notice of each meeting four days in advance of meeting date to Consultant and Owner.

.4 Provide physical space and make arrangements for meetings.

.5 Record the minutes. Include significant proceedings and decisions. Identify parties requiring action in right column of minute page.

.6 Reproduce and distribute copies of minutes within three days after each meeting and transmit to meeting participants, affected parties not in attendance, the Consultant and the Owner.

1.6 RELATIONS OF TRADES

.1 The Contract Specifications have been generally divided into trade sections for the purpose of ready reference.

.2 The Contractor is responsible for coordinating all trades. He is solely responsible for determining the lines of demarcation between Contractor and/or trades. Neither the Consultant nor the Owner, assumes any responsibility for any such determination or for any dispute arising concerning it. No extras will be considered due to any such dispute concerning either labour or materials.

.3 Specifications and drawings form an integral part of the Contract Documents. Any subject or item omitted from one, but which is mentioned or reasonably implied in the other shall be considered as properly and sufficiently specified and will be part of the Work.

1.7 ADDITIONAL DRAWINGS

.1 Consultant may furnish additional drawings to assist proper execution of the Work. These drawings will be issued for clarification only. Such drawings, however, shall have the same meaning and intent as if they were included with plans referred to in the Contract Documents.

1.8 EXISTING SITE CONDITIONS

.1 Exterior site work is not applicable.

.2 Locate all refuse bins in areas approved by the consultant and Owner's staff. Bins are not to interfere with playground areas parking or vehicle circulation and at the discretion of the Owner, may require construction fencing surrounding bins for safety during building's occupied hours.

1.9 TEMPORARY CONSTRUCTION FENCING

.1 Refer to Temporary Protection.

1.10 BYLAWS, PERMITS AND APPROVALS

.1 Nothing indicated on the Drawings or Specifications is intended to be in conflict with any law, by-law or regulation of Municipal, Provincial, or similar Authority Having Jurisdiction.

.2 Work of this Contract must conform with such laws, by-laws and/or regulations. Any required variation to, or deviation from, the drawings and specifications, shall be performed in accordance with the Contract.

.3 Furnish inspection certificates and/or permits as may be applicable as evidence that the installed Work conforms with laws, by-laws and regulations of Authorities Having Jurisdiction.

.4 Each subtrade shall obtain and pay for all permits and licenses required by Municipal, Provincial, or other authorities Having Jurisdiction, particular to their trade.

1.11 ORGANIZATION

.1 Organize the Work of each section as required for satisfactory and expeditious completion of the Work. Take field dimensions required for the Work. Fabricate and install work to suit field dimensions and conditions.

.2 If applicable, take into account existing work to ensure best arrangements of components in available space. Contact the Consultant prior to commencing Work in critical locations and interface with other Contractors' Work.

.3 Provide all forms, templates, anchors, sleeves, inserts and accessories required to be installed in the Work. Set in place or instruct the applicable subtrade as to their location. Pay costs of extra work, if required, as a result of a failure to comply with these requirements at the proper time.

.4 Before starting their work and from time to time as the work progresses, each Subcontractor shall examine the work and materials installed by the other Subcontractors insofar as it effects their own work, and the Contractor shall promptly notify the Consultant IN WRITING, if any condition exists that will prevent any Subcontractor from giving a satisfactory result in their own work.

.5 Should any Subcontractor start their own work without such notification, it shall be construed as an acceptance by him of all preceding work and as a waiver of all claims or questions as to its suitability for receiving their work.

1.12 CANADIAN PRODUCTS AND LOCAL LABOUR

.1 To the extent that the same are available and consistent with the proper economy and expeditious completion of the Contract, Canadian equipment, materials, products and other such applicable items are preferred by the Owner to be used in the Work, wherever possible and practical.

1.13 MATERIALS AND WORKMANSHIP

.1 All materials shall be new and the best of their respective kinds, where a specific grade or brand is not indicated. Pre-packaged materials shall be delivered and stored in unopened containers.

.2 All work performed under this Contract shall be done by three (3) competent persons skilled in their respective trades. They shall make use of such templates, jigs or special tools as may be required for the operation involved.

.3 The acceptance of any materials or workmanship shall not be a bar to their subsequent rejection, if found defective.

.4 Adequate, dry storage facilities shall be provided, and all stored materials shall be protected from damage and theft.

.5 All Contractors will do Work in accordance with the best industry practice of the type of work specified, unless the Contract Documents stipulate more precise requirements, in which case, the more precise requirements shall govern.

.6 Do Work in a neat, plumb & square manner. Ensure that various work components are properly installed, forming tight joints and appropriately aligned junctions, edges and surfaces, free of warps, twists, waves, or other such irregularities.

.7 Wherever indicated on the drawings or specifications, or in the manufacturers' / suppliers' written instructions, arrange to have manufacturers' / installer's representatives inspect the Work which incorporates their materials, products or items.

.8 Do not permit materials to come in contact with other materials such conditions may result in corrosion, staining, discolouration or deterioration of the completed Work. Provide compatible, durable separators where such contact is unavoidable.

.9 The design of the Work is based on the full interaction of its component parts. No provisions have been made for conditions occurring during construction. Ensure that no part of the Work is subjected to a load which will endanger its safety, or which might cause permanent deformation.

.10 Conceal pipes, ducts, conduit, wiring and other such items requiring concealment preferably in, wall or ceiling construction of all finished areas. If in doubt as to method of concealment, or intent of the Contract Documents in this regard, request clarification from the Consultant before proceeding with the Work.

.11 Lay out mechanical and electrical work well in advance of concrete placement and furring installation to allow for proper concealment. Test and inspect Work before applying pipe covering and before it is concealed.

.12 Provide and maintain control lines and levels required for the Work. Lay out the Work in accordance with these lines and levels and dimensions indicated on the drawings.

.13 Verify lines, levels and dimensions and report any errors or inconsistencies on the drawings to the Consultants.

.14 Final responsibility of satisfactory completion of all the Work, however, lies with the Contractor.

1.14 QUALITY CONTROL

.1 The Consultants and authorized Owners staff shall have access to all areas of the Work, including any off site construction facilities.

.2 The Contractor shall give timely notice requesting inspection if Work is designated for special tests, inspections, or approvals by the Consultants, or any other authorized Owners staff, or testing and inspection company.

.3 If the General Contract covers or permits to be covered Work that has been designated as outlined above, he shall uncover such work, have the inspections and tests satisfactorily completed and make good such work at no additional cost to the Owner.

.4 *The Consultants or the authorized Owners Staff may order any part of the Work to be examined, if such Work is suspected not to be according to the Contract Documents. If, upon examination, such work is found not to be in accordance with the Contract Documents, then the Contractor shall correct such Work and pay for cost of examinations and correction. If such Work is found to be in full accordance with the Contract Documents, the Owner shall pay for the cost of examination and making good.*

.5 If defects are revealed during inspection and/or testing, the appointed agency may request additional inspection and/or testing to ascertain the full degree of defects. The Contractor shall correct the defects and irregularities as reported by the inspection and/or testing agency, at no additional cost to the Owner and the Contractor shall pay all associated costs for retesting and re-inspection.

.6 The Contractor shall provide any tools, materials or equipment that may be required by the inspection and/or testing agencies in retesting the Work. (e.g., Video camera rental to re-inspect incorrectly installed sewer lines, if applicable).

.7 The employment of inspection and/or testing agencies does not, in any way, affect the Contractor's responsibility to perform the Work in strict accordance with the Contract Documents.

.8 The Contractor shall remove all defective work, whether the result of poor workmanship by themselves or their sub-trades, use of defective or damaged products, whether or not incorporated into the Work and any Work that has been rejected by the Consultants or authorized Owners Staff as failing to conform to the Contract Documents. Replacement and execution of the affected Work shall be done in full accordance with the Contract Documents, making good other trades' work damaged by such removals or replacements at no additional charge to the Owner.

.9 If, in the opinion of the Consultant and/or the authorized Owner's Staff, it is not expeditious to correct the defective Work, or Work not performed in accordance with the Contract Documents, the Owner, may, at its sole discretion, deduct from the Contract Price, the difference in value between the work performed and that required by the Contract Documents, the amounts of which shall be determined by the Owner.

.10 The notable exception to the above item is a faulty installation of base and asphalt paving. If, the inspection agency, after performing random test holes to determine compaction and thickness of sub base, base and asphalt, determines that either one or both, are not according to what was specified in the Contract Documents, the Owner will not accept credits for such inconsistencies but rather, demand that any such installation be removed and redone in its entirety, at the pleasure and convenience of the Owner, but within the first year of the warranty period.

1.15 OVERTIME

.1 The Contractor must include in their Total Stipulated Tender Price, all costs for overtime work which may be necessary to complete the various portions of the Work, in accordance with the Completion Dates specified in the *Form of Tender.*

.2 The Owner shall not entertain requests for any payments in connection with overtime work that may be required by the Contractor, or any of their sub-trades, in order to comply with the above referenced dates.

1.16 SCAFFOLDING

.1 All necessary scaffolding shall be provided and constructed according to all by-laws and safety regulations. It shall be removed promptly and completely when no longer required

1.17 PROTECTION OF OTHER WORK

.1 Each trade shall avoid damage to other trades and shall take all measures necessary and provide all masking and materials necessary, to provide adequate protection.

.2 Each Subcontractor shall be held responsible for all damage to work installed by others that is caused by this work or by anyone employed by him.

.3 Patching and repairing of damaged work shall be done by the Contractor who installed the work, as directed by the Consultant, but the cost of same, shall be paid for by the Contractor who is responsible for the damage.

1.18 FASTENINGS

.1 All fastenings must be permanent, of same metal, or compatible with any metals with which they are in contact, of adequate size and spacing, to ensure permanent anchorage against load or shear.

.2 Exposed fastenings must be evenly spaced, neatly laid out and must not mar surfaces of prefinished materials.

.3 No ram setting or similar techniques will be permitted, without prior written approval of the Consultant.

1.19 SUPPLY AND INSTALL

.1 Unless specifically noted, "*supply only*", any reference to supply intends the **supply and installation** of material or item so noted.

1.20 RENOVATIONS TO AN EXISTING OCCUPIED BUILDING

.1 For this project, construction hours will be restricted to the hours between 6 p.m. and 6 a.m. on all days where the building is operating **with students attending classes.**

.2 All access to the operating building will be made after hours or on weekends in coordination with the owner's staff.

.3 Connection of any services must be made after hours and in such a way that it leaves no disturbance to materials or systems, nor any exposed construction conditions within the operating building's area.

.4 If at any time, equipment of materials must be delivered to the site during occupied hours, and if approval of the owner's staff is received, the Contractor shall designate a full time Flag person to control construction traffic for the duration of any traffic or delivery related activities.

.5 The Contractor shall maintain construction fencing at all times.

.6 **Catering trucks are not permitted on the site whatsoever.**

.7 Contractor shall minimize nuisances to the facility's operation such as noise, dust, odours. Due to noxious fumes, roofing shall be done after hours (after 4:00 p.m., or during the weekends). Refer also to other specification sections.

.8 **During each daily work period, it will be the contractor's responsibility to carefully move, cover for protection or otherwise relocate all furniture out of the work area to suit their requirements. Daily communication with the staff is mandatory in this regard. Prior to 7 a.m. each day, the contractor shall replace all furniture to its original location ensuring the room and all furniture and equipment is in clean, fully functional condition. Again, each morning at the start of the facility's day, the Contractor's site superintendent will check with staff regarding the acceptability of the conditions as left by the contractor**.

1.21 SEQUENCE OF CONSTRUCTION

.1 At the outset of the construction period the contractor shall present and review with the consultants and Owner a detailed schedule of work and planned sequence of operations.

.2 The contractor shall regard and abide by the hours of construction as indicated and have regard for the ***sequence of work*** areas as indicated on the drawings.

.3 The contractor shall present and require approval of their work sequence prior to start of construction.

1.22 GENERAL REQUIREMENTS

.1 All Contractors shall examine carefully all drawings and specifications to inform themselves fully of all conditions and limitations pertaining to the work of the contract.

.2 All Contractors shall co-operate and co-ordinate their work for the proper completion of the work, including co-ordination of delivery dates and commencement of sub-trades work.

.3 The responsibility for all work, including temporary structures, shoring and erection shall at all times rest with the Contractor and their Subcontractors. The Consultant will review construction methods and shop drawings for general arrangements only. The method of obtaining the results contemplated by the Contract Documents shall be determined by the Contractor.

.4 The undertaking of period site review by the Consultant or Owner Representative shall not be construed as supervision of actual construction, nor make them responsible for providing a safe place for work, visit, use, access, travel, or occupancy of the Consultant's or Owner's employees or agents.

.5 The Contractor shall be fully responsible for coordinating and expediting the work of all Subcontractors and shall employ the necessary and qualified personnel to provide the required quality of labour and materials and to prevent delays in the progress of the project. Each trade shall be afforded all reasonable opportunities for the installation of its work and for the storage and handling of its materials.

1.23 COORDINATION

.1 The Contractor shall coordinate all work and preparation on which subsequent work depends to facilitate mutual progress, and to prevent any conflict.

.2 The Contractor shall ensure that each trade makes known, for the information of the Contractor and other trades, the environmental and surface conditions required for the execution of its work; and that each trade makes known the sequence of others' work required for installation of its work.

.3 The Contractor shall ensure that each trade, before commencing work, knows the requirements for subsequent work and that each trade is assisted in the execution of its preparatory work by trades whose work depends upon it.

.4 The Contractor shall ensure that shop and layout drawings, templates, and all information necessary for the location and installation of materials, openings, inserts, anchors, accessories, fastenings, connections and access panels are provided by each trade whose work requires cooperative location and installation by other trades and that such information is communicated to the applicable installer.

.5 The Contractor shall ensure that delivery of materials supplied by one trade to be installed by another is well before the installation begins.

.6 The Contractor shall inform all trades that giving installation information in error, or too late to incorporate in the work, shall be responsible for any extra work caused thereby.

1.24 ACCESS TO THE PROJECT

.1 The Contractor for this Work shall, at all times allow Owner, or any other Owner commissioned contractor or their employees, access into the building or around the premises, undisturbed, whether union or non-union, as may be required in the execution of other portions of the building work and installation of equipment, etc.

.2 The Contractor shall cooperate fully with any and all owners commissioned Contractors.

.3 The Contractor must obtain the keys from the Board office for use during the project. A cash deposit is required for each set of keys and codes. Deposit will be refunded when keys are returned.

1.25 SUBTRADE AWARD

.1 The Contractor shall, on notice of award of the contract, obtain the Consultants approval of a complete list of all persons or firms to which he proposes to sublet any part of the work, the trades or divisions of work which are to be sublet to each, and the amount of each trade. The Contractor shall provide to the Consultant a financial breakdown showing all divisions of the work amounting to the full sum of the contract. Mechanical and Electrical trades shall be further broken down as specified in Mechanical and Electrical Divisions.

1.26 SAFETY DATA SHEETS

.1 Contractors shall comply with WHMIS requirements in accordance with the Occupational Health and Safety Act (Ontario). Before commencement of work and during the full term of the Contract, the Contractor shall provide a list with current MSDS for all hazardous materials proposed for use on the Project. The Contractor shall label hazardous materials used and/or supplied on the Project in accordance with WHMIS requirements. The Contractor shall conform to the Environmental Protection Act for disposal and clean-up requirements. The Contractor shall obtain from the Owner, where applicable, a list and MSDS of hazardous materials that may be handled, stored or used by Owner's employees and/or other contractors retained by the Owner at the location where work of this Contract will be performed. The Contractor shall ensure that those who handle and/or are exposed to, or are likely to handle or to be exposed to hazardous materials, are fully instructed and trained in accordance with WHMIS requirements.

.2 The Contractor shall provide Material Safety Data Sheets for all WHMIS regulated products brought into the building, provide WHMIS training for specific regulated products to any building staff who will be working in the proximity of or who may be exposed to the product.

.3 The Contractor shall ensure that the following material and safety data sheets are submitted prior to commencing installation and application of at least the following:

Lead-free solder	sealants and caulking
resilient flooring	painting and finishing
fertilizers	glues and adhesives
pesticides	herbicides

any other product which may give off air borne particles after installation.

.4 The Contractor and all of their Subcontractors must note that specifically, Asbestos and Asbestos containing materials, solder for piping containing lead, and Painting & Coatings containing lead and/or mercury must be excluded from any part of the Work.

.5 The Contractor must submit Certificates of Compliance, prior to the application for Substantial performance, for each of the following items:

.1 An affidavit relative to the use of Lead-free solder for all domestic water lines, regardless of location.

.2 Products for which Material Safety Data Sheets have been submitted and accepted.

.3 Other Work/Products identified in the Contract Documents as requiring a Certificate of Compliance.

.6 Each Certificate of Compliance must indicate names and addresses of the project, the Owner, the date of Issue, produce description including name, number, manufacturer, with a statement verifying that the Work/Product installed meets specified requirements and, if applicable, complies with the submitted and accepted Material Safety Data Sheets.

.7 Each Certificate of Compliance must be issued on the trade's letterhead, properly executed, under whose work the respective Work/Product has been provided.

.8 Each Certificate of Compliance must be endorsed by the Contractor with their authorized stamp/signature.

1.27 REGULATING DOCUMENTS

.1 The Contractor and all of their Subcontractors, Suppliers/Installers etc, must conform to the Ontario Building Code, Canadian Electrical Code (CEC). CAN3-B44 and CAN3-W59, The Occupational Health and Safety Act, Ontario, 1990 (Bill 208), the National Fire Code, the local Municipal Fire Code, and all other applicable Codes and Building Bylaws. All must also conform to the requirements of the Authorities Having Jurisdiction, such as Public Utilities. Where required under the Occupational Health and Safety Act, engage a Professional Engineer to design formwork and falsework for concrete.

.2 Contract forms, codes, standards and manuals referred to in these specifications are the latest published editions at the date of close of tenders. The Contractor and all of their Subcontractors, Suppliers/Installers must meet or exceed the requirements of specified standards.

.3 Provide, on site, copies of documents referred to in the Specification for joint use of Contractor and Consultant.

1.28 PRIME CONTRACTOR'S RESPONSIBILITIES

The list of Contractor's responsibilities identified below is by no means comprehensive, nor is it in any priority or critical order. It is here, merely to identify the most often forgotten or ignored responsibilities of the Contractor and is reproduced only as a reminder. The Consultants and the Owner advise the Contractor that it is they who are responsible for all aspects and facets of the Project, from start to completion, from compliance with Occupational Health and Safety regulations to compliance with all codes and statutes.

.1 The Contractor will be responsible to take all necessary steps to protect personnel (workers, visitors, general public, etc.) and property from any harm during the course of the contract.

.2 All equipment shall be in safe operating condition and appropriate to the task.

.3 Only competent personnel will be permitted on site. During the site introduction, *only the Consultant* will determine who is competent. The Contractor will cause to remove from the site any persons not observing or complying with safety requirements.

.4 The Contractor shall comply with, and shall ensure that all of their Subcontractors, Suppliers, Installers etc., comply with all Federal, Provincial and Municipal Safety Codes and Regulations and the Occupational Health and Safety Act.

.5 The Contractor shall supply competent personnel to implement their safety program and ensure that all Subcontractors comply with the Owner's standards, and those of the Occupational Health and Safety Act.

.6 The Owner will provide periodic monitoring to ensure that safety requirements are met, and that safety records are properly kept and maintained. Continued disregard for safety standards can cause the Contract to be canceled and the Contractor removed from the site.

.7 The Owner may hire Commissioners to perform inspections of building systems at the closing stages of the work of this contract. If so contracted and identified in the *Instructions to Bidders*, the Contractor shall cooperate with and coordinate the work of the Owners Commissioners on site.

.8 The Contractor will report to the Owner and Jurisdictional Authorities any accident or incident involving personnel and/or property of the Contractor, Owner, or Public, arising from the Contractor's or any of their Subcontractors' execution of the work.

.9 The Contractor will include all provisions of this contract in any agreement with Subcontractors, and hold them equally responsible for safe work performance.

.10 If the Contractor is responsible for a delay in the progress of the work due to an infraction of legislation or Owner Health and Safety requirements, the Contractor will, without additional cost to the Owner, work such overtime, and acquire and use for the execution of the work such additional labour and equipment as to be necessary in the sole opinion of the Owner's Representative and Consultant, to avoid delay in the final completion of the work or any operations thereof.

1.29 MANUFACTURERS' INSTRUCTIONS

.1 Unless otherwise specified, the Contractor and all their Subcontractors shall comply with manufacturer's latest printed instructions for materials and installation methods.

.2 The Contractor shall notify the Consultant in writing of any conflict between the Specifications and Manufacturer's Instructions and have same clarified.

1.30 AIR AND VAPOUR SEAL

.1 For work within the scope of this project, the Contractor shall ensure that exterior walls, windows, floor and roof surfaces provide an airtight and vapour-tight membrane to prevent problems due to building vapour migration.

.2 In general, the air/vapour barrier must be achieved on the interior side of the thermal insulation.

1.31 FIRE SAFETY

.1 The Contractor and all of their Subcontractors must comply with requirements of standard for Building Construction Operations DFC No. 301-1975, issued by Dominion Fire Commissioner.

.2 The appropriate clauses of the Ontario Building Code relating to fire protection shall be strictly followed.

.3 The Contractor shall provide and maintain free access to temporary or permanent fire hydrants acceptable to local fire department.

1.32 HOT WORK

.1 All precautions will be taken by the contractor and sub trades staff to work safely and to provide the necessary protection to persons and property from open flames and hot sparks. All such construction activity is considered Hot Work and the following steps are to be followed:

.1 Whenever possible, the contractor is to complete hot work in their own shop or out of doors at the site.

.2 For on-site work (indoors, out of doors), advise the Owner's site contact prior to work being performed, of related dangers. In the event of a fire as a result of the Hot Work, notify the fire department and the Owner's site contact immediately, whether extinguished or not.

.3 When possible, remove or cover nearby flammable materials with a flame retardant blanket, set up barriers to protect staff (i.e., pilons, shields, caution tape).

.4 Have all necessary doors, windows and/or drapes closed to exposure to control arc flash and smoke migration. Request of the Owner's site contact to shut down all fan systems in the area to control smoke migration.

.5 The contractor shall provide and keep extinguishers handy and in good working condition. Temporarily cover all smoke detectors in area during time of work.

.6 When work is done, advise site contact and recommend a fire watch/spot check be done several hours after work is completed. Uncover smoke detectors.

1.33 CONSTRUCTION SAFETY

The Contractor and all their trades must observe and enforce construction safety measures required by Canadian Construction Safety Code, Workplace Safety & Insurance Board, (formerly known as Workers' Compensation Board), and Municipal statutes. In particular, the Ontario Construction Safety Act, the regulations of the Ontario Department of Labour and Ontario Hydro Safety Requirements shall be strictly enforced. In event of conflict between any provisions of above authorities the most stringent provisions will apply.

*The Contractor is reminded, once again, that it is **they** who are responsible for Occupational Health and Safety on this Project. The items listed below are only guidelines of the Owner's expectations in this regard and not to be construed to be comprehensive or total in nature.*

.1 **The Owner** will take every reasonable precaution to prevent injury or illness to **students,** employees and the public, participating in Owner activities, or performing their duties. This shall be accomplished by providing and maintaining a safe, health working environment by providing the education necessary to perform these activities or duties safely.

.2 **The Owner** is vitally interested in the health and safety of all Contractors and their workers performing work for the Owner. Cooperation and support of the Contractor in the protection of workers from injury or occupational disease is a major, continuing object of the Owner. To achieve these goals, the Owner, in concert with the Contractors, will endeavour to make every effort to ensure that the Contractors provide a work site, which is a safe and healthy work environment. The Owner insists that all Contractors and their workers are dedicated to the continuing objective of reducing risk and injury. The Board may cause to remove persons from the site for a duration determined solely by the Board and persons not observing or complying with the foregoing Health and Safety Standards. The Board may monitor the Project to ensure that foregoing Health and Safety standards are met and that safety records are properly kept and maintained. Repeated or continued disregard for the said Health and Safety standards will constitute breach of contract and may at the Board's discretion result in the contract being cancelled and the Contractor being removed from the site. The Contractor shall ensure that all provisions for Health and Safety Committees, minutes and records are made and that procedures in this regard are strictly followed. Committee size shall be outlined in the Occupational Health and Safety Act.

.3 The Contractor covenants and agrees to comply with all statutory and other obligations, including, without limitation, the provisions of the Occupational Health and Safety Act (Ontario) and all Regulations thereto, and all amending and successor legislation, including without limitation, Bill 208 (the "Act") in connection with all work performed by either the Contractor, Subcontractors, or any Other Contractor on, or in connection with, the Project.

.4 Without limiting the foregoing, for the purposes of this Contract, the Prime Contractor agrees that **they** shall be the "constructor" of the Project within the meaning of the Act, and as such, shall assume all the obligations and responsibilities, and observe all construction safety requirements and procedures, and duties of inspection imposed by the Act on the "constructor", as therein defined, for all work and services performed by the Prime Contractor, Subcontractors and Other Contractors on or in connection with the Project.

.5 The Contractor further covenants and agrees that the Owner and its existing and former officers, trustees, employees and agents, and their respective heirs, executors, administrators, successors and assigns (hereinafter collectively referred to as the "Owner") shall be released from any obligations or liabilities otherwise imposed on the Owner, or on any of them, pursuant to the Act in connection with the Project, and that the Contractor shall assume all liability and responsibility in connection with same.

.6 The Contractor agrees to save harmless and indemnify the Owner from any losses, damages, costs and expenses of any kind, or nature whatsoever, including all legal expenses, and all defense costs and related expert or consulting fees, incurred by the Owner, or any of them, arising in connection with the failure, default, or inability of the Contractor of the Owner, or any of them, to comply with any of the aforementioned statutory, or other legal requirements, or arising in connection with any breach by the Contractor of any of its covenants, agreements and obligations under this Contract.

.7 The Contractor shall inform and instruct Other Contractors that they, while performing work on this project, are under the authority of the Contractor. Other Contractors are to discuss and co-ordinate with, and follow instructions from, the Prime Contractor on all matters of site access, vehicles, deliveries, storage, temporary facilities, coordination with the work of other subcontractors, work methods, scheduling, labour conditions, construction safety, environmental protection, security and all other matters which relate to the safe and proper execution of construction work.

.8 The Contractor shall ensure that all supervisory personnel on job site are fully aware of the procedures and requirements outlined above and comply with all requirements specified.

.9 All Contractors are responsible to ensure that all machinery and/or equipment are/is safe and that the workers perform their tasks in compliance with established safe work practices or procedures. Workers must receive adequate training in their specific work tasks to protect their health and safety.

.10 The Contractor shall be responsible for all persons and companies performing work, including Other Contractors, on this project, at all times, up to and including, the date of Substantial Performance of the Work. Authority for coordination and instructions relating to all matters, which relate to the safe and proper execution of construction work shall rest with the Contractor. The Contract Price must include the Contractor's fees for the coordination and supervision of the work of all Other Contractors.

.11 In addition to the responsibility of all contractors as outlined above, Subcontractors will be held accountable for the health and safety of workers under their supervision.

.12 Every worker must protect his/her own health and safety by working in compliance with the law and with safe work practices and procedures established by the authorities having jurisdiction.

.13 All sections of the Occupational Health and Safety Act for Industrial Establishments, latest edition, and the Occupational Health and Safety Act for Construction projects, latest edition, shall be enforced, by the Contractor, in their entirety, throughout the duration of the construction project.

.14 The Contractor shall provide the Consultant with the telephone number where the Contractor or their representative can be reached at any time, day or night, for the duration of the contract.

.15 Where an accident, explosion, or fire causes a person injury at the work place, and the worker is disabled from performing the usual task, the Contractor shall prepare a written notice and shall forward same to the Ministry of Labour within four days of the occurrence with a copy to the Owner's Representative, who shall copy and inform the Owner's Supervisor of Health and Safety and/or the Owner's Joint Health and Safety Committee, containing such information and particulars as may be described.

.16 Where a person is killed or critically injured from any cause at the work place, the Contractor shall immediately call the Ministry of Labour. A written notice from the Contractor shall be given to the Ministry of Labour within forty-eight hours after the occurrence, containing such information and particulars as may be prescribed, with copies to the Consultant and the Owner's Representative.

.17 The Contractor is advised that the accident scene is under the jurisdiction of the Ministry of Labour and no wreckage, articles, etc., shall be interfered with, disturbed, destroyed, altered or carried away at the scene, or connected with the occurrence, until the Ministry of Labour has given permission.

1.34 INDEPENDENT TESTS AND INSPECTIONS

.1 The Contractor shall appoint inspection firms as directed by the Consultant and make payments from the cash allowances specified in Division noted, except for the following, which shall be included in the contract:

.1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.

.2 Inspection and testing performed exclusively for Contractor's convenience.

.1 Testing, adjustment and balancing of mechanical and electrical equipment and systems.

.2 Mill tests and certificates of compliance.

.3 Re-testing as already described in *Quality Control* of this Section.

.3 The Consultant will authorize payment of inspection services from specified cash allowances, if so specified.

.4 The Contractor shall furnish labour and facilities to:

.1 Provide access to work to be inspected and tested.

.2 Facilitate inspections and tests.

.3 Make good work disturbed by inspection and test.

.4 Pour concrete test cylinders and store as directed by Inspection Firm.

.5 The Contractor shall notify Inspection Firms sufficiently in advance of operations to allow for assignment of laboratory personnel and scheduling of test.

.6 Where materials are specified to be tested, the Contractor shall deliver representative samples in required quantity to testing laboratory.

1.35 TEMPORARY PROTECTION

.1 The Contractor must provide temporary barricades, screens or barriers as directed by the Consultant and/or authorized Owner Representative, for the safety of persons, or for dividing the Work from portion or portions of the building or site that may be required for use by the facility or others.

.2 Properly protect the Work from any damage by the elements. In cold weather cover all exterior openings in the work areas likely to cause water damage.

.3 During off hours and/or stages of suspended operations for whatever reasons, the Contractor must assume all responsibility for protection against the elements, theft and/or vandalism. This applies to all work in progress and to any materials, products, tools, equipment, or other such items left at the work site.

.4 Properly protect floors and roofs from any damage. As required to protect existing terrazzo and VCT floors from soiling or damage by the movement of workers or materials and equipment, cover surfaces **on a daily basis** by means of covering with plywood or plastic. Take special precautions when moving heavy loads or equipment over floors and roofs.

.5 The Contractor must keep floors free of oils, grease, or other such materials likely to discolour them and/or affect bonding of applied surfaces.

.6 The Contractor must ensure that no part of the Work is loaded greater than it was designed for, when completed. Make any temporary support as strong as the permanent support. Place no load on concrete structure until it has sufficient strength to safely bear such load.

.7 Protect glass and other finishes against heat, slab and weld splatters, using appropriate protective shields and covers.

.8 The Contractor must provide and maintain, in good working order, appropriately labeled ULC fire extinguishers, to the approval of Authorities Having Jurisdiction.

.9 The Contractor must provide a minimum of two safety helmets on site at all times for the use of the Consultant and any other Owner authorized visitors to the site. It is the Contractor's responsibility to make certain that any such visitors wear the protective headgear and any other safety gear, which may be necessary at that particular time of construction.

1.36 COMPLETION

.1 Upon completion of the Work, all protection erected shall be removed, all damage to the Work and adjoining Work due to the lack or failure of such protection shall be made good and all debris, surplus materials tools equipment shall be removed from the work areas and the site, and the Project shall be left clean and tidy to the full and complete satisfaction of the Consultant and Owner Staff. The Contractor shall give written notice to the Consultant, requesting final inspection of the completed Project.

.2 Refer to the pertinent sections of the Specifications for requirements with respect to submission of *Record Documents, Maintenance Materials, Special Tools,* and *Spare Parts.*

1.37 GUARANTEES

.1 The following is a summary of the guarantees (in number of years) required by the contract:

.1 Entire Building, General Contract 1

.2 Mechanical and Electrical: refer to mechanical and electrical divisions.

.3 The guarantee period shall start on the date of issue of the Certificate of Substantial Performance of the Contract by the Consultant.

1.38 DEMOLITION, RECONSTRUCTION, ALTERATIONS AND MAKING GOOD

.1 Refer also to Section Demolition and Removal. Where the new materials or equipment, additions and alterations interface with existing and where existing work is altered, execute all necessary cutting and fitting required to make satisfactory connections with existing Work under this Contract. Leave the entire Work in a finished workmanlike condition acceptable to Consultant.

.2 Make good all exterior and interior finishes, waterproofing, and other materials and finishes which are damaged or disturbed during execution of Work. Warranties specified for materials and workmanship shall apply.

.3 Disconnect and relocate, where necessary, existing services and reconnect as required to complete the Work. This work shall include, without being limited, to plumbing, drainage, electrical and gas required for accommodation of new work. Abandon all services not required in conformance with ordinances and laws.

.4 Co-ordinate work of the various trades, taking into account existing installations to assure best arrangements of pipes, conduit, ducts mechanical, electrical and other equipment, in the available space.

.5 If required, in critical locations prepare interference or installation drawings, or both, showing the work of various trades as well as existing installations. Submit to Consultant for written permission before commencement of work.

.6 Drilling and cutting of existing work shall be carefully done, leaving a clean hole no larger than required. All patching shall be done to Consultant's approval.

.7 Make good all areas disturbed to adjoining buildings due to the Work of this Contract.

.8 **Effectively seal off work area from the rest of the building to permit the continuation of Owner's operations during new construction. Maintain all areas accessible clean and safe as required for the continuing operation and occupancy of the building.**

.9 Provide dust and weather tight temporary enclosures complete with hinged doors, fastenings and locksets as required, to provide egress to and from all existing building areas. Do not obstruct or otherwise block required means of egress from the building at any time.

.10 Dust-tight enclosures shall be of adequate construction, sufficient to obviate dispersion of dust and dirt into existing building.

1.39 ASBESTOS

.1 It is the responsibility of this contractor to review the onsite asbestos report prior to starting any work. Find 'Appendix A' immediately following this section.

.2 Comply with the requirements of Regulations respecting Asbestos on Construction Projects and in Buildings and Repair Operations - made under the Occupational Health and Safety Act, ONT REG. 278/05 as amended.

.3 Asbestos, if found on piping or vinyl asbestos tile may release asbestos fibres when cut or broken, during demolition or installation.

.4 If asbestos is found, the Contractor shall stop work immediately and notify the Consultant with a list of the areas containing asbestos.

.5 If so directed by the Owner, the Contractor shall employ an independent contractor to make tests in the areas to be renovated to ascertain, by written reports, the materials containing asbestos and the type. Costs shall be paid by the owner as extra costs under the terms of the contract.

.6 No work shall proceed at this point, until all the asbestos has been removed or encapsulated according to approved regulations concerning asbestos removal.

.7 Significant findings of unanticipated asbestos shall be considered and reviewed by the Owner and the Consultant. Any abatement or removal of unanticipated asbestos shall be considered at the sole discretion and direction of the Owner, in consultation with the Consultant, as possible additional work to the contract. This includes but is not limited to the following measures: The air quality must be tested and documented. The air must also be ventilated to ensure the safety of the workers. Care must be taken that the pollutants do not enter the rest of the building. Only if these conditions are satisfied may the Contractor proceed with their work.

1.40 POLYCHLORINATED BIPHENYL (PCB)

.1 Conform to the Environmental Protection Act and Regulations, Ontario Regulation 11/82 as amended.

.2 Refer to Mechanical and Electrical drawings and specifications for specific locations of on-site storage of PCB containing ballasts and materials to be stored on site for later removal. At all times comply with all laws pertaining to the safe handling, storage and removal of PCB containing materials.

1.41 SANITARY FACILITIES

.1 Only designated existing facilities as designated may be used during the construction period.

.2 Maintain in a clean condition.

1.42 WATER SUPPLY

.1 Existing water supply may be used for construction purposes.

1.43 TEMPORARY POWER

.1 The existing building services may be used for temporary power required during construction for temporary lighting and the operating of power tools, to a maximum supply of 110 volts, 30 amps.

1.44 REQUIRED SUBMISSIONS AND PROCEDURES

.1 **At Commencement of Contract**

.1 Supply Public Liability and Property Damage Insurance Certificates.

.2 Supply Certificates of good standing from Workplace Safety and Insurance Board (WSIB) for the Prime Contractor and all Subcontractors.

.3 Supply Contract Sum Breakdown of all sub-trades or parts of work and general expense items.

.4 Supply Construction Schedule.

.5 Supply Schedule of Shop Drawing Submissions.

.2 **During Construction**

.1 Adjust Allowances, as required.

.2 Organize Job Meetings.

.3 Supply Monthly Progress Reports and Construction Schedule, as applicable

.4 Confirm that payments are being made to subcontractors and suppliers by submission of receipts with the second and subsequent Progress Payment Application. No payment will be made for material on the site but not installed or similarly incorporated into the work, unless Bill of Sale in proper format is provided.

.3 **Upon Completion**

.1 Upon completion of work before the Final Certificate of Payment is issued, the following to be observed, executed and submitted:

.1 All deficiencies to have been completed in a satisfactory manner.

.2 All final clean-up to have been executed, as specified in this Section.

.3 Organize a Final Inspection tour at which to be present: the Owner's authorized representative; The Consultants, and their supervisory personnel, if any; the Contractor and their superintendent.

.4 Where the above procedure is impossible or where any deficiencies remain outstanding, the Owner's representative and the Consultant concerned, to inspect and accept the affected work and/or material upon notification by the Contractor, that all deficiencies involving this Consultant have been made good.

.5 A complete release of all liens arising out of this Contract, other than their own. If a subcontractor or supplier refuses to furnish a release of such a lien, furnish a bond satisfactory to the Owner to indemnify him against any claim under such a lien.

.6 Certificates of good standing from the Workplace Safety and Insurance Board (WSIB), for the Prime Contractor and all Subcontractors.

.7 All reference records, as specified, under this Section.

.8 Certificate of Inspection from Mechanical and Electrical Engineers.

.9 Publication of substantial performance in the Daily Commercial News as per Section 32 of the Construction Lien Act and provide proof of such publication to owner.

.10 Copies of all Lists of Deficiencies with each Deficiency verified when complete by only this project's job Superintendent. The Final List of Deficiencies to be signed, completed by all concerned, if accepted.

.11 Statement of Completion from the Contractor.

.12 Final adjustment of all Allowances.

.13 If applicable, Certificates required by Provincial, Municipal and other authorities having jurisdiction, including Building Permit signed off by all authorities.

.14 As-built Drawings.

.15 Operation and Maintenance Manuals.

1.45 NO SMOKING POLICY

.1 Smoking is not permitted on-site.

END OF SECTION

Appendix A
Hazardous Building Materials Assessment (Preconstruction)

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February 20, 2025

Kawartha Pine Ridge District School Board
1994 Fisher Drive
Peterborough, Ontario, K9J 7A1

Re: Hazardous Building Materials Assessment (Pre-construction)
Lydia Trull Public School, 80 Avondale Drive, Courtice, Ontario
Pinchin File: 349417.021

Kawartha Pine Ridge District School Board (KPRDSB, Client) retained Pinchin Ltd. (Pinchin) to conduct a hazardous building materials assessment at Lydia Trull Public School located at 80 Avondale Drive, Courtice, Ontario.

Pinchin performed the assessment on December 23, 2024. The assessor was unaccompanied during the assessment. The assessed area was unoccupied at the time of the assessment.

The objective of the assessment was to identify specified hazardous building materials in preparation for building renovations. The proposed work includes renovations to the HVAC system in the Mechanical Room (HMIS Loc. 2) and on Roof Sections 1A & 1B (HMIS Loc. 1), as detailed in the architectural drawings provided by the Client titled "*Lydia Trull Public School, Mechanical Upgrades*", prepared by DEI Consulting Engineers Inc., dated September 2024.

The **assessed area** is limited to the portion of the building to be renovated, as described in the above detailed document provided by the Client, and identified in the drawings in Appendix I.

It should be noted, Roof Sections 1A & 1B were assessed as part of a previous assessment (Pinchin File 332605.015). The findings of this previous assessment are detailed in this report.

1.0 SUMMARY OF FINDINGS

- Caulking present on the exterior of the louver is presumed to contain asbestos.
- Beige paint on metal ducts and white paint on the concrete deck are lead-containing and lead-based, respectively.
- Low-level lead content is present in grey paint on concrete floor.
- Paint on the exterior of the louver is presumed to be lead-containing.
- Solid lead is presumed present in batteries of emergency lights.
- Crystalline silica is present in concrete and other materials such as masonry.

- Mercury vapour is present in lamp tubes.
- No PCB-containing items were identified.
- Mould or water damage building materials were not observed at the time of the assessment.

2.0 RECOMMENDATIONS

2.1 General

If suspected hazardous building materials are discovered during the planned work, which are not identified in this report, do not disturb, and arrange for further testing and evaluation.

Conduct further investigation of the following items, areas, or locations, which were not completed during this assessment:

- Sample presumed asbestos-containing caulking and lead-containing paint from the exterior of the louver in the Mechanical Room (Loc. 2), prior to disturbance.
- Any items listed as exclusions in this report, prior to disturbance.

Provide this report to the contractor prior to bidding or commencing work.

2.2 Remedial Work

Remedial work is not required.

2.3 Project Work

The following recommendations are made regarding renovation involving the hazardous materials identified:

2.3.1 Asbestos

Remove asbestos-containing materials (ACM) prior to renovation, alteration, or maintenance if ACM may be disturbed by the work.

If the identified ACM will not be removed prior to commencement of the work, any potential disturbance of ACM must follow asbestos precautions appropriate for the type of work being performed.

Asbestos-containing materials must be disposed of at a landfill approved to accept asbestos waste.

2.3.2 Lead

For lead-containing or lead-based paints (i.e., greater than the EACC guideline of 0.1% (1,000 mg/kg) for lead-containing paints, and 0.5% (5,000 mg/kg) for lead-based), construction disturbance may result in over-exposure to lead dust or fumes.

The need for work procedures, engineering controls and personal protective equipment should be assessed on a site-specific basis to comply with applicable regulations, and/or guidelines.

For paints identified as having low levels of lead (i.e., equal to or above 0.009% (90 mg/kg) but less than or equal to the EACC guideline of 0.1% (1,000 mg/kg) for lead-containing paints) special precautions are not recommended unless aggressive disturbance (grinding, blasting, torching) is planned.

Exposure from construction disturbance of paints containing lead less than 0.009% (90 mg/kg) is assumed to be insignificant.

Lead-containing items should be recycled when taken out of service.

2.3.3 Silica

Construction disturbance of silica-containing products may result in excessive exposures to airborne silica, especially if performed indoors and dry. Cutting, grinding, drilling or demolition of materials containing silica should be completed only with proper respiratory protection and other worker safety precautions that comply with applicable regulations and guidelines.

2.3.4 Mercury

Do not break lamps. Recycle and reclaim mercury from fluorescent lamps when taken out of service. Mercury is classified as a hazardous waste and must be disposed of in accordance with applicable regulations.

3.0 BACKGROUND INFORMATION

3.1 Assessed Area Description Summary

Description Item	Details
Building Use	Elementary School
Floors Above Grade	Two
Floors Below Grade	None
Total Area (square feet)	1,000 (assessed area)
Year of Construction	1998
Structure	Concrete block foundation, structural steel, precast concrete panels/slabs
Exterior Cladding	Brick, metal cladding (not assessed)
HVAC	Roof-top Air Handling Units
Roof	Built-up Roofing
Flooring	Concrete
Wall and Ceiling Finishes	Concrete block

3.2 Existing Reports

3.2.1 Review of Previous Reports

Pinchin reviewed the following reports and included relevant results as appropriate:

- "Hazardous Building Materials Assessment (Pre-construction) Roof Sections 1A and 1B Lydia Trull Public School, 80 Avondale Drive, Courtice, Ontario" Dated October 26, 2023, Pinchin File 332605.015.
- "Hazardous Building Materials Assessment (Preconstruction), Lydia Trull Public School, 80 Avondale Drive, Courtice, Ontario", dated February 28, 2024, Pinchin File 335495.006.

4.0 FINDINGS

Any quantities listed in this report or data tables are estimated based on visual approximations only and are subject to variation.

4.1 Asbestos

The following table summarizes the materials evaluated for asbestos in the assessed area. For details on approximate quantities, condition, friability, accessibility, and locations of hazardous building materials; refer to the Hazardous Material Summary / Sample Log and All Data Report in Appendices V and VI.

Sample Number	Material Description	Type of Asbestos	Confirmed Hazard	Total Quantity Present	Material Specific Notes
S0001 ABC	Roofing materials, roof sections 1A & 1B	None Detected	No	20,000 SF	See site specific note 1
S0002 ABC	Light grey caulking on flashing, roof sections 1A & 1B	None Detected	No	140 LF	See site specific note 1
S0003 ABC	Grey caulking on black AHU conduit	None Detected	No	4 SF	See site specific note 1
S0004 ABC	Grey with gold flake duct mastic	None Detected	No	60 SF	See site specific note 1
S0005 ABC	White/beige caulking on walls	None Detected	No	30 LF	See site specific notes 2 & 3
S0006 ABC	Grey firestopping	None Detected	No	25 SF	See site specific note 2

S0007 ABC	Grey caulking on door frame	None Detected	No	25 LF	See site specific notes 2 & 3
S0010 ABC	Grey caulking in expansion joints	None Detected	No	10 LF	-
V9500	Louvre exterior caulking	Presumed Asbestos	Yes	~60 LF	
V0000	Black rubber vibration damper	None	No	2 EA	-
V0000	Primer paint on concrete block walls	None	No	2,500 SF	Paint on concrete block walls

Site Specific Notes:

1. Material assessed during previous assessment (Pinchin File 332605.015).
2. Material assessed during previous assessment (Pinchin File 335495.006).
3. A second phase of material (homogeneous, grey, hard cementitious material) was identified in sample sets 5, 7, 8 and 9. This material is non-asbestos.

General Notes:

Materials identified as Sample Number V0000 were determined to be non-asbestos based on the manufacture date and known end of use of asbestos in these products.

4.1.1 Excluded Asbestos Materials

The following is a list of materials which may contain asbestos and were excluded from the assessment. These materials are presumed to contain asbestos until otherwise proven to be non-asbestos by sampling and analysis:

- Electrical components
- Interior of mechanical equipment
- Mechanical packing, ropes, and gaskets
- Fire resistant doors
- Sealants on pipe threads

4.2 Lead

Refer to the Hazardous Material Summary / Sample Log and All Data Report in Appendices V and VI for details on locations, condition and approximate quantities on paints sampled and their locations.

The following table summarizes the analytical results of paints sampled:

Sample Number	Material Description	Concentration	Confirmed Hazard	Total Quantity Present
L0001	Beige paint on concrete wall	0.00088%	No	2,500 SF
L0002	**Beige paint on metal ductwork**	**0.12%**	**Yes**	**500 SF**
L0003	**Grey paint on concrete floor and pads**	**0.024%**	**Yes**	**1,000 SF**
L0004	**White paint on concrete ceiling**	**0.73%**	**Yes**	**1,000 SF**
L0005	Light green paint on metal pipes	0.0071%	No	30 SF
L0006	Green paint on metal doors	0.0042%	No	40 SF
V9500	Paint on louvre	Presumed Lead	Yes	1 EA

General Notes:

Results above 0.1% (1,000 mg/kg) are considered lead-containing, and over 0.5% (5,000 mg/kg) are considered lead-based.

Results less than or equal to 0.1% (1,000 mg/kg), but equal to or greater than 0.009% (90 mg/kg), are considered low-level lead paints or surface coatings in accordance with the EACC guideline.

Paints containing lead less than 0.009% (90 mg/kg) are assumed to be insignificant relating to potential exposure from construction disturbance.

4.2.1 Lead Products and Applications

Refer to the Hazardous Material Summary / Sample Log and All Data Report in Appendices V and VI for details on lead-products including their locations and quantities.

Sample Number	Material Description	Confirmed Hazard	Total Quantity Present	Material Specific Notes
V9500	**Batteries In Emer. Lights**	**Yes**	**1 EA**	

General Notes:

Items identified as Sample Number V9500 were observed to be present but could not be definitively determined to contain lead (e.g., inaccessible batteries).

4.2.2 Excluded Lead Materials

Lead may be present in a number of materials which were not assessed and/or sampled. The following materials, where found, should be considered to contain lead:

- Electrical components, including wiring connectors, grounding conductors, and solder
- Solder on pipe connections

4.3 Silica

Crystalline silica is a presumed component of the following materials:

- Poured and pre-cast concrete
- Masonry and mortar

4.4 Mercury

Refer to the Hazardous Material Summary / Sample Log and All Data Report in Appendices V and VI for details on mercury-containing products including their locations and quantities.

Sample Number	Material Description	Confirmed Hazard	Total Quantity Present	Material Specific Notes
V9000	Light Fixture	Yes	24 EA	
V0000	Manometer	No	6 EA	See Material Specific Note #1

Material Specific Notes:

1. Visual assessment determined manometers do not contain mercury due to prior industry knowledge and known end of use of mercury in these products.

General Notes:

Items identified as Sample Number V9000 were observed to be present and were determined to contain mercury based on visual observation (e.g., labelled lamps and ampules in thermostats).

Items identified as Sample Number V0000 are items that historically may have contained mercury; however, have been visually identified as non-mercury types (e.g., LED lamps, digital or electric thermostats).

4.5 Polychlorinated Biphenyls

PCBs were banned in 1980; however, are found to be present in caulking and sealants until 1985. Based on the building date of construction, PCBs are not expected to be present in caulking.

Based on date of construction and confirmed by visual observations (e.g., evidence of T-5 or T-8 fixtures with electronic ballasts) the fixtures will not contain PCB ballasts.

4.6 Mould and Water Damage

Visible mould growth and water damage was not observed during the assessment.

5.0 METHODOLOGY

For the purpose of the assessment and this report, hazardous building materials are defined as follows:

- Asbestos
- Lead
- Silica
- Mercury
- Polychlorinated Biphenyls (PCBs)
- Mould and Water Damage

Arsenic, acrylonitrile, benzene, coke oven emissions, ethylene oxide, isocyanates and vinyl chloride monomer are not typically found in building materials in a composition/state that is hazardous and were not included in this assessment.

Pinchin conducted an assessment to identify the hazardous building materials as defined in the scope.

The assessment was performed to establish the type of specified hazardous building materials, locations and approximate quantities incorporated in the structure and its finishes.

The assessment did not include limited demolition of wall and ceiling finishes. Limited demolition of masonry block walls (core holes) was conducted to investigate for loose fill vermiculite insulation. Sampling of roofing materials was not conducted during the assessment.

For further details on the methodology including test methods and evaluation criteria, refer to Appendix III.

6.0 REFERENCES

The following legislation and documents were referenced in completing the assessment and this report:

1. Asbestos on Construction Projects and in Buildings and Repair Operations, Ontario Regulation 278/05.
2. Designated Substances, Ontario Regulation 490/09.
3. Lead on Construction Projects, Ministry of Labour Guidance Document.
4. The Environmental Abatement Council of Canada (EACC) Lead Guideline for Construction, Renovation, Maintenance or Repair.
5. Ministry of the Environment Regulation, R.R.O. 1990 Reg. 347 as amended.
6. Ministry of the Environment Regulation, R.R.O. 1990 Reg. 362 as amended.
7. Silica on Construction Projects, Ministry of Labour Guidance Document.
8. Alert – Mould in Workplace Buildings, Ontario Ministry of Labour.
9. PCB Regulations, SOR/2008-273, Canadian Environmental Protection Act.
10. Surface Coating Materials Regulations, SOR/2016-193, Canada Consumer Product Safety Act.
11. Consolidated Transportation of Dangerous Goods Regulations, including Amendment SOR/2019-101, Transportation of Dangerous Goods Act.
12. Mould Guidelines for the Canadian Construction Industry, Standard Construction Document CCA 82 – 2004 (Revised 2018), Canadian Construction Association.

7.0 LIMITATIONS

This work was performed subject to the Terms and Limitations referenced in the Master Service Agreement between Pinchin and the Client.

Information provided by Pinchin is intended for Client use only. Pinchin will not provide results or information to any party unless disclosure by Pinchin is required by law. Any use by a third party of reports or documents authored by Pinchin or any reliance by a third party on or decisions made by a third party based on the findings described in said documents, is the sole responsibility of such third parties. Pinchin accepts no responsibility for damages suffered by any third party as a result of decisions made or actions conducted. No other warranties are implied or expressed.

8.0 CLOSURE

The data presented in the appendices is prepared by Pinchin's Hazardous Materials Inventory System (HMIS). The information contained within this report was current at the time of this report issue, and is provided as a summary; however, HMIS should be accessed for the most current data.

Contact the Project Manager, Calvin Cathcart at 705.772.7933 or ccathcart@pinchin.com should you have any questions.

Sincerely,

Pinchin Ltd.

Prepared by:

Cole Reynolds, B.Sc.
Project Technologist

Project Managed by:

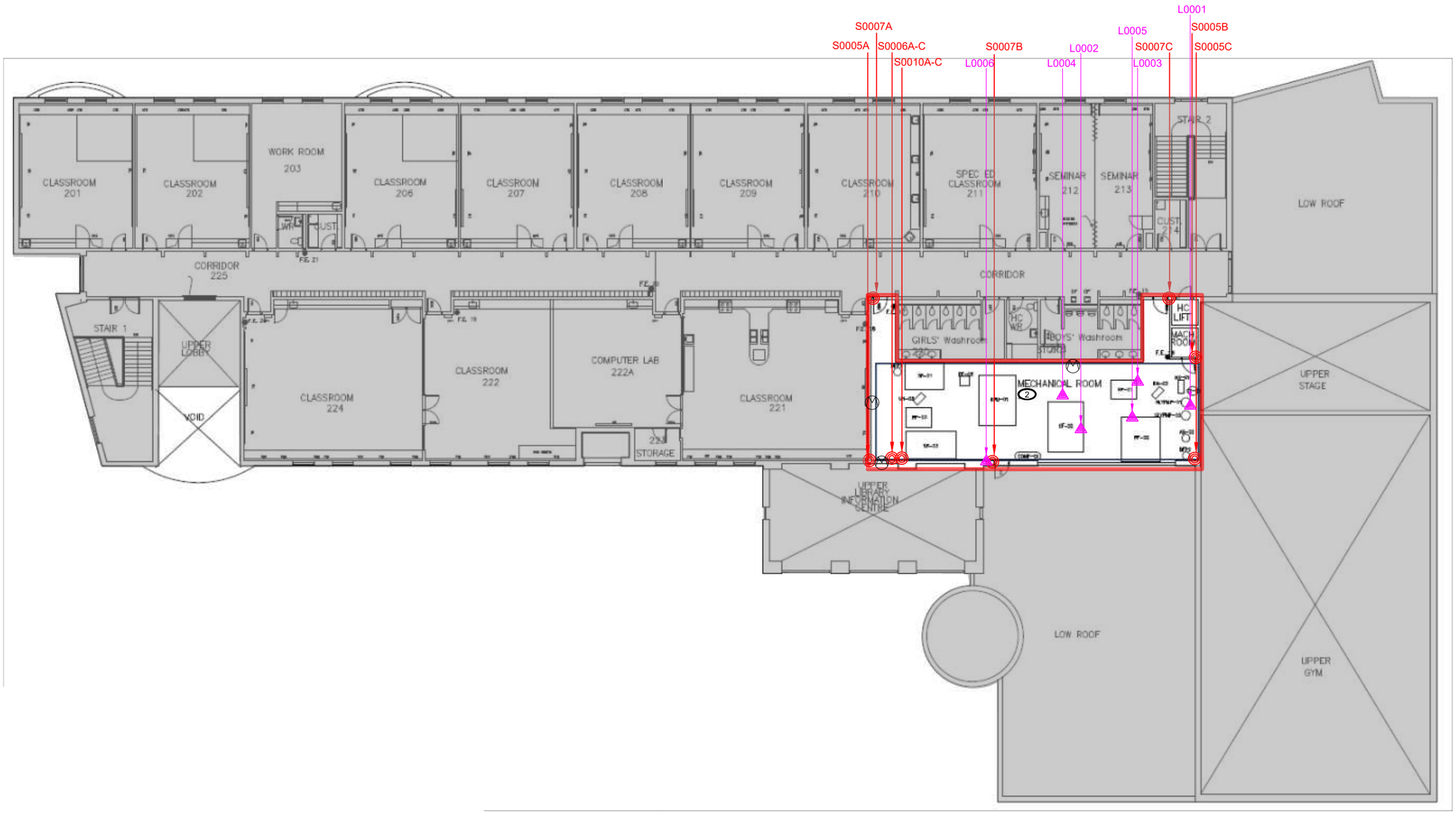
Calvin Cathcart, B.A.Sc., CIH
Senior Project Manager

Reviewed by:

Alex Brett, B.Sc., CRSP
Operations Manager

Encl:	APPENDIX I	Drawings
	APPENDIX II-A	Asbestos Analytical Certificates
	APPENDIX II-B	Lead Analytical Certificates
	APPENDIX III	Methodology
	APPENDIX IV	Location Summary Report
	APPENDIX V	Hazardous Materials Summary Report / Sample Log
	APPENDIX VI	All Data Report
	APPENDIX VII	Photographs

APPENDIX I
Drawings



LEGEND

- (X) PINCHIN LOCATION NUMBER
- ASBESTOS BULK SAMPLE
- LEAD BULK SAMPLE
- (M) VERMICULITE DRILLHOLE
- SURVEY BOUNDARY/ASSESSED AREA
- OUTSIDE ASSESSMENT SCOPE

NOT ALL KNOWN OR SUSPECTED HAZARDOUS BUILDING MATERIALS MAY BE DEPICTED ON THE DRAWING. REFER TO THE HAZARDOUS BUILDING MATERIALS ASSESSMENT REPORT FOR A COMPLETE LIST OF KNOWN AND SUSPECTED HAZARDOUS BUILDING MATERIALS.

LEGEND IS COLOUR DEPENDENT. NON-COLOUR COPIES MAY ALTER INTERPRETATION.

BASE PLAN PROVIDED BY CLIENT.

PINCHIN

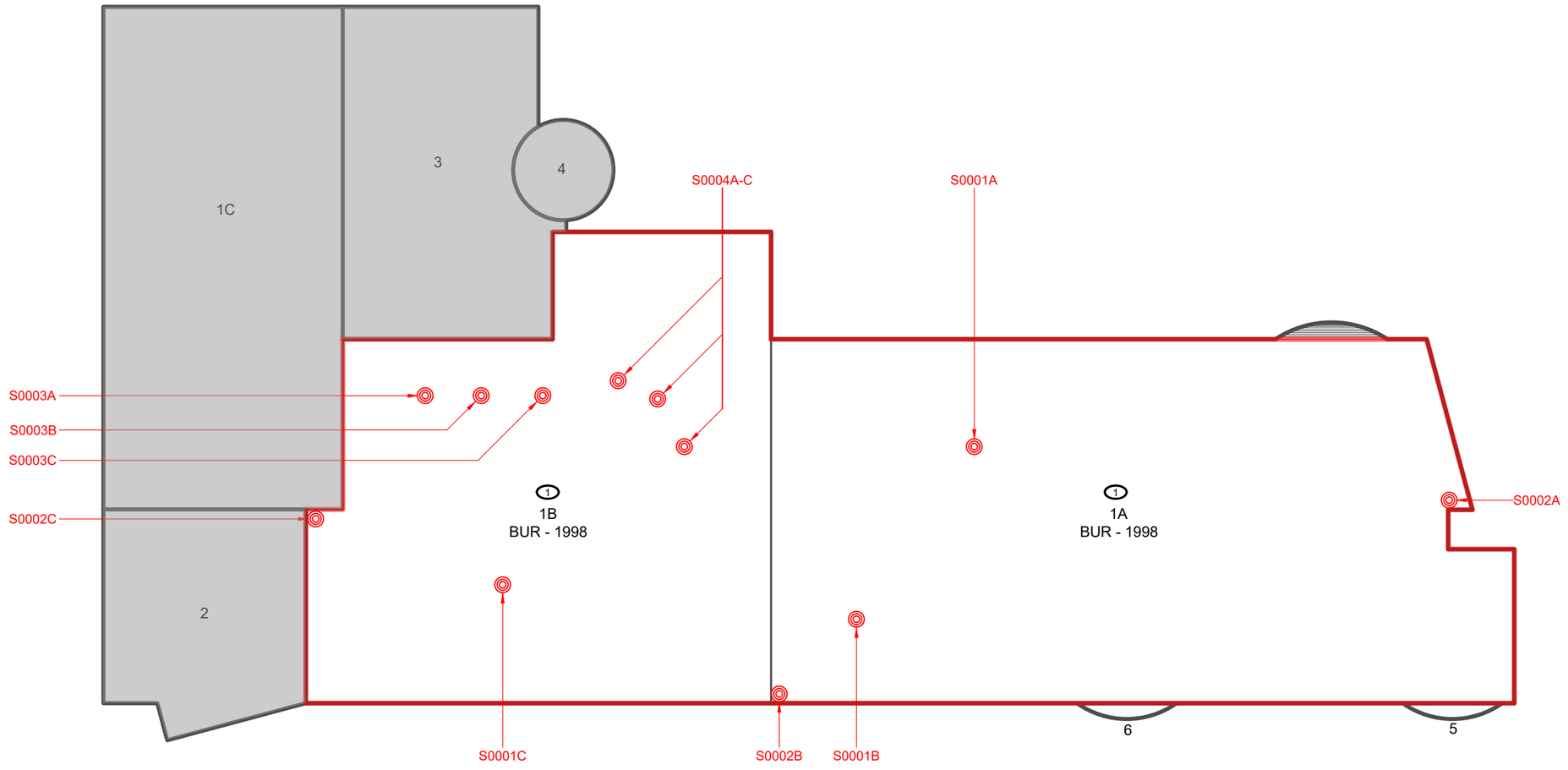
PROJECT NAME:
HAZARDOUS BUILDING MATERIAL ASSESSMENT

CLIENT NAME:
KAWARTHA PINE RIDGE DISTRICT SCHOOL BOARD

PROJECT LOCATION:
LYDIA TRULL PUBLIC SCHOOL
80 AVONDALE DRIVE,
COURTICE, ONTARIO

FIGURE NAME:
SECOND FLOOR

PROJECT NUMBER:	SCALE:
0349417.021	NOT TO SCALE
DRAWN BY:	REVIEWED BY:
JM	CC
DATE:	FIGURE NUMBER:
JANUARY 2025	1 OF 3



N

LEGEND

- PINCHIN LOCATION NUMBER
- ASBESTOS BULK SAMPLE
- LEAD BULK SAMPLE
- VERMICULITE DRILLHOLE
- SURVEY BOUNDARY/ASSESSED AREA
- OUTSIDE ASSESSMENT SCOPE

NOT ALL KNOWN OR SUSPECTED HAZARDOUS BUILDING MATERIALS MAY BE DEPICTED ON THE DRAWING. REFER TO THE HAZARDOUS BUILDING MATERIALS ASSESSMENT REPORT FOR A COMPLETE LIST OF KNOWN AND SUSPECTED HAZARDOUS BUILDING MATERIALS.

LEGEND IS COLOUR DEPENDENT. NON-COLOUR COPIES MAY ALTER INTERPRETATION.

BASE PLAN PROVIDED BY CLIENT.

PINCHIN

PROJECT NAME:
HAZARDOUS BUILDING MATERIAL ASSESSMENT

CLIENT NAME:
KAWARTHA PINE RIDGE DISTRICT SCHOOL BOARD

PROJECT LOCATION:
LYDIA TRULL PUBLIC SCHOOL
80 AVONDALE DRIVE,
COURTICE, ONTARIO

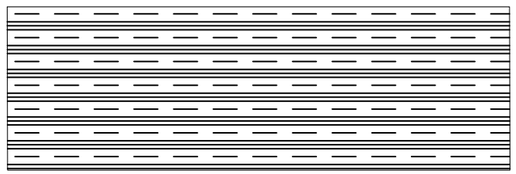
FIGURE NAME:
ROOF

PROJECT NUMBER:	SCALE:
0349417.021	NOT TO SCALE
DRAWN BY:	REVIEWED BY:
JM	CC
DATE:	FIGURE NUMBER:
DECEMBER 2024	2 OF 3

ROOF SECTION - 1A & 1B

3-PLY ASPHALT

1" FIBERBOARD



3" POLY ISO

2-PLY "MOPDOWN"
VAPOUR RETARDER

CONCRETE DECK

N

LEGEND

NOT ALL KNOWN OR SUSPECTED HAZARDOUS BUILDING MATERIALS MAY BE DEPICTED ON THE DRAWING. REFER TO THE HAZARDOUS BUILDING MATERIALS ASSESSMENT REPORT FOR A COMPLETE LIST OF KNOWN AND SUSPECTED HAZARDOUS BUILDING MATERIALS.

LEGEND IS COLOUR DEPENDENT. NON-COLOUR COPIES MAY ALTER INTERPRETATION.

BASE PLAN PROVIDED BY CLIENT.

PINCHIN

PROJECT NAME:
HAZARDOUS BUILDING MATERIAL ASSESSMENT

CLIENT NAME:
KAWARTHA PINE RIDGE DISTRICT SCHOOL BOARD

PROJECT LOCATION:
LYDIA TRULL PUBLIC SCHOOL
80 AVONDALE DRIVE,
COURTICE, ONTARIO

FIGURE NAME:
ROOF COMPOSITION

PROJECT NUMBER:	SCALE:
0349417.021	NOT TO SCALE
DRAWN BY:	REVIEWED BY:
JM	CC
DATE:	FIGURE NUMBER:
JANUARY 2025	3 OF 3

APPENDIX II-A
Asbestos Analytical Certificates

Pinchin Ltd. Asbestos Laboratory
Certificate of Analysis

Project Name:	**KPRDSB, ON**		
Project No.:	**0332605.015**		
Prepared For:	**B. Guindon / R. Northey**		
Lab Reference No.:	**b301564 Revision 1**		
Analyst(s):	**Y. Yan**		
Date Received:	**October 4, 2023**	**Samples Submitted:**	**3**
Date Analyzed:	**October 11, 2023**	**Phases Analyzed:**	**22**

The Pinchin Ltd. Dartmouth asbestos laboratory is accredited by the National Institute of Standards and Technology, National Voluntary Laboratory Accreditation Program (NVLAP Lab Code 201032-0) for the 'EPA – 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples, ' and the 'EPA 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials'; and meets all requirements of ISO/IEC 17025:2017. The Pinchin asbestos laboratory uses the aforementioned methods of analysis.

Bulk samples are checked visually and scanned under a stereomicroscope. Slides are prepared and observed under a Polarized Light Microscope (PLM) at magnifications of 40X, 100X or 400X as appropriate. Asbestos fibres are identified by a combination of morphology, colour, refractive index, extinction, sign of elongation, birefringence and dispersion staining colours. A visual estimate is made of the percentage of asbestos present. A reported concentration of less than (<) the regulatory threshold indicates the presence of confirmed asbestos in trace quantities, limited to only a few fibres or fibre bundles in an entire sample. This method complies with provincial regulatory requirements where applicable. Multiple phases within a sample are analyzed and reported separately.

All bulk samples submitted to this laboratory for asbestos analysis are retained for a minimum of three months. Samples may be retrieved, upon request, for re-examination at any time during that period.

This report relates only to the items tested.

Revision History:

Revision 1 (2023-10-25)	Changed sample description (S0001C).

Pinchin Ltd. Asbestos Laboratory
Certificate of Analysis

Project Name: **KPRDSB, ON**
Project No.: **0332605.015**
Prepared For: **B. Guindon / R. Northey**

Lab Reference No.: **b301564 Revision 1**
Date Analyzed: **October 11, 2023**

BULK SAMPLE ANALYSIS

SAMPLE IDENTIFICATION	SAMPLE DESCRIPTION	% COMPOSITION (VISUAL ESTIMATE)	
		ASBESTOS	OTHER
S0001A Roll Roofing, Roofing Material, Roofing Material 1a Roof, Loc:1, Roof Sections 1A and 1B	7 Phases: a) Homogeneous, black, layered, tar material. (bottom section)	None Detected	Tar Material > 75%
	b) Homogeneous, black, layered, tar-impregnated, compressed, fibrous material. (bottom section)	None Detected	Cellulose 50-75% Tar and other Non-Fibrous Material 25-50%
	c) Homogeneous, black, tar-impregnated, compressed, fibrous material. (middle section)	None Detected	Cellulose 25-50% Tar and other Non-Fibrous Material 50-75%
	d) Homogeneous, black, layered, tar material. (top section)	None Detected	Tar Material > 75%
	e) Homogeneous, black, tar-impregnated, compressed, fibrous material. (top section)	None Detected	Man-Made Vitreous Fibres 10-25% Tar and other Non-Fibrous Material > 75%
	f) Homogeneous, black, rubbery, tar material. (top section)	None Detected	Tar and other Non-Fibrous Material > 75%
	g) Homogeneous, black, tar-impregnated, compressed, fibrous material. (top section)	None Detected	Man-Made Vitreous Fibres 25-50% Tar and other Non-Fibrous Material 50-75%
Comments:	Foam and wood material are present on the surface of this sample.		

Pinchin Ltd. Asbestos Laboratory
Certificate of Analysis

Project Name: **KPRDSB, ON**
Project No.: **0332605.015**
Prepared For: **B. Guindon / R. Northey**

Lab Reference No.: **b301564 Revision 1**
Date Analyzed: **October 11, 2023**

BULK SAMPLE ANALYSIS

SAMPLE IDENTIFICATION	SAMPLE DESCRIPTION	% COMPOSITION (VISUAL ESTIMATE)	
		ASBESTOS	OTHER
S0001B Roll Roofing, Roofing Material, Roofing Material 1a Sample B, Loc:1, Roof Sections 1A and 1B	6 Phases: a) Homogeneous, black, tar-coated, compressed, fibrous material. (middle section)	None Detected	Cellulose > 75% Man-Made Vitreous Fibres 5-10% Tar and other Non-Fibrous Material 10-25%
	b) Homogeneous, black, tar material. (middle section)	None Detected	Tar Material > 75%
	c) Homogeneous, black, layered, tar material. (top section)	None Detected	Tar and other Non-Fibrous Material > 75%
	d) Homogeneous, black, layered, tar-impregnated, compressed, fibrous material. (top section)	None Detected	Man-Made Vitreous Fibres 25-50% Tar and other Non-Fibrous Material 50-75%
	e) Homogeneous, black, layered, tar material. (top section)	None Detected	Tar Material > 75%
	f) Homogeneous, brown, soft, cementitious material. (top section)	None Detected	Non-Fibrous Material > 75%
Comments:	Foam and wood material are present on the surface of this sample.		

Pinchin Ltd. Asbestos Laboratory
Certificate of Analysis

Project Name: **KPRDSB, ON**
Project No.: **0332605.015**
Prepared For: **B. Guindon / R. Northey**

Lab Reference No.: **b301564 Revision 1**
Date Analyzed: **October 11, 2023**

BULK SAMPLE ANALYSIS

SAMPLE IDENTIFICATION	SAMPLE DESCRIPTION	% COMPOSITION (VISUAL ESTIMATE)	
		ASBESTOS	OTHER
S0001C Roll Roofing, Roofing Material, Roofing Material 1a Roof1b Roof, Loc:1, Roof Sections 1B	9 Phases: a) Homogeneous, black, tar-coated, compressed, fibrous material. (bottom section)	None Detected	Cellulose > 75% Man-Made Vitreous Fibres 5-10% Tar and other Non-Fibrous Material 10-25%
	b) Homogeneous, black, tar material. (bottom section)	None Detected	Tar Material > 75%
	c) Homogeneous, black, tar-impregnated, compressed, fibrous material. (middle section)	None Detected	Cellulose 25-50% Man-Made Vitreous Fibres 10-25% Tar and other Non-Fibrous Material 25-50%
	d) Homogeneous, black, tar material. (middle section)	None Detected	Tar and other Non-Fibrous Material > 75%
	e) Homogeneous, black, tar material. (top section)	None Detected	Tar and other Non-Fibrous Material > 75%
	f) Homogeneous, black, tar-impregnated, compressed, fibrous material. (top section)	None Detected	Man-Made Vitreous Fibres 25-50% Tar and other Non-Fibrous Material 50-75%
	g) Homogeneous, black, tar-impregnated, compressed, fibrous material. (top section)	None Detected	Cellulose 10-25% Man-Made Vitreous Fibres 10-25% Tar and other Non-Fibrous Material 50-75%

Pinchin Ltd. Asbestos Laboratory
Certificate of Analysis

Project Name: **KPRDSB, ON**
Project No.: **0332605.015**
Prepared For: **B. Guindon / R. Northey**

Lab Reference No.: **b301564 Revision 1**
Date Analyzed: **October 11, 2023**

BULK SAMPLE ANALYSIS

SAMPLE IDENTIFICATION	SAMPLE DESCRIPTION	% COMPOSITION (VISUAL ESTIMATE)	
		ASBESTOS	OTHER
	h) Homogeneous, black, layered, tar material. (top section)	None Detected	Tar Material > 75%
	i) Homogeneous, brown, soft, cementitious material. (top section)	None Detected	Non-Fibrous Material > 75%
Comments:	Foam and wood material are present on the surface of this sample.		

Reviewed by:

Digitally signed by Karina Cockburn
Date: 2023.10.25 12:03:36-04'00'

Reporting Analyst:

Yewen Yan
2023.10.25 12:55:23-03'00'

Analyzed By: YY

Reviewed By: AC

Report Sent By: _____

Pinchin Ltd. - Asbestos Laboratory
Internal Asbestos Bulk Sample Chain of Custody

Client Name:	KPRDSB	**Project Address:**	ON
Portfolio/Building No:		**Pinchin File:**	0332605.015
Submitted by:	Bryan Guindon	**Email:**	bguindon@pinchin.com
CC Results to:	Rachel Northey	**CC Email:**	rnorthey@pinchin.com
Date Submitted:	October 02 2023	**Required by:**	October 10 2023
# of Samples:	12 X 3 Split 1/2	**Priority:**	5 Day Turnaround
Year of Building Construction (*Mandatory, Years ONLY*):		1998	
Do NOT Stop on Positive (Sample Numbers):			
Pinchin Group Company (*Mandatory Field*):		Pinchin	
HMIS2 Building Reference #:		125545/202382930268742	

To be Completed by Lab Personnel Only:

Lab Reference #:	b301564	**Time:**	24 hour clock		
Received by:	R. Scanlon	**Date:** Oct04/23	Month	Day	Year
Name(s) of Analyst(s):	Y. Yan				

Sample Prefix	Sample No.	Sample Suffix	Sample Description/Location (Mandatory)
S	0001	A	Roll Roofing,Roofing Material,Roofing Material 1a Roof,Loc:1,Roof Sections 1A and 1B a)ND b)ND c)ND d)ND e)ND f)ND g)ND
S	0001	B	Roll Roofing,Roofing Material,Roofing Material 1a Sample B,Loc:1,Roof Sections 1A and 1B a)ND b)ND c)ND d)ND e)ND f)ND
S	0001	C	Roll Roofing,Roofing Material,Roofing Material 1a Roof1b Roof,Loc:1,Roof Sections 1B a)ND b)ND c)ND d)ND e)ND f)ND g)ND h)ND i)ND
S	0002	A	Caulking,Flashing Caulking Roof 1a,Loc:1,Roof Sections 1A and 1B
S	0002	B	Caulking,Flashing Caulking Roof 1a,Loc:1,Roof Sections 1A and 1B
S	0002	C	Caulking,Flashing Caulking Roof 1b,Loc:1,Roof Sections 1A and 1B
S	0003	A	Caulking,Grey Caulking Over Black Ahu Conduit Isolation,Loc:1,Roof Sections 1A and 1B

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Pinchin Ltd. Asbestos Laboratory
Certificate of Analysis

Project Name:	**KPRDSB, ON**		
Project No.:	**0332605.015**		
Prepared For:	**B. Guindon / R. Northey**		
Lab Reference No.:	**b301565**		
Analyst(s):	**Y. Yan**		
Date Received:	**October 4, 2023**	**Samples Submitted:**	**9**
Date Analyzed:	**October 10, 2023**	**Phases Analyzed:**	**12**

The Pinchin Ltd. Dartmouth asbestos laboratory is accredited by the National Institute of Standards and Technology, National Voluntary Laboratory Accreditation Program (NVLAP Lab Code 201032-0) for the 'EPA – 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples, ' and the 'EPA 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials'; and meets all requirements of ISO/IEC 17025:2017. The Pinchin asbestos laboratory uses the aforementioned methods of analysis.

Bulk samples are checked visually and scanned under a stereomicroscope. Slides are prepared and observed under a Polarized Light Microscope (PLM) at magnifications of 40X, 100X or 400X as appropriate. Asbestos fibres are identified by a combination of morphology, colour, refractive index, extinction, sign of elongation, birefringence and dispersion staining colours. A visual estimate is made of the percentage of asbestos present. A reported concentration of less than (<) the regulatory threshold indicates the presence of confirmed asbestos in trace quantities, limited to only a few fibres or fibre bundles in an entire sample. This method complies with provincial regulatory requirements where applicable. Multiple phases within a sample are analyzed and reported separately.

All bulk samples submitted to this laboratory for asbestos analysis are retained for a minimum of three months. Samples may be retrieved, upon request, for re-examination at any time during that period.

This report relates only to the items tested.

Pinchin Ltd. Asbestos Laboratory
Certificate of Analysis

Project Name: **KPRDSB, ON**
Project No.: **0332605.015**
Prepared For: **B. Guindon / R. Northey**

Lab Reference No.: **b301565**
Date Analyzed: **October 10, 2023**

BULK SAMPLE ANALYSIS

SAMPLE IDENTIFICATION	SAMPLE DESCRIPTION	% COMPOSITION (VISUAL ESTIMATE)	
		ASBESTOS	OTHER
S0002A Caulking, Flashing Caulking Roof 1a, Loc:1, Roof Sections 1A and 1B	Homogeneous, light grey, caulking material.	None Detected	Non-Fibrous Material > 75%
S0002B Caulking, Flashing Caulking Roof 1a, Loc:1, Roof Sections 1A and 1B	Homogeneous, light grey, caulking material.	None Detected	Non-Fibrous Material > 75%
S0002C Caulking, Flashing Caulking Roof 1b, Loc:1, Roof Sections 1A and 1B	Homogeneous, light grey, caulking material.	None Detected	Non-Fibrous Material > 75%
S0003A Caulking, Grey Caulking Over Black Ahu Conduit Isolation, Loc:1, Roof Sections 1A and 1B	2 Phases: a) Homogeneous, black, caulking material. b) Homogeneous, green-grey, caulking material.	None Detected None Detected	Tar and other Non-Fibrous Material > 75% Non-Fibrous Material > 75%
S0003B Caulking, Grey Caulking Over Black Ahu Conduit Isolation, Loc:1, Roof Sections 1A and 1B	2 Phases: a) Homogeneous, black, caulking material. b) Homogeneous, green-grey, caulking material.	None Detected None Detected	Tar and other Non-Fibrous Material > 75% Non-Fibrous Material > 75%
S0003C Caulking, Grey Caulking Over Black Ahu Conduit Isolation, Loc:1, Roof Sections 1A and 1B	2 Phases: a) Homogeneous, light grey, caulking material. b) Homogeneous, green-grey, caulking material.	None Detected None Detected	Non-Fibrous Material > 75% Non-Fibrous Material > 75%
Comments:	Another phase is present but there was insufficient material submitted to analyze.		

Pinchin Ltd. Asbestos Laboratory
Certificate of Analysis

Project Name: **KPRDSB, ON**
Project No.: **0332605.015**
Prepared For: **B. Guindon / R. Northey**

Lab Reference No.: **b301565**
Date Analyzed: **October 10, 2023**

BULK SAMPLE ANALYSIS

SAMPLE IDENTIFICATION	SAMPLE DESCRIPTION	% COMPOSITION (VISUAL ESTIMATE)	
		ASBESTOS	OTHER
S0004A Duct, Mastic, Grey, A-c Gre Ymastic With Gold Flake Exhaust, Loc:1, Roof Sections 1A and 1B	Homogeneous, grey, mastic material.	None Detected	Vermiculite 10-25% Other Non-Fibrous > 75%
S0004B Duct, Mastic, Grey, Grey Mastic With Gold Flake Exhaust, Loc:1, Roof Sections 1A and 1B	Homogeneous, grey, mastic material.	None Detected	Vermiculite 10-25% Other Non-Fibrous > 75%
S0004C Duct, Mastic, Grey, Grey Mastic With Gold Flake Exhaust, Loc:1, Roof Sections 1A and 1B	Homogeneous, grey, mastic material.	None Detected	Vermiculite 10-25% Other Non-Fibrous > 75%
Comments:	Silicon is present on the surface of this sample.		

Reviewed by:

Jason Stapleton
2023.10.10 12:05:45-03'00'

Reporting Analyst:

Yewen Yan
2023.10.10 10:47:01-03'00'

Analyzed By: YV

Reviewed By: JS

Report Sent By: _____

Pinchin Ltd. - Asbestos Laboratory
Internal Asbestos Bulk Sample Chain of Custody

Client Name:	KPRDSB	**Project Address:**	ON
Portfolio/Building No:		**Pinchin File:**	0332605.015
Submitted by:	Bryan Guindon	**Email:**	bguindon@pinchin.com
CC Results to:	Rachel Northey	**CC Email:**	rnorthey@pinchin.com
Date Submitted:	October 02 2023	**Required by:**	October 10 2023
# of Samples:	12 9 Split 2/2	**Priority:**	5 Day Turnaround
Year of Building Construction (*Mandatory, Years ONLY*):	1998		
Do NOT Stop on Positive (Sample Numbers):			
Pinchin Group Company (*Mandatory Field*):	Pinchin		
HMIS2 Building Reference #:	125545/202382930268742		

To be Completed by Lab Personnel Only:

Lab Reference #:	b3c1565	**Time:**	24 hour clock
Received by:	R. Jansson	**Date:** Oct 04/23	Month Day Year
Name(s) of Analyst(s):	V. Vas		

Sample Prefix	Sample No.	Sample Suffix	Sample Description/Location (Mandatory)
S	0001	A	Roll Roofing,Roofing Material,Roofing Material 1a Roof,Loc:1,Roof Sections 1A and 1B
S	0001	B	Roll Roofing,Roofing Material,Roofing Material 1a Sample B,Loc:1,Roof Sections 1A and 1B
S	0001	C	Roll Roofing,Roofing Material,Roofing Material 1a Roof1b Roof,Loc:1,Roof Sections 1B
S	0002	A	Caulking,Flashing Caulking Roof 1a,Loc:1,Roof Sections 1A and 1B ND
S	0002	B	Caulking,Flashing Caulking Roof 1a,Loc:1,Roof Sections 1A and 1B ND
S	0002	C	Caulking,Flashing Caulking Roof 1b,Loc:1,Roof Sections 1A and 1B ND
S	0003	A	Caulking,Grey Caulking Over Black Ahu Conduit Isolation,Loc:1,Roof Sections 1A and 1B a)ND b)ND

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Sample Prefix	Sample No.	Sample Suffix	Sample Description/Location (Mandatory)
S	0003	B	Caulking,Grey Caulking Over Black Ahu Conduit Isolation,Loc:1,Roof Sections 1A and 1B a)ND b)ND
S	0003	C	Caulking,Grey Caulking Over Black Ahu Conduit Isolation,Loc:1,Roof Sections 1A and 1B a)ND b)ND
S	0004	A	Duct,Mastic, Grey,A-c Gre Ymastic With Gold Flake Exhaust,Loc:1,Roof Sections 1A and 1B ND
S	0004	B	Duct,Mastic, Grey,Grey Mastic With Gold Flake Exhaust,Loc:1,Roof Sections 1A and 1B ND
S	0004	C	Duct,Mastic, Grey,Grey Mastic With Gold Flake Exhaust,Loc:1,Roof Sections 1A and 1B ND

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Pinchin Ltd. Asbestos Laboratory
Certificate of Analysis

Project Name:	**Kawartha Pine Ridge District School Board**		
Project No.:	**0349417.021**		
Prepared For:	**C. Reynolds**		
Lab Reference No.:	**b329811**		
Analyst(s):	**K. Cockburn**		
Date Received:	**December 24, 2024**	**Samples Submitted:**	**3**
Date Analyzed:	**January 9, 2025**	**Phases Analyzed:**	**6**

The Pinchin Ltd. Mississauga asbestos laboratory is accredited by the National Institute of Standards and Technology, National Voluntary Laboratory Accreditation Program (NVLAP Lab Code 101270-0) for the 'EPA – 40 CFR Appendix E to Subpart E of Part 763, Interim Method of the Determination of Asbestos in Bulk Insulation Samples,' and the 'EPA 600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials'; and meets all requirements of ISO/IEC 17025:2017. The Pinchin asbestos laboratory uses the aforementioned methods of analysis for all bulk materials. Please be advised that bulk materials do not include debris, dust, and tape-lift samples, and the analysis and reporting of these materials does not conform with Pinchin Ltd.'s NVLAP accreditation.

Bulk samples are checked visually and scanned under a stereomicroscope. Slides are prepared and observed under a Polarized Light Microscope (PLM) at magnifications of 40X, 100X or 400X as appropriate. Asbestos fibres are identified by a combination of morphology, colour, refractive index, extinction, sign of elongation, birefringence and dispersion staining colours. A visual estimate is made of the percentage of asbestos present. A reported concentration of less than (<) the regulatory threshold indicates the presence of confirmed asbestos in trace quantities, limited to only a few fibres or fibre bundles in an entire sample. This method complies with provincial regulatory requirements where applicable. Multiple phases within a sample are analyzed and reported separately.

All bulk samples submitted to this laboratory for asbestos analysis are retained for a minimum of three months. Samples may be retrieved, upon request, for re-examination at any time during that period.

This report relates only to the items tested.

Pinchin Ltd. Asbestos Laboratory
Certificate of Analysis

Project Name: Kawartha Pine Ridge District School Board
Project No.: 0349417.021
Prepared For: C. Reynolds

Lab Reference No.: b329811
Date Analyzed: January 9, 2025

BULK SAMPLE ANALYSIS

SAMPLE IDENTIFICATION	SAMPLE DESCRIPTION	% COMPOSITION (VISUAL ESTIMATE)	
		ASBESTOS	OTHER
S0010A Caulking,Caulking In Expansion Joints,Loc:2,Mechanical Room	2 Phases: a) Homogeneous, beige, caulking material. b) Homogeneous, grey, hard, cementitious material.	None Detected None Detected	Non-Fibrous Material > 75% Non-Fibrous Material > 75%
S0010B Caulking,Caulking In Expansion Joints,Loc:2,Mechanical Room	2 Phases: a) Homogeneous, beige, caulking material. b) Homogeneous, grey, hard, cementitious material.	None Detected None Detected	Non-Fibrous Material > 75% Non-Fibrous Material > 75%
Comments:	Phase b) is small in size.		
S0010C Caulking,Caulking In Expansion Joints,Loc:2,Mechanical Room	2 Phases: a) Homogeneous, beige, caulking material. b) Homogeneous, grey, hard, cementitious material.	None Detected None Detected	Non-Fibrous Material > 75% Non-Fibrous Material > 75%
Comments:	Phase b) is small in size.		

Reviewed by:

Digitally signed by Pinchin Ltd.
Date: 2025.01.09 16:18:14-05'00'

Reporting Analyst:

Digitally signed by Pinchin Ltd.
Date: 2025.01.09 16:20:34-05'00'

Analyzed by:
Reviewed by:
Report Sent by:

Pinchin Ltd. - Asbestos Laboratory
Internal Asbestos Bulk Sample Chain of Custody

Special Instructions:

Client Name:	Kawartha Pine Ridge District School Board	**Project Address:**	ON
Portfolio/Building No:		**Pinchin File:**	349417.021
Submitted by:	Cole Reynolds	**Email:**	ccreynolds@pinchin.com
CC Results to:	Cal Cathcart	**CC Email:**	ccathcart@pinchin.com
Date Submitted:	December 23 2024	**Required by:**	January 2 2024
# of Samples:	3	**Priority:**	5 Day Turnaround
Year of Building Construction (*Mandatory, Years ONLY*):		1998	
Do NOT Stop on Positive (Sample Numbers):			
Pinchin Group Company (*Mandatory Field*):		Pinchin	
HMIS2 Building Reference #:		143944/2024112028332118	
To be Completed by Lab Personnel Only:	b329811		
Lab Reference #:		**Time:**	24 hour clock
Received by:	DEC 24 2024	**Date:**	Month Day Year
Name(s) of Analyst(s):			2025:01:09

Sample Prefix	Sample No.	Sample Suffix	Sample Description/Location (Mandatory)
S	0010	A	Caulking,Caulking In Expansion Joints,Loc:2,Mechanical Room a) ND b) ND
S	0010	B	Caulking,Caulking In Expansion Joints,Loc:2,Mechanical Room a) ND b) ND
S	0010	C	Caulking,Caulking In Expansion Joints,Loc:2,Mechanical Room a) ND b) ND

APPENDIX II-B
Lead Analytical Certificates

Your Project #: 349417.021
Your C.O.C. #: N/A

Attention: Cole Reynolds

Pinchin Ltd
2360 Meadowpine Blvd
Unit # 2
Mississauga, ON
CANADA L5N 6S2

Report Date: 2025/01/02
Report #: R8465114
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4BR667
Received: 2024/12/24, 10:10

Sample Matrix: Paint
Samples Received: 6

Analyses	Quantity	Date Extracted	Date Analyzed	Laboratory Method	Analytical Method
Metals in Paint	6	2025/01/02	2025/01/02	CAM SOP-00408	EPA 6010D m

Remarks:

Bureau Veritas is accredited to ISO/IEC 17025 for specific parameters on scopes of accreditation. Unless otherwise noted, procedures used by Bureau Veritas are based upon recognized Provincial, Federal or US method compendia such as CCME, EPA, APHA or the Quebec Ministry of Environment.

All work recorded herein has been done in accordance with procedures and practices ordinarily exercised by professionals in Bureau Veritas' profession using accepted testing methodologies, quality assurance and quality control procedures (except where otherwise agreed by the client and Bureau Veritas in writing). All data is in statistical control and has met quality control and method performance criteria unless otherwise noted. All method blanks are reported; unless indicated otherwise, associated sample data are not blank corrected. Where applicable, unless otherwise noted, Measurement Uncertainty has not been accounted for when stating conformity to the referenced standard.

Bureau Veritas liability is limited to the actual cost of the requested analyses, unless otherwise agreed in writing. There is no other warranty expressed or implied. Bureau Veritas has been retained to provide analysis of samples provided by the Client using the testing methodology referenced in this report. Interpretation and use of test results are the sole responsibility of the Client and are not within the scope of services provided by Bureau Veritas, unless otherwise agreed in writing. Bureau Veritas is not responsible for the accuracy or any data impacts, that result from the information provided by the customer or their agent.

Solid sample results, except biota, are based on dry weight unless otherwise indicated. Organic analyses are not recovery corrected except for isotope dilution methods.
Results relate to samples tested. When sampling is not conducted by Bureau Veritas, results relate to the supplied samples tested.

Reference Method suffix “m” indicates test methods incorporate validated modifications from specific reference methods to improve performance.
* RPDs calculated using raw data. The rounding of final results may result in the apparent difference.

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Your Project #: 349417.021
Your C.O.C. #: N/A

Attention: Cole Reynolds

Pinchin Ltd
2360 Meadowpine Blvd
Unit # 2
Mississauga, ON
CANADA L5N 6S2

Report Date: 2025/01/02
Report #: R8465114
Version: 1 - Final

CERTIFICATE OF ANALYSIS

BUREAU VERITAS JOB #: C4BR667
Received: 2024/12/24, 10:10

Encryption Key

Please direct all questions regarding this Certificate of Analysis to:
Nilushi Mahathantila, Project Manager
Email: Nilushi.Mahathantila@bureauveritas.com
Phone# (905) 817-5700

==========

This report has been generated and distributed using a secure automated process.
Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Rodney Major, General Manager responsible for Ontario Environmental laboratory operations.

Bureau Veritas Job #: C4BR667
Report Date: 2025/01/02

Pinchin Ltd
Client Project #: 349417.021
Sampler Initials: CR

ELEMENTS BY ATOMIC SPECTROSCOPY (PAINT)

Bureau Veritas ID		AMPQ01			AMPQ02			
Sampling Date		2024/12/23 12:00			2024/12/23 12:00			
COC Number		N/A			N/A			
	UNITS	L0001, WALL, CONCRETE (POURED), BEIGE PAINT ON MASONRY, LOC:	RDL	MDL	L0002, DUCT, METAL, BEIGE PAINT ON METAL DUCTS, LOC:2, MECHANICAL	RDL	MDL	QC Batch
Metals								
Lead (Pb)	%	0.00088	0.00010	0.000030	0.12	0.00036	0.00011	9853332

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Bureau Veritas ID		AMPQ03			AMPQ04			
Sampling Date		2024/12/23 12:00			2024/12/23 12:00			
COC Number		N/A			N/A			
	UNITS	L0003, FLOOR, CONCRETE (POURED), GREY PAINT ON CONCRETE FLOO	RDL	MDL	L0004, STRUCTURE, CONCRETE (PRECAST), WHITE PAINT ON CEILING,	RDL	MDL	QC Batch
Metals								
Lead (Pb)	%	0.024	0.00024	0.000072	0.73	0.0031	0.00093	9853332

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

Bureau Veritas ID		AMPQ05			AMPQ06			
Sampling Date		2024/12/23 12:00			2024/12/23 12:00			
COC Number		N/A			N/A			
	UNITS	L0005, PIPING, METAL, LIGHT GREEN PAINT ON PIPES, LOC:2, MECHANICAL	RDL	MDL	L0006, OTHER, METAL, GREEN PAINT ON DOORS, LOC:2, MECHANICAL	RDL	MDL	QC Batch
Metals								
Lead (Pb)	%	0.0071	0.00061	0.00018	0.0042	0.00094	0.00028	9853332

RDL = Reportable Detection Limit
QC Batch = Quality Control Batch

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TEST SUMMARY

Bureau Veritas ID: AMPQ01 **Collected:** 2024/12/23
Sample ID: L0001, WALL, CONCRETE (POURED), BEIGE PAINT ON MASONRY, LOC: **Shipped:**
Matrix: Paint **Received:** 2024/12/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	9853332	2025/01/02	2025/01/02	Jolly John

Bureau Veritas ID: AMPQ02 **Collected:** 2024/12/23
Sample ID: L0002, DUCT, METAL, BEIGE PAINT ON METAL DUCTS, LOC:2, MECHANICAL **Shipped:**
Matrix: Paint **Received:** 2024/12/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	9853332	2025/01/02	2025/01/02	Jolly John

Bureau Veritas ID: AMPQ03 **Collected:** 2024/12/23
Sample ID: L0003, FLOOR, CONCRETE (POURED), GREY PAINT ON CONCRETE FLOO **Shipped:**
Matrix: Paint **Received:** 2024/12/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	9853332	2025/01/02	2025/01/02	Jolly John

Bureau Veritas ID: AMPQ04 **Collected:** 2024/12/23
Sample ID: L0004, STRUCTURE, CONCRETE (PRECAST), WHITE PAINT ON CEILING, **Shipped:**
Matrix: Paint **Received:** 2024/12/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	9853332	2025/01/02	2025/01/02	Jolly John

Bureau Veritas ID: AMPQ05 **Collected:** 2024/12/23
Sample ID: L0005, PIPING, METAL, LIGHT GREEN PAINT ON PIPES, LOC:2, MECHANICAL **Shipped:**
Matrix: Paint **Received:** 2024/12/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	9853332	2025/01/02	2025/01/02	Jolly John

Bureau Veritas ID: AMPQ06 **Collected:** 2024/12/23
Sample ID: L0006, OTHER, METAL, GREEN PAINT ON DOORS, LOC:2, MECHANICAL **Shipped:**
Matrix: Paint **Received:** 2024/12/24

Test Description	Instrumentation	Batch	Extracted	Date Analyzed	Analyst
Metals in Paint	ICP	9853332	2025/01/02	2025/01/02	Jolly John

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GENERAL COMMENTS

Sample AMPQ02 [L0002, DUCT, METAL, BEIGE PAINT ON METAL DUCTS, LOC:2, MECHANICAL] : Metals Analysis: Due to limited amount of sample available for analysis, a smaller than usual portion of the sample was used. Detection limits were adjusted accordingly.

Sample AMPQ03 [L0003, FLOOR, CONCRETE (POURED), GREY PAINT ON CONCRETE FLOO] : Metals Analysis: Due to limited amount of sample available for analysis, a smaller than usual portion of the sample was used. Detection limits were adjusted accordingly.

Sample AMPQ04 [L0004, STRUCTURE, CONCRETE (PRECAST), WHITE PAINT ON CEILING,] : Metals Analysis: Due to limited amount of sample available for analysis, a smaller than usual portion of the sample was used. Detection limits were adjusted accordingly.

Sample AMPQ05 [L0005, PIPING, METAL, LIGHT GREEN PAINT ON PIPES, LOC:2, MECHANICAL] : Metals Analysis: Due to limited amount of sample available for analysis, a smaller than usual portion of the sample was used. Detection limits were adjusted accordingly.

Sample AMPQ06 [L0006, OTHER, METAL, GREEN PAINT ON DOORS, LOC:2, MECHANICAL] : Metals Analysis: Due to limited amount of sample available for analysis, a smaller than usual portion of the sample was used. Detection limits were adjusted accordingly.

Results relate only to the items tested.

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Bureau Veritas Job #: C4BR667
Report Date: 2025/01/02

QUALITY ASSURANCE REPORT

Pinchin Ltd
Client Project #: 349417.021
Sampler Initials: CR

			Matrix Spike		Method Blank		RPD		QC Standard	
QC Batch	**Parameter**	**Date**	**% Recovery**	**QC Limits**	**Value**	**UNITS**	**Value (%)**	**QC Limits**	**% Recovery**	**QC Limits**
9853332	Lead (Pb)	2025/01/02	NC	75 - 125	<0.00010	%	1.5	35	104	75 - 125

Duplicate: Paired analysis of a separate portion of the same sample. Used to evaluate the variance in the measurement.

Matrix Spike: A sample to which a known amount of the analyte of interest has been added. Used to evaluate sample matrix interference.

QC Standard: A sample of known concentration prepared by an external agency under stringent conditions. Used as an independent check of method accuracy.

Method Blank: A blank matrix containing all reagents used in the analytical procedure. Used to identify laboratory contamination.

NC (Matrix Spike): The recovery in the matrix spike was not calculated. The relative difference between the concentration in the parent sample and the spike amount was too small to permit a reliable recovery calculation (matrix spike concentration was less than the native sample concentration)

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Bureau Veritas Job #: C4BR667
Report Date: 2025/01/02

Pinchin Ltd
Client Project #: 349417.021
Sampler Initials: CR

VALIDATION SIGNATURE PAGE

The analytical data and all QC contained in this report were reviewed and validated by:

Cristina Carriere

Cristina Carriere, Senior Scientific Specialist

Bureau Veritas has procedures in place to guard against improper use of the electronic signature and have the required "signatories", as per ISO/IEC 17025, signing the reports. For Service Group specific validation, please refer to the Validation Signatures page if included, otherwise available by request. For Department specific Analyst/Supervisor validation names, please refer to the Test Summary section if included, otherwise available by request. This report is authorized by Rodney Major, General Manager responsible for Ontario Environmental laboratory operations.

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C4BR667
2024/12/24 10:10

NONT-2024-12-4897

6740 Campobello Road, Mississauga, Ontario L5N 2L8
Phone: 905-817-5700 Fax: 905-817-5779 Toll Free: 800-563-6266
CAM FCD-01191/6

RECORD

Invoice Information	Report Information (if differs from invoice)	Project Information (where applicable)	Turnaround Time (TAT) Required
Company Name: Pinchin Ltd.	Company Name:	Quotation #:	[x] Regular TAT (5-7 days) Most analyses
Contact Name: Cole Reynolds; Cal Cathcart	Contact Name:	P.O. #/ AFE#:	PLEASE PROVIDE ADVANCE NOTICE FOR RUSH PROJECTS
Address:	Address:	Project #: 349417.021	Rush TAT (Surcharges will be applied)
		Site Location:	[ ] 1 Day [ ] 2 Days [ ] 3-4 Days
Phone: Fax:	Phone: Fax:	Site #:	
Email: ccreynolds@pinchin.com; ccathcart@pinchin.com	Email:	Site Location Province: ____ ON	Date Required:
MOE REGULATED DRINKING WATER OR WATER INTENDED FOR HUMAN CONSUMPTION MUST BE SUBMITTED ON THE BUREAU VERITAS DRINKING WATER CHAIN OF CUSTODY		Sampled By: Cole Reynolds	Rush Confirmation #:

Regulation 153	Other Regulations
[ ] Table 1 [ ] Res/Park [ ] Med/ Fine	[ ] CCME [ ] Sanitary Sewer Bylaw
[ ] Table 2 [ ] Ind/Comm [ ] Coarse	[ ] MISA [ ] Storm Sewer Bylaw
[ ] Table 3 [ ] Agri/ Other	[ ] PWQO Region ____
[ ] Table ____	[ ] Other (Specify) ____
FOR RSC (PLEASE CIRCLE) Y / N	[ ] REG 558 (MIN. 3 DAY TAT REQUIRED)
	[ ] REG 406 Table ____

Include Criteria on Certificate of Analysis: Y / N

SAMPLES MUST BE KEPT COOL (< 10 °C) FROM TIME OF SAMPLING UNTIL DELIVERY TO BUREAU VERITAS

SAMPLE IDENTIFICATION	DATE SAMPLED (YYYY/MM/DD)	TIME SAMPLED (HH:MM)	MATRIX	# OF CONTAINERS SUBMITTED	FIELD FILTERED (CIRCLE) Metals / Hg / CrVI	BTEX/ PHC F1	PHCs F2 - F4	VOCs	REG 153 METALS & INORGANICS	REG 153 ICPMS METALS	REG 153 METALS (Hg, Cr VI, ICPMS Metals, HWS - B)	Lead (Pb) in Paints	PCBs	HOLD- DO NOT ANALYZE
L0001, Wall, Concrete (poured), Beige Paint On Masonry,Loc:	2024-12-23	12:00	BULK									x		
L0002, Duct, Metal, Beige Paint On Metal Ducts,Loc:2,Mecha	2024-12-23	12:00	BULK									x		
L0003, Floor, Concrete (poured), Grey Paint On Concrete Floo	2024-12-23	12:00	BULK									x		
L0004, Structure, Concrete (precast), White Paint On Ceiling,L	2024-12-23	12:00	BULK									x		
L0005, Piping, Metal, Light Green Paint On Pipes,Loc:2,Mecha	2024-12-23	12:00	BULK									x		
L0006, Other, Metal, Green Paint On Doors,Loc:2,Mechanical	2024-12-23	12:00	BULK									x		

LABORATORY USE ONLY

CUSTODY SEAL Y / N		COOLER TEMPERATURES
Present	Intact	

COOLING MEDIA PRESENT: Y / N

COMMENTS

RELINQUISHED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	RECEIVED BY: (Signature/Print)	DATE: (YYYY/MM/DD)	TIME: (HH:MM)	BV JOB #
Cole Reynolds	2024-12-23	12:00		24/12/24	10:10	

APPENDIX III
Methodology

1.0 GENERAL

An investigation was conducted to identify the type of Hazardous Building Materials incorporated in the structure and its finishes.

Information regarding the location and condition of hazardous building materials encountered and visually estimated quantities were recorded. The locations of any samples collected were recorded on small-scale plans. As-built drawings and previous reports were referenced where provided.

Sample collection was conducted in accordance with our Standard Operating Procedures.

1.1 Asbestos

The investigation for asbestos included friable and non-friable asbestos-containing materials (ACM). A friable material is a material that when dry can be crumbled, pulverized or powdered by hand pressure, or a material that has already become crushed, pulverized, or powdered.

A separate set of samples was collected of each type of homogenous material suspected to contain asbestos. A homogenous material is defined by the US EPA as material that is uniform in texture and appearance, was installed at one time, and is unlikely to consist of more than one type or formulation of material. The homogeneous materials were determined by visual examination and available information on the phases of construction and prior renovations.

Samples were collected at a rate that is in compliance with the requirements of local regulations and guidelines. The sampling strategy was also based on known ban dates and phase out dates of the use of asbestos; sampling of certain building materials is not conducted after specific construction dates. In addition, to be conservative, several years past these dates are added to account for some uncertainty in the exact start / finish date of construction and associated usage of ACM. In some cases, manufactured products such as asbestos cement pipe were visually identified without sample confirmation.

The asbestos analysis of select materials was completed using a stop-positive approach. Only one result meeting the regulated criteria was required to determine that a material is asbestos-containing, but all samples must be analyzed to conclusively determine that a material is non-asbestos. The laboratory stopped analyzing samples from a homogeneous material once a result equal to or greater than the regulated criteria is detected in any of the samples of that material. All samples of a homogeneous material were analyzed if no asbestos is detected. In some cases, all samples were analyzed in the sample set regardless of result.

The analysis was performed in accordance with Test Method EPA/600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials, July 1993.

Analytical results were compared to the following criteria:

Jurisdiction	Friable	Non-Friable
Ontario	0.5%	0.5%

Where building materials are described in the report as “non-asbestos” or “does not contain asbestos”, this means that either no asbestos was detected by the analytical method utilized in any of the multiple samples or, if detected, it is below the lower limit of an asbestos-containing material in the applicable regulation. Additionally, these terms are used for materials which historically are known to not include asbestos in their manufacturing.

Asbestos materials were evaluated in order to make recommendations regarding any remedial work. The priority for remedial action was based on several factors:

- Friability (friable or non-friable)
- Condition (good, fair, poor, debris)
- Accessibility (ranking from accessible to all building users to inaccessible)
- Visibility (whether the material is obscured by other building components)
- Efficiency of the work (for example, if damaged ACM is being removed in an area, it may be most practical to remove all ACM in the area even if it is in good condition)

1.2 Lead

Samples of distinctive paint finishes, and surface coatings present in more than a limited application, where removal of the paint is possible were collected. The samples were collected by scraping the painted finish to include base and covering applications.

Analysis for lead in paints or surface coatings was performed in accordance with EPA Method No. 3050B/Method No. 7420; flame atomic absorption.

Analytical results were compared to the following criteria:

Jurisdiction	Units (%)	Units (ppm) / (mg/kg)
Ontario	0.009	90

Other lead building products (e.g. batteries, lead sheeting, flashing) were identified by visual observation only.

1.3 Silica

Building materials known to contain crystalline silica (e.g. concrete, cement, tile, brick, masonry, mortar) were identified by visual inspection only. Pinchin did not perform sampling of these materials for laboratory analysis of crystalline silica content.

1.4 Mercury

Building materials, products or equipment (e.g. thermostats, barometers, pressure gauges, lamp tubes), suspected to contain mercury were identified by visual inspection only. Dismantling of equipment suspected of containing mercury was not performed. Sampling of these materials for laboratory analysis of mercury content was not performed.

1.5 Polychlorinated Biphenyls

The potential for light ballast and oil filled transformers to contain PCBs was based on the age of the building, a review of maintenance records, and examination of labels or nameplates on equipment, where present and accessible. The information was compared to known ban dates of PCBs and Environment Canada publications.

Dry type transformers were presumed to be free of dielectric fluids and hence non-PCB.

Fluids (mineral oil, hydraulic, Aroclor or Askarel) in transformers or other equipment were not sampled for PCB content.

1.6 Visible Mould

The presence of mould or water damage was determined by visual inspection of exposed building surfaces. If any mould growth or water damage was concealed within building cavities it was not addressed in this assessment.

APPENDIX IV
Location Summary Report

HMIS
HAZARDOUS MATERIALS INVENTORY SYSTEM

LOCATIONS LIST

PINCHIN
1.855.PINCHIN www.pinchin.com

Client:Kawartha Pine Ridge District School Board **Site: 80 Avondale Drive, Courtice, ON**
Building Name: Lydia Trull Public School
Survey Date: **Last Re-Assessment:**
Building Phases: A: 1998

Location No.	Name or Description	Area ft²	Floor No.	Bldg. Phase	Notes
1	Roof Sections 1A and 1B	20000		A	
2	Mechanical Room, room no. 216	1000	2	A	

APPENDIX V
Hazardous Materials Summary Report / Sample Log

HMIS
HAZARDOUS MATERIALS INVENTORY SYSTEM

HAZARDOUS MATERIALS SUMMARY / SAMPLE LOG

PINCHIN
1.855.PINCHIN www.pinchin.com

Client:Kawartha Pine Ridge District School Board **Site: 80 Avondale Drive, Courtice, ON** **Building Name: Lydia Trull Public School** **Survey Date:**

HAZMAT	Sample No	System/Component/Material/Sample Description	Locations	Bldg. Phase	LF	SF	EA	%	Type	Positive	Friability
Asbestos	S0001 ABC	Other | Roll Roofing | Roofing Material | Roofing Material 1a Roof1b Roof	1	A	0	20000	0	0	None Detected	No	
Asbestos	S0002 ABC	Other | | Caulking | Flashing Caulking Roof 1a	1	A	140	0	0	0	None Detected	No	
Asbestos	S0003 ABC	Other | | Caulking | Grey Caulking Over Black Ahu Conduit Isolation	1	A	0	4	0	0	None Detected	No	
Asbestos	S0004 ABC	Duct | | Mastic, Grey | A-c Grey Mastic With Gold Flake Exhaust	1	A	0	60	0	0	None Detected	No	
Asbestos	S0005 ABC	Other | | Caulking | White/beige Caulking	2	A	30	0	0	0	None Detected	No	
Asbestos	S0006 ABC	Other | | Firestopping (mastic) | Grey Firestopping	2	A	0	25	0	0	None Detected	No	
Asbestos	S0007 ABC	Other | | Caulking | Grey Caulking On Door Frame	2	A	25	0	0	0	None Detected	No	
Asbestos	S0008 ABC	Other | | Firestopping (mastic) | Grey Fireproofing	3	A	20	0	0	0	None Detected	No	
Asbestos	S0009 ABC	Other | | Caulking | Beige Caulking	3	A	45	0	0	0	None Detected	No	
Asbestos	S0010 ABC	Other | | Caulking | Grey Caulking In Expansion Joints	2	A	10	0	0	0	None Detected	No	
Asbestos	V9500	Other | Louver | Caulking | Caulking	1	A	60	0	0	0	Presumed Asbestos	Yes	NF
Asbestos	V0000	Duct | Duct Connector | Rubber | Black Rubber Vibration Damper	2	A	0	0	2	0	Non Asbestos	No	
Asbestos	V0000	Mechanical Equipment | Unit Heater | Not Insulated |	2	A	0	0	2	0	Non Asbestos	No	
Asbestos	V0000	Wall | | Paint |	2,3	A	0	4000	0	0	Non Asbestos	No	
Asbestos	V0000	Wall | | Vermiculite Investigation |	2	A	0	0	3	0	Non Asbestos	No	
Paint	L0001	Wall | Concrete (poured) | Beige Paint On Masonry	2	A	0	2500	0	0		No	-
Paint	L0002	Duct | Metal | Beige Paint On Metal Ducts	2	A	0	500	0	0	Lead (High)	Yes	-
Paint	L0003	Floor | Concrete (poured) | Grey Paint On Concrete Floor	2	A	0	1000	0	0	Lead (Low)	Yes	-
Paint	L0004	Structure | Concrete (precast) | White Paint On Ceiling	2	A	0	1000	0	0	Lead (High)	Yes	-
Paint	L0005	Piping | Metal | Light Green Paint On Pipes	2	A	0	30	0	0		No	-
Paint	L0006	Other | Metal | Green Paint On Doors	2	A	0	40	0	0		No	-
Paint	V9500	Mechanical Equipment | Paint |	3	A	0	500	0	0	Presumed Lead	Yes	-
Paint	V9500	Other | Metal | Paint	1	A	0	0	1	0	Presumed Lead	Yes	-
Paint	V9500	Wall | Paint |	3	A	0	1500	0	0	Presumed Lead	Yes	-
Lead Product	V9500	Batteries In Emer. Lights	2	A	0	0	1	0	Presumed Lead Product	Yes	-

HAZARDOUS MATERIALS SUMMARY / SAMPLE LOG

HAZMAT	Sample No	System/Component/Material/Sample Description	Locations	Bldg. Phase	LF	SF	EA	%	Type	Positive	Friability
Hg	V9000	Light Fixture	2,3	A	0	0	30	0	Hg	Yes	-
Hg	V0000	Manometer	2	A	0	0	6	0	-	No	-

Legend:

Sample number	
S####	Asbestos sample collected
L####	Paint sample collected
P####	PCB sample collected
M####	Mould sample collected
V####	Material visually similar to numbered sample collected
V0000	Known non Hazardous Material
V9000	Material is visually identified as Hazardous Material
V9500	Material is presumed to be Hazardous Material
[Loc. No.]	Abated Material

Units	
SF	Square feet
LF	Linear feet
EA	Each
%	Percentage

NF	Non Friable material.
F	Friable material
PF	Potentially Friable material

APPENDIX VI
All Data Report

HMIS
HAZARDOUS MATERIALS INVENTORY SYSTEM

ALL DATA REPORT

PINCHIN
1.855.PINCHIN www.pinchin.com

Client: Kawartha Pine Ridge District School Board **Site: 80 Avondale Drive, Courtice, ON** **Building Name: Lydia Trull Public School**
Location: #1 : Roof Sections 1A and 1B **Floor:** **Room #:** **Area (sqft): 20000**
Survey Date: 2024-12-20 **Last Re-Assessment: 0000-00-00**

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Duct		Mastic, Grey, Grey mastic with gold flake exhaust			C	Y		60			SF	S0004ABC	None Detected	N.D.	None	
Other		Caulking, Grey caulking over black ahu conduit isolation			C	Y		4			SF	S0003ABC	None Detected	N.D.	None	
Other		Caulking, Flashing caulking Roof 1A			C	Y		140			LF	S0002ABC	None Detected	N.D.	None	
Other[1]	Louver	Caulking, Caulking			C	Y		60(7)			LF	V9500	Presumed Asbestos		Presumed Asbestos	NF
Other[2]	Roll Roofing	Roofing material, Roofing Material 1A roof1B roof			C	Y		20000			SF	S0001ABC	None Detected	N.D.	None	
Structure	Deck	Concrete (precast)														

1 - Caulking On Louver From Mechanical Room
2 - Roof 1a

Client: Kawartha Pine Ridge District School Board **Site: 80 Avondale Drive, Courtice, ON** **Building Name: Lydia Trull Public School**
Location: #1 : Roof Sections 1A and 1B **Floor:** **Room #:** **Area (sqft): 20000**
Survey Date: 2024-12-20 **Last Re-Assessment: 0000-00-00**

PAINT								
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard
Other[1]	Metal	600		LF		Beige metal flashing		No
Other[2]	Metal	1		EA	V9500	Paint		Presumed Lead

1 - Flashing
2 - Paint on Louver From Mechanical Room

Client: Kawartha Pine Ridge District School Board **Site: 80 Avondale Drive, Courtice, ON** **Building Name: Lydia Trull Public School**
Location: #2 : Mechanical Room **Floor: 2** **Room #: 216** **Area (sqft): 1000**
Survey Date: 2024-12-23 **Last Re-Assessment: 0000-00-00**

ASBESTOS

System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	All	None Found														
Duct	All	Not Insulated														
Duct	Duct Connector	Rubber, Black rubber vibration damper			C	Y		2			EA	V0000	Non-Asbestos		None	
Floor	All	Concrete (poured)			B	Y		1000			SF					
Mechanical Equipment	Air Handling Unit	Not Insulated		Metal	B	Y		4			EA					
Mechanical Equipment	Unit Heater	Not Insulated			B	Y		2			EA	V0000	Non-Asbestos		None	
Other		Caulking, White/beige caulking			B	Y		30			LF	S0005ABC	None Detected	N.D.	None	
Other[1]		Caulking, Grey caulking on door frames			B	Y		25			LF	S0007ABC	None Detected	N.D.	None	
Other		Caulking, Caulking in expansion joints			B	Y		10			LF	S0010ABC	None Detected	N.D.	None	
Other		Firestopping (mastic), Grey firestopping			B	Y		25			SF	S0006ABC	None Detected	N.D.	None	
Piping		Fibreglass, Fiberglass insulated		Canvas	B	Y										
Piping		Armaflex			B	Y										
Piping		Not Insulated			B	Y										
Structure	All	Concrete (precast)			C	Y		1000			SF					
Wall[2]		Paint			B	Y		2500			SF	V0000	Non-Asbestos		None	
Wall		Vermiculite Investigation			B	Y		3			EA	V0000	Non-Asbestos		None	
Wall	All	Masonry			B	Y		2500			SF					

1 - Grey Caulking
2 - Paint on masonry (concrete block) walls

Client: Kawartha Pine Ridge District School Board **Site: 80 Avondale Drive, Courtice, ON** **Building Name: Lydia Trull Public School**
Location: #2 : Mechanical Room **Floor: 2** **Room #: 216** **Area (sqft): 1000**
Survey Date: 2024-12-23 **Last Re-Assessment: 0000-00-00**

PAINT

System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard
Wall	Concrete (poured)	2500		SF	L0001	Beige paint on masonry	Pb: 0.00088 %	No
Duct	Metal	500		SF	L0002	Beige paint on metal ducts	Pb: 0.12 %	Lead (High)
Floor	Concrete (poured)	1000		SF	L0003	Grey paint on concrete floor	Pb: 0.024 %	Lead (Low)
Structure	Concrete (precast)	1000		SF	L0004	White paint on ceiling	Pb: 0.73 %	Lead (High)
Piping	Metal	30		SF	L0005	Light green paint on pipes	Pb: 0.0071 %	No
Other	Metal	40		SF	L0006	Green paint on doors	Pb: 0.0042 %	No

Client: Kawartha Pine Ridge District School Board **Site: 80 Avondale Drive, Courtice, ON** **Building Name: Lydia Trull Public School**
Location: #2 : Mechanical Room **Floor: 2** **Room #: 216** **Area (sqft): 1000**
Survey Date: 2024-12-23 **Last Re-Assessment: 0000-00-00**

PB PRODUCTS

Component	Quantity	Unit	Sample	Hazard
Batteries In Emer. Lights	1	EA	V9500	Presumed

Client: Kawartha Pine Ridge District School Board **Site: 80 Avondale Drive, Courtice, ON** **Building Name: Lydia Trull Public School**
Location: #2 : Mechanical Room **Floor: 2** **Room #: 216** **Area (sqft): 1000**
Survey Date: 2024-12-23 **Last Re-Assessment: 0000-00-00**

MERCURY				
Component	**Quantity**	**Unit**	**Sample**	**Hazard**
Light Fixture[1]	24	EA	V9000	Yes
Manometer[2]	6	EA	V0000	

1 - T8
2 - Non-mercury fluid

Client: Kawartha Pine Ridge District School Board **Site: 80 Avondale Drive, Courtice, ON** **Building Name: Lydia Trull Public School**
Location: #3 : Boiler Room **Floor: 1** **Room #: 128** **Area (sqft): 500**
Survey Date: 2024-12-20 **Last Re-Assessment: 0000-00-00**

ASBESTOS																
System	Component	Material	Item	Covering	A*	V*	AP*	Good	Fair	Poor	Unit	Sample	Asbestos Type	Amount	Hazard	Friable
Ceiling	All	None Found			C	Y		500			SF					
Floor	All	Concrete (poured)			A	Y		500			SF					
Mechanical Equipment[1]	Boiler	Not Insulated		Metal												
Other[2]		Caulking, Beige caulking			A	Y		45			LF	S0009ABC	None Detected	N.D.	None	
Other		Firestopping (mastic), Grey fireproofing			A	Y		20			LF	S0008ABC	None Detected	N.D.	None	
Piping	All	Metal		Fibreglass												
Structure[3]	All	Masonry			C	Y		500			SF					
Wall[4]		Paint			B	Y		1500			SF	V0000	Non-Asbestos		None	
Wall[5]	All	Masonry			A	Y		1500								

1 - Insulation may be present in the interior of the boiler.
2 - beige caulking around door frame
3 - concrete block
4 - Paint on masonry (concrete block) walls
5 - conocrete block

Client: Kawartha Pine Ridge District School Board **Site: 80 Avondale Drive, Courtice, ON** **Building Name: Lydia Trull Public School**
Location: #3 : Boiler Room **Floor: 1** **Room #: 128** **Area (sqft): 500**
Survey Date: 2024-12-20 **Last Re-Assessment: 0000-00-00**

PAINT								
System	Item	Good	Poor	Unit	Sample	Sample Description	Amount	Hazard
Wall	Paint	1500		SF	V9500			Presumed Lead
Mechanical Equipment[1]	Paint	500		SF	V9500			Presumed Lead

1 - painted metal equipment

Client: Kawartha Pine Ridge District School Board **Site: 80 Avondale Drive, Courtice, ON** **Building Name: Lydia Trull Public School**
Location: #3 : Boiler Room **Floor: 1** **Room #: 128** **Area (sqft): 500**
Survey Date: 2024-12-20 **Last Re-Assessment: 0000-00-00**

MERCURY				
Component	Quantity	Unit	Sample	Hazard
Light Fixture	6	EA	V9000	Yes

Legend:

Sample number	
S####	Asbestos sample collected
L####	Paint sample collected
P####	PCB sample collected
M####	Mould sample collected
V####	Material is visually identified to be identical to S####
V0000	Known non hazardous material
V9000	Material visually identified as a Hazardous Material
V9500	Material is presumed to be a hazardous material

Units	
SF	Square feet
LF	Linear feet
EA	Each
%	Percentage
LF	Linear feet

Other	
A	Access
V	Visible
AP	Air Plenum
F	Friable material
NF	Non Friable material
PF	Potentially Friable material
Pb	Lead
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

APPENDIX VII
Photographs

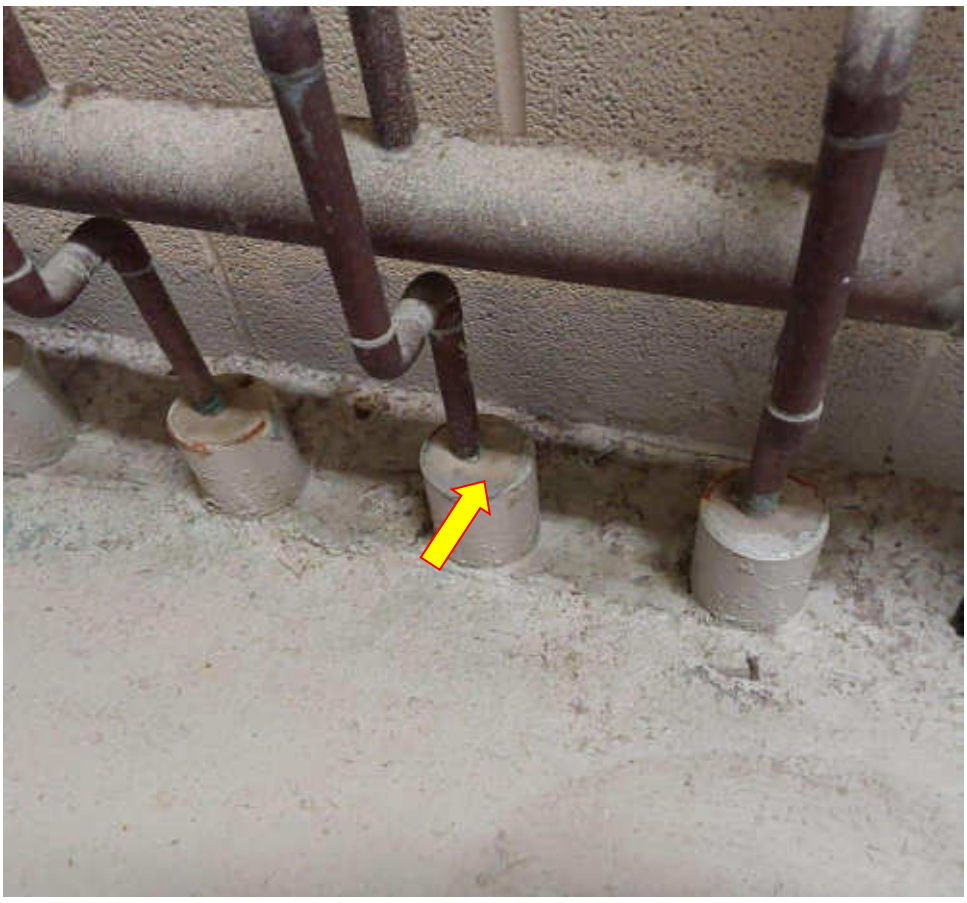
S0001A (None), Roofing material, Roof Sections 1A and 1B (Location #: 1) Roof 1a

S0002A (None), Flashing caulking Roof 1A, Caulking, Roof Sections 1A and 1B (Location #: 1)

S0003C (None), Grey caulking over black Air Handling Unit conduit isolation, Roof Sections 1A and 1B (Location #: 1)

S0004A (None), Grey mastic with gold flake exhaust, Duct, Mastic, Grey, Roof Sections 1A and 1B (Location #: 1)

S0005C (None), White/beige caulking, Other, Caulking, Mechanical Room (Location #: 2)



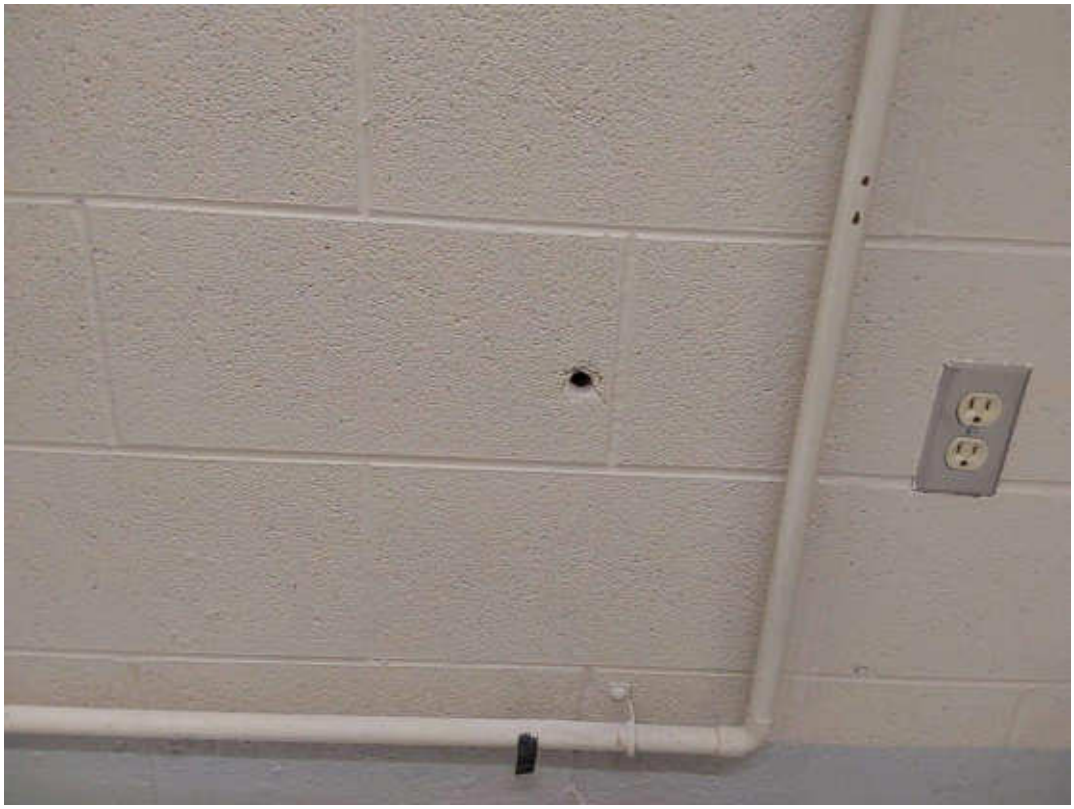
S0006C (None), Grey firestopping, Other, Firestopping (mastic), Mechanical Room (Location #: 2)

S0007C (None), Grey caulking on door frames, Other, Caulking, Mechanical Room (Location #: 2)

S0010C (None), Grey caulking in expansion joints, Other, Caulking, Mechanical Room (Location #: 2)

V0000 (None), Black rubber vibration damper, Duct, Duct Connector, Rubber, Mechanical Room (Location #: 2)

V0000 (None), Mechanical Equipment, Unit Heater, Not Insulated, Mechanical Room (Location #: 2)



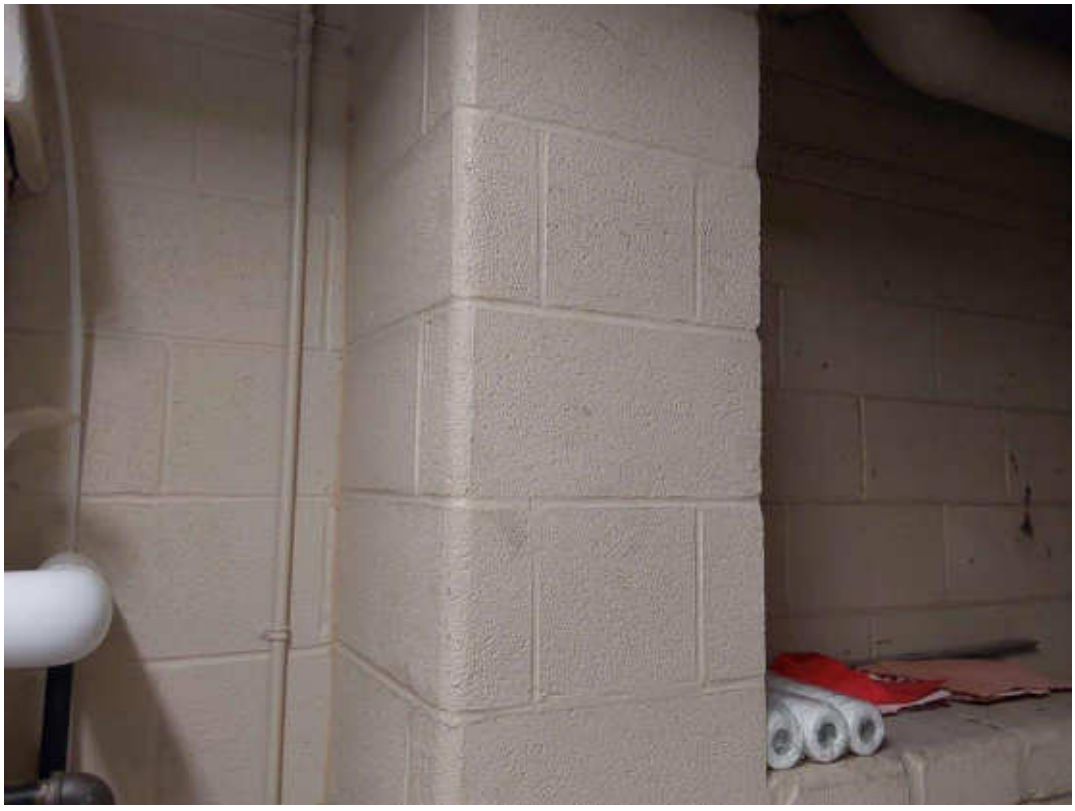
V0000 (None), Wall, Vermiculite Investigation, Mechanical Room (Location #: 2)

Fiberglass insulated, Piping, Fibreglass, Mechanical Room (Location #: 2)

Mechanical Equipment, Air Handling Unit, Not Insulated, Mechanical Room (Location #: 2)

Duct, All, Not Insulated, Mechanical Room (Location #: 2)

Piping, Not Insulated, Mechanical Room (Location #: 2)



L0001(Lead, None), Beige paint on masonry, Wall, Mechanical Room (Location #: 2)

L0002(Lead, High), Beige paint on metal ducts, Duct, Mechanical Room (Location #: 2)

L0003(Lead, Low), Grey paint on concrete floor, Floor, Mechanical Room (Location #: 2)

L0004(Lead, High), White paint on ceiling, Structure, Mechanical Room (Location #: 2)

L0005(Lead, None), Light green paint on pipes, Piping, Mechanical Room (Location #: 2)

L0006(Lead, None), Green paint on doors, Other, Mechanical Room (Location #: 2)

Pb Products, V9500(Presumed), BATTERIES IN EMER. LIGHTS, Mechanical Room (Location #: 2)

Mercury, V9000(Yes), LIGHT FIXTURE, T8, Mechanical Room (Location #: 2)

Mercury, V0000(No), MANOMETER, Non-mercury fluid, Mechanical Room (Location #: 2)

Mechanical Room (Location #: 2)

Building Photo

Part 1 General

1.1 DESCRIPTION OF WORK

.1 This contractor is responsible for the following item(s), including all related labour and materials necessary to successfully complete the installation of same as detailed on the Drawing.

.2 Do any drilling, cutting, fitting, patching and finishing that may be required to make new and existing work appear seamless.

.3 Do not endanger property by cutting, digging, or similar activities.

.4 No cutting, drilling, or digging shall be undertaken which will interfere with the operation of the facility or obstruct operations without prior permission from the Owner and property safety and protection measure in place.

.5 Patch or replacement of work done under this Contract shall be the responsibility of the Contractor and at no additional cost to the Owner.

.6 Patching or replacement of existing work damaged under this Contract shall be undertaken by personnel skilled in this type of work.

.7 Where new work connects with existing structures or features, or where existing work is altered, cut, patch and make good to match existing work.

1.2 REQUEST FOR CUTTING, PATCHING AND REMEDIAL WORK

.1 Submit written request in advance of cutting, coring, or alteration which affects or is likely to affect:

.1 Structural integrity of any element of the *Work*.

.2 Integrity of weather-exposed or moisture-resistant elements.

.3 Efficiency, maintenance, or safety of any operational element.

.4 Visual qualities of sight-exposed elements.

.5 Work of *Owner* or other contractors.

.6 Warranty of *Products* affected.

.2 Include in request:

.1 Identification of *Project*.

.2 Location and description of affected work, including drawings or sketches as required.

.3 Statement on necessity for cutting or alteration.

.4 Description of proposed work, and *Products* to be used.

.5 Alternatives to cutting and patching.

.6 Effect on work of *Owner* or other contractors.

.7 Written permission of affected other contractors.

.8 Date and time work will be executed.

1.3 PRODUCTS

.1 Unless otherwise specified, when replacing existing or previously installed *Products* in the course of cutting and patching work, use replacement *Products* of the same character and quality as those being replaced.

.2 If an existing or previously installed *Product* must be replaced with a different *Product*, submit request for substitution in accordance with Section 01 25 00 - Substitution Procedures.

1.4 PREPARATION

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

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

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

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

.5 Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.

1.5 EXISTING UTILITIES

.1 When breaking into or connecting to existing services' utilities, execute the *Work* at times directed by local governing authorities, with a minimum of disturbance to the *Work*, pedestrian and vehicular traffic, and ongoing *Owner* operations.

.2 Maintain excavations free of water.

.3 Keep duration of interruptions to a minimum.

.4 Carry out interruptions after regular working hours of occupants, preferably on weekends, unless *Owner*'s prior written approval is obtained.

.5 Protect and maintain existing active services. Record location of services, including depth, on as-built drawings.

.6 Construct or erect barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures as required to protect pedestrian and vehicular traffic.

1.6 CUTTING, PATCHING, AND REMEDIAL WORK

.1 Coordinate and perform the *Work* to ensure that cutting and patching work is kept to a minimum.

.2 Perform cutting, fitting, patching, and remedial work including excavation and fill, to make the affected parts of the *Work* come together properly and complete the *Work*.

.3 Provide openings in non-structural elements of the *Work* for penetrations of mechanical and electrical work.

.4 The removal, repair and reinstallation as required to make good *existing acoustic unit ceilings shown to remain* where required to be removed for routing new services.

.5 Perform cutting by methods to avoid damage to other work

.6 Provide proper surfaces to receive patching, remedial work, and finishing.

.7 Perform cutting, patching, and remedial work using competent and qualified specialists familiar with the *Products* affected, in a manner that neither damages nor endangers the *Work*.

.8 Do not use pneumatic or impact tools without *Consultant*'s prior approval.

.9 Ensure that cutting, patching, and remedial work does not jeopardize manufacturers' warranties.

.10 Refinish surfaces to match adjacent finishes. For continuous surfaces refinish to nearest intersection. For an assembly, refinish entire unit.

.11 Fit work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces with suitable allowance for deflection, expansion, contraction, acoustic isolation, and firestopping.

.12 Maintain fire ratings of fire rated assemblies where cutting, patching, or remedial work is performed. Completely seal voids or penetrations of assembly with firestopping material to full depth or with suitably rated devices.

1.7 MATERIALS

.1 Concrete lintel block, reinforcing steel and concrete fill for openings if required at new penetrations in walls or existing penetrations in walls where steel lintels or lintel blocks may be missing.

.2 Portland Cement based Concrete for new floor openings or floor leveling, or patching of floor openings.

.3 New acoustic ceiling tiles and grid to match existing to make good ceiling at location of temporary removal where existing ceilings are scheduled to remain. All other materials not listed in other Sections, but detailed on the Drawings.

.4 Change in materials: Submit request for substitutions in accordance with Product Requirements section.

END OF SECTION

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Part 1 General

1.1 REGULATORY REQUIREMENTS

.1 Comply with applicable regulatory requirements when disposing of waste materials.

.2 Obtain permits from authorities having jurisdiction and pay disposal fees where required for disposal of waste materials and recyclables.

1.2 GENERAL CLEANING REQUIREMENTS

.1 Provide adequate ventilation during use of volatile or noxious substances. Do not rely on building ventilation systems for this purpose.

.2 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

.3 Prevent cross-contamination during the cleaning process.

.4 Notify the *Consultant* of the need for cleaning caused by *Owner* or other contractors.

1.3 PROGRESSIVE CLEANING AND WASTE MANAGEMENT

.1 Maintain the *Work* in a tidy and safe condition, free from accumulation of waste materials and construction debris.

.2 Remove waste materials and recyclables from work areas, separate, and deposit in designated containers at end of each *Working Day*. Collect packaging materials for recycling or reuse.

.3 Remove waste materials and recyclables from *Place of the Work* daily weekly at regular intervals.

.4 Clean interior building areas prior to start of finish work and maintain free of dust and other contaminants during finishing operations.

.5 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly finished surfaces nor contaminate building systems.

.6 Clear snow and ice from public sidewalks as required to comply with applicable municipal regulatory requirements.

1.4 FINAL CLEANING

.1 Before final cleaning, arrange a meeting at *Place of the Work* to determine the acceptable standard of cleaning. Ensure that *Owner*, *Consultant*, *Contractor* and cleaning company are in attendance.

.2 Remove from *Place of the Work* surplus *Products*, waste materials, recyclables, *Temporary Work*, and *Construction Equipment* not required to perform any remaining work.

.3 Provide professional cleaning by a qualified, established cleaning company.

.4 Lock or otherwise restrict access to each room or area after completing final cleaning in that area.

.5 Re-clean as necessary areas that have been accessed by *Contractor*'s workers prior to *Owner* occupancy.

.6 Remove stains, spots, marks, and dirt from finished surfaces, electrical and mechanical fixtures, furniture fitments, walls, floors.

.7 Remove dust from lighting reflectors, lenses, lamps, bulbs, and other lighting surfaces.

.8 Vacuum clean and dust exposed wall, floor, and ceiling surfaces, behind grilles, louvres and screens, above suspended ceiling tiles.

.9 Clean mechanical, electrical, and other equipment. Replace filters for mechanical equipment if equipment is used during construction.

.10 Remove waste material and debris from crawlspaces and other accessible concealed spaces.

.11 Remove stains, spots, marks, and dirt from exterior facades.

.12 Clean exterior and interior window glass and frames.

.13 Clean and sweep roofs, clear roof drains, clean gutters and downspouts, sunken wells,

.14 Sweep clean power wash remove snow and ice from exterior sidewalks, steps, driveways, roads, parking lots, and other paved surfaces.

.15 Use leaf blowers to clean landscaped surfaces.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Dispose of waste materials and recyclables at appropriate municipal landfills and recycling facilities in accordance with applicable regulatory requirements.

.2 Do not burn or bury waste materials at *Place of the Work*.

.3 Do not dispose of volatile and other liquid waste such as mineral spirits, oil, paints and other coating materials, paint thinners, cleaners, and similar materials together with dry waste materials or on the ground, in waterways, or in storm or sanitary sewers. Collect such waste materials in appropriate covered containers, promptly remove from *Place of the Work*, and dispose of at recycling facilities or as otherwise permitted by applicable regulatory requirements.

.4 Cover or wet down dry waste materials to prevent blowing dust and debris.

END OF SECTION

Part 1 General

1.1 READY-FOR-TAKEOVER

.1 The prerequisites to attaining *Ready-for-Takeover* of the *Work* are described in the General Conditions of the *Contract*.

1.2 INSPECTION AND DECLARATION PROCEDURES FOR SUBSTANTIAL PERFORMANCE

.1 Contractor's Inspection for Substantial Performance:

.1 When the Contractor determines that the project meets the requirements of Substantial Performance as defined in the Construction Lien Act, the Contractor and all Subcontractors shall conduct an inspection of the work.

.2 Identify deficiencies and defects and prepare a Contractor's deficiency list.

.3 Issue to the Consultant.

.4 Obtain approval for occupancy from authorities having jurisdiction.

.2 Review allowances in relation to contract price, change orders, hold-backs and other contract price adjustments. Provide detailed record of all approved expenditures for cash and contingency allowances, change orders, and work authorizations.

.3 Contractor's Application for Certificate of Substantial Performance:

.1 When the procedures in paragraph .1 are completed submit to the Consultant a written application for a Certificate of Substantial Completion.

.4 Consultant's Inspection for Substantial Performance: If the Consultant approves the Contractor's application, the Consultant shall make his inspection and assessment of the work to establish the validity of the application.

.5 Consultant's Certificate of Substantial Performance:

.1 If the Consultant determines through his inspection that the project meets the requirements of Substantial Performance as defined in the Construction Lien Act, the Consultant will issue a Certificate of Substantial Performance to the Owner and the Contractor.

.2 The Contractor shall publish this certificate and submit proof of the date of publication to the Consultant to establish the start of the 60 day period prior to release of the basic holdback.

.6 Consultant's Certificate of Payment of Basic Holdback:

.1 The Consultant will issue to the Owner the certificate of payment of the basic holdback monies dated one day after the termination of the 60 day period.

.2 If no liens exist, the Owner will pay the basic holdback monies due as shown on the Contractor's approved application for a Certificate of Substantial Performance.

1.3 INSPECTION AND REVIEW BEFORE READY-FOR-TAKEOVER

.1 *Contractor*'s Inspection: Before applying for the *Consultant*'s review to establish *Ready-for-Takeover* of the *Work*:

.1 Ensure that the specified prerequisites to *Ready-for-Takeover* of the *Work* are completed.

.2 Conduct an inspection of the *Work* to identify defective, deficient, or incomplete work.

.3 Prepare a comprehensive and detailed list of items to be completed or corrected.

.4 Provide an anticipated schedule and costs for items to be completed or corrected.

.2 *Consultant*'s Review: Upon receipt of the *Contractor*'s application for review, together with the *Contractor*'s list of items to be completed or corrected, the *Consultant* will review the *Work*. The *Consultant* will advise the *Contractor* whether or not the *Work* is *Ready-for-Takeover* and will provide the *Contractor* with a list of items, if any, to be added to the *Contractor*'s list of items to be completed or corrected. Provide the *Consultant* with a copy of the *Contractor*'s revised list.

.3 Maintain the list of items to be completed or corrected and promptly correct or complete defective, deficient and incomplete work. The Contractor's inspection and *Consultant*'s review procedures specified above shall be repeated until the *Work* is *Ready-for-Takeover* and no items remain on the *Contractor*'s list of items to be completed or corrected.

.4 When the *Consultant* determines that the *Work* is *Ready-for-Takeover*, the *Consultant* will notify the *Contractor* and the *Owner* in writing to that effect.

1.4 PREREQUISITES TO FINAL PAYMENT

.1 After *Ready-for-Takeover* of the *Work* and before submitting an application for final payment in accordance with the General Conditions of Contract:

.1 Correct or complete all remaining defective, deficient, and incomplete work.

.2 Remove from the Place of the Work all remaining surplus Products, Construction Equipment, and Temporary Work.

.3 Perform final cleaning and waste removal necessitated by the Contractor's work performed after Ready-for-Takeover, as specified in Section 01 74 00 – Cleaning and Waste Management.

1.5 PARTIAL USER OCCUPANCY

.1 If partial *Owner* occupancy of a part of the *Work* is required before the date of *Ready-for-Takeover* of the entire *Work* of the *Contract,* the provisions of this Section shall apply, to the extent applicable, to that part of the *Work* that the *Owner* intends to occupy.

1.6 CONSULTANT'S FINAL CERTIFICATE OF PAYMENT:

.1 When all deficiencies have been corrected submit to the Consultant an invoice for final payment.

.2 When the Consultant is satisfied that all deficiencies established in the final inspection have been corrected he will issue to the Owner a final certificate of payment for the remaining monies due to the Contractor under the Contract.

1.7 CONSULTANT'S CERTIFICATE OF PAYMENT OF MONIES FOR HOLDBACK FOR DEFICIENCY WORK:

.1 The Consultant will issue to the Owner the certificate of payment of finishing work holdback monies dated one day after the termination of the 60 day period commencing on the Date of Completion of the Contract.

.2 If no liens exist the Owner will pay the finishing work holdback monies due as shown on the Contractor's approved application for a statement of completion.

1.8 WARRANTY PERIOD

.1 The date of Ready-For-Takeover of the Contract shall be the date for commencement of the warranty period. The warranty period is for 1 year.

.2 Prior to the completion of the warranty period the Consultant will review defects or deficiencies observed by the Owner and will notify the Contractor. The Contractor shall correct the noted defects or deficiencies to complete the terms of the Contract.

END OF SECTION

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Part 1 General

1.1 REQUIREMENTS INCLUDED

.1 Record documents, samples, specifications.

.2 Equipment and systems.

.3 Product data, materials and finishes, and related information.

1.2 QUALITY ASSURANCE

.1 Prepare instructions and data by personnel experience in maintenance and operation of described products.

1.3 FORMAT OF OPERATION MAINTENANCE MANUALS AND DRAWINGS

.1 Organize data in the form of an instructional manual.

.2 Binders: commercial quality, (8-1/2 x 11 inch) 219 x 279 mm maximum (2-1/2") 65 mm ring size.

.3 When multiple binders are used, correlate data into related consistent groupings.

.4 Label binder with Project title, Place, and Date and titling binder “Operation Data and Maintenance Manual”.

.5 Cover: Identify each binder with type or printed title “Project Record Documents”, list title of Project, identify subject matter of contents.

.6 Arrange content under Section numbers and sequence of Table of Contents.

.7 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment. Labeled tabs to be protected with celluloid covers fastened to hard paper dividing sheets.

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

1.4 CONTENT, EACH VOLUME

.1 Table of Contents: Provide title of project; names, addresses, and telephone numbers of Consultant and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

.2 For each Product or System: list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.3 Product Data: mark sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.5 Typed Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer’s instructions.

1.5 SUBMISSION OF OPERATION AND MAINTENANCE MANUALS

.1 Submit one copy of completed volume(s) in final form not later than 15 days prior to Substantial Performance. Preliminary submissions will not be accepted. For equipment put into use with Owner's permission during construction, submit Operating and Maintenance Manuals within 10 days after start-up. For items of Work delayed materially beyond date of Substantial Performance, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period.

.2 Submission for Consultant's review can be done electronically in pdf format or as a hardcopy.

.1 Electronic submission/pdf file is required to be bookmarked. Any submission received without bookmarking will be immediately returned as unacceptable.

.2 Hardcopy submission shall be in a three-ring binder (minimum 50 mm (2") ring) and labelled as 'Operation and Maintenance Manual' with project name and location. Dividers are to be used for binder organization.

.3 Copy will be returned after inspection, with Consultant comments.

.4 Revise content of documents as required prior to final submittal.

.5 For final submission:

.1 Submit **two (2) copies** of revised volumes of data in final form within 10 days after final inspection as well as a pdf file of approved volume(s) on USB stick. Only one USB stick is to be provided containing both the approved Operation and Maintenance Manual and As-built Drawings.

1.6 RECORD DOCUMENTS AND SAMPLES

.1 Maintain at the site for Owner one record copy of:

.1 Contract Drawings.

.2 Specifications.

.3 Addenda

.4 Change Orders and other modifications to the Contract.

.5 Reviewed shop drawings, product data and samples.

.6 Field test records.

.7 Manufacturer's certificates.

.2 Store Record Documents and Samples in Field Office apart from documents used for construction. Provide files, racks, and secure storage.

.3 Label and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "Project Record" in neat, large, printed letters.

.4 Maintain Record Documents in a clean, dry, and legible condition. Do not use Record Documents for construction purposes.

.5 Keep Record Documents and samples available for inspection by Consultant.

1.7 AS-BUILT DRAWINGS AND AS BUILT CONDITIONS

.1 Contractor shall provide two (2) complete full sized sets of white prints of project drawings and two (2) complete sets of specifications for the purpose of recording as-built conditions. Mark and record one set on an on-going basis as construction proceeds. **Near the end of the construction period transfer all marks neatly to second set for submission as project record documents**.

.2 Record information on a set of black line opaque drawings and in a copy of Project Manual, provided by Consultant. Refer to Mechanical and Electrical Divisions for additional mechanical and electrical requirements.

.3 Record information concurrently with construction progress. Do not conceal work until required information is recorded.

.4 Contract drawings and shop drawings: legibly mark each item to record actual construction, including:

.1 Measure depths of elements of foundation in relation to finish floor datum.

.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.

.3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.

.4 Field changes of dimension and detail.

.5 Changes made by addenda and change orders.

.6 Details not on original contract drawings.

.7 References to related shop drawings and modifications.

.5 Specifications: legibly mark each item to record actual construction, including:

.1 Manufacturer, trade name, and catalog number of each project actually installed, particularly optional items and substitute items.

.2 Changes made by Addenda and Change Orders.

.6 Other documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

.7 Submit to Consultant for approval and make corrections as directed.

.8 Submit approved completed reproducible as-built drawings as well as a scanned full sized pdf file copy on a USB stick.

1.8 EQUIPMENT AND SYSTEMS

.1 Provide copy of hardware and paint schedules.

.2 Maintenance instruction for finished surface and materials.

.3 Each Item of Equipment and each System: include description of unit or system, and component parts. Indicate nameplate information such as make, size, capacity, and serial number. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

.4 Panelboard Circuit Directories: provide electrical service characteristics, controls, and communications.

.5 Include installed colour coded wiring diagrams.

.6 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instruction. Include summer, winter, and any special operating instructions.

.7 Maintain Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair and reassemble instructions; and alignment, adjusting, balancing, and checking instructions.

.8 Provide servicing and lubrication schedule, and list of lubricants required.

.9 Include manufacturer's printed operation and maintenance instructions.

.10 Include sequence of operation by controls manufacturer.

.11 Provide original manufacturer's parts lists, illustrations, assembly drawings, and diagrams required for maintenance.

.12 Provide installed control diagrams by controls manufacturer.

.13 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.

.14 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.15 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.16 Include test balancing reports as specified in Mechanical specifications.

.17 Certificates of approval of the work by local agencies having jurisdiction.

.18 Electrical Safety Authority certificate.

.19 Additional Requirements and Certificates: As specified in individual specification sections.

1.9 SPARE PARTS, MAINTENANCE MATERIALS, AND SPECIAL TOOLS

.1 Supply spare parts, maintenance materials, and special tools in quantities specified in technical *Specifications* sections.

.2 Ensure spare parts and maintenance materials are new, not damaged nor defective, and of same quality, manufacturer, and batch or production run as installed *Products*.

.3 Provide tags for special tools identifying their function and associated *Product*.

.4 Deliver to and store items at location directed by *Owner* at *Place of the Work*. Store in original packaging with manufacturer's labels intact and in a manner to prevent damage or deterioration.

.5 Catalogue all items and submit to *Consultant* an inventory listing organized by *Specifications* section. Include *Consultant* reviewed inventory listing in operation and maintenance manual.

1.10 MATERIALS AND FINISHES

.1 Building Products, Applied Materials, and Finishes: include product data, with catalog number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.

.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Moisture-protection and weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommend schedule for cleaning and maintenance.

.4 Additional Requirements: as specified in individual specifications sections.

1.11 GUARANTEES, WARRANTIES AND BONDS

.1 Separate each warranty or bond with index tab sheets keyed to the List of Contents listing.

.2 Guarantee commencement date noted (date of Final Certificate of Completion).

.3 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal. Provide written form for each extended warranty specified in individual specification sections.

.4 Provide duration of guarantee. Provide written form for each extended warranty specified in individual specification sections.

.5 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work. Ensure warranties clearly indicate what is being guaranteed and what remedial action will be taken under guarantee.

.6 Verify that documents are in proper form, contain full information, and are notarized.

.7 Co-execute submittals when required.

.8 Retain warranties and bonds until time specified for submittal.

.9 Signature and seal of Contractor.

.10 Additional material used in project listed under various Sections showing name of manufacturer and source of supply.

1.12 SHOP DRAWINGS

.1 Include one complete set of final shop drawings indicating corrections and changes made during fabrication and installation.

Part 2 Products

.1 Not applicable.

Part 3 Execution

.1 Not applicable.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Comply with the Requirements of Division 1 as if written here.

.2 Cutting and Patching – Section 01 73 29.

1.2 EXISTING CONDITIONS

.1 Take over structures to be demolished based on their condition on date that tender is accepted, at time of examination prior to tendering.

.2 Demolition of spray or trowel-applied asbestos can be hazardous to health. Refer to Section 1001, “Asbestos” for procedures to be followed prior to and during construction.

.3 Prior to beginning demolition, confirm with Owner that no items to be salvaged or turned over to the owner remain in the work areas.

1.3 DEMOLITION AND CONSTRUCTION WITHIN AN OCCUPIED BUILDING

.1 Refer to Section 01 73 00 General Instructions for specific requirements under this contract for work to be executed within an occupied building**. In addition to the requirements and procedures of this section,** the Contractor shall carefully review and abide by all the requirements contained therein.

1.4 PROTECTION

.1 Prevent movement, settlement or damage of adjacent structures, services, walks, paving, trees, landscaping, adjacent grades parts of existing building to remain. Provide bracing, shoring and underpinning required. Make good damage and be liable for injury caused by demolition.

.2 Take precautions to support structures and, if safety of building being demolished or adjacent structures or services appears to be endangered, cease operations and notify Consultant.

.3 Prevent debris from blocking surface drainage system, elevators, mechanical and electrical systems which must remain in operation.

Part 2 Products

.1 Not applicable.

Part 3 Execution

3.1 RELATED WORK

.1 Dispose of demolished materials except where noted otherwise and in accordance with authorities having jurisdiction. Confirm in Divisions 15 and 16 for removal and re-use of mechanical and electrical materials and equipment.

.2 If so designated by the Owner, carefully remove materials and equipment and store in location designated by Owner.

3.2 PREPARATION

.1 Do not disrupt active or energized utilities traversing premises designated to remain undisturbed.

3.3 DEMOLITION

.1 Follow best trade practices for all demolition and alteration work. This includes but is not limited to the following items.

.1 Protect all areas from damage and intrusion by means of locking rooms under construction when not in use, use of hoarding, signage to be posted at all times.

.2 Notify all building occupants in advance at each possible interruption in services or utilities.

.3 Take precautions to demolish only areas as necessary to complete the work, and avoid damage to adjacent areas. Make good all areas affected by demolition or renovation activities, whether specifically included in the contract documents or not.

.4 The Contractor shall be responsible for damage to all areas affected by renovation or alteration activities.

.5 Seal off and isolate areas of demolition by means of polyethylene sheets, or similar means, securely sealed at all edges to walls, ceiling and floors. Similarly, seal all ducts and grilles to the work area to isolate dust. Do not leave the work area open until all refuse and dust has been removed. The Contractor shall be responsible for cleaning of rooms, furniture in adjacent areas or equipment made dusty or soiled as a result of demolition which has not been properly isolated.

.6 Prior to demolition, the Contractor shall carefully examine the drawings in relation to the site conditions, to ensure that all intended work can be carried out without ambiguity. Incorrect demolition of any work by the Contractor, will be back-charged to him. Any discrepancies between the drawings and the site conditions, must be reported to the Consultants immediately.

.7 Demolish or remove interior elements as indicated.

.8 Remove existing equipment, services, and obstacles where required for refinishing or making good of existing surfaces, and replace as work progresses.

.9 At end of each day's work, leave work in safe condition so that no part is in danger of toppling or falling. Protect interiors of parts not to be demolished from exterior elements at all times.

.10 Demolish to minimize dusting. Keep dusty materials wetted.

.11 Demolish masonry and concrete walls in small sections. Carefully remove and lower structural framing and other heavy or large objects as required. Where partial walls of exposed concrete block masonry is to remain, grind all exposed edges to a bullnose and patch as required suitable for final painting.

.12 Do not sell or burn materials on site.

.13 Remove contaminated or dangerous materials from site and dispose of in safe manner to minimize danger at site or during disposal, in accordance with all governing legislation.

3.4 DISCONNECTION AND REMOVAL OF MATERIALS AND EQUIPMENT

.1 Contractor shall cooperate with the Owner to determine which materials are to be removed and retained by Owner. The Owner will decide which items or equipment they wish to retain as their property and all other materials shall be removed from the premises by this Contractor. The equipment which is to be retained by the Owner shall be stored on site where directed by the Owner.

.2 Refer to mechanical and electrical drawings and for disconnection and removal and/or relocated existing electrical, ductwork, piping and/or equipment.

.3 Refer to Mechanical specifications for reuse existing piping, and/or equipment.

3.5 REFER TO ALL FINISHES AND COLOURS

.1 Repaint all walls in rooms or areas modified as indicated in the Finish Schedule, or as directed by the Consultant. Repair and make good all fixtures, finishes, trims and surfaces to all floor, wall and ceiling areas in rooms or areas whether or not they have been modified or affected by the work.

END OF SECTION

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Part 1 General

1.1 SECTION INCLUDES

.1 Cast in place concrete for house keeping pads for Mechanical and Electrical equipment.

.2 Patching and repair of concrete at new openings.

.3 Concrete formwork.

.4 Concrete finishing.

1.2 RELATED SECTIONS

.1 Divisions 15 and 16: Mechanical and Electrical equipment.

1.3 REFERENCE

.1 CSA A23.1-94: Concrete Materials and Methods of Concrete Construction.

.2 CSA A23.3-94: Design Of Concrete Structures for Buildings.

.3 CAN3-A266.2-M78: Chemical Admixtures for Concrete.

.4 CAN/CSA-S269.3-M92 Formwork.

1.4 SUBMITTALS

.1 Submit samples to the Testing Laboratory as required.

.2 Submit complete and accurate records of concrete operations.

.3 Record Documents: Indicate date, location, and test samples taken.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Store materials to requirements of CSA A23.1.

.2 Arrange delivery to avoid interruption of existing operations.

Part 2 Products

2.1 CONCRETE MATERIALS

.1 Portland Cement: to CAN/CSA-A5, Type 10.

.2 Fine and Coarse Aggregate: to CSA A23.1.

.3 Water: potable, to CSA A23.1.

2.2 ADMIXTURES

.1 Air Entrainment Admixture: to CAN3-A266.1-M.

.2 Chemical Admixture: to CAN3-A266.2-M.

.3 Superplasticizer Admixture: to CAN3-A266.6-M.

2.3 CONCRETE ACCESSORIES

.1 Concrete Formwork: solid one side, Douglas fir plywood.

.2 Lumber: SPF species, NLGA Light framing grade, “Utility” stress group: with grade stamp clearly visible.

.3 Isolation Joint: closed cell compressible foam, Sealtight Ceramar by W. R. Meadows or Rodofoam PR by Sternson Construction Products Ltd.

.4 Bonding Agent: acrylic emulsion.

.5 Curing-Sealing Compound: 100% water based acrylic copolymer, to ASTM C309, Type 1 Class B. Vocomp 20 by W. R. Meadows.

.6 Non-metallic Hardener: Diamag 7 by Sternson, Construction Products Ltd., Mastercron Aggregate by The Master Builders Co. Ltd., or Sealtight Type R Premixed by W. R. Meadows.

2.4 CONCRETE MIXES

.1 Mix concrete to requirements of CSA A23.1

.2 Coarse aggregates shall be not more than 20 mm (3/4") and not less than 8 mm (5/16") in size.

.3 Concrete shall be designed to prevent segregation and excessive bleeding. Submit mix designs for approval. Provide any necessary evidence that the mix designs will provide the desired properties.

.4 Determine concrete strengths from standard cylinders, sampled cured and tested at 28 days in accordance with CAN/CSA-A23.2

.5 Refer to drawings for strength of concrete required for various locations, but in all cases, the minimum 28 day strength shall be not lest than 20 MPa.

.6 Provide concrete with an average slump of 75 mm (3"), ±25 mm (1").

Part 3 Execution

3.1 EXAMINATION

.1 Verify that site conditions are ready to receive work.

.2 Ensure all forms are rigid and structurally safe, and all formwork, sleeves, anchor bolts and other Items are installed in accordance with the Contract Documents.

.3 Ensure that all trades have checked the security and location of all component required in the concrete by those trades

.4 Beginning of installation implies acceptance of site conditions.

3.2 FORMWORK ERECTION

.1 Construct formwork in accordance with CAN/CSA-S269.3-M to meet design and code requirements.

.2 Align joints and make watertight.

.3 Apply a form release agent prior to placing reinforcing steel, anchoring devices and embedded items.

3.3 PREPARATION

.1 Notify Consultant at least 24 hours before each placement of concrete.

.2 Set sleeves, ties, anchor bolts, pipe hangers and other inserts. openings and sleeves in concrete work, as required by other Sections. Sleeve openings. etc., greater than 100 mm (4") square or in diameter not indicated on the structural drawings must be approved by the Consultant.

3.4 INSTALLATION

.1 Place concrete to requirements of CSA A23.1.

.2 Maintain records of poured concrete Items. Record date, location of pour, quantity, air temperature, and test samples taken.

.3 Pour concrete continuously between predetermined construction and control joints. Each housekeeping pad must be completed in one pour.

.4 In locations where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack solidly with non-shrink grout.

3.5 FIELD QUALITY CONTROL

.1 Test concrete to requirements of CSA A23.2.

.2 Supply additional labour required to assist the Testing Laboratory in making such tests. Pay for cost of such material and labour.

.3 Slump tests shall be carried out following the requirements of CSA A23.2; Test A23.2-5C.

.4 Slump tests shall be taken in conjunction with sampling of concrete for cylinder tests. If the slump is excessive, remove the balance of that concrete from the site without further instructions.

.5 If Consultant suspects that the slump of concrete is excessive. Carry out additional slump tests in the presence of the Consultant. No further concrete shall be placed until the test is carried out. Remove concrete with excessive slump from to site. Provide a slump testing equipment on the site, readily available for this testing.

3.6 FORM REMOVAL

.1 Do NOT remove forms until concrete has gained sufficient strength to carry its own weight, and any loads, which are liable to be imposed on It.

.2 Remove forms progressively and to requirements of local codes.

3.7 PATCHING

.1 Patch imperfections as directed by Consultant.

3.8 DEFECTIVE CONCRETE

.1 Modify or replace concrete not conforming to required lines, details and elevations.

.2 Repair or replace concrete with excessive honeycombing and other defects.

3.9 CONCRETE FINISHING

.1 Provide concrete surfaces to be left exposed with sack rubbed finish.

3.10 CURING AND PROTECTION

.1 Apply dry shake hardener, in accordance with manufacturer's instructions, to all surfaces scheduled to remain exposed.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 American Concrete Institute (ACI)

.1 ACI 315R-80, Manual of Engineering and Placing Drawings for Reinforced Concrete Structure.

.2 American National Standards Institute/American Concrete Institute (ANSI/ACI)

.1 ANSI/ACI 315-80, Details and Detailing of Concrete Reinforcement.

.3 American Society for Testing and Materials (ASTM)

.1 ASTM A 775/A 775M-91c, Specification for Epoxy-Coated Reinforcing Steel Bars.

.4 Canadian Standards Association (CSA)

.1 CAN/CSA-A23.1-94, Concrete Materials and Methods of Concrete Construction.

.2 CAN3-A23.3-94, Design of Concrete Structures for Buildings.

.3 CSA G30.3-M1983(R1991), Cold Drawn Steel Wire for Concrete Reinforcement.

.4 CSA G30.5-M1983(R1991), Welded Steel Wire Fabric for Concrete Reinforcement.

.5 CSA G30.14-M1983(R1991), Deformed Steel Wire for Concrete Reinforcement.

.6 CSA G30.15-M1983(R1991), Welded Deformed Steel Wire Fabric for Concrete Reinforcement.

.7 CAN/CSA-G30.18-M92, Billet-Steel Bars for Concrete Reinforcement.

.8 CAN/CSA-G40.21-M92, Structural Quality Steels.

.9 CAN/CSA-G164-M92, Hot Dip Galvanized of Irregularly Shaped Articles.

.10 CSA W186-1990, Welding of Reinforcing Bars in Reinforced Concrete Construction.

1.2 SHOP DRAWINGS

.1 Submit shop drawings including placing of reinforcement in accordance with Submittals Section.

.2 Indicate on shop drawings, bar bending details, lists, quantities of reinforcement, sizes, spacings, locations of reinforcement and mechanical splices if approved by Consultant, with identifying code marks to permit correct placement without reference to structural drawings. Indicate sizes, spacings and locations of chairs, spacers and hangers. Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice – by Reinforcing Steel Institute of Canada.

.3 Detail lap lengths and bar development lengths to CAN3-A23.3, unless otherwise indicated.

Part 2 Products

2.1 MATERIALS

.1 Substitute different size bars only if permitted in writing by Consultant.

.2 Reinforcing steel: billet steel, grade 400, deformed bars to CAN/CSA-G30.18, unless indicated otherwise.

.3 Reinforcing steel: weldable low alloy steel deformed bars to CAN/CSA-30.18.

.4 Cold-drawn annealed steel wire ties: to CSA G30.3.

.5 Deformed steel wire for concrete reinforcement: to CSA G30.14.

.6 Welded steel wire fabric: to CSA G30.5. Provide in flat sheets only.

.7 Welded deformed steel wire fabric: to CSA G30.15. Provide in flat sheets only.

.8 Epoxy coating of non-prestressed reinforcement: to ASTM A 775/A 775M.

.9 Chairs, bolsters, bar supports, spacers: to CAN/CSA-A23.1.

.10 Mechanical splices: subject to approval of Consultant.

.11 Plain round bars: to CAN/CSA-G40.21.

2.2 FABRICATION

.1 Fabricate reinforcing steel in accordance with CAN/CSA-A23.1, ANSI/ACI 315, and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada unless indicated otherwise.

.2 Obtain Consultant's approval for locations or reinforcement splices other than those shown on placing drawings.

.3 Upon approval of Consultant, weld reinforcement in accordance with CSA W186.

.4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

.1 Upon request, provide Consultant with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis.

.2 Upon request inform Consultant of proposed source of material to be supplied.

Part 3 Execution

3.1 FIELD BENDING

.1 Do not field bend or field weld reinforcement except where indicated or authorized by Consultant.

.2 When field bending is authorized, bend without heat, applying a slow and steady pressure.

.3 Replace bars which develop cracks or splits.

3.2 PLACING REINFORCEMENT

.1 Place reinforcing steel as indicated on reviewed placing drawings and in accordance with CAN/CSA-A23.1.

.2 Use plain round bars as slip dowels in concrete. Paint portion of dowel intended to move within hardened concrete with [one coat of asphalt paint]. When paint is dry, apply a thick even film of mineral lubricating grease.

.3 Prior to placing concrete, obtain Consultant's approval of reinforcing material and placement.

.4 Ensure cover to reinforcement is maintained during concrete pour.

.5 Protect epoxy and paint coated portions of bars with covering during transportation and handling.

.6 Chair welded wire fabric in floor slabs.

.7 Use epoxy coated wire to tie epoxy coated reinforcement.

3.3 FIELD TOUCH-UP

.1 Touch-up damaged and cut ends of epoxy coated or galvanized reinforcing steel with compatible finish to provide continuous coating.

END OF SECTION

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Part 1 General

1.1 GENERAL REQUIREMENTS

.1 Conform to all applicable Sections of Division 1.

1.2 DESCRIPTION

.1 Related Work Specified Elsewhere:

.1 Mechanical and electrical equipment bases, catch basins, manholes and similar work shown on Mechanical and Electrical drawings.

.2 Scope of Work:

.1 Note that all miscellaneous concrete items shown throughout the drawings and not forming part of the work of other Sections shall be supplied and installed by this Section. Such items may include:

.1 Walkway and driveway and swale curbs.

.2 Concrete sidewalks.

.3 Flagpole and sign bases.

.4 Concrete Sonotube bases for fence posts and steel bollards.

1.3 QUALITY ASSURANCE

.1 Codes and By-Laws:

.1 Conform to the Building Code, Ontario Regulation 413/90 and local building by-laws. The more stringent requirements indicated by the above shall govern.

.2 Inspection and Testing:

.1 Follow procedures in accordance with CSA Standard A23.2, Inspection and Testing shall be carried out and pain for in Division 1.

.3 Workmanship:

.1 Maintain a copy of latest CSA A23 and the By-Laws of the Municipality and Provincial Regulations on the site throughout the construction period.

.2 Provide for all work to be performed by skilled and experienced workmen, with a competent Superintendent to be present on the site continuously throughout each working day.

.4 Tolerances:

.1 Conform to the tolerances given on Typical Detail and CSA A23.

1.4 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings, including placing drawings and bar list, to the Consultant for approval in accordance with General Conditions. Shop drawings prepared in accordance with 'Manual of Standard Practice for Detailing Reinforced Concrete Structures, ACI 315 and typical details on the drawings to a minimum scale of 1:50. Check shop drawings before submission for approval in general and fabricate only when drawings are returned approved from the Consultant.

Part 2 Products

2.1 MATERIALS

.1 General:

.1 Use materials specified herein or approved equal as defined in General Conditions.

.2 Only ready mix concrete is permitted on this job conforming to the requirements of CAN/CSA 23.1-00, Table 13, Alternate 1. Concrete supplier shall assume full responsibility for the concrete mix proportions and shall certify the compliance with the requirements of CSA.

.2 Concrete:

.1 Conform to the requirements of CSA 23.1-00 Clause 14 for mix proportioning.

.2 Provide concrete (normal density) in accordance with CAN/CSA 23.1-00, Table 10, 11, 12, and 14 and as follows:

Location	Strength	Class of Exposure	Max. Size of Aggregate	Slump	Air Content
Footing & unspecified concrete	25Mpa	N	20mm	50-100	0-3% max.
Interior slab on grade	25Mpa	N	20mm	50-100	0-3% max.

.3 Slump:

.1 Concrete slumps shall not exceed the requirements of Clause 14.2.3 – CSA A23.1-00.

.4 Cement:

.1 Normal Portland Cement, which complies at the time of incorporation in the mix with requirement of CSA Standard CAN3-A5 Portland Cement.

.5 Aggregates:

.1 Provide coarse aggregate in accordance with requirements of CSA Standard CAN3-A23.1-00, Table 5, Group 1. Maximum size shall be 20mm.

.6 Concrete Topping:

.1 The mix proportion for the topping shall be:

.1 1 part cement

.2 1 ½ parts fine aggregate

.3 2 ½ parts 10mm max. coarse aggregate

.4 18 litres of water per 45 kg. of cement

.5 Maximum slump 40mm

.7 Low Density Concrete:

.1 Concrete mix using expanded shale, clay or slate aggregate by rotary kiln method achieving density of 1760 (+/- 50) kg/m3 with nominal compressive strength of 24 MPa.

.2 Concrete mix using expanded blast furnace slag aggregate with density of 1955 (+/- 50) kg/m3 with nominal compressive strength of 24MPa.

.8 Admixtures – Water Reducing Admixtures:

.1 To conform to the requirements of CSA Standard CAN3-A266.3 Pozzolanic Mineral Admixtures. Pozzolith-Type N manufactured by Master Builders. W.R.D..1 manufactured by W.R. Grace & Co. P.D..1 manufactured by Construction Chemical Ltd., Brampton, Ontario.

.9 Air Entraining Agent:

.1 Provide an approved admixture, which conforms to the requirements of CSA Standard CAN3-A266.1, Air Entraining Admixtures for concrete. M..2V.R. manufactured by Master Builders. Darex .1E..1 manufactured by W.R. Grace & Co. N.V.R. manufactured by Sternson Co. ProAir manufactured by Construction Chemicals.

.10 Bonding Agents:

.1 ‘Albitol' manufactured by Sternson Ltd., Brantford, Ontario; ‘Intralok’ manufactured by W.R. Meadows of Canada, Milton, Ontario.

.11 P.V.C. Waterstops:

.1 'Durajoint' Type #7 manufactured by Sternson Ltd., Brantford, Ontario, 'Koroseal' Type 900-B manufactured by .2G. Goodrich, Toronto, Ontario.

.12 Dry Pack Grout:

.1 Use a mix consisting of one part Portland Cement, one and one half parts sand and two parts of 10mm pea gravel with only sufficient water to dampen the mixture or 'M-BED' standard premixed non-shrink grout by Sternson Ltd., CG-86 Grout by W.R. Meadows of Canada.

.13 Concrete Reinforcement:

.1 Provide reinforcing steel of the strength shown on the drawings in accordance with CSA Standard G30.12, Billet Steel Bars for Concrete Reinforcement.

.2 Provide welded wire mesh, which conforms to CSA Standard G30.5, Welded Steel Wire Fabric for Concrete Reinforcement.

.3 Reinforce slabs on grade with welded wire mesh or polypropylene or nylon fibres in concrete shall be used. Install 8 Flexcel where slab abuts wall.

.4 Welded wire mesh shall be set 38mm from top of sla.2. Extend mesh to within 40mm of construction joints and edge of slab. Reinforcement for slabs shall be 152 x 152 - MW 18.7/MW 18.7 wire mesh unless otherwise indicated on the drawings.

.5 Polypropylene or nylon fibres meeting ASTM C-1116 and C-1018 standards shall be added at the ready mix concrete plant in a quantity specified by the fibre manufacturer and proposed type of fibre shall be approved by this office.

.14 Forms:

.1 Use finished plywood sheets not less than 17mm thick. Provide Sonotube tubular forms for round columns. Provide 18mm chamfer strips in the corners of forms to produce bevelled edges on permanently exposed surfaces unless noted otherwise on Architectural drawings.

.2 Ties shall be metal and sufficiently stiff to act as spreaders or ties. Wire ties are not acceptable.

Part 3 Execution

3.1 PREPARATION

.1 Forms:

.1 Confirm to the requirements of CSA Standard A23.1-00, the Municipal and Provincial regulations including the construction safety regulations.

.2 Assume full responsibility for the design, engineering and construction of formwork including shoring and bracing to resist all vertical and horizontal forces.

.2 Placing Reinforcing:

.1 Tie and support bars to prevent displacement during construction.

.2 Support reinforcing over ground on concrete blocks.

.3 Support reinforcement on formwork on metal chairs or concrete blocks approved by the Consultant.

.4 Reinforcing shall not be spliced except where shown on the drawings.

.5 Protect reinforcing to prevent bending or contamination.

.6 At time concrete is placed; reinforcing shall be clean and free from any coating, which will reduce the bond.

.7 Form oil shall be applied before reinforcing is placed.

.8 Check alignment and elevations of forms before and during placing of concrete.

.9 Provide means of adjusting formwork so that settlement or miss-alignment may be corrected during concrete placing.

.3 Placing Concrete:

.1 Notify the Consultant and Testing Company 48 hours before placing concrete.

.2 Before placing concrete; obtain the Consultant's approval of the preparatory work, concreting procedure and construction joint locations.

.3 Before placing concrete, the forms, reinforcing and built in items must be free of debris, ice, snow and excess water.

.4 Concrete shall be placed within 1 1/2 hours after the introduction of the mixing water.

.5 For freefalls greater than 1500mm use chutes or spouts to prevent segregation of the aggregates.

.6 Deposit concrete continuously in horizontal layers so that no 'cold joint' or planes of weakness are formed in the section.

.7 Use internal vibrators to compact concrete. Use spades or rods to work the concrete around reinforcing, embedded items and into the corners of the forms.

.8 Internal vibrators shall have a minimum frequency of 7000rpm. Maintain spare vibrator on site during concrete placing.

.4 Concrete Topping:

.1 Replace or repair the finish or topping if it is deemed unsatisfactory by the Consultant, for a period of 3 years after acceptance by the Owner.

.2 Ensure that surface of cast in place or precast slabs to receive topping are well cleaned. Apply an approved and compatible bonding agent to all slabs in accordance with manufacturer's instructions.

.3 Ensure that the surface to receive topping is at a temperature of 10 degrees C minimum.

.4 Provide control joints directly over junction of abutting ends of precast slabs or joints in base sla.2. Control joints shall be saw cuts, 3mm x 25mm deep carried out within 24 hours of placing the concrete. Fill saw-cuts with an approved epoxy joint filler of a colour approved by the Consultant.

.5 Apply one coat of curing-sealing compound as soon as the surface will support a workman without damage to the finish. Protect floors against contamination by oil, paint, etc., and damage until the building is accepted by the Owner.

.5 Hot Weather Concreting:

.1 Comply with hot weather requirements of CSA Standard A23.1-00, Clause 21.

.6 Relations to Other Trades:

.1 Give instructions and information in writing and by schedules to other trades of the requirements necessary for services, materials, and inserts to be prepared and supplied by other trade which will affect the work of this Section. Submit for Consultant's approval shop drawings showing type, extent and location of items to be cast in and openings to be formed in concrete work prior to placing of concrete. Set column anchor bolts with templates.

.2 Provide and place dry-pack concrete grout for setting column and beam bearing plates and cooperate with other trades in placing them.

.7 Construction Joints:

.1 Construction joints to conform to CSA A23.1. -00 and as shown on the drawings.

.2 Review with the Consultants the proposed location of construction joints not specifically shown and detailed on the drawings.

.3 Provide vertical construction joints in walls at not more than 25.0 meters centre to centre.

.4 Bond fresh concrete to hardened concrete in accordance with Clause 19.2 of CSA Standard A23.1-00.

.5 Provide and install an approved 150mm wide PVC Waterstop for the full height of construction joints in concrete walls, which retain earth. Make joints in the Waterstop watertight and tie the edges of the material to the reinforcement sufficiently to prevent its displacement during placing of construction.

.6 Extend reinforcing through the joint.

.8 Stripping of Formwork:

.1 Slab formwork shall remain in place until concrete has reached 70% of its ultimate capacity as proven by the testing of concrete cylinder which has been stored on the slab

.2 The slab should be re-shored until it has reached its ultimate 28-day strength or any construction loading exceeding its design load has been removed.

.3 Wall and footing forms shall remain in place until the concrete has reached 60% of its ultimate capacity as proven by testing a concrete cylinder which has been stored on site at the same exposure as the wall or footing.

.9 Treatment of Formed Surfaces:

.1 Conform to CSA A23.1-00, Clause 24.

.2 Bolts, ties, nails or other metal not required shall be removed or cut back to a depth of 25mm from the surface of the concrete.

.3 Finished Architectural concrete shall be to the Consultant's approval.

.4 Formed surfaces exposed to view after completion of the work shall be sack rubbed finished in accordance with CSA A23.1-00, Clause 24.3.7.

.5 All exposed concrete surfaces to receive a coat of paint or textured spray finish shall have all joints ground smooth and holes filled to the Consultants approval ready for the specified final finish.

.10 Granular Underbed for Floor Slabs on Grade:

.1 Place slab on grade on granular backfill placed in accordance with the requirements of Section 2.1

.11 Floor Slabs on Grade:

.1 Provide screeds set to an engineer's level for levelling the surfaces of floor slabs on grade.

.2 Provide keys or dowels at construction joints as detailed on the drawings.

.3 Saw cut slab into panels not exceeding 40m2 and with no saw cuts further than 6.5m apart. Provide saw cut at all doorways and narrow links.

.4 Make saw cuts as soon as possible without damaging slab and in no case longer than 24 hours after placing sla.2. Saw cut to a depth of 1/4 of slab depth.

.12 Exterior Slabs & Sidewalks:

.1 Exterior slabs shall be finished with a spin trowel finish followed with a fine broom and the edges shall be rounded with an edging tool. Slab thickness shall be 125mm except as noted on drawings. Reinforce slab with one layer of welded wire mesh or as noted on drawings and apply one coat of curing sealing compound as soon as the concrete will support a workman without damage to the finish. Saw cut slab into areas not exceeding 20 square meters.

3.2 CONCRETE FLOOR FINISHING

.1 Guarantees:

.1 Provide a written guarantee to make good defects which may appear in finished work within a period of three years after completion and acceptance of the building by the Owner and which are judged by the Architect as being the result of faulty workmanship or material provided under this contract.

.2 Products:

.1 Use materials specified herein or approved equal as defined in General Conditions. Concrete materials shall conform to the standards specified above.

.3 Curing and Sealing Compound:

.1 Provide curing or sealing compound formulated from chorinated rubber conforming to ASTM C-309 ‘Standard Specification for Liquid Membrane Forming Compounds for Curing Concrete' Type 1.

.2 In rooms where slab on grade is to remain exposed, the slab is to be painted in accordance with the Architectural Specifications.

.4 Provide laminated waterproof paper which consist of laminations of Kraft paper and water resisting materials capable of retaining the moisture in the concrete and tough enough to remain intact for the specified time.

.5 Approved Proprietary Materials:

.1 <u>General:</u> The products listed below are approved for use on this project. Approved equal materials as defined by the General Conditions require submission of complete data on physical and chemical characteristics.

.2 <u>Curing & Sealing Compounds:</u> Master Seal supplied by Master Builders, Toronto, Florseal supplied by Sternson Ltd., Brantford, Sealtight CS-309/Vocomp 20 supplied by W. R. Meadows of Canada, Milton.

.3 <u>Sawcut Filler:</u> Loadflex by Sternson Ltd., Brantford, Ontario or Rezi Weld Flex by W.R. Meadows of Canada.

.6 Application:

.1 Refer to the drawings and/or finish schedule for floor finishes and coverings.

.2 Provide a smooth, well-trowelled surface free from ridges, trowel marks or undulation for floors, which are to receive a permanent covering, such as tile, linoleum and carpet.

.3 Provide a hard, smooth and dense trowelled surface free from blemishes for floors, which are to remain, exposed.

.4 Provide a swirl trowel finish or a trowel finish plus fine hair brooming for floors, which are exposed and require a non-slip surface.

.5 Provide a hand or mechanical float surface for floors or roofing.

.6 Cure and protect concrete in accordance with the requirements of CAN3-A23.1-94 and as hereinafter specified.

.7 Cure finished non-coloured concrete surfaces with an approved curing and sealing compound, which will leave the surface with a uniform appearance and with a minimum of discoloration after drying. Ensure that the curing compound will be compatible with the architectural finishes or adhesives for architectural finishes to be applied later. Apply the compound in strict accordance with the manufacturer's instructions.

.8 Protect surfaces that will be exposed to direct sunlight during the curing period, with a light coloured laminated waterproof paper immediately after the curing and sealing compound has hardened sufficiently for the paper to be placed without damage to the sealed surface. Lap the paper a minimum of four inches and seal the laps. Leave the paper in place for at least seven days.

.9 Cure and protect the floor finish in accordance with CAN3-A23.1-00, Clause 21 and in particular to the requirements for either Hot Weather or Cold Weather Curing in extreme temperatures.

.10 Fill saw cuts in exposed floors with epoxy joint filler 'Loadflex' by Sternson Ltd. Fill all other saw cuts with silica sand, cement, latex joint filler.

.11 As late as possible, prior to turning the building over to the Owner, clean down concrete to remove surface discolorations, efflorescence and the like. Use a suitable cleaning agent, which will not itself stain the surface or mark the texture through chemical reaction.

3.3 CLEAN UP

.1 Upon satisfactory completion of the work, clear away from the building and site, excess waste materials and debris and leave the premises in a condition acceptable to the Consultant within the schedule.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section - Mortar and Masonry Grout.

.2 Section - Masonry Anchorage and Reinforcing.

.3 Section - Brick Masonry.

.4 Section - Concrete Unit Masonry.

.5 Section - Metal Fabrications.

1.2 REFERENCES

.1 CSA Group

.1 CAN/CSA-A165 Series-04(R2009), CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).

.2 CAN/CSA-A179-04(R2014), Mortar and Grout for Unit Masonry.

.3 CAN/CSA-A371-04(R2014), Masonry Construction for Buildings.

.2 International Masonry Industry All-Weather Council (IMIAC)

.1 Recommended Practices and Guide Specification for Cold Weather Masonry Construction.

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation meetings: Conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to:

.1 Verify project requirements, including mock-up requirements.

.2 Verify substrate conditions.

.3 Coordinate products, installation methods and techniques.

.4 Sequence work of related sections.

.5 Coordinate with other building subtrades.

.6 Review manufacturer's installation instructions.

.7 Review masonry cutting operations, methods and tools and determine worker safety and protection from dust during cutting operations.

.8 Review warranty requirements.

.2 Sequencing: sequence with other work in accordance with project schedule. Comply with manufacturer's written recommendations for sequencing construction operations.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01340 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for masonry and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit 2 copies of WHMIS MSDS in accordance with Health and Safety Requirements and Section 01570 - Environmental Procedures.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Submit shop drawings detailing temporary bracing required, designed to resist wind pressure and lateral forces during installation.

.4 Samples:

.1 Provide samples as follows:

.1 Two of each type of brick and concrete masonry units specified, including special shapes, supplemented with specific requirements in Sections.

.2 Two cured, and coloured samples of mortar and grout, illustrating mortar colour and colour range, supplemented with specific requirements in Section 04512 - Masonry Mortar and Grout.

.3 Two of each type of masonry accessory and flashing specified, supplemented by specific requirements in Section 04523 - Masonry Accessories.

.4 Two of each type of masonry anchorage, reinforcement and connector proposed for use, supplemented by specific requirements in Section 04 05 19 - Masonry Anchorage and Reinforcing.

.5 Samples: used for testing and when accepted become standard for material used.

.5 Certificates: submit manufacturer's product certificates certifying materials comply with specified requirements, when requested by Consultant.

.6 Test and Evaluation Reports:

.1 Submit certified test reports if requested by Consultant.

.2 Test reports to certify compliance of masonry units and mortar ingredients with specified performance characteristics and physical properties.

.3 Submit data for masonry units, in addition to requirements set out in referenced CSA and ASTM Standards, indicating initial rates of absorption, when requested by Consultant.

.7 Installer Instructions: provide manufacturer's installation instructions, including storage, handling, safety and cleaning.

1.5 CLOSEOUT SUBMITTALS

.1 Submit manufacturer's instructions for care, cleaning and maintenance of prefaced masonry units for incorporation into manual specified in Section - Closeout Submittals.

1.6 QUALITY ASSURANCE

.1 Mock-ups:

.1 Construct mock-up panel of exterior and interior masonry wall construction 1200 x 1800 mm showing masonry colours and textures, use of reinforcement, ties, through-wall flashing, weep holes, jointing, pointing, coursing, mortar and quality of work.

.2 Mock-up used:

.1 To judge quality of work, substrate preparation, operation of equipment and material application.

.3 Construct mock-up where directed by Consultant.

.4 Allow 24 hours for inspection of mock-up by Consultant before proceeding with work.

.5 When accepted by Consultant, mock-up will demonstrate minimum standard for this work. Mock-up may remain as part of finished work if deemed acceptable by Consultant.

.6 Start work only upon receipt of written approval of mock-up by Consultant.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:

.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect material from nicks, scratches, and blemishes.

.3 Keep materials dry until use.

.4 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.

.5 Replace defective or damaged materials with new.

1.8 SITE CONDITIONS

.1 Ambient Conditions: assemble and erect components when temperatures are above 4 degrees C.

.2 Weather Requirements: to CAN/CSA-A371 to IMIAC - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

.3 Hot weather requirements:

.1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.

.2 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry work is completed and protected by flashings or other permanent construction.

.3 Spray mortar surface at intervals and keep moist for maximum of three days after installation.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Masonry materials are specified elsewhere in related Sections:

.1 Section - Masonry Mortar and Grout.

.2 Section - Masonry Anchorage and Reinforcing.

.3 Section - Brick Masonry.

.4 Section - Concrete Unit Masonry.

Part 3 EXECUTION

3.1 INSTALLERS

.1 Experienced and qualified masons to carry out erection, assembly and installation of masonry work. Masonry contractor to have a minimum of 5 years experience in masonry projects equal in size and type of work. Provide documentation where requested by Consultant.

3.2 EXAMINATION

.1 Examine conditions, substrates and work to receive work of this Section. Co-ordinate with Section 01700 - Examination and Preparation.

.2 Examine openings to receive masonry units. Verify opening size, location, and that opening is square and plumb, and ready to receive work of this Section.

.1 Inform Consultant of unacceptable conditions immediately upon discovery.

.2 Proceed with installation after receipt of written approval from Consultant.

.3 Verification of Conditions:

.1 Verify that:

.1 Substrate conditions which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of brick and concrete block.

.2 Field conditions are acceptable and are ready to receive work.

.3 Built-in items are in proper location, and ready for roughing into masonry work.

.2 Commencing installation means acceptance of existing substrates.

3.3 PREPARATION

.1 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations.

.2 Establish and protect lines, levels, and coursing.

.3 Protect adjacent materials from damage and disfiguration.

3.4 INSTALLATION

.1 Do masonry work in accordance with CAN/CSA-A371 except where specified otherwise.

.2 Build masonry plumb, level, and true to line, with vertical joints in alignment, respecting construction tolerances permitted by CAN/CSA-A371.

.3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

3.5 CONSTRUCTION

.1 Exposed masonry: remove chipped, cracked, and otherwise damaged units, in accordance with CAN/CSA-A165, in exposed masonry and replace with undamaged units.

.2 Jointing: Allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, joints true to line, compressed, uniformly concave joints where concave joints are indicated.

.3 Cutting:

.1 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects.

.2 Make cuts straight, clean, and free from uneven edges.

.4 Building-In:

.1 Build in items required to be built into masonry.

.2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.

.5 Wetting of bricks:

.1 Except in cold weather, wet bricks having initial rate of absorption exceeding 1 g/minute/1000 mmý: wet to uniform degree of saturation, 3 to 24 hours before laying, and do not lay until surface dry.

.2 Wet tops of walls built of bricks qualifying for wetting, when recommencing work on such walls.

.6 Support of loads:

.1 Refer to Section 03300 - Cast-in-Place Concrete, where concrete fill is used in lieu of solid units.

.2 Use grout to CAN/CSA-A179(R2014) where grout is used in lieu of solid units.

.3 Install building paper below voids to be filled with concrete grout; keep paper 25 mm back from faces of units.

.7 Provision for movement:

.1 Leave 3 mm space below shelf angles.

.2 Leave 6 mm space between top of non-load bearing walls and partitions and structural elements. Do not use wedges.

.3 Built masonry to tie in with stabilizers, with provision for vertical movement.

.8 Loose steel lintels: Install loose steel lintels. Center over opening width. Unless otherwise indicated, provide at least 200 mm bearing for lintels and beams.

.9 Control joints: Construct continuous control joints to CSA-A371 or as indicated or every 6 m intervals as a minimum. Confirm location of joints with Consultant.

.10 Movement joints: Build-in continuous movement joints as indicated.

3.6 SITE TOLERANCES

.1 Tolerances in notes to CAN/CSA-A371 apply.

3.7 FIELD QUALITY CONTROL

.1 Site Tests, Inspection: notify inspection agency minimum of 48 hours in advance of requirement for tests.

3.8 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01710 - Cleaning. Leave Work area clean at end of each day.

3.9 PROTECTION

.1 Temporary Bracing:

.1 Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.

.2 Bracing approved by Consultant.

.3 Brace masonry walls as necessary to resist wind pressure and lateral forces during construction.

.2 Moisture Protection:

.1 Keep masonry dry using waterproof, non staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until completed and protected by flashing or other permanent construction.

.2 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.

.3 Air Temperature Protection: protect completed masonry as recommended in 1.8, SITE CONDITIONS of this Section.

END OF SECTION

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Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 04 05 19 - Masonry Anchorage and Reinforcing.

.2 Section 04 21 13 - Brick Masonry.

.3 Section 04 22 00 - Concrete Unit Masonry.

1.2 REFERENCES

.1 CSA Group

.1 CSA A23.1/A23.2-09, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CAN/CSA-A179-04(R2014), Mortar and Grout for Unit Masonry.

.3 CAN/CSA-A371-04(R2014), Masonry Construction for Buildings.

.4 CAN/CSA-A3000-08, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

.2 International Masonry Industry All-Weather Council (IMIAC) - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

.3 South Coast Air Quality Management District (SCAQMD) - SCAQMD Rule 1168-05, Adhesive and Sealant Applications.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for masonry mortar and grout and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 29 - Health and Safety Requirements and 01 35 43 - Environmental Procedures. Indicate VOC's mortar, grout, parging, colour additives and admixtures. Expressed as grams per litre (g/L).

.3 Samples:

.1 Samples: submit unit samples in accordance with Section 04 05 00 - Common Work Results for Masonry, supplemented as follows:

.1 Submit two size samples of mortar and coloured mortar.

.2 Submit samples confirmation of source or product data sheet, prior to mixing or preparation of mortars, to Consultant of:

.1 Aggregate: course aggregate and sand.

.2 Cement.

.3 Lime.

.4 Colour pigment samples.

.4 Manufacturers' Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00 - Common Work Results for Masonry.

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

.3 Mock-ups: construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:

.1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect masonry mortar and grout from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.6 SITE CONDITIONS

.1 Ambient Conditions: maintain materials and surrounding air temperature to:

.1 Minimum 5 degrees C prior to, during, and 48 hours after completion of masonry work.

.2 Maximum 32 degrees C prior to, during, and 48 hours after completion of masonry work.

.2 Weather Requirements: CAN/CSA-A371 International Masonry Industry All-Weather Council (IMIAC) - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Use same brands of materials and source of aggregate for entire project.

.2 Cement:

.1 Portland Cement: to CAN/CSA-A3000, Type GU - General use hydraulic cement (Type 10) MS - Moderate sulphate-resistant hydraulic cement (Type 20) HE - High-early-strength hydraulic cement (Type 30) HS - High-sulphate-resistant hydraulic cement (Type 50) MH-Moderate heat of hydration hydraulic cement (Type 40) gray white colour.

.1 Use low VOC products in compliance with SCAQMD Rule 1168-05.

.2 Masonry Cement: to CAN/CSA-A3002 and CAN/CSA-A179, Type N or S for load bearing applications and Type N for non-load bearing applications.

.3 Mortar Cement: to CAN/CSA-A3002 and CAN/CSA-A179, Type N or S for load bearing applications and Type N for non-load bearing applications, integral water repellents.

.4 Use low VOC products in compliance with SCAQMD Rule 1168-05.

.5 Packaged Dry Combined Materials for mortar: to CAN/CSA-A179, Type N or S, using gray colour cement.

.3 Aggregate: supplied by one supplier.

.1 Fine Aggregate: to CAN/CSA-A179, natural sand.

.2 Course Aggregate: to CAN/CSA-A179.

.4 Water: clean and potable.

.5 Lime: lime types suitable to application.

.1 Quick Lime: to CAN/CSA-A179, Type N, NA, S, SA.

.2 Hydrated Lime: to CAN/CSA-A179, Type S, SA.

2.2 COLOUR ADDITIVES

.1 Use colouring admixture not exceeding 10% of cement content by mass, or integrally coloured masonry cement, to produce coloured mortar to match approved sample. Admixtures to be approved prior to use. Use in accordance with the specific manufacturer's recommendations.

2.3 MORTAR MIXES

.1 Mortar for exterior masonry above grade:

.1 Load Bearing: Type S or N based on proportion specifications.

.2 Non-Load Bearing: Type N based on proportion specifications.

.2 Mortar for interior masonry:

.1 Load Bearing: Type S or N based on proportion specifications.

.2 Non-Load Bearing: Type N based on proportion specifications.

.3 Mortar for Parapet walls, unprotected walls: type N based on proportion specifications, CAN/CSA-A179 Table.

.4 Pointing Mortar: CAN/CSA-A179, Type N using proportion specification.

.5 Parging Mortar: Type N to CAN/CSA-A179.

.6 Mortar for foundation walls, manholes, sewers, pavements, walks, patios and other exterior masonry at or below grade: type M based on proportion specifications.

.7 Following applies regardless of mortar types and uses specified above:

.1 Mortar for calcium silicate brick and concrete brick: type O based on proportion specifications.

.2 Mortar for stonework: Type N based on proportion specifications.

.3 Mortar for grouted reinforced masonry: Type S based on proportion specifications.

2.4 MORTAR MIXING

.1 Use pre-blended, pre-coloured mortar prepackaged under controlled factory conditions. Ingredients batching limitations to be within 1% accuracy.

.2 Mix mortar ingredients in accordance with CAN/CSA-A179 in quantities needed for immediate use.

.3 Maintain sand uniformly damp immediately before mixing process.

.4 Add mortar colour and admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and colouration.

.5 Do not use anti-freeze compounds including calcium chloride or chloride based compounds.

.6 Do not add air entraining admixture to mortar mix.

.7 Use a batch type mixer in accordance with CAN/CSA-A179.

.8 Pointing mortar: prehydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that will retain its form when pressed into ball. Allow to stand for not less than 1 hour no more than 2 hours then remix with sufficient water to produce mortar of proper consistency for pointing.

.9 Re-temper mortar only within two hours of mixing, when water is lost by evaporation.

.10 Use mortar within 2 hours after mixing at temperatures of 32 degrees C, or 2-1/2 hours at temperatures under 5 degrees C.

2.5 GROUT MIXES

.1 Bond Beams: grout mix 10 to 12.5 MPa strength at 28 days; 200-250 mm slump; premixed type in accordance with CSA A23.1/A23.2 mixed in accordance with CAN/CSA-A179 fine grout.

.2 Lintels: grout mix 10 to 12.5 MPa strength at 28 days; 200-250 mm slump; premixed type in accordance with CSA A23.1/A23.2 mixed in accordance with CAN/CSA-A179 fine grout.

.3 Grout: Minimum compressive strength of 12.5 MPa at 28 days. Maximum aggregate size and grout slump: CAN/CSA-A179.

2.6 GROUT MIXING

.1 Mix batched and delivered grout in accordance with CSA A23.1/A23.2 transit mixed.

.2 Mix grout ingredients in quantities needed for immediate use in accordance with CAN/CSA-A179 fine grout.

.3 Add admixtures in accordance with manufacturer's instructions; mix uniformly.

.4 Do not use calcium chloride or chloride based admixtures.

2.7 MIX TESTS

.1 Testing Mortar Mix:

.1 Test mortar to requirements of Section 01 45 00 - Quality Control, and in accordance with CAN/CSA-A179, for proportion specification. Test during construction for:

.1 Compressive strength.

.2 Consistency.

.3 Mortar aggregate ratio.

.4 Sand/cement ratio.

.5 Water content and water/cement ratio.

.6 Air content.

.7 Splitting tensile strength.

.2 Testing Grout Mix:

.1 Test grout to requirements of Section 01 45 00 - Quality Control, and in accordance with CAN/CSA-A179, for proportion specification. Test during construction for:

.1 Compressive strength.

.2 Sand/cement ratio.

.3 Water content and water/cement ratio.

.4 Slump.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for masonry installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Consultant.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 PREPARATION

.1 Plug clean-out holes with block masonry units. Brace masonry for wet grout pressure.

3.3 CONSTRUCTION

.1 Do masonry mortar and grout work in accordance with CAN/CSA-A179 except where specified otherwise.

3.4 MIXING

.1 All pointing mortar can be mixed using a regular paddle mixer. Only electric motor mixers are permissible. Mixers run on hydrocarbons are not permitted, due to fumes.

.2 Clean all mixing boards and mechanical mixing machine between batches.

.3 Mortar must be weaker than the units it is binding.

.4 Contractor to appoint one individual to mix mortar, for duration of project. In the event that this individual must be changed, mortar mixing must cease until the new individual is trained, and mortar mix is tested.

3.5 MORTAR PLACEMENT

.1 Install mortar to requirements of CAN/CSA-A179.

.2 Remove excess mortar from grout spaces.

3.6 GROUT PLACEMENT

.1 Install grout in accordance with manufacturer's instructions.

.2 Install grout in accordance with CAN/CSA-A179.

.3 Work grout into masonry cores and cavities to eliminate voids.

.4 Do not install grout in lifts greater than 400 mm, without consolidating grout by rodding.

.5 Do not displace reinforcement while placing grout.

3.7 FIELD QUALITY CONTROL

.1 Site Tests, Inspection: in accordance with Section 04 05 00 - Common Work Results for Masonry supplemented as follows:

.1 Test and evaluate mortar during construction in accordance with CAN/CSA-A179.

.2 Test and evaluate grout during construction to CAN/CSA-A179; test in conjunction with masonry unit sections specified.

.2 Manufacturer's Field Services: in accordance with Section 04 05 00 - Common Work Results for Masonry.

3.8 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.

.2 Remove droppings and splashings using clean sponge and water.

.3 Clean masonry with low pressure clean water and soft natural bristle brush.

.4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.9 PROTECTION

.1 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.

END OF SECTION

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Part 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 04 05 00 - Common Work Results for Masonry.

.2 Section 04 05 12 - Mortar and Masonry Grout.

.3 Section 04 21 13 - Brick Masonry.

.4 Section 04 22 00 - Concrete Unit Masonry.

.5 Section 05 12 00 - Structural Steel.

.6 Section 05 50 00 - Metal Fabrications.

1.2 REFERENCES

.1 ASTM International

.1 ASTM A36/A36M-14, Standard Specification for Carbon Structural Steel.

.2 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.

.3 ASTM A580/A 580M-13a, Standard Specification for Stainless Steel Wire.

.4 ASTM A641/A 641M-14, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.

.5 ASTM A 666-10, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

.2 CSA Group

.1 CSA A23.1/A23.2-(R2014), Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CAN/CSA-A179-04(R2014), Mortar and Grout for Unit Masonry.

.3 CAN/CSA-A370-04(R2014), Connectors for Masonry.

.4 CAN/CSA-A371-04(R2014), Masonry Construction for Buildings.

.5 CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement.

.6 CSA S304.1-04(R2010), Design of Masonry Structures.

.7 CSA W186-M1990(R2012), Welding of Reinforcing Bars in Reinforced Concrete Construction.

.3 Reinforcing Steel Institute of Canada (RSIC) - Reinforcing Steel Manual of Standard Practice, 2004.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

.2 Product Data: Submit manufacturer's instructions, printed product literature and data sheets for anchorage and reinforcing materials and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Submit drawings detailing bar bending details, anchorage details lists and placement drawings

.3 On placement drawings, indicate sizes, spacing, location and quantities of reinforcement and connectors.

.4 Manufacturers' Instructions: submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties, and in accordance with Section 04 05 00 - Common Work Results for Masonry.

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

.3 Mock-ups: Construct mock-ups in accordance with Section 01 45 00 - Quality Control and requirements of Section 04 05 00 - Common Work Results for Masonry.

1.5 SITE MEASUREMENTS

.1 Make site measurements necessary to ensure proper fit of members.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

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

.3 Storage and Handling Requirements:

.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect anchorage and reinforcing materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

Part 2 PRODUCTS

2.1 MATERIALS

.1 Bar reinforcement: to CSA-A371 and CAN/CSA G30.18, Grade 400.

.2 Wire reinforcement: to CSA-A371 and CSA G30.14, ladder type.

.3 Connectors: to CAN/CSA-A370 and CSA S304.1.

.4 Corrosion protection: to CSA S304.1, galvanized to CSA S304.1 and CAN/CSA-A370.

.5 Fasteners: installed post-construction:

.1 Bolts and Screws: size and type to suit application, locate where indicated.

.2 Nails: case-hardened cut or spiral nails, size and type to suit fastening application.

.3 Powder-Driven Fasteners: pin styles and lengths to suit fastening application in accordance with manufacturers use, load and hold recommendations.

.4 Adhesives: epoxies, mastics and contact cements for fastening applications, use in accordance with manufacturers' recommendations.

.6 Horizontal reinforcement:

.1 Shall be sized to suit width of masonry in accordance with CSA-A371. Undersized or oversized reinforcing is not acceptable.

.2 Provide pre-manufactured "L" and "T" corner units. Crimped metal strap ties are not acceptable for connecting intersecting walls.

.3 Corrosion protection to CSA-A370, hot-dip galvanized for metal ties and horizontal reinforcing in exterior walls.

.4 Single wythe masonry: heavy-duty, 4.76 mm (3/16") wire with hot-dip galvanized finish after fabrication to CSA-A371. Reinforcing shall occur every second course, unless noted other wise. Acceptable products:

.1 BL-10 Ladder Reinforcement by Blok-Lok Ltd.

.2 Consultant approved alternate.

.5 Masonry cavity walls - composite:

.1 Joint reinforcing to be Blok-Lok BL-10 (or equivalent) heavy-duty, 4.76 mm (3/16") wire with hot-dip galvanized finish after fabriction to CSA-A371. Reinforcing shall occur every second course, unless noted otherwise.

.2 Use Fero Block Shear Connector, 16 gauge, hot-dip galvanized with 4.76 mm diameter V-ties, hot-dip galvanized and length to provide placement of V-tie legs at centerline of veneer.

.3 The length of block shear connection shall provide anchorage at both the inner and outer face shell of the masonry unit.

.4 Provide block shear ties at 800 mm horizontal and 600 mm vertical spacing, at 300 mm maximum spacing around openings and / or as noted on drawings.

.7 Anchors: to CAN/CSA-A370:

.1 Conventional Anchors: type steel bolts with bent bar anchors plate anchors through bolts, shape J L, sized to suit application.

.2 Wedge Anchors: expansion anchors type wedge and bolt, sized to suit application.

.3 Sleeve Anchors: type sleeve and bolt, sized to suit application.

.4 Self-Contained Anchors: type double-glass/plastic vial system, with epoxy resin and hardener.

.5 Dovetail Anchors: bent steel strap, x mm size x mm thick, galvanized to CAN/CSA-A370 Table 5.2 coated uncoated finish.

.6 Spiral Anchors: 8 mm stainless steel spiral anchors to Grade 304.

.7 Stone Anchors: series 300 stainless steel conforming to ASTM A666. Anchors to be manufactured as per drawings.

.8 Anchor Bolts: conventional (unpatented) anchors proprietary (patented) anchors, steel stainless steel, galvanized to CAN/CSA-A370 Table 5.2 uncoated finish.

.8 Conventional Bolts:

.1 Bolts: to ASTM A 36, bar stock shop threaded, straight bolts with square or hex-headed nuts bent bar anchors, J L shaped.

.2 Plate anchors: steel to ASTM A36, weld square of circular steel plate perpendicular to axis of steel bar threaded on opposite end.

.3 Through bolt rods: to ASTM A307 threaded rod or threaded ASTM A 36 bar stock.

2.2 FABRICATION

.1 Fabricate reinforcing in accordance with CSA A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

.2 Fabricate connectors in accordance with CAN/CSA-A370.

.3 Obtain Consultant's approval for locations of reinforcement splices other than shown on placing drawings.

.4 Upon approval of Consultant, weld reinforcement in accordance with CSA W186.

.5 Ship reinforcement and connectors, clearly identified in accordance with drawings.

2.3 SOURCE QUALITY CONTROL

.1 Upon request, provide Consultant with certified copy of mill test report of reinforcement steel and connectors, showing physical and chemical analysis, minimum five weeks prior to commencing reinforcement work.

.2 Upon request inform Consultant of proposed source of material to be supplied.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for anchorage and reinforcing materials installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Consultant.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 PREPARATION

.1 Direct and coordinate placement of metal anchors for masonry supplied to other Sections.

3.3 INSTALLATION

.1 Supply and install masonry connectors and reinforcement in accordance with CAN/CSA-A370, CAN/CSA-A371, CSA A23.1/A23.2 and CSA S304.1 unless indicated otherwise.

.2 Prior to placing grout, obtain Consultant's approval of placement of reinforcement and connectors.

.3 Supply and install additional reinforcement to masonry as indicated.

3.4 BONDING AND TYING

.1 Bond walls of two or more wythes using metal connectors in accordance with CSA S304.1, CAN/CSA-A371 and as indicated.

.2 Tie masonry veneer to backing in accordance with NBC, CSA S304.1, CAN/CSA-A371 and as indicated.

.3 Install unit, adjustable, single wythe and multiple wythe joint reinforcement where indicated and in accordance with CAN/CSA-A370 and CAN/CSA-A371 manufacturer's instructions.

.1 Bond walls of two or more wythes using metal connectors in accordance with CAN/CSA-A371 and as indicated.

.2 Install horizontal joint reinforcement 400 mm on centre.

.3 Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 400 mm each side of opening.

.4 Place joint reinforcement continuous in first and second joint below top of walls.

.5 Lap joint reinforcement ends minimum 150 mm.

.6 Connect stack bonded unit joint corners and intersections with strap anchors 400 mm on centre.

3.5 REINFORCED LINTELS AND BOND BEAMS

.1 Reinforce masonry beams, masonry lintels and bond beams as indicated.

.2 Place and grout reinforcement in accordance with CSA S304.1, CAN/CSA-A371, and CAN/CSA-A179.

.3 Support and position reinforcing bars in accordance with CAN/CSA-A371.

3.6 GROUTING

.1 Grout masonry in accordance with CSA S304.1, CAN/CSA-A371 and CAN/CSA-A179 and as indicated.

3.7 ANCHORS

.1 Supply and install metal anchors in accordance with CAN/CSA-A370 and CAN/CSA-A371 as indicated.

3.8 LATERAL SUPPORT AND ANCHORAGE

.1 Supply and install lateral support and anchorage in accordance with CSA S304.1 and as indicated.

3.9 MOVEMENT JOINTS

.1 Reinforcement will not be continuous across movement joints unless otherwise indicated.

3.10 FIELD BENDING

.1 Do not field bend reinforcement and connectors except where indicated or authorized by Consultant.

.2 When field bending is authorized, bend without heat, applying a slow and steady pressure.

.3 Replace bars and connectors which develop cracks or splits.

3.11 FIELD QUALITY CONTROL

.1 Site inspections in accordance with Section 04 05 00 - Common Work Results for Masonry.

.2 Obtain Consultant approval of placement of reinforcement and connectors, prior to placing mortar grout.

3.12 FIELD TOUCH-UP

.1 Touch up damaged and cut ends of epoxy coated or galvanized reinforcement steel and connectors with compatible finish to provide continuous coating.

3.13 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning. Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 04051 Masonry Procedures.

.2 Section 04080 Masonry Reinforcing and Connectors.

.3 Section 04211 Brick Unit Masonry.

.4 Section 04220 Concrete Block Masonry - Concrete Masonry Unit.

1.2 REFERENCES

.1 ASTM D 2240-91, Test Method for Rubber Property - Durometer Hardness.

.2 CAN3-A371-94, Masonry Construction for Buildings.

Part 2 Products

2.1 MATERIALS

.1 Control joint filler: purpose-made elastomer of full size and shape required to friction fit joint cavity.

.2 Masonry flashing:

.1 Self-adhered membrane consisting of SBS rubberized asphalt compound which is integrally laminated to a yellow coss-laminated polyethylene film, 1 mm thick.

.1 Acceptable material: Blueskin TWF manufactured by Bakor.

.2 Polyethylene: 0.075 mm thick polyethylene bonded to asphalt treated crepe paper reinforced with 50 x 50 mm glass fibre scrim.

.3 Lap adhesive: recommended by manufacturer of flashing material.

.3 Weep hole vents: purpose-made PVC designed to drain cavities to exterior.

.4 Plastic Mortar Drop Control Device: Mortar Maze manufactured by Advanced Building Products and distributed by Form & Build Supply Inc. Mississauga (905) 620-0242. Sheet dimensions to be 1524 mm long x 279 mm wide x 25mm thick.

.5 Install Blueskin TWF as per manufacturer's instructions.

Part 3 Execution

3.1 INSTALLATION

.1 Install continuous control joint fillers in control joints at locations indicated.

.2 Install weep hole vents in vertical joints immediately over flashings, in exterior wythes of cavity wall and masonry veneer wall construction, at maximum horizontal spacing of 600 mm oc.

.3 Install “mortar maze” in air space gap by friction fitting sheets between interior face of face brick and exterior face of insulation. Place sheet at the base of cavity masonry wall. A continuous run must be maintained by butt edging subsequent sheet together. Ensure “mortar maze” is place in conjunction with through wall membrane flashing in strict accordance with manufacturer’s instruction.

3.2 CONSTRUCTION

.1 Build in flashings in masonry in accordance with CAN3 A371 as follows:
Install flashings under exterior masonry bearing on foundation walls, slabs, shelf angles, and steel angles over openings. Install flashings under weep hole courses and as indicated.

.2 In cavity walls and veneered walls, carry flashings from front edge of masonry, under outer wythe, then up backing not less than 150 mm, and as follows:

.1 For masonry backing embed flashing 25 mm in joint.

.2 For concrete backing, insert flashing into reglets.

.3 For wood frame backing, staple flashing to walls behind sheathing paper.

.4 For gypsum board backing, bond to wall using manufacturer's recommended adhesive.

.3 Lap joints 150 mm and seal with adhesive.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Installation of anchors in masonry

.2 Cutting & Patching for new Mechanical openings

.3 Finish painting

1.2 SCOPE

.1 Provide all miscellaneous metal items except those specified within Sections listed above Under Article

.2 Refer also to drawings for Structural Steel items specified.

1.3 REFERENCE STANDARDS

.1	ASTM A167-87	Specification for Stainless and Heat-Resisting Chromium - Nickel Steel Plate, Sheet and Strip.
.2	ASTM A325-90	Specification for High Strength Bolts for Structural Steel Joints.
.3	ASTM A143-74(1989)	Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
.4	ASTM A307-90	Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
.5	ASTM A563M-90	Specification for carbon and Alloy Steel Nuts.
.6	ASTM A780-90	Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized coatings.
.7	CAN/CSA-S16.1-M89	Limit States Design of Steel Structures.
.8	CSA W59-M1989	Welded Steel Construction (Metal Arc Welding)
.9	CAN/CSA-G40.20-M92	General Requirements for Rolled or Welded Structural Quality Steel.
.10	CAN/CSA-G40.21-M92	Structural Quality Steels.
.11	CAN/CSA-G164-M92	Hot-Dip Galvanizing of Irregularly Shaped Articles
.12	CISC/CPMA 2-75	Canadian Institute of Steel Construction/Canadian Paint Manufacturers Association-A Quick Drying Primer for Use on Structural Steel.
.13	CAN/CGSB-1.40-M89	Primer, Structural Steel, Oil Alkyd Type.
.14	CAN/CGSB-1.108-M89	Bituminous Solvent Type Paint.

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01340 prepared and stamped by a Professional Engineer licensed to design structures in the Province of Ontario.

.2 Clearly indicate materials, core thickness, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details and accessories.

Part 2 Products

2.1 MATERIALS

.1 Metals

.1 Steel sections and plates: to CAN3 G40.21-latest edition, Grade 300 W and Grade 50W for tubes and Grade 44W for plates and flat shapes.

.2 Steel roof decking: to match existing depths and flute design of existing, as required for roof patching at removed roof vents..

.3 Welding Materials: to CSA W59-M1989.

.4 Bolts and anchor bolts: to ASTM A307, A325, and A563 as applicable.

.5 Stainless Steel: Type 302 or 304 alloy conforming to ASTM A167, No. 4 finish.

.2 Primers, Coatings and Shop Painting

.1 Interior Steel in Dry Areas: Quick drying oil alkyd conforming to CISC/CPMA 2.75.

.2 Exterior Steel, Interior Steel in Unheated Areas, Steel Embedded in Concrete:

Hot dip galvanized conforming to CSA G164, minimum Z275 coating.

.3 Galvanizing of structural steel components and loose lintels: refer to Section 5120.

.4 Galvanized Coating Touch-Up: W.R. Meadows “Galvafroid” or Kerry Industries “Z.R.C.” zinc rich coating or similar manufacturer containing minimum 90% zinc by weight.

.5 Apply one shop coat(s) of primer or coating as indicated above and according to manufacturers recommendations. Do not prime aluminum, stainless steel or those components to be galvanized or encased in concrete.

.6 Use primer unadulterated, as provided by manufacturer. Paint on dry surfaces free from rust scale and grease. Do not paint when temperature is lower than 10 deg. Celsius and rising.

.7 Clean surfaces to be field welded; do not paint.

.3 Fastenings

.1 Use nuts and bolts conforming to ASTM A307, A325, and A563 as applicable.

.1 For interior work, use cadmium-plated fastenings where other protection is not specified.

.2 For exterior work, use Type 300 or 400 stainless steel.

.4 Anchors and Shims

.1 For exposed anchorage of aluminum, if applicable, use stainless steel and otherwise to match metal anchored. For non-exposed work, anchors and shims may be galvanized steel.

.5 Bituminous Paint

.1 Alkali-resisting to meet specified requirements of CAN/CGSB-1.108, Type .2 Use to insulate contact between dissimilar metals.

2.2 FABRICATION

.1 Build work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

.2 Weld all connections where possible, and bolt where not possible unless indicated otherwise on drawings.

.3 Use self-tapping shake-proof countersunk flat headed screws on items required to be assembled by screws or as indicated.

.4 Where possible, work to be fitted and shop assembled, ready for erection.

.5 Exposed welds to be continuous for length of each joint. File or grind exposed welds smooth and flush.

.6 Weld all stainless steel by the Argon Arc Process. Grind smooth and polish joints, crence-free, and flush without seams.

.7 Fabricate structural steel, as indicated, in accordance with CAN/CSA-S16.1 and in accordance with reviewed shop drawings.

2.3 LIST OF MISCELLANEOUS METAL FABRICATIONS

.1 This Section includes, but is not limited to the following list. Note : Galvanize all exterior items and other items noted. Prime paint all interior items.

.1 Anchors, Bolts, Inserts, Sleeves for work in this Section.

.2 Hangers and Supports (for work in this Section).

.3 Lintels (if not by Structural Steel).

.4 Support Framing for Rooftop Mechanical Units (if not by Structural Steel).

Part 3 Execution

3.1 GENERAL

.1 Supply and install all miscellaneous metal work indicated on the Drawings and not indicated in work of other Sections in addition to items listed below.

3.2 FABRICATION AND ERECTION

.1 Erect metal work square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.2 Insulate metals, where necessary, to prevent corrosion due to contact between dissimilar metals and between metals and masonry or plaster. Use bituminous paint, butyl tape, building paper or other approved means.

.3 Provide suitable and acceptable means of anchorage, such as dowels, anchor clips, bar anchors, expansion bolts and shields, toggles.

.4 Make field connections with items specified in Articles 2.1.4 and 2.1.5 or weld to CSA S16-1969 and CSA S16S1-1975.

.5 Hand items to be cast into concrete or built into masonry over to appropriate trades together with setting templates.

.6 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection.

.7 Touch-up galvanized surfaces with zinc primer where burned by field welding. Spray or brush apply a minimum of three (3) coats of zinc-rich paint to achieve a dry film thickness of 8 mils. Apply a finish coat of aluminum paint to provide a colour blend with the surround galvanizing.

3.3 GALVANIZED STEEL

.1 Galvanize steel members, fabrications, and assemblies after fabrication by the hot dip process in accordance with CSA G164, minimum Z275 coating.

.2 Galvanize bolts, nuts and washers and iron and steel hardware components in accordance with CSA G164.

.3 Safeguard products against steel embrittlement in conformance with ASTM A143.

.4 Design features which may lead to difficulties during galvanizing shall be pointed out prior to dipping.

.5 The composition of metal in the galvanizing bath shall be not less than 98.0% zinc.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 04051 Masonry Procedures - Masonry Cavity Walls.

.2 Section 07160 Sheet Vapour Barriers - Sheet vapour barrier.

.3 Section 07213 Batt and Blanket Insulation - Batt and blanket insulation.

.4 Section 07271 Air Barriers - Air Barriers barrier.

.5 Section 07510 Built-up Bituminous Roofing - Roof insulation.

.6 Section 15200 Insulation for mechanical work.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA A101-M1983 Thermal Insulation, Mineral Fibre, for Buildings.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.20-M87 Thermal Insulation, Polystyrene, Boards and Pipe Covering.

.2 CGSB 51-GP-21M-78 Thermal Insulation, Urethane and Isocyanurate, Unfaced.

.3 CAN/CGSB-51.25-M87 Thermal Insulation, Phenolic, Faced.

.4 CAN/CGSB-51.26-M86 Thermal Insulation, Urethane and Isocyanurate, Boards, Faced.

.5 CAN/CGSB-51.38-92, Cellular Glass Thermal Insulation.

.6 CGSB 71-GP-24M-77 Adhesive, Flexible, for Bonding Cellular polystyrene Insulation.

.3 Canadian Gas Association (CGA)

.1 CAN/CGA-B149.1-M95 Natural Gas Installation Code.

.2 CAN/CGA-B149.2-M91 Propane Installation Code.

.4 Underwriters Laboratories of Canada (ULC)

.1 CAN4-S604-M82 Factory-Built, Type A Chimneys.

.5 American Society for Testing and Materials (ASTM)

.1 ASTM E 96-96 Test Methods for Water Vapor Transmission of Materials.

Part 2 Products

2.1 INSULATION

.1 Urethane (Polyisocyanurate).

.1 Faced: to CAN/CGSB-51.26, Type 1, Facing reflective foil type, flame spread classification:

.1 Less than 20, smoke developed max 120, thickness 50 mm or as indicated, R.S.I. # 2.5, edges routed to suit Air Barrier System.

2.2 ACCESSORIES

.1 Insulation clips: impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, adhesive back, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self locking type.

Part 3 Execution

3.1 WORKMANSHIP

.1 Install insulation after building substrate materials are dry.

.2 Install insulation to maintain continuity of thermal protection to building elements and spaces.

.3 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.

.4 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of CAN4-S604 type A chimneys and CAN/CGA-B149.1 and CAN/CGA-B149.2 type B and L vents.

.5 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.

.6 Offset both vertical and horizontal joints in multiple layer applications.

.7 Do not enclose insulation until it has been inspected and approved by Consultant.

3.2 EXAMINATION

.1 Examine substrates and immediately inform Consultant in writing of defects.

.2 Prior to commencement of work ensure:

.1 Substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.

3.3 CAVITY WALL INSTALLATION

.1 Install polyisocyanurate insulation over air barrier and fasten in place using air barrier system components.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Structural & Mechanical Sections.

1.2 QUALITY ASSURANCE

.1 Work of this Section shall be performed by skilled specialists having minimum 5 years experience in this trade. Carry out Work in accordance with recommendations of Canadian Roofing Contractor's Association (CRCA). Use only competent mechanics.

.2 Install all products in conformance with manufacturer's printed instructions.

.3 All work shall conform to C.R.C.A. requirements. Procedures outlined by suppliers shall be deemed as minimum requirements. Work shall be subject to independent inspection. Work not approved by the independent inspection agency will be rejected and payment will not be made until such time as the work is deemed satisfactory. Notify the Consultant a minimum 48 hours prior to starting work and provide all samples requested and provide access for the inspector as may be requested.

1.3 PRE-QUALIFIED CONTRACTORS

.1 Only the following Board pre-qualified roofing contractors may be used for this project:

.1 Dafoe Roofing Ltd.
291 Maitland Drive
Bellville, Ontario
K8N 4Z5
Tel: (613) 968-4305
Fax: (613) 968-5980
Contact: Mr. Dayle Dafoe

.2 French Brothers Roofing (Belleville)
109-A Parks Drive
Belleville, Ontario
K8N 4Z5
Tel: (613) 968-4991
Fax: (613) 968-3752
Contact: Mr. Colleen Martin

.3 ICI Roofing Limited
709C The Parkway, P.O. Box 238
Peterborough, Ontario
K9J 6W4
Tel: (705) 741-6032
Fax: (705) 741-1626
Contact: Mr. Steve Carr

1.4 PRODUCT HANDLING

.1 Store materials on raised platforms in approved manner at Site preceding application, and protect from inclement weather at all times. Roofing felts which become wet will be rejected.

.2 Store roofing felts and insulation in heated atmosphere 21°C for 24hr. before application in cold weather. Polywrap roofing felts.

.3 Do not store gravel on roof ahead of demand. Bring gravel to roof only as it is required for spreading as Work proceeds.

1.5 PROTECTION

.1 Protect Work of other trades from roofing procedural damage. Cover vertical surfaces with tarpaulins at hoisting locations.

.2 When using open flame in connection with this Work, maintain at all times 9 kg dry chemical fire extinguisher fully charged and in operable condition at location where open flames are in use.

.3 Locate kettles at grade level and minimum 750mm from face of building.

.4 Protect completed portions of roofing from damage due to traffic and materials handling until completion of work.

1.6 ENVIRONMENTAL CONDITIONS

.1 Do not apply built-up roofing materials during rain, fog, snow, or other damp or otherwise unsuitable surfaces.

1.7 WARRANTY

.1 Contractor hereby warrants that membrane roof system installed under this section shall remain free of defects in accordance with General Conditions, but for a period of **ten (10) years**. Contractor hereby agrees to make good promptly any defects, which occur or become apparent with warranty period. Warranty period commences on the date of Substantial Completion and must cover materials, labour and workmanship. It must include OIC and NDL provisions from manufacturer.

.2 Within 24 hours of the Owners notification, repair any leaks into the building or roof assembly.

.3 The standard form of warranty as per the Ontario Industrial Roofing Contractors Association (OIRCA) shall be issued.

1.8 INSPECTION AND TESTING

.1 An independent inspection and testing agency nominated by the Consultant will be appointed to inspect and test roofing and sheet metal work.

.2 Arrange site meeting with Roofing Inspector and Consultant, maximum two weeks prior to commencement of Work on Site. Obtain Inspector's instructions re procedures to be followed.

.3 Co-operate with the Inspector and afford all facilities necessary to permit full inspection of the Work and testing of materials prior to their use. Act immediately on instructions given by the inspector. Where the inspector deems a change is required which will involve a change in cost, obtain Consultants written approval BEFORE proceeding.

.4 Make cut-outs for testing purposes when required and make good roofing at no extra cost to the Owner.

.5 Pay Inspection and Testing Agency from cash allowance in Section 01 73 00.

Part 2 MATERIALS

Examine the site in advance of the tender and refer to part 3 for compatible materials to be used for this project.

2.1 MATERIALS

.1 All roofing materials must be approved by the Roofing Inspection Agency.

.2	Roofing Asphalts:	Premier type Glasply Type IV by Johns Manville, conforming to ASTM D2178, Type IV.
.3	Roofing Felts:	No. 15 perforated and/or air vent saturated roofing felts, conforming to CSA A.123.3 with maximum moisture content of 1.5% reasonably distributed throughout the felts.
.4	Asphalt Primer:	Conforming to CGSB 37-GP-9A
.5	Insulation:	Polyisocyanurate roof insulation, E'NRG'Y 2 by Johns Manville conforming to ASTMC 1289 and CAN/ULC S704. Apply in 2 layers, 51mm base, 38mm overlay, total thickness 89mm.
.6	Protection Board:	12mm "Retro-fit" board by Johns Manville conforming to ASTM C728, a high density perlite based utility board.
.7	Elastic Flashing:	Expand-O-Flash flexible reinforced membrane by Johns Manville.
.8	Gravel:	Clean, gravel, well graded within limits of 9.5mm to 15.9mm, no fines permitted.
.9	Vapour Barrier:	Permstop by Johns Manville.
.10	Mechanical Fasteners:	Type recommended by Insulation manufacturer.

.11 Modified Bituminous Flashing System (Cold Adhesive Application):

.1	Base Sheet	1 ply of APP fiber glass reinforced, APP modified bitumen base sheet.
.2	Cap Sheet	1 ply of Bicor M cap sheet, flexible polyester/glass scrim reinforced, mineral surfaced, APP modified bitumen cap sheet.

.3 Adhesive MBR utility cement.

.4 As manufactured by Johns Manville

.12 Roof Mastic: MBR Utility Cement, a one part, trowelling grade, elastomeric adhesive by Johns Manville.

Part 3 Execution

3.1 PREPARATION

.1 Examine materials over which Work of this Section are applied and ensure that roof deck is free of snow, ice, loose or adhering materials which would impair this Work. Substrate shall be clean, dry and suitable for roofing application. Dry with torches if necessary.

3.2 WORKMANSHIP

.1 Employ experienced and qualified workmen and competent supervision to ensure satisfactory installation in accordance with specified requirements.

.2 Maintain roofing equipment in good working order.

.3 Do not overheat bitumen. Maximum temperature for Type 2 and Type 3 oxidized asphalt is 243°C. Do not apply to the roof under 205°C. Once asphalt temperatures exceed 246°C, the material will be considered unsatisfactory and must be removed from the site.

.4 Construct roof in conformity to Class 1A roof assembly conforming to ULC S126/S107.

.5 Keep an accurate thermometer suspended in the heating kettle while the work is in progress and provide a similar thermometer to test bitumen temperature at point of application.

.6 Locate bitumen kettles and tankers to avoid smoke discolouration of existing and adjacent buildings.

.7 Handle and store materials carefully to prevent damage. Keep manufacturer's labels and seals intact. Store bitumen containers in an upright position and store roofing rolls on end to prevent flattening. Protect materials from moisture at all times. When temperature is below 5°C, store roofing felts in a warm atmosphere for 48 hours before using.

.8 Commence roofing as soon as structure is ready. Do not apply roofing materials during inclement weather.

.9 All plies of roofing felt except when otherwise specified shall be "mopped solid" and squeezed into bitumen. Apply felts in straight lines, free from air pockets, wrinkles, fishmouths, open laps or tears.

.10 Do not leave installed insulation or roofing felts unprotected. Coat with bitumen and ensure that edges are sealed against penetration of moisture.

3.3 ROOFING – APPLICATION

.1 Vapour Barrier

.1 Adhere vapour barrier to steel deck with fire retardant adhesive, sealing all laps with same adhesive. Extend vapour barrier onto all vertical surfaces, under cant strips, over parapets, and blocking and seal with adhesive. Ensure that vapour barrier overlaps wall air seal and lap all joint.

.2 At wood deck, install one ply of dry sheeting and 2 plies of felt, mopped on.

.2 Thermal Insulation and Protection Board

.1 Keep insulation dry at all times. Insulation showing evidence of having been dampened since its manufacture or separation of laminations shall not be used.

.2 Lay insulation boards in parallel courses. Stagger end joints in alternative courses. Lay boards to moderate contact without forcing joints. Cut boards to fit neatly around projections through roof.

.3 Lay only as much insulation in one day as can be covered by felts the same day.

.4 Installed roof insulation which has become wet shall be removed and replaced with dry insulation.

.5 Reduce thickness of insulation at roof drains by 25mm to prevent puddling.

.6 Where insulation abutts perimeter, envelope the insulation with vapour barrier material, carrying vapour barrier up sides and over top minimum of 100mm.

.7 Secure base course of insulation to metal deck with mechanical fasteners. Secure insulation within 1200mm of the roof perimeter with 50% additional anchors.

.8 Fully adhere second course of insulation to the base course with a solid mopping of type III asphalt.

.9 Stagger joints in second layer half board width or length and embed in full mopping of Type 2 or 3 asphalt.

.10 Install fibreboard protection board over insulation, fully mopped in.

.11 Provide tapered insulation at locations noted on drawings.

.3 Roofing Felts

.1 Built up roofing membrane shall consist of 4 plies of Glasply type IV felts each ply lapped ¾ width of sheet plus 15 mm over the preceding sheet. End lap sheets 150mm minimum. Terminate all plies at the top of the cant strips, unless otherwise specified or detailed. Provide additional plies where detailed.

.2 Apply Type 2 hot asphalt uniformly and continuously at the rate of 1 kg/m sq of roof area over the insulation and each ply of membrane. Lap end joints minimum 150mm.

.4 Gravelling

.1 Apply flood coating of Type 2 asphalt at rate of 3.7 kg/m sq and embed aggregate at rate of 20 kg/m sq.

.2 Broom off excess and apply additional 3 kg/m sq asphalt and embed aggregate at rate of 20 kg/m sq.

.3 Terminate aggregate at base of cant strips.

3.4 RESTRICTED TIMES OF APPLICATION

.1 Restricted Application to times when school is not occupied:

.1 If application of roofing is required during dates when the existing building is occupied, hot asphalt work will be restricted to weekends and after 4 p.m. each school day. At no times shall hot asphalt kettles be active when the school is occupied.

END OF SECTION

Part 1 General

1.1 QUALIFICATIONS

.1 Applicator to be of local recognized standing with proven record of satisfactory installations and to be approved by the Consultant Applicator must have, at least, five (5) years of proven experience in this work.

.2 Supply and install sheet metal flashings in accordance with, and to the standards of the CRCA FL Series details.

1.2 SHOP DRAWINGS

.1 Submit Shop Drawings in accordance with Section 01340.

Part 2 Products

2.1 MATERIALS

.1 Galvanized steel sheet with factory applied Stelco or Dofasco 10,000 Series coating. One colour to be used for this project: Colour at all flashing/parapet cap areas to be to later selected by Consultant, from manufacturers full range, to match existing prefinished metal flashing and trim. All prefinished metal to be of same colour and from same run to match siding for roof screens. Refer to Section 07615.

.2 Metal thickness to be 0.76 (26 ga.). Where exposed face of flat faced flashing and trim exceeds 250 mm, provide details to lap two layers providing on intermediate lock joint to achieve total depth required for exposed surface.

.3 Isolation coating to CGSB 1-GP-108C.

.4 Plastic cement to CGSB 37-GP-5M.

.5 Sealant compound of one (1) part polysulphide polymer base.

.6 Cleats of same material, and temper as sheet metal, minimum 50 mm wide, 45 mm thick.

.7 Fasteners: of same material as sheet metal to CSA B111-1974. Flat head roofing nails of length and thickness suitable for metal flashing application.

.8 Washers: of same material as sheet metal, 1 mm thick with rubber packings.

Part 3 Execution

3.1 INSTALLATION

.1 Install sheet metal work to CRCA Specifications and complete as soon as possible following application of roof membrane.

.2 Use concealed fastenings except where approved before installation.

.3 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock forming tight fit over hook strips, except where otherwise shown.

.4 Lock end joints and caulk with sealant.

.5 Flashings to be anchored into reglets or folded over continuous strips at maximum 300 mm centers.

.6 Supply and assist in the installation of reglets where required for metal flashings.

.7 Use isolation coating where galvanized metal is in contact with concrete, masonry or mortar.

.8 Form flashing over control and expansion joints to Consultant's approval.

.9 Install specialty sleeves for conduits and piping not supplied by Section 07510, around items projecting through roof membrane to CRCA Specifications.

.10 Install fasteners and cleats in sufficient numbers and proper size to prevent metal from lifting or tearing under 125 km/h winds.

.11 Contractor must inform roofing inspector 48 h prior to start of any work. Roofing inspector has authority to reject incorrect procedure, inferior work and materials.

END OF SECTION

Part 1 General

1.1 RELATED WORK

.1 Cutting and Patching:

.2 Gypsum Board:

.3 Firestopping and Smoke Seals for Mechanical Work: Mechanical

.4 Firestopping and Smoke Seals for Electrical Work: Electrical

Note: Firestopping and Smoke Seals within mechanical and electrical assemblies are specified in Divisions Mechanical and Electrical. All other firestopping and smoke seals are the responsibility of this Section.

1.2 REFERENCE

.1 ASTM E814 - Test Method of fire tests of through-penetration firestops, Factory Mutual.

.2 CAN4-S101M - Standard Methods of Fire Endurance Tests of Building Construction and Materials.

.3 CAN4-S115M - Standard Method of Fire Tests of Firestop Systems.

.4 ULC - List of Equipment and Materials.

1.3 SYSTEM DESCRIPTION

.1 Firestopping Materials: CAN4-S115M ASTM E814 to achieve a fire protection rating as noted on Drawings.

.2 It is the intent of this Section that in conjunction with Divisions Mechanical and Electrical a competent, single source be responsible for the firestopping and smoke seals of the entire project.

1.4 SUBMITTALS

.1 Submit a product data.

.2 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, ULC design references.

.3 Submit proposed type of fireproofing system for each location for approval by Consultant. Fireproofing System must be appropriate to achieve expected appearance and finish.

1.5 QUALITY ASSURANCE

.1 Manufacturer: Company specializing in manufacturing products of this Section with minimum five years documented experience.

.2 Applicator: Approved, licensed and supervised by the manufacturer of firestopping materials. Company with minimum five years documented experience.

.3 Product: Manufactured under ULC Follow-up Program. Each container or package shall bear ULC label.

1.6 REGULATORY REQUIREMENTS

.1 Conform to applicable code for fire protection ratings.

.2 Provide certificate of compliance for authority having jurisdiction indicating approval.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver and store materials in a dry, protected area, off ground in original, undamaged, sealed containers with manufacturer's labels and seals intact.

1.8 PROJECT AND SITE CONDITIONS

.1 Application temperature and ventilation as per Manufacturer's instructions.

1.9 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.

Part 2 Products

2.1 MATERIALS

.1 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 and not to exceed opening sizes for which they are intended.

.2 Mineral Wood Backing Insulation: ULC labeled, pre-formed non-combustible material (A/D Firebarrier Mineral Wool) by A/D Fire Protection Systems Inc.

.3 Retainers: Clips to support mineral wool.

.4 Firestopping Sealant: ULC labeled, single component silicone bases, A/D Silicone Firebarrier Sealant by A/D Fire Protection Systems Inc.

.5 Firestopping Seal: ULC labeled, single component water-base seal, A/D Firebarrier Seal by A/D Fire Protection Systems Inc.

.6 Firestopping Foam: ULC labeled, two components silicone foam, A/D Firebarrier RTV Foam by A/D Fire Protection Systems Inc.

.7 Firestopping Mortar: ULC labeled, non-combustible fibre reinforced, foamed cement mortar, A/D Firebarrier Mortar by A/D Fire Protection Systems Inc.

.8 Damming Material: In accordance with tested assembly being installed as applicable and as acceptable to authorities having jurisdiction.

Part 3 Execution

3.1 EXAMINATION

.1 Examine surfaces to receive work of this Section and report any defects, which may affect the Work of this Section.

.2 Verify that openings are ready to receive the Work of this Section.

.3 Confirm compatibility of surfaces to receive firestopping and smoke seal materials.

.4 Beginning of installation means acceptance of existing surfaces and substrate.

3.2 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 clean, dry and frost free.

.2 Prepare surfaces in contact with firestopping materials and smoke seals to manufacturer's instruction.

3.3 APPLICATION

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

.2 Seal holes or voids made by through penetrations, poke-through termination devices, and un-penetrated openings or joints to ensure continuity and integrity of fire separation are maintained.

.3 Apply in sufficient thickness to achieve rating to uniform density and texture.

.4 Provide temporary forming if required.

.5 Tool or trowel exposed surfaces to a neat finish where required.

.6 Remove excess material promptly as work progresses and upon completion.

.7 Protect installed material until cured or set.

3.4 CLEANING

.1 Clean adjacent surfaces of firestopping and smoke seal materials.

3.5 FIELD QUALITY CONTROL

.1 Notify Consultant when ready for inspection and prior to concealing or enclosing firestopping materials and service penetration assemblies.

3.6 SCHEDULING

.1 Firestop and smoke seal at:

.1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.

.2 Top of fire-resistance rated masonry and gypsum board partitions.

.3 Intersection of fire-resistance rated masonry and gypsum board partitions.

.4 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.

.5 Penetrations through fire-resistance rated floor slabs, ceilings and roofs, as applicable.

.6 Openings and sleeves installed for future use through fire separations.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1 Firestopping Section 07 80 00

1.2 DESCRIPTION

.1 Sprayed fireproofing applied directly to structural steel framing members. Replace any fireproofing damaged by renovations

.2 Requirements of regularity agencies: Provide materials and application procedures which have been tested and listed by U.L.C. and are acceptable to the Building Department for the hourly fire protection. ULC R806, or acceptable alternate U.L.C. design, providing minimum 1 hour fire resistance.

.3 Upon completion of the fireproofing application the Contractor must submit to the Consultant a certificate stating what system of fireproofing material was applied and that it complies with the fire protection requirements

1.3 HANDLING

.1 Deliver materials, other than those normally shipped in bulk form, in unopened containers being their manufacture's label showing compliance with Building Code requirements.

.2 Comply with manufacturer's printed recommendations for product handling, storage and protection.

1.4 JOB CONDITIONS

.1 Environmental requirements: Comply with manufacturer's printed recommendations for ambient temperature requirements before, during and after the installation of the sprayed fireproofing.

.2 Provide natural or mechanical ventilation to properly dry this work during and after its application in confined areas.

1.5 SCOPE OF WORK

.1 Spray fireproof all existing steel, including steel deck, where existing spray fireproofing is damaged by work under this Contract.

.2 Provide unit price to provide additional spray fireproofing where original fireproofing has previously been removed or has separated from existing structural steel. Coordinate removal of all damaged and poor quality existing fireproofing, and clean substrate, before applying new fireproofing.

Part 2 Products

2.1 MATERIALS

.1 Sprayed fireproofing: Monokote as manufactured by W.R.Grace Canada Ltd., as manufactured by Double A/D Ltd, or Cafco Industries.

.2 Water: Clean and fresh, free of substances harmful to the fireproofing mix.

.3 Sealer: A/D TC-55 clear sealer.

.4 Surface Coating: A/D Type HC surface coating for fireproofing.

.5 Ensure that new materials are compatible with any existing fireproofing to remain.

2.2 MIX

.1 Proportion mix to comply with requirements of regulatory agencies for the required hourly fire resistances. Add mixing water only with calibrated equipment.

Part 3 Executions

3.1 INSPECTION AND TESTING

.1 Inspect adjacent construction and make sure that all conditions detrimental to the timely or proper execution of this work have been corrected before proceeding.

.2 Clean steel surfaces of all grease, oil and other foreign matter which would prevent the proper adhesion of the sprayed fireproofing. Clean off remnants of existing fireproofing.

3.2 SPRAYED FIREPROOFING

.1 Do not apply sprayed fireproofing until all hangers and other attachments to the members being fireproofed have been installed.

.2 Do not spray junction boxes or wiring or any other item that will require future servicing.

.3 Protect adjacent surfaces and equipment from being damaged by the application, overspray, fall-out and dusting of fireproofing material. Remove excess and spillage promptly.

.4 Comply with manufacturer's printed instructions and recommendations for mixing, handling and machine application of fireproofing material.

.5 Mix sprayed fireproofing using mechanical mixing equipment, except hand mixing will be permitted for small applications requiring less than 1 bag of cementitious materials.

.6 Apply the sprayed fireproofing at the various locations in the thicknesses required to obtain the required fire resistances. Take care to spray the material completely into inverted corners. Cover substrates in a monolithic blanket of the uniform density, texture, and thickness necessary to achieve the required hourly protection.

.7 Where required to apply fireproofing in more than one coat to obtain necessary thickness, apply first coat 13mm to 19mm thick allow to set and partially dry, and follow with a second coat to bring the fireproofing to the necessary thickness. Carefully follow the manufacturer`s printed instructions for the time delay required for doubleback operation.

.8 Trowelling of the sprayed fireproofing is not required.

.9 Fireproofing application must comply strictly with all requirements of the specifically listed Underwriters Laboratories of Canada test design assemblies.

.10 Supply and install sealer over applied fireproofing in all rooms with exposed fireproofing. Apply sealer in 3 even coats to manufacturers specifications.

.11 Supply and install “hard coat” surface coating to exposed spray fireproofing, ready for paint finish, in any rooms where spray fireproofing remains exposed. Confirm compatibility of paint/hard coat prior to painting.

3.3 FIELD QUALITY CONTROLS

.1 Take depth-gauge measurement at 3 m o.c. maximum as the work progresses to verify installed material thickness.

.2 Take measurements along each surface covered with fireproofing.

.3 Apply additional fireproofing materials where measurements indicate thicknesses less than required by the appropriate test data.

.4 Inspect fireproofing after completion of all work in Contract with fireproofed shell and apply additional fireproofing where necessary to cover any areas damaged by work of other trades.

END OF SECTION

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Part 1 General

1.1 GENERAL REQUIREMENTS

.1 Comply with requirements of Division 1.

1.2 DEFINITION

.1 Caulking = Sealant.

1.3 QUALITY ASSURANCE

.1 Sealants must be installed by qualified caulking contractor with minimum five years experience and proven record of being able to produce good quality work.

.2 Upon Consultant's request arrange for sealant manufacturer's technical representative to visit the site, investigate conditions and make recommendations in connection with work of this Section.

1.4 PRODUCT HANDLING

.1 Deliver sealants to site in sealed containers bearing manufacturer's name, brand name of sealant and reference standard to which sealant complies.

.2 Store materials in a dry area having ambient temperature within limitations recommended by material manufacturer.

1.5 JOB CONDITIONS

.1 Unless otherwise specified, apply sealants when air temperature is between 10°C and 25°C. When air temperature is above 25°C or below 10°C follow sealant manufacturer's recommendations regarding application.

1.6 WARRANTY

.1 At no cost to Owner remedy any defects in work, including work of this and other Sections, due to faults in materials and workmanship provided under this Section appearing within a period of two (2) years from date of Substantial Performance.

Part 2 Product

2.1 MATERIALS

.1 Sealants:

.1 Exterior use: low modulus one part silicone to CAN/CGSB-19.18-M87; acceptable product: Dow Corning 790 Building Sealant.

.2 Interior use: one part silicone mildew resistant to CAN/CGSB-19.22-M89 and one part polyurethane for floors: Vulkem 116C by Tremco or Sika 1a, and one part acrylic emulsion to CAN/CGSB 19.17-M90.

.3 Colours: selected by Consultant, not necessarily from manufacturer's standard colours.

.2 Primers, thinners, cleaners: as recommended by sealant manufacturer, non-staining type.

.3 Premoulded backup for sealant: non-gassing closed cell foam rope, compressed 25% when in joint: Sof-Rod by Tremco.

.4 Bond breaker: closed cell polyethylene or vinyl foam tape, self-adhering one side.

Part 3 Execution

3.1 EXAMINATION

.1 Examine joints to be caulked and report in writing to the Consultant any defects in work of other Sections which would impair installation, performance and warranty of sealants.

.2 Do not commence installation of sealants until conditions are acceptable.

.3 Start of work implies acceptance of conditions.

3.2 PREPARATION

.1 Clean and prepare joints to be caulked to produce clean sound surfaces for sealant adhesion.

.2 Remove dust, oil, grease, water, frost, loose mortar and other foreign matter. Remove loose particles by blowing joint out with compressed air.

.3 Chemically clean non-porous surfaces such as metal and glass, taking care to wipe solvents dry with a clean cloth. Use solvents recommended by sealant manufacturer.

.4 Clean porous surfaces such as masonry, concrete and stone by mechanical abrading.

.5 Surfaces adjacent to joints to be primed and which may be stained by primer shall be masked with tape before primer is applied.

.6 Prime joints in accordance with sealant manufacturer's recommendations. Apply primer before installing premoulded backup.

.7 Install premoulded backup in joints 6 mm and more in width. Roll rope type backup into joint, do not stretch or braid. Install bond breaker in joints less than 6 mm in width.

.8 Protect adjacent surfaces from stains and contamination. Make good any damage caused.

3.3 APPLICATION

.1 Apply sealants under pressure using suitable equipment. Gun nozzle shall be of proper size to fit, and seal joint.

.2 Force sealant into joints in full bead, making certain that void free contact is made with sides of joint. Tool joints to produce a slightly concave surface.

.3 Caulking must appear as a concave recessed joint, free of ridges, wrinkles and embedded foreign matter. Caulking shall not spread or bulge beyond surfaces on each of joint.

.4 Apply sealants in accordance with following table:

Joint Width	Sealant Depth
5 mm	5 mm
10 mm	7 mm
15 mm	10 mm
20 mm	12 mm
25 mm	15 mm

.5 Where recommended by sealant manufacturer, vent exterior joints in accordance with such recommendations.

3.4 CLEANING

.1 As work progresses, remove sealant smears and stains from adjacent surfaces. Use cleaning method recommended by sealant manufacturer.

.2 Leave adjacent surfaces in neat and clean condition.

3.5 SCHEDULE

.1 Apply sealant at the following exterior locations:

.1 Between dissimilar materials in exposed locations except where specifically indicated otherwise.

.2 Control joints in masonry elements.

.3 Below door thresholds (double bead).

.4 At perimeter of door, screen and louver frames.

.5 At penetrations through exterior building elements.

.6 Where indicated.

.2 Apply sealant at the following interior locations:

.1 Between dissimilar materials in exposed locations except where specifically indicated otherwise.

.2 Perimeter of exterior door, louver and screen frames.

.3 Between interior door frames and wall where gap exceeds 1.5 mm or where gap is irregular.

.4 Control joints in masonry elements, and joints between bearing and non-bearing masonry walls.

.5 At ceramic tile control joints.

.6 Perimeter of firehose cabinets, access panels, and control panels.

.7 Between vanities/countertops and flooring.

.8 Between interior door frame and flooring.

.9 Where indicated.

.3 At interior locations use acrylic emulsion sealant except:

.1 At floor control joints use polyurethane for floors.

.2 At vanities/countertops and at ceramic wall tile control joints use silicone sealant.

.3 Where expected joint movement exceeds movement capability of acrylic emulsion sealant, use sealant specified for exterior use as directed by Consultant.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 Conform to the requirements of Divisions 00 and 01.

1.2 SCOPE

.1 Mention herein or indication on the drawings of articles, materials, operations or methods requires that the contractor provide each item mentioned or indicated, perform each operation prescribed and provide all labour, materials, equipment, and services to complete the Epoxy Flooring.

1.3 EXAMINATION

.1 Examine the work of other divisions on which the work of this section is dependent. Report any defects in construction or levels to the Consultant. The work of this section shall not commence until such defects have been corrected.

1.4 CHECKING DIMENSIONS

.1 Check all dimensions concerning this work as shown on the drawings and report all discrepancies to the Consultant before commencing application.

1.5 REFERENCES

.1 Reference is made to spec standards produced by various organizations to conform to edition of standards specified or, if not specified, to last edition as amended and revised to date of contract.

.2 ACI Committee #503/pp1139-41

- Bond Strength: 2.8 Mpa (400 psi) 100% concrete failure)

.3 ASTM C-307 - Tensile Strength: 5.7 Mpa (820 psi)

- Test Method for Tensile Strength of Chemical Resistant Mortars, Grouts and Monolithic Surfacings.

.4 ASTM D-638 - Percent Elongation: 100%

- Test Method for Rubber Property - Durometer Hardness

.5 ASTM D-2240/Shore D. Durometer

- Hardness: 80

- Test Method for Rubber Property - Durometer Hardness

.6 Cure Rate (at 77F/25C) allow:

- 8 - 10 hours for tack free surface

- 24 hours for normal operations

.7 Heat Resistance Limitation:

- 140F/60C (for continuous exposure)

- 200F/93C (for intermittent exposure)

.8 Pot Life @ 77F/25C

- 30 -35 minutes

1.6 SUBMITTALS

.1 Submit manufacturer's technical data, installation instructions, and general recommendations for each epoxy flooring material required.

.2 Submit, for verification purposes, 300mm x 300mm square sample of each type of resinous flooring required, applied to a rigid backing, in colour and finish indicated.

1.7 QUALITY ASSURANCE

.1 Obtain primary epoxy flooring materials including primers, resins, hardening agents, finish or sealing coats from a single manufacturer with not less than ten years of successful experience in manufacturing and installing principal materials described in this section. Contractor must have completed at least five projects of similar size and complexity. Provide secondary materials only of type and from source recommended by manufacturer of primary materials.

.2 Arrange a site review meeting not less than 30 days prior to starting work.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver material to job site. Flooring contractor will check material for completeness and shipping damage prior to job start.

.2 All materials must be factory pre-weighed and pre-packaged in single, easy to manage batches to eliminate on site mixing errors. No on site weighting or volumetric measurements allowed.

.3 Store material in a dry, enclosed area protected from exposure to moisture. Temperature of storage area shall be maintained between 16 and 32C.

1.9 MOCK-UP

.1 At site, under manufacturer's supervision, apply for approval with 1sm of complete floor finish in area designated, to match submitted samples. When approved, site applied sample to be standard for appearance, colour, texture, workmanship, etc., and all work to conform to this sample.

1.10 ENVIRONMENT REQUIREMENTS

.1 Concrete substrate must be properly cured for a minimum of 30 days.

.2 Maintain ambient temperature of not less than 18C from 7 days before installation to at least 48 hours after completion of work and maintain relative humidity not higher than 40% during same period.

.3 Ensure substrate is within moisture limits prescribed by epoxy flooring manufacturer.

.4 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage and disposal of hazardous materials.

.5 Job area to be free of other trades during, and for a period of 24 hours, after floor installation.

.6 Protect finished floor from damage by subsequent trades.

.7 Manufacturer's representative must be on job site at start of installation.

1.11 WARRANTY

.1 Furnish a single, written warranty covering both material and workmanship for a period of one full year from date of installation.

Part 2 PRODUCTS

2.1 EPOXY FLOORING

.1 100% solid, O VOC, epoxy, two-component liquid applied Elastomeric Waterproof Membrane with one coat of 100% solid, two-component epoxy coating, selected graded silica aggregate, **Stonproof ME7** with **Stonkote CE4**, as manufactured by Stonhard. Colour to be as later selected by the Owner. Flooring meeting the requirements of the specification, supplied by Sternson, Duochem or DRE Industries are acceptable.

Part 3 EXECUTION

3.1 PREPARATION

.1 Prepare concrete by mechanical means by using a shot blast machine for complete removal of bond inhibiting materials such as curing compounds, existing flooring adhesive or laitance.

3.2 APPLICATION

.1 Apply each component of epoxy flooring system in compliance with manufacturer's directions to produce a uniform monolithic wearing surface of 3mm thickness, uninterrupted except at divider strips, sawed joints or other types of joints, indicated or required.

.2 Mix and apply primer over properly prepared substrate with strict adherence to manufacturer's installation procedures and coverage rates. Primer shall be **Stonhard Undercoat**.

.3 Apply membrane to uniform film thickness. Membrane shall be **Stonproof ME7** as manufactured by Stonhard.

.4 Remove any surface imperfections by lightly abrading and vacuuming the floor surface. Mix top coating according to manufacturer's recommended procedures. Squeegee apply and backroll top coating with strict adherence to manufacture's installation procedures and coverage rates. Broadcast **Stonshield Aggregate** into freshly rolled coat. Top coating shall be **Stonkote CE4**.

.5 Install cove integral with the floor 100mm in height, around perimeter of room, housekeeping pads and curbs around floor openings.

.6 Install manufacturer's epoxy or urethane sealant compatible with floor finish.

3.3 FIELD QUALITY CONTROL

.1 The right is reserved to invoke the following material testing procedure at any time, and any number of times during period of flooring application.

.2 The Owner will engage service of an independent testing laboratory to sample materials being used on the job site. Samples of material will be taken, identified and sealed, and certified in presence of Contractor.

.3 Testing laboratory will perform tests for any of characteristics specified, using applicable testing procedures referenced herein, or if none referenced, in manufacturer's product data.

3.4 CURING, PROTECTION AND CLEANING

.1 Cure epoxy flooring materials in compliance with manufacturer's directions, taking care to prevent contamination during stages of application and prior to completion of curing process. Close area of application for a minimum of 24 hours.

.2 Protect epoxy flooring materials from damage and wear during construction operation. Where temporary covering is required for this purpose, comply with manufacturer's recommendations for protective materials and method of application. General Contractor is responsible for protection and cleaning of surfaces after final coats.

.3 Remove temporary covering and clean epoxy flooring must prior to final inspection. Use cleaning materials and procedures recommended by epoxy flooring manufacturer.

END OF SECTION

Part 1 General

1.1 RELATED WORK SPECIFIED ELSEWHERE

.1	Miscellaneous Metals	Section 05 50 00
.2	Unit Masonry	Section 04 22 00
.3	Gypsum Board	Section 09 25 00
.4	Mechanical Work	Division 20
.5	Electrical Work	Division 26

1.2 SCOPE OF WORK

.1 With exceptions specified above or specifically called for in other Sections of the Specification, all paintwork is included in the scope of this Section of the Specification.

.2 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 wood and metal surfaces normally painted or similarly finished shall be so treated.

.3 Paint exposed gypsum board/cement board 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 or patched work, including miscellaneous metal work, and metal stairs shall be painted. Patched work shall require a complete surface to be painted, back to a proper cut off point, i.e. corner or change in direction from floor to ceiling for walls and wall to wall for ceilings.

.5 Paint pipes, conduit, ducts and related thermal insulation and all prime painted mechanical and electrical equipment and supports located in mechanical and electrical rooms and in all locations 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.

.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 new steel doors and frames to match existing.

.10 Paint existing housekeeping pads including where equipment was removed and/or modified.

.11 Interior of ducts and diffusers visible from exterior on room side.

.12 All paint colours are to match existing, unless noted otherwise on drawings or as noted in pipe colouring schedule

1.3 QUALIFICATIONS

.1 The successful Contractor will be required to provide proof satisfactory to the Owner that they have had a minimum of five years experience using materials specified.

.2 The successful Contractor shall confirm in writing that they have an awareness of lead materials specified.

.3 The successful Contractor will employ only skilled trades people to perform the work specified.

.4 A sample of on site work quality may be required for approval before proceeding with the work.

1.4 SUBMITTALS

.1 Submit triplicate samples 300mm x 200mm panels of each type of paint finish specified. Panels shall be of same material as that on which sample coatings are to be applied in the field where possible. Identify each sample as to job, name of paint manufacturer, finish, colour, name and number, sheen and gloss units and name of Contractor.

.2 Furnish one year guarantee from date of Substantial Completion.

1.5 MAINTENANCE MATERIALS

.1 Provide one sealed can, 3.78 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 labeled with manufacturer's name, type of paint, and colour.

1.6 STORAGE

.1 Store paint and painter's materials in locations approved by the Consultant.

.2 Provide C02 fire extinguisher minimum 9 kg capacity in paint storage area.

1.7 SIGNS

.1 Provide legible signs throughout the Work reading "WET PAINT" in prominent positions during painting and while paint is drying.

.2 Use 75mm high letters on white card or board.

1.8 TEMPORARY COVERS AND PROTECTION

.1 Protect floors and other surfaces with temporary covers such as dust sheets, polyethylene film or tarpaulins. All to Consultant's approval.

.2 Mask identification plates occurring on equipment, switch boxes, and fire rating labels, etc., which require painting.

.3 Protect, remove and replace hardware, accessories, lighting fixtures, and similar items as required except primed for paint door closers, which shall be painted. Light switches and electrical communication outlet plates to be removed and reinstalled on completion of paint application.

.4 Keep oily rags, waste and other similar combustible materials in closed metal containers; take every precaution to avoid spontaneous combustion, remove waste and combustible materials daily.

.5 Clean surfaces soiled by spillage of paint, paint spattering and the like. If such cleaning operations damage the surface, repair and replace damaged work at no cost to the Owner.

1.9 RETOUCHING

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

.2 After fully decorating and retouching a room or other area notify Consultant. After inspection and final approval by Consultant post sign 'DECORATING COMPLETE - NO ADMITTANCE WITHOUT PERMISSION'.

1.10 TEST AREA

.1 A room or area in the building will be designated by the Consultant 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 Consultant, Contractor, Subcontractor and OPCA Inspector to review conditions, surfaces, anticipated problems and to clarify quality of workmanship acceptable to Consultant.

.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 it 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 Consultant to request all Work previously painted to be repainted.

Part 2 Products

2.1 MATERIALS

.1 All materials shall be delivered to the building in the original containers, labels intact and seals unbroken and stored in a single clean locked space. Waste shall not be stored in the building at any time and every precaution shall be taken to avoid and control fire danger and to prevent damage to the floors. All priming, sealing, and painting materials shall be manufactured by Benjamin Moore & Company Limited.

.2 All materials shall be pure and of the manufacturers highest quality for work specified, and shall bear an identifying label on its containers.

.3 Application shall be carried out by applicators, approved by manufacturer, and shall be applied in accordance with manufacturer’s current printed instructions.

.4 All priming, sealing, and painting materials shall be manufactured by Benjamin Moore & Company Limited. Paint colour to be specified on site by Owner.

.1 Metal and Glazed Surfaces Primed with: Fresh Start (023-00).

.2 All other areas not specified herein: Acrylic Latex Semi-Gloss (594).

.3 Interior Trim: MooreStyle Interior Alkyd Semi-Gloss (578).

.4 Millwork: MooreStyle Interior Alkyd Semi-Gloss (578).

.5 Ceilings: Muresco ceiling white (258).

.6 Hallways: MooreStyle Interior Alkyd semi-Gloss (578).

.7 Concrete floors: water based epoxy.

.5 Alternate Materials:

.1 Approved alternate materials are:

.1 Glidden Pants:

Acrylic Latex Semi-Closs 59210 series

Interior Low Odour Alkyd Semi-Gloss Enamel

.6 All materials shall be pure and of the manufactures highest quality for work specified, and shall bear an identifying label on the containers.

.7 Application shall be carried out by applicators, approved by manufacturer, and shall be applied in accordance with manufacturer's current printed instructions.

.8 Deliver materials to Site in original unbroken containers bearing brand and manufacturer's name. The presence of any unauthorized material or containers for such, on Site shall be of sufficient cause for rejection of ALL paint materials on Site at that time, and all previous painted work repainted with proper material.

2.2 COLOUR SCHEDULE

.1 In general, paint colours will match existing. All colours must be confirmed with the Consultant, and conform to approved paint samples.

.2 Refer to room finishing notes for detailed application instructions.

.3 Refer to pipe colouring code for mechanical room piping.

2.3 FINISHING SYSTEM

.1 Drywall:

.1 Institutional Low Odour/ Low VOC, semi-gloss finish.

.2 1 coat Primer; MPI #149

.3 Walls: 2 coats MPI #147

.4 Ceilings: 2 coats of one of the following: Interior Acrylic Ceiling Flat Zero VOC.

.5 All drywall, whether requiring finish paining or not, must receive prime coat.

.2 New Concrete Block, paint:

.1 INT 4.2E (modified), Institutional Low Odour/Low VOC, Semi-gloss finish, 4 coat system/

.2 2 coats latex blockfiller; MPI #4

.3 2 coats finish; MPI #147

.4 Provide gloss finish, MPI #148, where noted as “gloss” in Room Finish Schedule.

.3 Ferrous Metal:

.1 Institutional Low Odour/Low VOC, semi-gloss finish.

.2 1 coat MPI #107

.3 2 coats MPI #147

.4 Shop Primed Ferrous Metal:

.1 Institutional Low Odour/Low VOC, semi-gloss finish.

.2 Confirm type of shop primer used with structural steel supplier.

.3 Confirm compatibility of all coatings with manufacturers.

.4 Touch up prime coat where damaged, with compatible primer, type MPI #107.

.5 2 coats interior latex, MPI #147.

.5 Galvanized Metal:

.1 Includes all hollow metal doors, frames and screens.

.2 Institutional Low Odour / Low VOC, semi-gloss finish.

.3 1 coat galvanized Prime MPI #134.

.4 2 coats Acrylic Semi-Gloss MPI #147.

.6 Insulation on Pipes and Ducts

.1 Institutional Low Odour / Low VOC, semi-gloss finish.

.2 1 coat Primer MPI #17.

.3 2 coats Acrylic Semi-Gloss MPI #147.

.7 Mechanical Equipment:

.1 Institutional Low Odour/Low VOC, semi-gloss finish.

.2 As specified for metal types.

.8 Piping, Conduit, and Ductwork (uncoated)

.1 Institutional Low Odour/Low VOC, semi-gloss finish.

.2 1 coat galvanized Primer MPI #134

.3 2 coats Acrylic Semi-Gloss MPI #147

.9 Concrete Floors:

.1 1 coat water-borne epoxy (diluted 10-20% with water) MPI #115

.2 2 coats water-borne epoxy MPI #115

.3 VOC emissions of coating not to exceed 200 g/l.

Part 3 Execution

3.1 PREPARATION OF SERVICES

.1 Prepare surfaces in accordance with the following standards:

.1 Touch up damaged spots of shop paint primer on steel with CAN/CGSB 1.40M to CGSB 85-GP-14M.

.2 Prepare galvanized steel and zinc coated surfaces to CGSB 85-GP-16M. This includes wiped coated steel surfaces.

.3 Prepare masonry and concrete surfaces to CGSB 85-GP-31M.

.4 Prepare wallboard surfaces to CGSB 85-GP-33M. Fill minor cracks with plaster patching compound for stained woodwork.

.5 Prepare concrete floors to CGSB 85-GP-32M.

.2 Remove dust, wax and grease with Trisodium phosphate (TSP); rinse surface thoroughly with clean water and allow to dry prior to painting.

.3 Where sanding is required it shall be with the wet sanding method.

.4 Where existing paint is flaking or peeling, remove using the following procedure:

.1 Spray area with water.

.2 Remove loose, scaling paint by scraping and sanding while continually spraying.

.5 Dull glossy surfaces by wet sanding.

.6 When using wet sanding the surface and paper shall be kept wet at all times. Dust shall not be made under any circumstances. The floor and surrounding areas shall be protected at all times by means of either a disposable drop sheet or plastic. The worker shall wear rubber gloves during surface preparation.

.7 Remove mildew with bleach and clean water; ensure surface is dry prior to painting.

.8 Fill cracks and large voids in block work by caulking, repointing or other approved methods; spot prime these areas before applying overall coat of paint.

.9 Repair damaged or dented surfaces in drywall and plaster with shackling compound or other appropriate measures; wet sand these areas flush with adjacent surface's for best results, spot prime with an Alkyd Primer Sealer before applying overall coat of paint.

.10 Contractor shall adhere to the proposed regulation respecting lead in paint on construction projects.

.11 Contractors shall adhere to the regulation respecting lead under the Occupational Health and Safety Act, Revised Statues of Ontario, 1980 Chapter 321, Ontario Regulation 843. As amended by Ontario Regulation 519/92.

.12 All drop sheets, sanding material and gloves shall be placed in a sealed garbage bag and disposed of daily off site.

3.2 APPLICATION

.1 All coats shall be of the proper consistency and well applied to show the minimum of brush or roller marks. Varnish and enamel finish coat shall be uniformly flowed on with brush. All brushes or other equipment shall be clean and in good condition. Remove all electrical outlet plates and hardware, escutcheons or plates before painting and replace properly.

.2 All woodwork to be refinished with enamel or varnish and shall be smooth and the surface cleaned before proceeding with the application of the first coat. Enamel or varnish finish applied to wood or metal shall produce an even, smooth finish ALL SURFACES SHALL RECEIVE A MINIMUM OF TWO FINISH COATS UNLESS OTHERWISE SPECIFIED. PRIME COATS NOT INCLUDED. All glazed wall surfaces shall be primed with Benjamin Moore FRESH START 023-00 and where possible tinted to half finish colour and then receive a minimum of two finish coats of Benjamin More M22 of chosen finish colour. All coats shall be thoroughly dry before the succeeding coat is applied.

.3 All work where a coat of material including primer has been applied must be inspected and approved by Consultant before the application of the succeeding specified coat, otherwise no credit for the coat applied will be given, and the Contractor automatically assumes the responsibility to re-coat the work in question. The painting Contractor will notify the Consultant when a particular coat is completed for inspection.

.4 Both sides, tops, bottoms and edges of doors shall be painted or varnished to match face of doors.

.5 Exterior painting shall not be done while the surface is damp, or during rainy or frost weather (below 50 degrees F.).

.6 Painting coats as specified are intended to cover surfaces perfectly; if the surfaces are not covered further coat shall be applied, at no addition to the contract sum.

.7 All surfaces in the designed areas, previously paint or urethaned are to be re-painted or re-urethane. Coating procedures remain as noted in the main specification.

.8 Concrete block surface and edge irregularities shall be repaired before filler. Concrete blocks shall be filled with masonry latex block filler except where thermoplastic coating is used, and specifications require a different base.

.9 Temperature of space in building were painting is being done or where it is drying shall be maintained over 50 degrees F.

.10 All work shall be done by skilled trades people in a quality work like manner. All materials shall be applied under adequate illumination, including filler on concrete block. Wood and steel surfaces may be brushed, masonry surfaces shall be rolled. All materials shall be evenly brushed or rolled and be free of sags, runs, crawls, or other defects. NOTE: Spraying is not permitted.

.11 Upon completion of the work, all paint and varnish spots shall be removed from the floors, sash, fixtures, hardware, glass and other surfaces. All empty paint cans, brushes, rollers, rags and accumulated materials shall be removed from the school site daily. Work areas are to be left clean and in an orderly condition, that is acceptable to the Owner.

3.3 SCHEDULING OF WORK

.1 At no time shall work be done during normal school hours unless special arrangements are made with Board's Representative.

3.4 PREPARATION AND RESTORATION OF ROOMS PRIOR TO AND AFTER PAINTING

.1 Contractor shall advise Owner 24 hours prior to painting.

.2 Contractor shall be responsible for moving of all equipment and materials in rooms. This may be stored in the centre of the room.

.3 All building contents and components shall be protected by the Contractor during the painting operation.

.4 Shut down all air handling units and cover all grilles with plastic carefully taped in place.

.5 Air monitoring may be conducted by the Owner's consultant.

3.5 PIPE COLOURING CODE:

Domestic Cold Water	Visa Green - M22 - 441
Hot Water Heating Feed	Safety Orange - M22 - 021
Hot Water Heating Return	Sand - M22 - 176

.1 All colours are Benjamin Moore Ironclad Industrial Enamel with the exception of chilled supply water (satin impervo).

3.6 WARRANTY/GUARANTEE

.1 Furnish a 100% Maintenance Bond, valid for two (2) years from date of Substantial Performance, or from date of completion of work if work is not complete at date of Substantial Performance.

.2 Subcontractor's shall warrant that the work has been performed in accordance with the standards and requirements of the MPI Architectural Painting Specification Manual, most recent edition.

END OF SECTION

Division 20 Common Requirements for Mechanical

Division 21 Fire Suppression

Division 22 Plumbing

Division 23 Heating, Ventilating, and Air Conditioning (HVAC)

END OF SECTION

Part 1 General

1.1 GENERAL PROVISIONS

.1 This section covers items common to all sections of Mechanical Division.

.2 Conform to Division 1 General Conditions.

.3 Furnish labour, materials, and equipment necessary for completion of work as described in contract documents.

.4 Unless specifically indicated, all materials and equipment provided under this contract shall be new and shall be manufactured in the project year.

1.2 INTENT

.1 Mention herein or indication on Drawings of articles, materials, operations or methods requires: supply of each item mentioned or indicated, of quality, or subject to qualifications noted; installation according to conditions stated: and, performance of each operation prescribed with furnishing of necessary labour, equipment, and incidentals for mechanical work.

.2 Where used, words “Section” and “Division” shall also include other Subcontractors engaged on site to perform work to make building and site complete in all respects.

.3 Where used, word “supply” shall mean furnishing to site in location required or directed complete with accessory parts.

.4 Where used, word “install” shall mean secured in place and connected up for operation as noted or directed.

.5 Where used, word “provide” shall mean supply and install as each is described above.

1.3 TENDERS AND BONDING

.1 Submit tender based on specified described equipment or Alternates listed.

.2 State in Tender, names of all Subcontractors proposed for work under this Division.

1.4 REGULATIONS, PERMITS, AND FEES

.1 All materials and quality of work shall meet all current and latest Provincial, Municipal and Fire Marshall requirements, regulations, codes, and by-laws in force in the area of the project.

.2 Each contractor shall give all necessary notices, obtain all necessary permits, and pay all fees in order that the work shown or specified may be carried out. Each contractor shall furnish any certificates necessary as evidence that the work installed conforms with the laws and regulations of all authorities having jurisdiction.

.3 In the event that changes, or alterations are required on completed work by authorized inspectors, these changes shall be made at the contractor’s expense.

.4 Special equipment which does not have a standard CSA label shall be inspected by the local electrical authority having jurisdiction and the Approval Certificate shall be submitted to the Consultant as soon as possible. All costs and fees for inspections shall be borne by this contractor.

1.5 DRAWINGS

.1 Mechanical Drawings do not show structural and related details. Take information involving accurate measurement of building from building drawings, or at building. Make, without additional charge, any necessary changes, or additions to runs of piping, conduits, and ducts to accommodate structural conditions. Location of pipes, ducts, conduits and other equipment may be altered by Consultant without extra charge provided change is made before installation and does not necessitate major additional material.

.2 As work progresses and before installing piping, ductwork, heating units, registers, diffusers, fixtures and any other fittings and equipment which may interfere with interior treatment and use of building, provide detail drawings, or obtain directions for exact location of such equipment and fittments.

.3 Mechanical Drawings indicate general location and route of pipes, ducts and conduits which are to be installed. Where required work is not shown or only shown diagrammatically, install same at maximum height in space to conserve head room (minimum 2200 mm (88") clear) and interfere as little as possible with free use of space through which they can pass. Follow building lines, conceal piping, conduits and ducts in furred spaces, ceilings and walls unless specifically shown otherwise. Install work close to structure so furring will be small as practical.

.4 Install piping and ductwork to clear structural members and any fireproofing. Locate mechanical work to permit installation of specified insulation. Do not remove or damage structural fireproofing. Leave space to permit fireproofing and insulation to be inspected and repaired.

.5 Before commencing work, check and verify all sizes, locations, grade and invert elevations, levels, and dimensions to ensure proper and correct installation. Verify existing/municipal services.

.6 Locate all mechanical and electrical equipment in such a manner as to facilitate easy and safe access to and maintenance and replacement of any part.

.7 In every place where there is indicated space reserved for future or other equipment, leave such space clear, and install piping and other work so that necessary installation and connections can be made for any such apparatus. Obtain instructions whenever necessary for this purpose.

.8 Relocate equipment and/or material installed but not co-ordinated with work of other Sections and/or installed incorrectly as directed, without extra charge.

.9 Where drawings are done in metric and product not available in metric, the corresponding imperial trade size shall be utilized.

1.6 QUALITY ASSURANCE

.1 Perform work in accordance with applicable provisions of local Plumbing Code, Gas Ordinances, and adoptions thereof for all mechanical systems. Provide materials and labor necessary to comply with rules, regulations, and ordinances.

.2 In case of differences between building codes, provincial laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Promptly notify Consultant in writing of such differences.

1.7 ALTERNATES AND SUBSTITUTIONS

.1 Throughout Mechanical Division are lists of “Alternate Equipment” manufacturers acceptable to Consultant if their product meets characteristics of specified described equipment. Submitted Bids shall be based on the supply of named articles and or products as specified in the Bid Documents.

.2 Each bidder may elect to use “Alternate Equipment” from lists of Alternates where listed. Include for any additional costs including all costs for revisions to electrical contract to suit Alternate used. Prices are not required in Tender for Alternates listed except where specifically noted as “Separate Price”. Complete the Supplementary Tender Form.

.3 When two or more suppliers/manufacturers are named in the Bid Documents, only one supplier/manufacturer of the products named will be acceptable; however, it is the responsibility of this Division to ensure “Alternate Equipment” fits space allocated and gives performance specified. If an “Alternate Equipment” nor “equal” specified product unit is proposed and does not fit space alloted in Consultant’s opinion, supply of specified described equipment will be required without change in Contract amount. Should electrical characteristics for “alternate” or “equal” equipment differ from equipment specified it shall be the responsibility of the equipment manufacturer to pay all costs associated with the revisions to the electrical contract. Only manufacturers listed will be accepted for their product listing. All other manufacturers shall be quoted as substitution stating conditions and credit amount.

.4 If item of material specified is unobtainable, state in Tender proposed substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after Contract has been awarded.

.5 If pipe or item, of size or weight indicated, is unobtainable, supply next larger size or heavier weight without additional charge.

1.8 EXAMINATION

.1 Site Reviews

.1 Examine premises to understand conditions, which may affect performance of work of this Division before submitting proposals for this work.

.2 No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.

.2 Drawings:

.1 Mechanical Drawings show general arrangement of piping, ductwork, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.

.2 Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over Plumbing, Mechanical, and Fire Protection Drawings.

.3 Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.

.3 Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.

1.9 SEQUENCING SCHEDULING AND COORDINATION

.1 It is understood that while Drawings are to be followed as closely as circumstances permit, this Division will be held responsible for installation of systems according to the true intent and meaning of Contract Documents. Anything not clear or in conflict will be explained by making application to Consultant. Should conditions arise where certain changes would be advisable, secure Consultant's approval of these changes before proceeding with work.

.2 Coordinate work of various trades in installing interrelated work. Before installation of mechanical items, make proper provision to avoid interferences in a manner approved by Consultant. Each Contractor shall refer to all sections of the specification for their responsibilities with other trades. Changes required in work specified in Mechanical Division caused by neglect to do so shall be made at no cost to Owner.

.3 Arrange pipes, ducts, and equipment to permit ready access to valves, unions, traps, starters, motors, control components, and to clear openings of doors and access panels.

.4 Furnish and install inserts and supports required by Mechanical Division unless otherwise noted. Furnish sleeves, inserts, supports, and equipment that are an integral part of other Divisions of the Work to Sections involved in sufficient time to be built into construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location or installation of items above shall be borne by Mechanical Division.

.5 Be responsible for required excavation, backfilling, cutting, and patching incident to work of this Division and make required repairs afterwards to satisfaction of Consultant. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns, or trusses.

.1 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.

.2 Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.

.3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.

.6 Adjust locations of pipes, ducts, equipment, fixtures, etc, to accommodate work from interferences anticipated and encountered. Determine exact route and location of each pipe and duct prior to fabrication.

.1 Make offsets, transitions, and changes in direction of pipes, ducts, and electrical raceways as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.

.2 Furnish and install traps, air vents, sanitary vents, pull boxes, etc, as required to effect these offsets, transitions, and changes in direction.

.7 Slots and openings through floors, walls, ceilings, and roofs shall be provided by this contractor but performed by a trade specializing in this type of work. This Division shall see that they are properly located and do any cutting and patching caused by its neglect to do so.

1.10 REQUEST FOR INFORMATION (RFI) PROCEDURES

.1 RFIs shall be submitted to the consultant minimum two (2) weeks prior to answer being required. Failure to submit an RFI in a timely manner will forfeit delay claims and schedule extension requests by the contractor.

.2 All RFIs will be submitted with the following information:

.1 RFI number

.2 Name of project

.3 Date of initiation

.4 Date response required by (minimum two (2) weeks)

.5 Subject

.6 Submitter’s name

.7 Drawing/specification reference

.8 Photograph of the issue (if applicable)

.9 Description of the issue

.10 Contractor’s proposed resolution

1.11 CONTRACT BREAKDOWN

.1 Provide breakdown of contract exclusive of HST to acceptance of consultants prior to first draw submission.

.2 Provide labour and material cost for each item.

.3 Breakdown shall indicate total contract amount.

.4 Contract breakdown shall be as follows as a minimum.

Mobilization and shop drawings (max. $2000.00)
Demolition
Above grade rough-in plumbing and drainage
Sprinkler system and heads
Heating piping
Piping Insulation
Ductwork
Duct Insulation
Grilles & Diffusers
Fire Stopping
Fans & Equipment
Building Automation Systems
Testing Adjusting and Balancing
HVAC system commissioning
Refrigeration Piping
Mechanical contractor closeout requirements (min. of 3% for the first $500,000.00, 1% from $500,000.00 to $5,000.000.00, and 0.5% beyond. Shall not be less than $5,000.00)

.5 Progress claims, when submitted are to be itemized against each item of the contract breakdown, this shall be done in table form showing contract amount, work complete to date, previous draw, amount this draw and balance.

.6 Mobilization amount may only be drawn when all required shop drawings have been reviewed by the consultant.

1.12 COMMISSIONING CONTRACT BREAKDOWN

.1 This contractor shall work with the HVAC system commissioning contractor as specified elsewhere. The following commissioning breakdown shall be indicated on the contract breakdown draw.

1.13 SHOP DRAWINGS AND PRODUCT DATA

.1 Furnish complete catalog data for manufactured items of equipment to be used in the Work to Consultant for review within 14 days after award of Contract.

.2 Upon receipt of reviewed shop drawing, product is to be ordered immediately.

.3 Provide a complete list of shop drawings to be submitted prior to first submission.

.4 Before submitting to the Consultant, review all shop drawings to verify that the products illustrated therein conform to the Contract Documents. By this review, the Contractor agrees that it has determined and verified all field dimensions, field construction criteria, materials, catalogue numbers, and similar data and that it has checked and coordinated each shop drawing with the requirements of the work and of the Contract Documents. The Contractor's review of each shop drawings shall be indicated by stamp, date and signature of a qualified and responsible person possessing by the appropriate authorization.

.5 If material or equipment is not as specified or submittal is not complete, it will be rejected by Consultant.

.6 Additional shop drawings required by the contractor for maintenance manuals, site copies etc., shall be photocopies of the "reviewed" shop drawings. All costs to provide additional copies of shop drawings shall be borne by the contractor.

.7 Submit all shop drawings for the project as a package. Partial submittals will not be accepted.

.8 Catalog data or shop drawings for equipment, which are noted as being reviewed by Consultant or their Engineer shall not supersede Contract Documents.

.9 Review comments of Consultant shall not relieve this Division from responsibility for deviations from Contract Documents unless Consultant's attention has been called to such deviations in writing at time of submission, nor shall they relieve this Division from responsibility for errors in items submitted.

.10 Check work described by catalog data with Contract Documents for deviations and errors.

.11 Shop drawings and product data shall show:

- .1 Mounting arrangements.
- .2 Operating and maintenance clearances. e.g., access door swing spaces.

.12 Shop drawings and product data shall be accompanied by:

- .1 Detailed drawings of bases, supports, and anchor bolts.
- .2 Acoustical sound power data, where applicable.
- .3 Points of operation on performance curves.
- .4 Manufacturer to certify as to current model production.
- .5 Certification of compliance to applicable codes.

.13 State sizes, capacities, brand names, motor HP, accessories, materials, gauges, dimensions, and other pertinent information. List on catalog covers page numbers of submitted items. Underline applicable data.

.14 Shop drawings shall be submitted electronically as per the following directions:

- .1 Electronic Submissions:
  - .1 Electronically submitted shop drawings shall be prepared as follows:
    - .1 Use latest software to generate PDF files of submission sheets.
    - .2 Scanned legible PDF sheets are acceptable. Image files are not acceptable.

.3 PDF format shall be of sufficient resolution to clearly show the finest detail.

.4 PDF page size shall be standardized for printing to letter size (8.5"x11"), portrait with no additional formatting required by the consultant. Submissions requiring larger detail sheets shall not exceed 11"x17".

.5 Submissions shall contain multiple files according to section names as they appear in Specification.

.6 File names shall include consultant project number and description of shop drawing section submitted.

.7 Each submission shall contain an index sheet listing the products submitted, indexed in the same order as they appear in the Specification. Include associated PDF file name for each section.

.8 On the shop drawing use an “electronic mark” to indicate what is being provided.

.9 **Each file shall bear an electronic representation of the “company stamp” of the contractor. If not stamped the file submission will not be reviewed.**

.2 Email submissions shall include subject line to clearly identify the consultants project number and the description of the shop drawings submitted.

.3 Electronic attachments via email shall not exceed 10MB. For submissions larger than 10MB, multiple email messages shall be used. Denote related email messages by indicating “1 of 2” and “2 of 2” in email subject line for the case of two messages.

.4 Electronic attachments via web links (URL) shall directly reference PDF files. Provide necessary access credentials within link or as username/password clearly identified within body of email message.

.5 On site provide one copy of the “reviewed” shop drawings in a binder as noted above.

.6 Contractor to print copies of “reviewed” shop drawings and compile into maintenance manuals in accordance with requirements detailed in this section.

1.14 EQUIPMENT NAMEPLATE DATA

.1 Between the manufactures design published literature, the shop drawing submission literature, and the nameplate data on the equipment, they can all read differently.

.2 Most of the confusion and differences are coming out of the electrical power installation.

.3 The contractors installing and connecting the equipment are responsible for the coordination of this data through the construction period.

.4 The contractors shall share and/or request this information through out the project and monitor/make adjustments, provide recommendations accordingly based on any discrepancies.

.5 The contractors are responsible for any cost associated with the changing data.

.6 The final installation must meet the “Nameplate Data” on the equipment on site.

1.15 OPERATION AND MAINTENANCE MANUAL

.1 Provide operation and maintenance data for incorporation into manual as in submittals’ requirements.

.2 Operation and maintenance manual to be approved by, and final copies deposited with, Consultant before final inspection.

.3 Submit 1 copy of Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless so directed by Consultant. Submission can be done electronically in pdf format or as a hardcopy.

.1 Electronic submission/pdf file is required to be bookmarked. Any submission received without bookmarking will be immediately returned as unacceptable.

.4 Make changes as required and re-submit as directed by Consultant.

.5 Operation data to include:

.1 Control schematics for each system including environmental controls.

.2 Description of each system and its controls.

.3 Description of operation of each system at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for each system and each component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

.8 Spare parts equipment list.

.9 Manufacturers standard or extended warranty information.

.6 Maintenance data shall include:

.1 Servicing, maintenance, operation, and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.7 Performance data to include:

.1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified elsewhere.

.4 Testing, adjusting and balancing reports as specified in Testing, Adjusting and Balancing Section.

.5 Copy of all substantial performance final certificates.

.8 Miscellaneous data to include:

.1 Letter of contractor's warranty and guarantee.

.2 Index sheet.

.3 Tabbed format for each section.

.4 Manufacturers approved shop drawings.

.5 Spare parts list and source.

.6 List of Manufacturers and suppliers address for each piece of equipment.

.9 Final Submittals:

.1 Electronic submission/pdf file is required.

1.16 AS-BUILT DRAWINGS

.1 Site records:

.1 Contractor shall provide 2 sets of reproducible mechanical drawings. Provide sets of white prints as required for each phase of the work. Mark thereon all changes as work progresses and as changes occur. This shall include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 On a weekly basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection at all times.

.2 As-Built drawings:

.1 Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of as-built drawings.

.2 Identify each drawing in lower right hand corner in letters at least 3 mm (1/8") high as follows: - "AS-BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).

.3 TAB to be performed using as-built drawings.

.1 Electronic submission/pdf file is required.

.2 Once approved, submit completed reproducible paper as-built drawings as well as a scanned pdf file copy with Operating and Maintenance Manuals.

1.17 WARRANTIES

.1 In addition to guarantee specified in General Conditions, guarantee heating, cooling, and plumbing systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.

.2 Provide certificates of warranty for each piece of equipment made out in favor of Owner. Clearly record "start-up" date of each piece of equipment on certificate. Include certificates as part of Operation & Maintenance Manual.

.3 Contractor shall rectify any installation deficiencies in the boiler or pressurized other systems identified by a TSSA Inspector for a period of three (3) years from ready for takeover.

.4 Warranty period shall start from date of ready for takeover.

1.18 OCCUPANCY REQUIREMENTS

.1 The contractor shall provide the following documentation to the consultant's satisfaction prior to receiving occupancy. Failure to provide the proper documentation will result in the occupancy not being granted. List of required documentation:

.1 Final Certificates (required prior to consultant's release of conformance letter).

.1 NFPA-13 Contractors Material and Test Certificate (sprinkler)

.2 TSSA Certificate of Authorization for split air conditioning systems ***exceed 5 tons

.3 Contractor letter verifying all refrigeration leak detection systems and their interlocks to downstream devices have been installed and tested.

1.19 READY FOR TAKEOVER

.1 Complete the following to the satisfaction of the consultant prior to request for ready for takeover.

.1 As-Built Drawings.

.2 Maintenance Manuals

.3 System Start up

.4 TAB Reports

.5 HVAC System Commissioning

.6 Instructions to Owners

1.20 REVISION TO CONTRACT

.1 Provide the following:

.1 Itemized list of material with associated costs.

.2 Labour rate and itemized list of labour for each item.

.3 Copy of manufacturers/supplier's invoice if requested.

1.21 DELIVERY, STORAGE, AND HANDLING

.1 Follow Manufacturer's directions in delivery, storage, and protection, of equipment and materials. Contractor to include all costs associated with delivery storage and handling in tender price.

.2 Deliver equipment and material to site and tightly cover and protect against dirt, water, and chemical or mechanical injury but have readily accessible for inspection. Store items subject to moisture damage (such as controls) in dry, heated space.

1.22 DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS

.1 If designated substances and/or hazardous materials are suspected or identified cease all work in the immediate area in accordance with OHSA and notify consultant.

.2 Each contractor and on site employee of the contractor shall have "asbestos awareness training".

.3 The Contractor shall ensure that employees who may come into contact with designated substances and/or hazardous materials due to the nature of the work that they perform, have received training that enables them to recognize designated substances and/or hazardous materials and that enables them to react in accordance with the Occupational Health and Safety Act and regulations thereto should contact with designated substances and/or hazardous materials occur during the course of their work.

.4 It is the responsibility of the contractor to review the designated substances and/or hazardous materials book in the building prior to starting any work.

.5 Existing occupied buildings (depending upon their age) may contain designated substances and/or hazardous materials in thermal insulating materials and some manufactured products, such as vinyl asbestos floor tile. Any insulating materials, on pipes, fittings, boilers, tanks, ductwork, etc. may contain designated substances and/or hazardous materials and shall not be disturbed.

.6 A survey of each building documenting the location and condition of designated substances and/or hazardous materials -containing materials is available for your mandatory review prior to commencing any work on premises.

1.23 TSSA INSPECTION

.1 Prior to final completion of the project, this contractor shall make application, arrange, and pay for a TSSA inspection of all piping systems and equipment installations, including, but not limited to medical gasses, refrigeration, fuel piping, compressed air, heating plant, cooling plant, and associated equipment installed under the contract.

.2 Provide a copy of the TSSA report in the maintenance manuals for each system.

1.24 CONFINED SPACES

.1 Certain areas of the building may be defined as a “Confined Space”. Any personnel working in these areas must have confined space training, appropriate equipment and undertake all work in conformance with appropriate codes and standards.

.2 Refer to building documentation for any spaces deemed “Confined Space”.

1.25 ENERGY EFFICIENCY

.1 The mechanical systems of this building must achieve the energy efficiency levels by conforming to ANSI/ASHRAE/IESNA 90.1 “Energy Standard for Buildings Except Low-Rise Residential Buildings” and Chapter 2 of Division 3 of SB-10 prescriptive method from the Ontario Building Code.

.2 All equipment, products, and installations must conform to the Codes and Standards.

END OF SECTION

Part 1 General

1.1 TESTS

.1 Give 48 hours written notice of date for tests.

.2 Insulate or conceal work only after testing and approval by Consultant.

.3 Conduct tests in presence of Consultant.

.4 Bear costs including retesting and making good.

.5 Piping:

.1 General: maintain test pressure without loss for 4 h unless otherwise specified.

.2 Hydraulically test steam and hydronic piping systems at 1-1/2 times system operating pressure or minimum 860 kPa, whichever is greater.

.3 Test natural gas systems to CSA-B149.1-00, TSSA requirements and requirements of authorities having jurisdiction.

.4 Test drainage, waste and vent piping to Ontario Building Code and authorities having jurisdiction.

.5 Test domestic hot, cold and recirculation water piping at 1-1/2 times system operating pressure or minimum 860 kPa (124.8 psi), whichever is greater.

.6 Test fire systems in accordance with authorities having jurisdiction and as specified elsewhere.

.6 Equipment: test as specified in relevant sections.

.7 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

1.2 SYSTEM START UP

.1 Provide adjusting testing and start up of all equipment prior to testing and balancing (TAB) specified elsewhere.

.2 Provide consultant with written notice verifying all equipment operation and installation is complete.

.3 Start up shall be in presence of the following: owner or representative, contractor, building automation systems (BAS) contractor, and manufacturer's representative. Each person shall witness and sign off each piece of equipment. Consultant's attendance will be determined by consultant.

.4 Simulate system start up and shut down and verify operation of each piece of equipment.

.5 Arrange with all parties and provide 72 hours notice for start up procedure.

.6 Arrange with building automation systems contractor to sequence all components and ensure system operation.

1.3 COMMISSIONING

.1 Co-ordinate and direct each step of the commissioning process and recommend acceptance or non-acceptance to the Owner/Owner's Representative.

.2 Prepare, in writing, documentation of any deficiencies discovered during the commissioning process. Submit to consultant and Owner/Owner's Representative.

.3 The Commissioning Process is detailed in *ASHRAE Guideline 1-1996 HVAC Commissioning Process.* The commissioning plan may be modified to reflect the actual construction schedule and design.

.4 Provide a pre-functional test of all HVAC mechanical system and sub-system elements, including control devices, shall be checked for the following:

.1 Verify that each element has been properly installed, properly identified, and that all connections (including electrical) have been made correctly.

.2 Verify that each element has been checked for proper lubrication, drive rotation, belt tension, control sequence, flow direction, or other conditions which may cause damage or reduce system performance.

.3 Verify that tests, meter readings, and specific mechanical/electrical performance characteristics agree with those required by equipment or system manufacturer.

.4 Controls calibration to be completed in accordance with the specification.

.5 The TAB shall be done in accordance with the specifications.

.5 A functional performance testing shall be done during two separate periods – one during the cooling season and one during the heating season. The first (cooling) testing period shall occur as soon after completion of installation as practical. The heating testing period shall occur as soon as weather conditions make it practical to test warm-up, zone heating and economizer functions. These tests ensure that all equipment and systems operate in accordance with design intent. The tests are dynamic tests, and test the systems through all possible modes of operation.

.6 Reports:

.1 The contractor shall be responsible for recording, documenting, and maintaining detailed inspection and testing data on the test documentation reports. The data record shall be comprehensive and concise.

.2 All data must be recorded as soon as possible during the course of the inspection and testing.

.3 All documentation shall have the date, time, and names of persons participating in the inspection and testing.

.4 All test instruments shall be documented for valid calibration.

.5 The recording work sheets, inspection check lists, and Performance Testing plans must all be approved by the Engineer and the owner's representative prior to the start of the testing.

.6 Include all commissioning documentation in the maintenance manuals.

.7 Mechanical System Execution:

.1 Operate equipment and systems shall be tested in the presence of the owner's representative and the consultant to demonstrate compliance with specified requirements. To minimize the time of Commissioning Team members, testing shall be done in four seasonal single blocks of time insofar as possible.

.2 Notify the consultant, in writing, fourteen (14) days prior to tests scheduled under requirements of this Section.

.3 Testing shall be conducted under specified design operating conditions as recommended or approved by the consultant.

.4 All elements of systems shall be tested to demonstrate that total systems satisfy all requirements of these Specifications. Testing shall be accomplished on hierarchical basis. Test each piece of equipment for proper operation, followed by each sub-system, followed by entire system, followed by any inter-ties of other major systems.

.5 All special testing materials and equipment shall be provided by the appropriate contractor.

.6 Provide three copies of all test reports and records to the consultant.

.8 The verification testing procedures shall address all operating characteristics of all mechanical equipment and systems, including:

Equipment Checklist
Rooftop Heating/Cooling Unit(s)
Air Handling Unit(s)
Heat Recovery Unit(s)
Controllers/Valves/Dampers
Relays/Sensors/Transducers

System Checklist
Air Handling Units

1.4 DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTION

.1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.2 Mechanical contractor to schedule and coordinate the demonstration all on the same day, starting at a pre-approved time and continuing consequently until complete.

.3 Where specified elsewhere in Mechanical Division, qualified manufacturers' representatives who are knowledgeable about the project to provide demonstrations and instructions.

.4 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.

.5 Instruction duration time requirements as specified in appropriate sections.

.6 Where deemed necessary, Consultants may record these demonstrations on video tape for future reference.

1.5 TRIAL USAGE

.1 Consultant or owner may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

.2 Trial usage to apply to following equipment and systems:

.1 HVAC

.2 Exhaust air

.3 Domestic water

.4 Plumbing and drainage.

1.6 DEFICIENCIES

.1 During the course of construction, the consultants will monitor construction and provide written reports of work progress, discussions, and instruction to correct work.

.2 Instruction to correct work shall be done within the work period before the next review.

.3 The contractor shall not conceal any work until inspected.

.4 The contractor shall expedite 100% complete rough-in work and have inspected prior to concealing services and equipment especially above ceiling.

.5 Upon completion of the project the consultant will do a final review. Upon receiving the final inspection report, the contractor must correct and sign back the inspection report indicating the deficiencies are completed. A re-inspection will only be done once consultant receives this in writing.

1.7 EQUIPMENT INSTALLATIONS

.1 Unions or flanges: provide for ease of maintenance and disassembly.

.2 Space for servicing, disassembly and removal of equipment and components: provide as recommended by manufacturer or as indicated.

.3 Equipment drains: pipe to floor drains.

.4 Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines.

1.8 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to equipment unless specified or indicated otherwise. Coordinate with block coursing (if applicable).

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install mechanical equipment at following heights unless indicated otherwise.

.1	Hose bibbs	+/- 600 (24")
.2	Fire extinguisher	1350 (4'– 0") to hanger
.3	**Backflow preventors**	**900 – 1200 (3'– 4') to centerline of unit**
.4	Thermostats: Barrier Free (operable)	1200 mm (47.25")
	Non Barrier Free	1500 mm (59")

Also follow direction of architectural drawings and where discrepancies occur clarify prior to rough-in.

1.9 ANCHOR BOLTS AND TEMPLATES

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

1.10 PROTECTION OF OPENINGS

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

1.11 ELECTRICAL

.1 Electrical work to conform to Electrical Division including the following:

.1 Supplier and installer responsibility and related mechanical responsibility is indicated in Equipment Schedule on mechanical and/or electrical drawings

.2 Power wiring and conduit is specified in Electrical Division except for conduit, wiring and connections below 50 V which are related to control systems specified in Mechanical Division. Follow Electrical Division for quality of materials and workmanship.

.3 Electrically operated equipment shall be C.S.A. approved label. Special Inspection Label of Provincial Authority having jurisdiction will be accepted in lieu of C.S.A. approval. Each motor shall have an approved starter. Starter will be supplied and installed by Electrical Division unless otherwise indicated.

1.12 CONTROL WIRING

.1 Furnish and install all components, devices, and control wiring for all plumbing, fire protection, HVAC equipment, HVAC systems, lighting, and other electrical loads to make all equipment operable to satisfaction of owner and consultant and to manufacturer's requirements and recommendations.

.2 All electrical wiring, mechanical wiring and installations shall comply with local and national electrical and mechanical codes.

.3 Supply and install wiring as required for all devices and systems. Install wiring in EMT conduit and otherwise comply with all requirements of the Electrical Division. Approved plenum wire may be used for sensor and network communication wiring where it complies with appropriate building codes and regulatory authorities.

.4 All wiring concealed in walls and chases, and all exposed wiring shall be run in conduit.

.5 Provide recessed conduit and backer boxes where controls are wall mounted. Surface mounted boxes and conduit are acceptable in mechanical or service rooms.

.6 Free-run plenum rated cable shall be run in cable hangers where provided by electrical division or tied neatly to pipe and duct hangers in the ceiling. Avoid wiring that droops. Follow building lines and do not run wiring "as the crow flies".

1.13 MOTORS

.1 Provide high efficiency motors for mechanical equipment as specified.

.2 If delivery of specified motor will delay delivery or installation of any equipment, install motor approved by Consultant for temporary use. Final acceptance of equipment will not occur until specified motor is installed.

.3 Motors under 373 W, (1/2 hp): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, voltage as indicated.

.4 Motors 373 W, (1/2 hp) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C (72°F), 3 phase, voltage as indicated.

1.14 BELT DRIVES

.1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.

.2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.

.3 For motors under 7.5 kW 10 hp: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.

.4 For motors 7.5 kW 10 hp and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.

.5 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.

.6 Motor slide rail adjustment plates to allow for centre line adjustment.

.7 Provide sheave changes as required for final air balancing.

1.15 GUARDS

.1 Provide guards for unprotected devices.

.2 Guards for belt drives:

.1 Expanded metal screen welded to steel frame.

.2 Minimum 1.2 mm (18 gauge) thick sheet metal tops and bottoms.

.3 40 mm (1 1/2") diameter holes on both shaft centres for insertion of tachometer.

.4 Removable for servicing.

.3 Provide means to permit lubrication and use of test instruments with guards in place.

.4 Install belt guards to allow movement of motors for adjusting belt tension.

.5 Guard for flexible coupling:

.1 "U" shaped, minimum 1.6 mm (16 gauge) thick galvanized mild steel.

.2 Securely fasten in place.

.3 Removable for servicing.

.6 Unprotected fan inlets or outlets:

.1 Wire or expanded metal screen, galvanized, 20 mm (3/4") mesh.

.2 Net free area of guard: not less than 80% of fan openings.

.3 Securely fasten in place.

.4 Removable for servicing.

.7 Duct Openings in Floor

.1 Provide reinforced expanded mesh grating, style 3 (3 lbs/sq.ft.) cover on accessible unprotected duct openings over 300 mm (12”) wide and as indicated. This includes all ductwork terminating in air handling units and plenums.

.2 Securely Fasten in place.

.3 Removable for servicing.

1.16 PIPING AND EQUIPMENT SUPPORTS

.1 Equipment supports supplied by equipment manufacturer: specified elsewhere in Mechanical Division.

.2 Piping and equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of - Structural Steel Section. Submit structural calculations with shop drawings.

.3 Mount base mounted equipment on chamfered edge housekeeping pads, minimum of 100 mm (4") high and 150 mm (6") larger than equipment dimensions all around. Concrete specified elsewhere.

.4 Where housekeeping pads incorporate existing pads provide 10 mm dowels into existing pads. New pad height shall match existing.

1.17 SLEEVES

.1 Pipe sleeves: at points where pipes pass through masonry, concrete or fire rated assemblies and as indicated. Grout sleeves in place.

.2 Schedule 40 steel pipe.

.3 Sleeves with annular fin continuously welded at midpoint:

.1 Through foundation walls.

.2 Where sleeve extends above finished floor.

.3 Through fire rated walls and floors.

.4 Sizes: minimum 6 mm (1/4") clearance all around, between sleeve and uninsulated pipe or between sleeve and insulation.

.5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25 mm (1") above other floors.

.6 Fill voids around pipes:

.1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof fire retardant non-hardening mastic.

.2 Where sleeves pass through walls or floors, provide space for firestopping. Where pipes/ducts pass through fire rated walls, floors and partitions, maintain fire rating integrity.

.3 Ensure no contact between copper tube or pipe and ferrous sleeve.

.4 Fill future-use sleeves with lime plaster or other easily removable filler.

.5 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CGSB 1-GP-181M+Amdt-Mar-78.

.7 Provide minimum 20 gauge duct sleeves where ducts pass through masonry concrete or fire rated assemblies. Maintain minimum 25 mm clearance all around or to the requirements of the authority having jurisdiction. Seal at wall as indicated.

1.18 FIRE STOPPING

.1 This contractor shall work with all other contractors on the project in providing one common method of fire stopping all penetrations made in fire rated assemblies.

.2 Approved fire stopping and smoke seal material in all fire separations and fire ratings within annular space between pipes, ducts, insulation and adjacent fire separation and/or fire rating.

.3 Do not use cementious or rigid seals around penetrations for pipe, ductwork, or other mechanical items.

.4 Insulated pipes and ducts: ensure integrity of insulation and vapour barrier at fire separation.

.5 Provide materials and systems capable of maintaining effective barrier against flame, smoke and gases. Ensure continuity and integrity of fire separation.

.6 Comply with the requirements of CAN4-S115-M35, and do not exceed opening sized for which they have been tested.

.7 Systems to have an F or FT rating (as applicable) not less than the fire protection rating required for closures in a fire separation. Provide “fire wrap” blanket around services penetrating fire walls. Extent of blanket must correspond to ULC recommendations.

.8 The fire stopping materials are not to shrink, slump or sag and to be free of asbestos, halogens and volatile solvents.

.9 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.

.10 Fire stop materials are to be capable of receiving finish materials in those areas which are exposed and scheduled to receive finishes. Exposed surfaces are to be acceptable to consultant prior to application of finish.

.11 Firestopping shall be inspected and approved by local authority prior to concealment or enclosure.

.12 Install material and components in accordance with ULC certification, manufacturers instructions and local authority.

.13 Submit product literature and installation material on fire stopping in shop drawing and product data manual. Maintain copies of these on site for viewing by installers and consultant.

.14 Manufacturer of product shall provide certification of installation. Submit letter to the consultant.

.15 Acceptable Alternate Manufacturers to approval of local authority:

.1 Minnesota Mining and Manufacturing

.2 Fryesleeve Industries Inc.

.3 General Electric Pensil Firestop Systems

.4 International Protective Coatings Corp.

.5 Rectorseal Corporation (Metacaulk)

.6 Proset Systems

.7 3M

.8 AD Systems

.9 Hilti

.16 Ensure firestop manufacturer representative performs onsite inspections and certifies installation. Submit inspection reports/certification at time of substantial completion.

1.19 ESCUTCHEONS

.1 On pipes and ductwork passing through walls, partitions, floors and ceilings in exposed finished areas and on water and drain pipes inside millwork and cabinets.

.2 Chrome or nickel plated brass or Type 302 stainless steel, one piece type with set screws.

.3 Outside diameter to cover opening or sleeve.

.4 Inside diameter to fit around finished pipe.

1.20 PAINTING

.1 Refer to Section Interior Painting and specified elsewhere.

.2 Apply at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.

.3 Apply two coats of paint to exposed piping service in mechanical room, base colour as specified in Mechanical Identification Section.

.4 Prime and touch up marred finished paintwork to match original.

.5 Restore to new condition, or replace equipment at discretion of consultant, finishes which have been damaged too extensively to be merely primed and touched up.

1.21 SPARE PARTS

.1 Furnish spare parts in accordance with general requirements and as follows:

.1 One set of packing/mechanical seals 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 set of belts for each type or each size of machinery.

.6 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

.2 Provide list of equipment in maintenance manuals indicating corresponding spare parts required. List of spare parts to be signed off by receiving personnel.

1.22 SPECIAL TOOLS

.1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Maintenance Materials Special Tools and Spare Parts.

1.23 ACCESS DOORS

.1 Provide access doors to concealed mechanical equipment for operating, inspecting, adjusting and servicing.

.2 Flush mounted 600 x 600 mm (24" x 24") for body entry and 300 x 300 mm (12" x 12") for hand entry unless otherwise noted. Doors to open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.

.3 Material:

.1 Special areas such as tiled or marble surfaces: use stainless steel with brushed satin or polished finish as directed by Consultant.

.2 Remaining areas: use prime coated steel.

.3 Fire rated areas: provide ULC listed access doors.

.4 Washrooms or high moisture area ceilings: Aluminum with mill finish suitable for painting.

.4 Installation:

.1 Locate so that concealed items are accessible.

.2 Locate so that hand or body entry (as applicable) is achieved.

.5 Acceptable materials:

.1 Le Hage

.2 Zurn

.3 Acudor

.4 Nailor Industries Inc.

1.24 DIELECTRIC COUPLINGS

.1 General:

.1 To be compatible with and to suit pressure rating of piping system.

.2 Where pipes of dissimilar metals are joined.

.2 Pipes NPS 50 mm (2") and under: isolating unions.

.3 Pipes NPS 65 mm (2 1/2") and over: isolating flanges.

1.25 DRAIN VALVES

.1 Locate at low points and at section isolating valves unless otherwise specified.

.2 Minimum NPS 20 mm (3/4") unless otherwise specified: bronze, with hose end male thread and complete with cap and chain.

.3 Drain valves on potable water systems shall be complete with vacuum breaker.

1.26 REPAIRS, CUTTING, AND RESTORATION

.1 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.

.2 Each Section of this Division shall bear expense of cutting, patching, and repairing to install their work and/or replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.

.3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.

.4 All patching, painting and making good of the existing walls, floors, ceilings, partitions and roof will be at the expense of this Contractor, but performed by the Contractor specializing in the type of work involved unless otherwise noted.

1.27 EXISTING SYSTEMS

.1 Connections into existing systems to be made at time approved by Consultant. Request written approval of time when connections can be made.

.2 Be responsible for damage to existing plant by this work.

1.28 CLEANING

.1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units prior to turn over to owner.

.2 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition including replacement of all filters in all air and piping systems.

1.29 DISCONNECTION AND REMOVAL

.1 Disconnect and/or remove equipment, piping, ductwork, etc. as indicated.

.2 Cap and conceal all redundant and obsolete connections.

.3 Provide a list of equipment to be removed to the owner, for his acceptance of same. Remove all equipment from site, which the owner does not retain.

.4 Store equipment to be retained by owner on site where directed by consultant.

1.30 OWNER SUPPLIED EQUIPMENT

.1 Connect to equipment supplied by the owner and make operable.

1.31 DEMOLITION

.1 The general requirements are indicated on the drawings and on the outline specification in Division 1.

.2 The general execution of the demolition is to be carried out in a clean and efficient manner.

.3 Demolition of existing ceiling, walls etc., to facilitate removal of existing services or equipment or installation of new to be kept to a minimum and then restored to match existing.

.4 All openings or holes created by removal of existing mechanical systems which are not being reused are to be patched with the same material surrounding surfaces.

.5 All new holes and openings to facilitate mechanical systems are to be patched to match surrounding surfaces.

.6 Protect all existing furnishings materials and equipment. Any damage occurring as a result of the work of this Division shall be repaired or replaced at the expense of this Division.

.7 Where work involves breaking into or connecting to existing services, carry out work at times directed by the Owners in an expedient manner with minimum disruption to the facility and systems downtime.

.8 Where unknown services are encountered, immediately advise Consultant and confirm findings in writing.

.9 Where the location of any services has been shown on the plans, such information is not guaranteed. It is this Division's responsibility to verify locations, invert elevations, etc., immediately after moving on site. Should for any reason the information obtained necessitates changes in procedure or design, advise the Consultant at once. If verification of existing conditions is not done at the outset and any problems arise, the responsibility for same is entirely this Division's.

1.32 CONFINED SPACES

.1 Certain areas of the building may be defined as a "Confined Space". Any personnel working in these areas must have confined space training, appropriate equipment and undertake all work in conformance with appropriate codes and standards.

.2 Refer to building documentation for any spaces deemed "Confined Space".

1.33 TSSA INSPECTION

.1 Prior to final completion of the project, this contractor shall make application, arrange, and pay for a TSSA inspection of all piping systems and equipment installations, including, but not limited to medical gasses, refrigeration, fuel piping, compressed air, heating plant, cooling plant, and associated equipment installed under the contract.

.2 Provide a copy of the TSSA report in the maintenance manuals for each system.

1.34 INTEGRATED LIFE SAFETY SYSTEMS TESTING

.1 Mechanical systems in this building, including but not limited to smoke control dampers, smoke control fans, high speed low velocity ceiling fans, makeup air units, heat tracing for fire protection systems and fire protection system components may be subject to Integrated Life Safety Systems testing.

.2 The Mechanical Contractor shall co-ordinate with the Integrated Life Safety Systems Testing Agent as follows:

.1 Confirm which mechanical systems are to be included as part of the testing process.

.2 Verify in writing to the Integrated Life Safety Systems Testing Agent that mechanical commissioning of the affected systems/devices is complete prior to the scheduled testing date(s).

.3 Participate in the Integrated Life Safety Systems Testing to confirm proper operation of all associated systems.

.4 This contractor shall work with the Integrated Life Safety Systems Testing Agent to reset all systems back to normal operating mode after the testing is complete.

.3 Include all costs associated with Integrated Life Safety System Testing in the tender value.

.4 Refer to Division 1/Division 26 Integrated Life Safety Systems Testing specifications for additional information/requirements.

1.35 REFRIGERANT CONTAINING EQUIPMENT

.1 A2L refrigerants are classified as mildly flammable. CSA B52-2023 has specific safety clauses related to the use of refrigerants with this classification within buildings.

.2 This Contractor shall be responsible to ensure that the installation requirements of CSA B52-2023 are met.

.3 Throughout this specification various pieces of equipment have been specified with refrigerant leak detection systems. Field wiring of the alarm status of this system to various downstream system components is required under Annex P of the standard and is the responsibility of this Contractor. These devices include the following:

.1 Open all zone dampers connected to the affected system.

.2 Disable electric reheat coils within the affected system.

.3 Activate field installed safety shut off valves on the affected refrigeration systems

.4 De energize any potential sources of ignition with the ductwork system of the affected system.

.5 Energize fans within the ductwork system.

.6 Activate any designated refrigeration leak ventilation systems.

END OF SECTION

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Part 1 General

1.1 GENERAL PROVISIONS

.1 Conform to the General Provisions of General Requirements Section.

.2 This project is one of a retrofit nature in part, and which will require some demolition.

.3 Allow for all remedial work in areas indicated on the drawings and as generally defined in the relevant sections of the specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

.1 Electrical Division.

1.3 SCOPE OF WORK

.1 The scope of work is essentially the selected disconnection and/or removal of services and/or equipment, piping ductwork etc. as indicated or required to complete the work.

Part 2 Products

2.1 GENERAL

.1 This Division is to liaise with the Owners or Consultant for equipment being removed that may be suitable for reuse to that specified or handed over to the owner.

.2 This Division to take full responsibility for any special tools or equipment required to disassemble or remove material from building.

Part 3 Execution

3.1 GENERAL

.1 The general requirements are indicated on the drawings and on the outline specification in Division 1.

.2 The general execution of the demolition is to be carried out in a clean and efficient manner.

.3 Demolition of existing ceiling, walls etc., to facilitate removal of existing services or equipment or installation of new to be kept to a minimum and then restored to match existing.

.4 All openings or holes created by removal of existing mechanical systems which are not being reused are to be patched with the same material surrounding surfaces.

.5 All new holes and openings to facilitate mechanical systems are to be patched to match surrounding surfaces.

.6 Protect all existing furnishings materials and equipment. Any damage occurring as a result of the work of this Division shall be repaired or replaced at the expense of this Division.

.7 Where work involves breaking into or connecting to existing services, carry out work at times directed by the Owners in an expedient manner with minimum disruption to the facility and systems downtime.

.8 Where unknown services are encountered, immediately advise Consultant and confirm findings in writing.

.9 Where the location of any services has been shown on the plans, such information is not guaranteed. It is this Division's responsibility to verify locations, invert elevations, etc., immediately after moving on site. Should for any reason the information obtained necessitates changes in procedure or design, advise the Consultant at once. If verification of existing conditions is not done at the outset and any problems arise, the responsibility for same is entirely this Division's.

.10 Disconnect and/or remove equipment piping, ductwork, etc. as indicated.

.11 Cap and conceal all redundant and obsolete connections.

.12 Provide a list of equipment to be removed to the owner, for his acceptance of same. Remove all equipment from site which the owner does not retain.

.13 Maintain equipment to be retained by owner on site where directed by consultant.

.14 Demolition of all parts of the work must be completed within the confines of the work area and in such a way as the dust produced and risk to injury of will not adversely affect the building users.

.15 Demolished areas of the existing building will remain in their current use in some cases. Demolition in these areas must be kept to the minimum required to complete the work.

.16 Demolition shall take place within areas isolated from all other areas with appropriate hoarding, scaffolding, netting, fencing or other means of security between building users and the work.

.17 Co-ordinate making safe electrical devices, capping plumbing and removal of fixtures prior to commencement of demolition.

.18 All piping and equipment to be removed and/or abandoned shall be drained prior to capping and/or abandoning. Disposal of all liquids shall be to the approval of authority of having jurisdiction and/or provincial regulations.

3.2 EXISTING SYSTEM DRAINAGE

.1 Drain all existing piping and drainage systems including all related equipment as required to facilitate system renovations.

.2 Disposal of existing system shall be to the requirements of the local and/or provincial regulations.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 American Society for Testing and Materials

.1 ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

.2 ASTM A105/A105M, Specification for Carbon Steel Forgings for Piping Applications.

1.2 PRODUCT DATA

.1 Submit product data in accordance with general requirements.

.2 Indicate for each item as applicable:

.1 Manufacturer, model number, line contents, pressure and temperature rating.

.2 Movement handled; axial, lateral, angular and the amounts of each.

.3 Nominal size and dimensions including details of construction and assembly.

1.3 CLOSEOUT SUBMITTALS

.1 Submit maintenance data in accordance with general requirements.

.2 Data to include:

.1 Servicing requirements, including any special requirements, stuffing box packing, lubrication and recommended procedures.

Part 2 Products

2.1 SLIP TYPE EXPANSION JOINTS

.1 Application: for axial pipe movement, as indicated.

.2 Repacking: under full line pressure.

.3 Body and packing housings: Class 150, 1Mpa carbon steel pipe to ASTM A53/A53M, Grade B. Wall thickness to match pipe and with raised face slip-on flanges to match pipe.

.4 Slip or traverse sleeves: carbon steel pipe to ASTM A53/A53M, Grade B, hard chrome plated.

.5 Anchor base: construction steel, welded to body.

.6 Guides (internal and external): embody into packing housing with concentric alignment of slip or traverse sleeve with packing housing.

.7 Extension limit stop: stainless steel, to prevent over-extension with accessible and removable pins.

.8 Packing rings: 6 minimum, P7FE (teflon) or graphite impregnated non-asbestos fiber.

.9 Thermal plastic packing: P7FE (teflon) or graphite impregnated non-asbestos fiber slug supplied loose.

.10 Lubricating fittings: pet cocks with grease nipple.

.11 Plunger body and plunger:

.1 Plunger body: heavy wall carbon steel welded to body.

.2 Plunger: carbon steel with hex head for use with socket wrench.

.12 Lubricant: to manufacturer's recommendations.

.13 Lubricant gun: complete with hose assembly.

.14 Drip connection: 20 MPa (2900 psi) forged steel to ASTM A105. Include half coupling with drain plug.

.15 Lubricant fittings, plunger, gun not required for low friction self lubricating packing.

2.2 FLEXIBLE CONNECTION

.1 Application: to suit motion.

.2 Minimum length in accordance with manufacturer's recommendations to suit offset.

.3 Inner hose: stainless steel corrugated.

.4 Braided wire mesh stainless steel outer jacket.

.5 Diameter and type of end connection: as indicated.

.6 Operating conditions:

.1 Working pressure: 1034 kPa (150 psi).

.2 Working temperature: 250°C (482°F).

.3 To match system requirements.

2.3 ANCHORS AND GUIDES

.1 Anchors:

.1 Provide as indicated.

.2 Alignment guides:

.1 Provide as indicated.

.2 To accommodate specified thickness of insulation.

.3 Vapour barriers, jackets to remain uninterrupted.

Part 3 Execution

3.1 INSTALLATION

.1 Install expansion joints with cold setting, as indicated as instructed by Consultant. Make record of cold settings.

.2 Install expansion joints and flexible connections in accordance with manufacturer's instructions.

.3 Install pipe anchors and guides as indicated. Anchors to withstand 150% of axial thrust.

3.2 APPLICATION

.1 Provide on all vibration isolated equipment.

.2 Provide where requested by equipment manufacturers installation manuals.

.3 Install in accordance with manufacturer’s recommendations.

3.3 THERMAL EXPANSION

.1 Provide in long runs of heating mains exceeding 100 ft. in length.

END OF SECTION

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Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 ANSI/ASME B40.100, Pressure Gauges and Gauge Attachments.

.3 CAN/CGSB-14.4, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.

.4 CAN/CGSB-14.5, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with general requirements.

.2 Submit manufacturer's product data for following items:

.1 Thermometers.

.2 Pressure gauges.

.3 Stop cocks.

.4 Syphons.

.5 Wells.

Part 2 Products

2.1 GENERAL

.1 Design point to be at mid point of scale or range.

.2 Ranges: suitable for application.

2.2 DIRECT READING THERMOMETERS

.1 Industrial, variable angle type, liquid filled, 225 mm (9") scale length: to CAN/CGSB 14.4.

.1 Acceptable materials:

.1 Trerice

.2 Winters 91T

.3 Wiess

2.3 REMOTE READING THERMOMETERS

.1 100 mm (4") diameter liquid filled activated dial type: to CAN/CGSB-14.5, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished stainless steel case for wall mounting.

.1 Acceptable materials:

.1 Trerice

.2 Winters Contractor

2.4 THERMOMETER WELLS

.1 Copper pipe: copper or bronze.

.2 Steel pipe: brass or stainless steel.

2.5 PRESSURE GAUGES

.1 115 mm (4 1/2"), dial type: to ANSI/ASME B40.100, Grade 2A, stainless steel phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.

.1 Acceptable materials:

.1 Winters

.2 Trerice

.3 Wiess

.2 Provide:

.1 Siphon for steam service.

.2 Snubber for pulsating operation.

.3 Diaphragm assembly for corrosive service.

.4 Gasketted pressure relief back with solid front.

.5 Bronze stop cock.

Part 3 Execution

3.1 GENERAL

.1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.

.2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

.1 Install in wells on all piping. Provide heat conductive material inside well.

.2 Install in locations as indicated and on inlet and outlet of:

.1 Heat exchangers.

.2 Water heating and cooling coils.

.3 Mechanical Room 6 HWS and 6 HWR.

.4 In other locations indicated.

.3 Install wells as indicated only for balancing purposes.

.4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

.1 Install in following locations:

.1 Suction and discharge of pumps.

.2 Upstream and downstream of PRVs.

.3 Upstream and downstream of control valves.

.4 Inlet and outlet of coils.

.5 Inlet and outlet of liquid side of heat exchangers.

.6 Outlet of boilers.

.7 Inlet and outlet of water meters.

.8 Inlet and outlet of backflow prevention.

.9 In other locations as indicated.

.2 Install gauge cocks for balancing purposes, elsewhere as indicated.

.3 Use extensions where pressure gauges are installed through insulation.

3.4 NAMEPLATES

.1 Install engraved lamicoid nameplates as specified elsewhere identifying medium.

END OF SECTION

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Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)

.1 ANSI/ASME B31.1, Power Piping, (SI Edition).

.3 American Society for Testing and Materials (ASTM)

.1 ASTM A 125, Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A 563, Specification for Carbon and Alloy Steel Nuts.

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP-58, Pipe Hangers and Supports - Materials, Design, Manufacture Selection, Application, and Installation.

1.2 DESIGN REQUIREMENTS

.1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP-58.

.3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.

.4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP-58.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with general requirements.

.2 Submit shop drawings and product data for following items:

.1 All bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

1.4 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into manual specified in general requirements.

Part 2 Products

2.1 GENERAL

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

.2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

.1 Finishes:

.1 Pipe hangers and supports: to ANSI & ULC requirements

.2 Ensure steel hangers in contact with copper piping are copper plated.

.2 Upper attachment structural: Suspension from upper flange of I-Beam or joist.

.1 Cold piping NPS 50 mm (2") maximum: Ductile iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.

.1 Rod: 10 mm (3/8") UL listed

.2 Cold piping NPS 65 mm (2 1/2") or greater, all hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed & FM approved.

.3 Upper attachment structural: Suspension from upper flange of I-Beam.

.1 Cold piping NPS 50 mm (2") maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed.

.2 Cold piping NPS 65 mm (2 1/2") or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nuts.

.4 Upper attachment to concrete.

.1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm (1/4") minimum greater than rod diameter.

.2 Concrete inserts: wedge shaped body with knockout protector plate ULC listed. Note: Rapidex and Siporex are <u>not</u> considered concrete. Should one of these systems be encountered, piping/ductwork and/or equipment shall be supported from adjacent walls or from supplemental steel provided by this contractor attached to the adjacent walls/structure.

.5 Shop and field-fabricated assemblies.

.1 Trapeze hanger assemblies: ASME B31.1.

.2 Steel brackets: ASME B31.1.

.6 Hanger rods: threaded rod material to MSS SP-58.

.1 Ensure that hanger rods are subject to tensile loading only.

.2 Provide linkages where lateral or axial movement of pipework is anticipated.

.7 Pipe attachments: material to MSS SP-58.

.1 Attachments for steel piping: carbon steel.

.2 Attachments for copper piping: copper plated black steel.

.3 Use insulation shields for all piping.

.4 Oversize pipe hangers and supports to accommodate thermal insulation. Provide 1.5 mm (16 gauge) saddles.

.8 Adjustable clevis: material to MSS SP-58 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.

.1 Ensure "U" has hole in bottom for rivetting to insulation shields.

2.3 RISER CLAMPS

.1 Steel or cast iron pipe: black carbon steel to MSS-SP-58, type 42, UL listed.

.2 Copper pipe: carbon steel copper plated to MSS-SP-58, type 42.

.3 Bolts: to ASTM A 307.

.4 Nuts: to ASTM A 563.

2.4 INSULATION PROTECTION SHIELDS

.1 Insulated cold piping:

.1 64 kg/m² (13.12 lbs/ft²) density insulation plus insulation protection shield to: MSS SP-69, galvanized sheet carbon steel. Length designed for maximum 3 m (10') span.

.2 Insulated hot piping:

.1 Curved plate 300 mm (12") long, with edges turned up, welded-in centre plate for pipe sizes NPS 300 mm (12") and over, carbon steel to comply with MSS SP-58.

2.5 CONSTANT SUPPORT SPRING HANGERS

.1 Springs: alloy steel to ASTM A 125, shot peened, magnetic particle inspected, with +/- 5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

.2 Load adjustability: [10]% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.

.3 Provide upper and lower factory set travel stops.

.4 Provide load adjustment scale for field adjustments.

.5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm (1") minimum.

.6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.6 VARIABLE SUPPORT SPRING HANGERS

.1 Vertical movement: 15 mm (1/2") minimum, 50 mm (2") maximum, use single spring pre-compressed variable spring hangers.

.2 Vertical movement greater than 50 mm (2"): use double spring pre-compressed variable spring hanger with 2 springs in series in single casing.

.3 Variable spring hanger to be complete with factory calibrated travel stops. Provide certificate of calibration for each hanger.

.4 Steel alloy springs: to ASTM A 125, shot peened, magnetic particle inspected, with +/-5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.

2.7 EQUIPMENT SUPPORTS

.1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of miscellaneous metals, specified herein. Submit calculations with shop drawings.

2.8 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

2.9 OTHER EQUIPMENT SUPPORTS

.1 From structural grade steel meeting requirements of structural steel section specified herein.

.2 Submit structural calculations with shop drawings.

2.10 MANUFACTURER

.1 Acceptable materials:

.1 Grinnell
.2 Anvil
.3 Myatt
.4 Taylor

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Vibration Control Devices:

.1 Install on piping systems at pumps, boilers, chillers, cooling towers, elsewhere as indicated.

.3 Clamps on riser piping:

.1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.

.2 Bolt-tightening torques to be to industry standards.

.3 Steel pipes: Install below coupling or shear lugs welded to pipe.

.4 Cast iron pipes: Install below joint.

.4 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.2 HANGER SPACING

.1 Plumbing piping: most stringent requirements of Canadian Plumbing Code, Provincial Code, or authority having jurisdiction.

.2 Fire protection: to applicable fire code.

.3 Gas and fuel oil piping: up to NPS 15 mm (1/2"): every 1.8 m (6').

.4 Copper piping: up to NPS 15 mm (1/2"): every 1.5 m (5').

.5 Within 300 mm (12") of each elbow and:

Maximum Pipe Size: NPS	Spacing Steel	Maximum Spacing Copper
up to 32 mm (1 1/4")	2.1 m (7')	1.8 m (6')
40 mm (1 1/2")	2.7 m (9')	2.4 m (8')
50 mm (2")	3.0 m (10')	2.7 m (9')
65 mm (2 1/2")	3.6 m (12')	3.0 m (10')
80 mm (3")	3.6 m (12')	3.0 m (10')
90 mm (3 1/2")	3.9 m (13')	3.3 m (11')
100 mm (4")	4.2 m (14')	3.6 m (12')
125 mm (5")	4.8 m (16')	
150 mm (6")	5.1 m (17')	
200 mm (8")	5.7 m (19')	
250 mm (10")	6.6 m (22')	
300 mm (12")	6.9 m (23')	

.6 Pipework greater than NPS 300 mm (12"): to MSS SP-69.

3.3 HANGER INSTALLATION

.1 Install hanger so that rod is vertical under operating conditions.

.2 Adjust hangers to equalize load.

.3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.

.4 Do “NOT” support piping, ductwork and equipment from roof deck, on bottom chord of floor and/or roof joist and/or from OWSJ bridging. Provide structural member between joist.

3.4 HORIZONTAL MOVEMENT

.1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4mm (5/32") from vertical.

.2 Where horizontal pipe movement is less than 15 mm (1/2"), offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.5 FINAL ADJUSTMENT

.1 Adjust hangers and supports:

.1 Ensure that rod is vertical under operating conditions.

.2 Equalize loads.

.2 Adjustable clevis:

.1 Tighten hanger load nut securely to ensure proper hanger performance.

.2 Tighten upper nut after adjustment.

.3 C-clamps:

.1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.

.4 Beam clamps:

.1 Hammer jaw firmly against underside of beam.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)

.1 ANSI/ASME B31.1, Power Piping, (SI Edition).

.3 American Society for Testing and Materials (ASTM)

.1 ASTM A 125, Specification for Steel Springs, Helical, Heat-Treated.

.2 ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.3 ASTM A 563, Specification for Carbon and Alloy Steel Nuts.

.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)

.1 MSS SP-58, Pipe Hangers and Supports - Materials, Design, Manufacture Selection, Application, and Installation.

.5 CSA B272-93 – Prefabricated Self-Sealing Roof Vent Flashings

.6 CRCA (Canadian Roofing Contractor’s Association)

.7 SPRI (Single Ply Roofing Institute)

.8 CUFCA (Canadian Urethane Foam Contractor’s Association) and CGSB-51-GP-46MP, Manual for “Installers of Spray Polyurethane Foam Thermal Insulation”

.9 CSA G40.21-M1987, M350W, and M300W (Structural Quality Steels)

.10 CSA W47.1-1983 (Certificate of Companies for Fusion Welding of Structural Steel)

.11 CSA W59-M1989 (Welded Steel Construction – Metal Arc Welding)

.12 CSA G164-M1981 (Hot Dip Galvanizing of Irregularly Shaped Articles)

1.2 RELATED SECTIONS

.1 Section 03300 – Cast-in-place Concrete

.2 Section 05210 – Steel Joists

.3 Section 05300 – Metal Deck

.4 Section 06100 – Rough Carpentry

.5 Section 07200 – Thermal Protection

.6 Section 07500 – Membrane Roofing

.7 Section 07900 – Joint Sealers

1.3 DESIGN REQUIREMENTS

.1 Construct support systems to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.

.2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP-58.

.3 Design supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.

.4 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP-58.

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with general requirements.

.2 Submit shop drawings and product data for following items:

.1 All bases, hangers and supports.

.2 Connections to equipment and structure.

.3 Structural assemblies.

.3 Manufacturer's installation instruction.

1.5 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into manual specified in general requirements.

1.6 QUALITY ASSURANCE

.1 Roof accessories manufactures to have minimum five (5) years documented experience in the design and fabrication of roofing specialties and accessories.

1.7 SPECIAL WARRANTY

.1 Warrant products installed under this section of work to be free of leaks, condensation, and defects in materials and/or manufacture for a period of twenty (20) years when installed in accordance with the manufacturer's written instructions.

Part 2 Products

2.1 DUCT SUPPORT

.1 Duct support:

.1 Adjustable height 6061-T6, hollow aluminum with mill finish, urethane insulated supports, 2" (51mm) diameter.

.2 Stack Jack Flashing:

.1 Height to suit application.

.2 Fully urethane insulated.

.3 Aluminum construction.

.4 Complete with EPDM triple pressure grommet seal and EPDM base seal and other accessories as required to suit roof type.

.3 Provide appropriate stainless steel mounting hardware to suit application.

.4 Cross-bar carrier assembly of length to suit application with EPDM end caps.

.5 Basis of design/Acceptable Manufacturer

.1 Thaler MERS-800 series.

.2 Acceptable equals if submitted during tender period.

2.2 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

.1 Provide templates to ensure accurate location of anchor bolts.

2.3 ROOF CURB MOUNTED EQUIPMENT

.1 Install as per manufacturer's instructions on roof curbs provided by manufacturer as indicated.

.2 Provide all necessary continuous pressure treated wood blocking and 24 gauge metal liner on all exposed wood as required to install roof curb level.

2.4 PIPING THROUGH ROOF

.1 Provide Thaler MEF-9 or equal gas piping flashing where pipe and/or relief vent penetrates roof.

2.5 ROOF MOUNTED PIPE SUPPORT

.1 Provide zero penetration pipe support on roof where indicated.

.2 Base shall be made of high density polypropylene with UV protection. Maximum loading shall be 50 lb/sq.ft.

.3 Frames shall be galvanized. All fastenings, rods, nuts, washers, hangers, etc. shall be stainless steel.

.4 Provide shop drawings as specified. Install to manufacturers recommendations.

.5 Acceptable material:

.1 Portable pipe hanger

.2 Bigfoot systems

.3 Miro rooftop supports

.4 Walravin BIS Yeti

.5 Ecofoot

Part 3 Execution

3.1 INSTALLATION

.1 Roof support install in accordance with:

.1 Manufacturer's instructions and recommendations.

.2 Provide protection against deterioration due to contact of dissimilar metals.

.2 Flashing Installation:

.1 Install roof support flashing in accordance with manufacturer's printed instructions.

.3 Vibration Control Devices:

.1 Install as indicated and at all roof mounted mechanical equipment that is not internally isolated.

.4 Clevis plates:

.1 Attach to concrete with 4 minimum concrete inserts at each corner.

.5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.2 PIPE SUPPORT SPACING

.1 Plumbing piping: most stringent requirements of Canadian Plumbing Code, Provincial Code, or authority having jurisdiction.

.2 Gas and fuel oil piping: every 1.8 m (6').

.3 Copper piping: up to NPS 15 mm (1/2"): every 1.5 m (5').

.4 Within 300 mm (12") of each elbow and:

Maximum Pipe Size: NPS	Spacing Steel	Maximum Spacing Copper
up to 32 mm (1 1/4")	2.1 m (7')	1.8 m (6')
40 mm (1 1/2")	2.7 m (9')	2.4 m (8')
50 mm (2")	3.0 m (10')	2.7 m (9')
65 mm (2 1/2")	3.6 m (12')	3.0 m (10')
80 mm (3")	3.6 m (12')	3.0 m (10')
90 mm (3 1/2")	3.9 m (13')	3.3 m (11')
100 mm (4")	4.2 m (14')	3.6 m (12')
125 mm (5")	4.8 m (16')	
150 mm (6")	5.1 m (17')	
200 mm (8")	5.7 m (19')	
250 mm (10")	6.6 m (22')	
300 mm (12")	6.9 m (23')	

.5 Pipework greater than NPS 300 mm (12"): to MSS SP-69.

3.3 EXAMINATION

.1 Report to the contractor in writing, defects of work prepared by other trades and other unsatisfactory site conditions. Verify site dimensions. Commencement of work will imply acceptance of prepared work.

3.4 ADJUSTING

.1 Verify that all manufactured units have been installed in accordance with specifications and details and will function as intended. Adjust any items where necessary to ensure proper operation.

3.5 CLEANING

.1 Clean manufactured units using materials and methods approved by manufacturer. Do not use cleaning techniques which could impair performance of the roofing system.

END OF SECTION

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Part 1 General

1.1 SHOP DRAWINGS

.1 Submit shop drawings in accordance with general requirements.

.2 Provide separate shop drawings for each isolated system complete with performance and product data.

Part 2 Products

2.1 GENERAL

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

.2 To be of the same manufacturer for all isolation.

.3 Acceptable materials:

.1 Korfund

.2 Vibro-Acoustics

.3 Vibron

2.2 ELASTOMERIC PADS

.1 Type EP1 - neoprene waffle or ribbed; 10 mm (3/8") minimum thick; 50 durometer; maximum loading 350 kPa (50.8 psi).

.2 Type EP2 - rubber waffle or ribbed; 10 mm (3/8") minimum thick; 30 durometer natural rubber; maximum loading 415 kPa (60.2 psi).

.3 Type EP3 - neoprene-steel-neoprene; 10 mm (3/8") minimum thick neoprene bonded to 1.5 mm (16 gauge) steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa (50.8 psi).

.4 Type EP4 - rubber-steel-rubber; 10 mm (3/8") minimum thick rubber bonded to 1.5 mm (16 gauge) steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa (60.2 psi).

.5 Acceptable materials:

.1 Korfund

.2 IAC Acoustics

.3 Vibro-Acoustics

.4 Vibron

2.3 ELASTOMERIC MOUNTS

.1 Type M1 - colour coded; neoprene in shear; maximum durometer of [60]; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

.2 Acceptable materials:

.1 Vibro-Acoustics

.2 Korfund

.3 IAC Acoustics

.4 Vibron

2.4 SPRINGS

.1 Design stable springs so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times the ratio of static deflection to working height. Select for 50% travel beyond rated load. Units to be complete with levelling devices.

.2 Ratio of height when loaded to diameter of spring to be between 0.8 to 1.0.

.3 Cadmium plate for all installations.

.4 Colour code springs.

2.5 SPRING MOUNT

.1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.

.2 Type M2 - stable open spring: support on bonded 6 mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad.

.3 Type M3 - stable open spring: 6 mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; leveling bolt for rigidly mounting to equipment.

.4 Type M4 - restrained stable open spring: supported on bonded 6 mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.

.5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg (2100 lbs) maximum.

.6 Performance: as indicated.

.7 Acceptable materials:

.1 Korfund

.2 IAC Acoustics

.3 Vibron

.4 Vibro-Acoustics

2.6 HANGERS

.1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.

.2 Type H1 - neoprene - in-shear, molded with rod isolation bushing, which passes through hanger box.

.3 Type H2 - stable spring, elastomeric washer, cup with molded isolation bushing which passes through hanger box.

.4 Type H3 - stable spring, elastomeric element with pre-compression washer and nut [with deflection indicator].

.5 Performance as indicated.

.6 Acceptable materials:

.1 Vibron

.2 IAC Acoustics

.3 Korfund

.4 Vibro-Acoustics

2.7 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

.1 Acoustic barriers: between pipe and support, consisting of 25 mm (1") minimum thick heavy-duty duct and neoprene isolation material.

.2 Acceptable materials:

.1 Vibron

.2 IAC Acoustics

.3 Vibro-Acoustics

2.8 HORIZONTAL THRUST RESTRAINT

.1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 10 mm (3/8").

.2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.

.3 Acceptable materials:

.1 Korfund

.2 IAC Acoustics

.3 Vibron

.4 Vibro-Acoustics

Part 3 Execution

3.1 INSTALLATION

.1 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.

.2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.

.3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm (1") minimum static deflection as follows:

.1 Up to NPS 100 mm (4"): first 3 points of support. NPS 125 mm (5") to NPS 200 mm (8"): first 4 points of support. NPS 250 mm (10") and Over: first 6 points of support.

.2 First point of support shall have a static deflection of twice deflection of isolated equipment, but not more than 50 mm (2").

.4 Where isolation is bolted to floor use vibration isolation rubber washers.

.5 Block and shim level bases so that ductwork and piping connections can be made to a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.2 SITE VISIT

.1 Manufacturer to visit site and provide written certification that installation is in accordance with manufacturer's instructions and submit report to Consultant.

.2 Provide Consultant with notice 24 h in advance of visit.

.3 Make adjustments and corrections in accordance with written report.

3.3 TESTING

.1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Testing Adjusting and Balancing Section.

.2 Vibration measurements shall be taken for equipment-listed below:

.3 Provide Consultant with notice 48 h in advance of commencement of tests.

.4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations including sound curves.

.5 Submit complete report of test results including sound curves.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.

.2 CAN/CGSB-24.3, Identification of Piping Systems.

.3 National Fire Protection Association

.1 NFPA 13, Installation of Sprinkler Systems.

1.2 PRODUCT DATA

.1 Submit product data in accordance with General Requirements.

.2 Product data to include paint colour chips, all other products specified in this section.

1.3 PRODUCT LITERATURE

.1 Submit product literature in accordance with General Requirements.

.2 Product literature to include nameplates, labels, tags, lists of proposed legends.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

.1 Metal or plastic lamicoid nameplate mechanically fastened to each piece of equipment by manufacturer.

.2 Lettering and numbers to be raised or recessed.

.3 Information to include, as appropriate:

.1 Equipment: Manufacturer's name, model, size, serial number, capacity.

.2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

.1 Colours:

.1 Hazardous: red letters, white background.

.2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).

.2 Construction:

.1 3 mm (1/8") thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

Size	No. of Sizes mm (")	Height of Line mm (")	Letters mm (")
1	10 x 50 (3/8" x 2")	1 (3/64")	3 (1/8")
2	15 x 75 (1/2" x 3")	1 (3/64")	6 (1/4")
3	15 x 75 (1/2" x 3")	2 (5/64")	3 (1/8")
4	20 x 100 (3/4" x 4")	1 (3/64")	10 (3/8")
5	20 x 100 (3/4" x 4")	2 (6/64")	6 (1/4")
6	20 x 200 (3/4" x 8")	1 (3/64")	10 (3/8")
7	25 x 125 (1" x 5")	1 (3/64")	15 (1/2")
8	25 x 125 (1" x 5")	2 (5/64")	10 (3/8")
9	32 x 200 (1¼" x 8")	1 (3/64")	20 (3/4")

.2 Use maximum of 25 letters/numbers per line.

.4 Locations:

.1 Terminal cabinets, control panels: Use size #5.

.2 Equipment in Mechanical Rooms: Use size #9.

.3 Roof top equipment: use size #9.

.4 Equipment above ceiling: use size #1 riveted to ceiling suspension system.

2.3 EXISTING IDENTIFICATION SYSTEMS

.1 Apply existing identification system to new work.

.2 Where existing identification system does not cover for new work, use identification system specified this section.

.3 Before starting work, obtain written approval of identification system from Consultant.

.4 Upon completion of this project all references to room names and numbering shall be to the Owner's requirements which may or may 'NOT' be the numbering system used on the drawings. Each contractor shall verify the proper numbering scheme to be used prior to project completion.

.5 All equipment shall be identified in sequence from the existing equipment and "NOT" duplicate numbering of equipment.

2.4 PIPING SYSTEMS GOVERNED BY CODE

.1 Identification:

.1 Sprinklers: To NFPA 13.

2.5 IDENTIFICATION OF PIPING SYSTEMS

.1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.

.2 Legend:

.1 Block capitals to sizes and colours listed in CAN/CGSB-24.3.

.3 Arrows showing direction of flow:

.1 Outside diameter of pipe or insulation less than 75 mm (3"): 100 mm (4") long x 50 mm (2") high.

.2 Outside diameter of pipe or insulation 75 mm (3") and greater: 150 mm (6") long x 50 mm (2") high.

.3 Use double-headed arrows where flow is reversible.

.4 Extent of background colour marking:

.1 To full circumference of pipe or insulation.

.2 Length to accommodate pictogram, full length of legend and arrows.

.5 Materials for background colour marking, legend, arrows:

.1 Pipes and tubing 20 mm (3/4") and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.

.2 All other pipes: Pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150°C (300°F) and intermittent temperature of 200°C (395°F).

.6 Colours and Legends:

.1 Where not listed, obtain direction from Consultant.

.2 Colours for legends, arrows: To following table:

Background colour:	Legend:	Arrows:
Yellow	White	Black
Green	White	Black
Red	White	Black

.7 Background colour marking and legends for piping systems:

CONTENTS	BACKGROUND COLOUR MARKING	LEGEND
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Make-up water	Yellow	MAKE-UP WTR
Glycol heating water supply	Yellow	GLYCOL HEATING WATER SUPPLY
Glycol heating water return	Yellow	GLYCOL HEATING WATER RETURN
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HW recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Trap Primer	Green	TRAP PRIMER
Condensate	Green	CONDENSATE

Refrigeration suction	Yellow	REF. SUCTION
Refrigeration liquid	Yellow	REF. LIQUID
Refrigeration hot gas	Yellow	REF. HOT GAS
Fire protection water	Red	FIRE PROT. WTR
Sprinklers	Red	SPRINKLERS
Instrument air	Green	INSTRUMENT AIR
Conduit for low voltage Control wiring	White	CONTROL WIRING___VOLTS

2.6 IDENTIFICATION DUCTWORK SYSTEMS

.1 50 mm (2") high stencilled letters and directional arrows 150 mm (6") long x 50 mm (2") high.

.2 Colours: Black, or co-ordinated with base colour to ensure strong contrast.

2.7 VALVES, CONTROLLERS

.1 Brass tags with 15 mm (1/2") stamped identification data filled with black paint.

.2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.

.3 Provide adhesive coloured tab (max. size 15 mm) indication on ceiling to locate valves/equipment above. Same applies to grid. Colour to be approved by consultant.

2.8 CONTROLS COMPONENTS IDENTIFICATION

.1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.

.2 Inscriptions to include function and (where appropriate) fail-safe position.

.3 Provide equipment identification and/or indication on ceiling to locate devices/equipment above ceiling. Install identification on grid. Colours to be approved by consultant.

2.9 LANGUAGE

.1 Identification to be in English.

Part 3 Execution

3.1 TIMING

.1 Provide identification only after all painting specified has been completed.

3.2 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Provide ULC and/or CSA registration plates as required by respective agency.

3.3 NAMEPLATES

.1 Locations:

.1 In conspicuous location to facilitate easy reading and identification from operating floor.

.2 Standoffs:

.1 Provide for nameplates on hot and/or insulated surfaces.

.3 Protection

.1 Do not paint, insulate or cover in any way.

3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

.1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels not more than 1.7 m (5'-8") intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.

.2 Adjacent to each change in direction.

.3 At least once in each small room through which piping or ductwork passes.

.4 On both sides of visual obstruction or where run is difficult to follow.

.5 On both sides of separations such as walls, floors, partitions.

.6 Where system is installed in pipe chases, ceiling spaces, galleries, other confined spaces, at entry and exit points, and at each access opening.

.7 At beginning and end points of each run and at each piece of equipment in run.

.8 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.

.9 Identification to be easily and accurately readable from usual operating areas and from access points.

.1 Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 VALVES, CONTROLLERS

.1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.

.2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Consultant. Provide one copy (reduced in size if required) in each operating and maintenance manual.

.3 Number valves in each system consecutively. Where existing numbering system is installed start new numbering system at 100.

END OF SECTION

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Part 1 General

1.1 GENERAL

.1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do all other work as specified in this section including all air handling systems and equipment, all plumbing systems and equipment and all temperature controls system, building automation systems and equipment.

.2 This contractor must co-ordinate their work with that of the TAB contractor.

1.2 QUALIFICATIONS OF TAB AGENCIES

.1 Names of all personnel it is proposed to perform TAB to be submitted to and approved by Consultant within 30 days of start of work.

.2 Provide documentation confirming qualifications, successful experience.

.3 Only the following NEBB (National Environmental Balancing Bureau) TAB contractors may quote:

.1 Air Audit Inc.
110 Turnbull Court, Unit 11
Cambridge, Ontario
N1T 1K6
(519) 740-0871

.2 Air Velocities Control Ltd.
100 Premium Way
Mississauga, Ontario
L5B 1A2
(905) 279-4433

.3 Flowset Balancing Ltd.
431 Willis Dr.
Oakville, Ontario
L6L 4V6
(416) 410-9793

.4 Air Adjustments & Balancing Inc.
P.O. Box 176,
Schomberg, Ontario
L0G 1T0
(416) 254-3004

.5 Verify TAB
857 Dovercourt Road
Toronto, ON
M6H 2X4
(647) 970-5275

.6 **VPG Associates**
2062 King Road
King City, Ontario
L7B 1K9
(905) 833-4334

.7 Dynamic Flow Balancing Ltd.
1200 Speers Road, Unit 36
Oakville, Ontario
L6L 2X4
(905) 338-0808

1.3 PURPOSE OF TAB

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average (95% design) and low (75% of design) loads using actual or simulated loads. TAB contractor to perform equipment evaluation upon start up and once during each season in the first year of operation.

.2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with all other related systems under all normal and emergency loads and operating conditions. Confirm all equipment interlocks and functions of associated systems.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges and temperatures. Refer to BAS for system operating functions.

1.4 EXCEPTIONS

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

1.5 CO-ORDINATION

.1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.

.2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems. Co-ordinate with other trades to ensure all systems are interlocked as indicated elsewhere prior to TAB.

1.6 PRE-TAB REVIEW

.1 Review contract documents before project construction is started and confirm in writing to Consultant adequacy of provisions for TAB and all other aspects of design and installation pertinent to success of TAB.

.2 Review specified standards and report to Consultant in writing all proposed procedures which vary from standard.

.3 During construction, co-ordinate location and installation of all TAB devices, equipment, accessories, measurement ports and fittings.

.4 During construction indicate all tolerances of piping, ductwork etc conforms to specifications.

1.7 START-UP

.1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.

.2 Follow special start-up procedures specified elsewhere in the Mechanical Division.

1.8 OPERATION OF SYSTEMS DURING TAB

.1 Operate systems for length of time required for TAB and as required by Consultant for verification of TAB reports.

1.9 START OF TAB

.1 Notify Consultant in writing 3 days prior to start of TAB.

.2 Start TAB only when building is essentially completed, including:

.1 Installation of ceilings, doors, windows, other construction affecting TAB.

.2 Application of weather-stripping, sealing, caulking.

.3 All pressure, leakage, other tests specified elsewhere in the Mechanical Division.

.4 All provisions for TAB installed and operational.

.5 Start-up, verification for proper, normal and safe operation of all mechanical and associated electrical and control systems affecting TAB including but not limited to:

.1 Proper thermal overload protection in place for electrical equipment.

.2 Air systems:

.1 Filters in place, clean.

.2 Duct systems clean.

.3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.

.4 Correct fan rotation.

.5 Fire, smoke, volume control dampers installed and open.

.6 Coil fins combed, clean.

.7 Access doors, installed, closed.

.8 All outlets installed, volume control dampers open.

.3 Liquid systems:

.1 Flushed, filled, vented.

.2 Correct pump rotation.

.3 Strainers in place, baskets clean.

.4 Isolating and balancing valves installed, open.

.5 Calibrated balancing valves installed, at factory settings.

.6 Chemical treatment systems complete, operational.

.7 Control valves are properly piped.

.8 Coils and radiation are properly piped.

.9 BAS in operation.

1.10 APPLICATION TOLERANCES

.1 Do TAB to following tolerances of design values:

.1 HVAC systems: plus 10%, minus 5%.

.2 Hydronic systems: plus or minus 10%.

1.11 ACCURACY TOLERANCES

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

1.12 INSTRUMENTS

.1 Prior to TAB, submit to Consultant list of instruments to be used together with serial numbers.

.2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.

.3 Calibrate within 3 months of TAB. Provide certificate of calibration to Consultant.

1.13 SUBMITTALS

.1 Submit, prior to commencement of TAB:

.1 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

.1 Submit for checking and approval of Consultant, prior to submission of formal TAB report, sample of rough TAB sheets. Include:

.1 Details of instruments used.

.2 Details of TAB procedures employed.

.3 Calculations procedures.

.4 Summaries.

1.15 TAB REPORT

.1 Format to be in accordance with NEBB, AABC, or SMACNA.

.2 The following additional information shall be provided for all air systems:

.1 Minimum damper position (MAD/Economizer) and the corresponding BAS signal and the voltage to the actuator to meet the full ASHRAE occupied ventilation requirements.

.2 Minimum damper position (MAD/Economizer) and the corresponding BAS signal and the voltage to the actuator to meet the full ASHRAE unoccupied ventilation requirements.

.3 Static pressure reading for each HVAC/AHU unit with VAV/VVT boxes open to 80% of design airflow and bypass damper closed to 0%. Provide reading at normal MAD/economizer damper position, dampers fully closed and dampers fully open.

.3 TAB report to show all results in SI or imperial units as indicated on plans and to include:

.1 Project as-built drawings.

.2 System schematics.

1.16 VERIFICATION

.1 All reported results subject to verification by Consultant.

.2 Provide manpower and instrumentation to verify up to 30% of all reported results.

.3 Number and location of verified results to be at discretion of Consultant.

.4 Bear costs to repeat TAB as required to satisfaction of Consultant.

1.17 SETTINGS

.1 After TAB is completed to satisfaction of Consultant, replace drive guards, close all access doors, lock all devices in set positions, ensure sensors are at required settings. Replace all ceiling tile etc.

.2 Permanently mark all settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.18 COMPLETION OF TAB

.1 TAB to be considered complete only when final TAB Report received and approved by Consultant.

1.19 AIR SYSTEMS

.1 Standard: TAB to be to most stringent of TAB standards of NEBB, AABC, SMACNA, ASHRAE.

.2 Do TAB of all systems, equipment, components, controls specified in the Mechanical Division including but not limited to following:

.1 Air handling systems and equipment

.2 Duct testing to SMACNA standards.

.3 Qualifications: personnel performing TAB to be current member in good standing of NEBB.

.4 Quality assurance: Perform TAB under direction of qualified supervisor.

.5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

.6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:

.1 Inlet and outlet of each damper, filter, coil, humidifier, fan, and other equipment causing changes in conditions.

.2 At each controller, controlled device.

.7 Locations of systems measurements to include, but not be limited to, following as appropriate: Each main duct, main branch, sub-branch, grille, register or diffuser.

1.20 HYDRONIC SYSTEMS

.1 Definitions: for purposes of this section, to include low pressure hot water heating, chilled water, condenser water, glycol systems.

.2 Standard: TAB to be the most stringent of TAB standards of NEBB, AABC, SMACNA, ASHRAE.

.3 Do TAB of all systems, equipment, components, controls specified in Mechanical Division including but not limited to hydronic equipment testing.

.4 Qualifications: personnel performing TAB to be current member in good standing of NEBB.

.5 Quality assurance: perform TAB under direction of qualified supervisor.

.6 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: Flow rate, static pressure, pressure drop (or loss), temperature, specific gravity, density, RPM, electrical power voltage, noise, vibration.

.7 Locations of equipment measurement: To include, but not be limited to, following as appropriate:

.1 Inlet and outlet of each heat exchanger (primary and secondary sides), boiler, chiller, coil, humidifier, cooling tower, condenser, pump, PRV, control valve, other equipment causing changes in conditions.

.2 At each controller, controlled device.

.8 Locations of systems measurements to include, but not be limited to, following as appropriate: Supply and return of each primary and secondary loop (main, main branch, branch, sub-branch of all hydronic systems, inlet connection of make-up water.

1.21 DUCT LEAKAGE TESTING

.1 Co-ordinate leakage testing with the sheet metal contractor. TAB contractor will be responsible for all duct testing.

.2 Duct to be tested in accordance with SMACNA HVAC Duct Leakage Test Manual and as indicated.

1.22 OTHER TAB REQUIREMENTS

.1 General requirements applicable to all work specified this paragraph:

.1 Qualifications of TAB personnel: as for air systems specified this section.

.2 Quality assurance: as for air systems specified this section.

.3 Zone pressure differences:

.1 Adjust HVAC systems, equipment, controls to establish air pressure differentials, with all systems in all possible combinations of normal operating modes.

.4 Provide duct testing as specified.

.5 Provide AHU testing as specified.

.6 Provide plenum testing as specified.

.7 Changing of air handling equipment sheave and belts as required for specified air flow sheaves and belts supplied by unit manufacturer. Retest equipment after sheave change.

END OF SECTION

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Part 1 General

1.1 GENERAL

.1 The Mechanical Contractor shall provide the labour and material to conduct the closeout process as outlined in this specification section.

.2 The mechanical contractor shall perform the closeout requirements specified in conjunction with the independent commissioning consultant (CC) retained by the owner.

Part 2 Products

2.1 GENERAL

.1 The mechanical contractor and manufacturers shall provide all instrumentation and equipment necessary to conduct the tests specified. The Mechanical Contractor shall advise the Mechanical Consultant of instrumentation to be used and the dates the instruments were calibrated.

Part 3 Execution

3.1 THE CONTRACT CLOSE OUT PROCESS

.1 The mechanical contractor close out process shall consist of:

- Shop Drawings and As-built Drawings
- Installation inspection and equipment verification
- Testing of piping systems
- Independent contractor balancing of water systems
- Testing of air systems
- Independent contractor balancing of air systems
- Testing of equipment and systems
- BAS Commissioning
- Verification of refrigeration leak detection systems
- Operating and maintenance manuals
- Training
- Systems Demonstration and turnover
- Testing forms
- Warranties
- Contractor to provide list of equipment maintenance including schedule of maintenance parts, quantities, and model fixtures, etc.

3.2 SHOP DRAWINGS AND AS-BUILT DRAWINGS

.1 Conform to General Requirements Section for shop drawings and as-built drawings requirements.

3.3 INSTALLATION INSPECTION AND EQUIPMENT VERIFICATION

.1 The Mechanical Contractor shall co-ordinate with the Consultant who will inspect the mechanical installation.

.2 The Mechanical Contractor shall complete the equipment verification forms for each piece of equipment. The forms shall be included in the operating and maintenance manual. The equipment data shall include:

- Manufacturers name, address and telephone number
- Distributors name, address and telephone number
- Make, model number and serial number
- Pumps - RPM, impeller sizes, rated flow
- Fans - belt type and size, shive type and size
- Electrical - volts, amps, fuse size, overload size
- Any other special characteristics.

3.4 THE CONTRACTOR'S TESTING OF PIPING SYSTEMS

.1 Test all piping systems in accordance with all applicable plumbing codes and General Requirements section.

.2 All tests for the systems shall be performed in the presence of the Consultant or Commissioning Consultant. Complete the testing forms and forward to the Consultant.

3.5 THE INDEPENDENT CONTRACTORS TESTING AND BALANCING OF WATER SYSTEMS

.1 Conform with the specification section, Testing, Adjusting and Balancing.

.2 The Independent Contractor shall be hired by The Mechanical Contractor and shall report to the Commissioning Consultant.

3.6 THE CONTRACTORS TESTING OF AIR SYSTEMS

.1 Conform with the specification section, Testing, Adjusting and Balancing.

.2 All tests shall be performed in the presence of the Mechanical Consultant or the Commissioning Consultant. Complete the testing forms and forward to the Consultant.

3.7 THE INDEPENDENT CONTRACTORS TESTING AND BALANCING OF AIR SYSTEMS

.1 Conform with specification section, Testing, Adjusting and Balancing.

.2 The Independent Contractor shall be hired by The Mechanical Contractor and shall report to the Commissioning Consultant.

3.8 TESTING OF EQUIPMENT AND SYSTEMS

.1 General:

.1 The Mechanical Contractor shall hire the services of the manufacturers technicians to test the equipment and associated systems. The technician shall record the results of the tests on the testing forms. The tests shall be witnessed by the Consultant or Owners representative. When the tests have been completed satisfactorily the technician and witnessing authority shall sign the forms. A copy of the forms shall be forwarded to the Consultant. The original shall be inserted into the operating and maintenance manual.

.2 Should equipment or systems fail a test, the test shall be repeated after repairs or adjustments have been made. The additional tests shall be witnessed.

.3 Tests which have not been witnessed shall not be accepted and shall be repeated.

.4 The equipment and systems to be tested shall include:
- Condensing Units
- Air Handling Units
- Life Safety and Fire Protection Systems
- Water Treatment Systems
- Building Automation Systems (BAS)

.2 BAS Testing:

.1 The BAS Contractor shall test the system as described in General Requirements and/or Controls Sections.

.2 Co-ordinate with the Consultant and submit completed test forms monthly.

.3 Demonstrate to the Owner and Consultant the operation of the BAS when all tests have been completed.

.3 Verification of Refrigeration Leak Detection System Operation:

.1 The commissioning process shall include the verification of the refrigeration leak detection system.

.2 All interlocks between leak detection systems installed and system components, as well as interlocks between field installed detection systems and associated safety system components shall be tested and verified to operate as per the requirements of CSA B52. Specifically, the following shall occur for each independent system on registration of a refrigerant leak:

.1 Open all zone dampers in the affected system.

.2 Disable all electric reheat coils within the affected system.

.3 Activate field installed safety shut off valves within the affected refrigeration system.

.4 Energize all fans within the affected ductwork system.

.5 Activate all refrigerant leak system specific ventilation systems.

.6 De-energize any other potential sources of ignition within the affected system.

3.9 CLOSEOUT SCHEDULE

.1 The Mechanical Contractor shall include the schedule for all tests and equipment start-up tests in the construction schedule.

.2 All testing forms and reports associated with the mechanical systems shall be directed to the Consultant with copies to the Owner and Consultant.

.3 The forms and reports to be issued shall include:

- Shop drawings, issued and accepted
- Equipment verification forms
- Testing forms
- Reports resulting from tests
- Testing schedule
- Equipment Start-up Forms

3.10 OPERATION AND MAINTENANCE MANUAL

.1 Conform to General Requirements section for the Operating and Maintenance Manual requirements.

3.11 OPERATOR TRAINING

.1 Conform to General Requirements section for requirements for Instruction to Operating Staff.

.2 The training shall be conducted in a classroom and at the equipment or system.

.3 Training will begin when the operating and maintenance manuals have been delivered to The Owner and approved by the Consultant.

.4 Each training session shall be structured to cover:

The operating and maintenance manual
- Operating procedures
- Maintenance procedures
- Trouble-shooting procedures
- Spare parts required
- Submit a course outline to the Mechanical Consultant before training commences. Provide course documentation for up to eight people.

.5 The training sessions shall be scheduled and co-ordinated by the Mechanical Contractor.

.6 Training shall be provided for the following systems:

System	Minimum Training Times
Condensing Units	2 hours
Air Handling Units	2 hours
Water Treatment Systems	2 hours
The Mechanical System	8 hours
Life Safety & Fire Protection	½ hour

.7 The minimum training for the BAS shall be 16 hours. The training shall include:

- A walk through of the installation for the Building Owner to review the installation and equipment
- Operation of the central computer
- Operation of portable terminals
- Control sequences
- Report set-up and generation
- Managing the system
- Maintenance requirements

Refer to Controls specification section for further information.

.8 The training requirement for the mechanical system shall include a walk-through of the building by the Mechanical Contractor. During the walk through the Mechanical Contractor shall:

- Identify equipment
- Identify starters associated with equipment
- Identify valves and balancing dampers
- Identify access doors
- Review general maintenance of equipment
- Review drain points in pipework systems
- Identify maintenance items

.9 When each training session has been completed The Owner shall sign the associated form to verify completion.

3.12 MECHANICAL SYSTEM DEMONSTRATION AND TURNOVER

.1 Refer to General Requirements section, Mechanical Project Completion.

.2 The system demonstration and turnover to The Owner shall occur when:

- The installation is complete
- The acceptance test conducted by the Mechanical Consultant has been completed successfully
- The Commissioning Consultant system performance testing has been completed successfully
- Training has been completed
- Operating and Maintenance Manuals have been accepted
- Shop-drawings have been updated
- As-built drawings have been completed

.3 The systems demonstration shall be conducted by the Mechanical Contractor and the manufacturers. The demonstration shall cover a demonstration of equipment installation and operation.

3.13 TESTING FORMS

.1 The Mechanical Contractor and manufacturers shall provide forms for testing. The forms must be approved by the Consultant and The Owner before they are used.

3.14 WARRANTIES

.1 Equipment and system warranties shall not begin until the system demonstration and turnover has been conducted successfully and accepted by The Owner.

.2 The Mechanical Contractor shall fill out the warranty form listing the equipment and systems and the start and finishing dates for warranty.

.3 Refer to the general conditions specification section for the requirements during the warranty period.

3.15 CLOSEOUT PROCESS ALLOCATION

.1 The mechanical contractor closeout process shall be as follows:

.1 3% for the first $500,000 of contract value.

.2 1% of the contract value for value between $500,000 to $5,000,000.

.3 0.5% of contract value for the value in excess of $5,000,000.

.4 Minimum Allocation for Close Out Documents is $5,000.

.2 The Mechanical Contractor shall submit all test and verification forms. The Consultant will use these forms to calculate percentage complete.

.3 The monies shall not be paid out until the performance testing, O & M manuals, systems demonstration, and training including all required paperwork have been completed to the satisfaction of the consultant. Refer to General Requirements section for contract breakdown.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 NFPA 13 latest edition, Installation of Sprinkler Systems.

.3 Ontario Fire Code.

.4 Ontario Building Code.

.5 Factory Mutual guidelines.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with general requirements in accordance with NFPA 13, working plans and design requirements.

.2 Shop drawings shall be approved by authority having jurisdiction prior to submission

.3 Submit to consultant for general review and information only.

.4 Submitted drawings shall be reproducible. Do not submit marked up prints.

.5 Drawings shall be in AutoCad format.

1.3 SAMPLES

.1 Submit samples in accordance with general requirements.

.2 Submit samples of following:

.1 Each type of sprinkler head.

.2 Signs.

1.4 ENGINEERING DESIGN CRITERIA

.1 Design system in accordance with Ontario Fire Marshall, local authority having jurisdiction, owner's underwriters as required, and NFPA 13, NFPA 20, and NFPA 45 using following parameters:

.1 To suit occupancy as indicated.

.2 Pipe size and layout: Hydraulic design.

.3 Conduct flow and pressure test of water supply in vicinity of project to obtain criteria for bases of design in accordance with NFPA 13. Indicate location and flow on shop drawings.

.4 System zoning as indicated in accordance with NFPA 13.

.5 Provide complete drawings and calculations stamped by a qualified professional engineer registered in the Province of Ontario.

.6 Professional Engineer shall provide on site review and certification for local building code review.

.2 System shall be approved by Ontario Fire Marshall, local authority, and owner's underwriter prior to shop drawing submission.

1.5 COMMISSIONING & INTEGRATED TESTING OF FIRE PROTECTION & LIFE SAFETY SYSTEMS

.1 Sprinkler contractor to perform services with the Fire Commissioning Agent (FCA) to meet their requirements for administration, verification, and final sign-off.

.2 The Fire Commissioning Agent (FCA) is being retained by the electrical contractor, however; this contractor's work to satisfy the FCA requirements shall be included in the tender price.

.3 The sprinkler contractor at a minimum must include for:

.1 Providing FCA all documentation of design and shop drawings.

.2 Provide documents for sequence of operation and maintenance of system.

.3 Movement of all valves and accessories to confirm Alarm/Supervisory/Trouble at the fire panel.

.4 Create flow at all initiating devices to verify detection at the fire panel.

.5 Testing and operation of any fire pumps.

.6 Other items that may be requested by the FCA.

.7 Re-commissioning of any items that may have failed.

.8 Putting the system back into proper operation after tests are completed.

.4 All work to be performed in accordance with NFPA 3 2010 Edition. Special consideration to be given to Figure A3.3.16 (b) for Sequence of Operation Form required to be completed in conjunction with the FCA and submitted to the consultant's prior to occupancy.

.5 The work to be performed by this contractor is also described in NFPA 3 table A.5.1.1 as labelled "Construction Stage" and "Occupancy Stage".

1.6 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into manual specified in general requirements.

1.7 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with general requirements.

.2 Provide spare sprinklers and tools as required by NFPA 13.

1.8 QUALIFICATIONS

.1 Contractor to be specialist in performing work of this section, and have **at least 3 years** successful experience in this size and type of project.

1.9 PERMITS AND FEES

.1 Obtain and pay for all permits, fees, and inspections as required by authority having jurisdiction.

1.10 EQUIPMENT

.1 ULC listed and labeled.

1.11 STORAGE

.1 Store in original packaging with manufacturers' labels and seals intact.

.2 Store in dry secure location.

.3 Damaged material and/or equipment shall be replaced.

1.12 INSURANCE

.1 Confirm with owner prior to submitting quote.

.2 Owners insurance underwriters:
Factory Mutual Insurance Company
165 Commerce Valley Drive West, Suite 500
Thornhill, Ontario
L3T 7V8
Ph: (905) 763-5555 Fax: (905) 763-5622

1.13 UNDERWRITERS REQUIREMENTS

.1 Confirm with owner insurance underwriters prior to submitting quote.

.2 Ordinary hazard group II

.3 Retail areas:

.1 0.15 gpm/sq over 2500 sq ft.

.2 250 gpm for hose allowance.

.3 165°F or 286°F sprinkler heads.

.4 Stockroom areas:

.1 0.45 gpm/sq ft over 2000 sq ft.

.2 500 gpm for hose allowance.

.3 286°F sprinkler heads.

Part 2 Products

2.1 PIPE, FITTINGS, AND VALVES

.1 Pipe and Fittings:

.1 25 mm (1"): Schedule 40 steel pipe with screwed fittings.

.2 32 mm (1¼") to 50 mm (2"):

.1 Schedule 40 steel pipe with screwed fittings or,

.2 Schedule 10 steel pipe with roll grooved fittings.

.3 65 mm (2½") and larger: Schedule 10 steel pipe with roll grooved fittings.

.2 Valves:

.1 ULC listed for fire protection service.

.2 Up to NPS 2: bronze, screwed ends, OS&Y gate.

.3 NPS 2 1/2 and over: cast iron, flanged or roll grooved ends, indicating butterfly valve.

.4 Swing check valves.

.5 Ball drip.

.3 Pipe hangers:

.1 ULC listed for fire protection services.

.4 End switches:

.1 Provide on all isolating valves.

.2 Coordinate voltage and location with fire alarm contractor.

.5 Flow switches:

.1 Provide where indicated and required.

.2 Coordinate voltage and location with fire alarm contractor.

2.2 SPRINKLER HEADS

.1 General: to NFPA 13 and ULC listed for fire services.

.2 Indicate type and location of sprinkler heads on drawings. Co-ordinate sprinkler heads location with other trades.

.3 Locate sprinkler heads in acoustic tile ceiling in centre of tile.

.4 Provide sprinkler heads as follows:

.1 Upright bronze: exposed with no ceilings.

.2 Concealed fusible link type brass pendent with ring and cup in ceiling and brass coverplate. Coverplate finish selected by consultant. Concealed heads installed in unsupervised areas (corridors, washrooms).

.3 White semi-recessed fusible link type brass pendent with adjustable, recessed escutcheon ring and cup. Sprinkler and escutcheon cup. Finish selected by consultant. Semi-recessed heads installed in supervised areas (classrooms, offices, seminar rooms etc.).

.4 Sprinkler heads with O-ring design shall not be used.

.5 Provide guards on upright sprinkler heads in all storage rooms, in the gymnasium and on heads below 1800 mm AFF.

.5 Provide sprinkler heads under all equipment/ductwork over 1200 mm wide.

2.3 SPARE PARTS CABINET

.1 For storage of maintenance materials, spare sprinkler heads and special tools.

.2 Include all types and temperature ratings of sprinkler heads installed.

.3 Construct to sprinkler head manufacturers standard.

.4 Install where directed on site or next to alarm valve.

2.4 DOCUMENTATION

.1 Prepare documentation as indicated.

.2 Provide documentation based on tender documents. Coordinate sprinkler drawings with all trades.

.3 Provide one hard copy and one electronic copy of As Built drawings acceptable to consultant prior to final payment.

2.5 UNIT PRICES

.1 Provide unit prices as follows.

.1 Additional sprinkler head including hangers, 3.6 M piping and two elbows.

.2 Delete sprinkler head including hangers, 3.6 M piping and two elbows.

2.6 UNDERWRITERS APPROVED GATE VALVE

.1 NPS 65 – 350 mm (2 1/2" - 14"), OS&Y:

.1 Approvals: UL and FM approved for fire service.

.2 UL and FM Label: on valve yoke.

.3 Body, Bonnet: cast iron to ASTM A 126 Class B. Wall thicknesses to ANSI B 16.1 and ULC 262(B).

.4 Bonnet bushing, yoke sleeve: bronze, to FM requirements.

.5 Packing gland: bronze.

.6 Stem: manganese bronze. Diameter to ULC C-262(B).

.7 Stuffing box dimensions, gland bolt diameter: to ULC C 262(B).

.8 Bosses for bypass valve, drain: on NPS 100 mm (4") and over.

.9 Disc: solid taper wedge. Up to NPS 80 mm (3"): bronze. NPS 100 mm (4") and over: cast iron with bronze disc rings.

.10 Disc seat ring: self-aligning, Milwood undercut on NPS 80 mm (3").

.11 Pressure rating:

.1 NPS 65 – 300 mm (2-1/2" - 12"): 1.7 MPa (250 psi) CWP

.2 NPS 350 mm (14"): 1.2 MPa (175 psi) CWP

.12 Operator: Handwheel.

Part 3 Execution

3.1 INSTALLATION

.1 Install, inspect and test to acceptance in accordance with NFPA 13 and FC 403.

.2 Testing to be witnessed by authority having jurisdiction.

.3 Space hangers and support of sprinkler piping in accordance with N.F.P.A. regulations.

.4 Hydrostatically test systems at 350kPa in excess of normal working pressure, but not less than 1.4 MPA for two hours without loss under supervision of authority having jurisdiction and NFPA requirements.

.5 Provide hydraulic pump, temporary connections and labour required for tests.

.6 Protect exposed work, in accordance with ‘Painting’ section.

.7 Do not cover or conceal piping accessories or work prior to inspection and approval by authorities having jurisdiction.

.8 Adjust equipment to satisfaction of authority having jurisdiction and consultant.

.9 Protect equipment during painting. Replace damaged and painted components.

.10 Co-ordinate the sprinkler piping and equipment with that of other trades on the job. Mains and branches shall be run so as not to interfere with building's structure, mechanical, or electrical installations. Branch piping above ceilings is to run in joist space or minimum 300 mm above ceiling. Provide drops at head locations only. All exposed piping to run in joist space.

.11 Guarantee that the systems and equipment be installed in accordance with all Local and Provincial by-laws and the rules and regulations of the Insurance Underwriters and the Building Code of Ontario.

.12 Provide a flow test for each system on the remote inspectors test connection using methods approved by the local fire department and local water commission. Report the test results in writing to the consultant.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 ASTM B32, Specification for Solder Metal.

.3 ASTM B306, Specification for Copper Drainage Tube (DWV).

.4 ASTM C564, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

.5 CAN/CSA-B70, Cast Iron Soil Pipe, Fittings and Means of Joining.

.6 CAN/CSA-B125.3, Plumbing Fittings.

Part 2 Products

2.1 COPPER TUBE AND FITTINGS

.1 Above ground sanitary, and vent, maximum 65 mm (2½") Type DWV copper to: ASTM B306.

- .1 Fittings.
  - .1 Cast brass: to CAN/CSA B125.3.
  - .2 Wrought copper: to CAN/CSA B125.3.
- .2 Solder: tin-lead, 50:50, to ASTM B32, type 50A.

2.2 CAST IRON PIPING AND FITTINGS

.1 Above ground sanitary, and vent, minimum NPS 80 mm (3"), cast iron to: CAN/CSA-B70.

- .1 Mechanical joints (vents)
  - .1 Neoprene or butyl rubber compression gaskets: to ASTM C564 or CAN/CSA-B70.
  - .2 Stainless steel clamps (2 band).
- .2 Mechanical joints (sanitary)
  - .1 Heavy duty neoprene or butyl rubber compression gaskets to: ASTM C1540.
  - .2 Stainless steel clamps (4 band min).

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.

.2 Install above ground piping parallel and close to walls and ceilings to conserve headroom and space, and to grade as indicated.

.3 Place Cleanouts

.1 Where shown on Drawings and near bottom of each stack and riser.

.2 At every 90 degree change of direction for horizontal lines.

.3 Every 15 m (50') of horizontal run.

.4 Extend clean out to accessible surface. Do not place cleanouts in carpeted floors. In such locations, use wall type cleanouts.

.4 Each fixture and appliance discharging water into sanitary sewer or building sewer lines shall have a seal trap in connection with a complete venting system so gases pass freely to atmosphere with no pressure or syphon condition on water seal.

.5 Vent entire waste system to atmosphere.

.1 Discharge 500 mm (20") above roof. Join lines together in fewest practicable number before projecting above roof.

.2 Set back vent lines so they will not pierce roof near an edge or valley.

.3 Venting shall be 7.5 m (25'-0") from any outdoor air intakes.

.4 Provide copper vent piping through roof as per detail.

.6 Use torque wrench to obtain proper tension in cinch bands when using hubless cast iron pipe. Butt ends of pipe against centering flange of coupling.

.7 Flash pipes passing through roof with 453 g (16 oz) sheet copper flashing fitted snugly around pipes and caulk between flashing and pipe with flexible waterproof compound.

.1 Flashing base shall be at least 600 mm (24") square.

.2 Flashing may be a 24 kg/m^2 (5 lb/ft^2) lead flashing fitted around pipes and turned down into pipe 15 mm (½") with turned edge hammered against pipe wall.

.8 Before piping is covered, conduct tests in presence of Consultant and correct leaks or defective work. Conduct test prior to placing floor slab but after backfill is placed.

.1 Do not caulk threaded work.

.2 Fill waste and vent system to roof level [a minimum of 3,100 mm - (10')] with water and show no leaks for 2 hours.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 ASTM D2235, Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

.3 ASTM D2564, Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.

.4 CAN/CSA-B181.1, ABS Drain, Waste and Vent Pipe and Pipe Fittings.

.5 CAN/CSA-B181.2, PVC and CPVC Drain, Waste and Vent Pipe and Pipe Fittings.

.6 CAN/CSA-B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.

Part 2 Products

2.1 PIPING AND FITTINGS

.1 Above grade sanitary and vent piping:

.1 80 mm (3") and smaller: IPEX: PVC-XFR drain waste and vent pipe to CAN/CSA-B181.2.

.2 100 mm (4") and larger: IPEX: PVC-XFR drain waste and vent pipe to CAN/CSA-B181.2.

.3 Vent piping: any size, IPEX: PVC-XFR plastic drain and sewer pipe and fittings CAN/CSA-B181.2.

.2 Where piping pierces a fire separation an approved fire stop system to the approval of authority having jurisdiction shall be used.

2.2 JOINTS

.1 Solvent weld for PVC: to ASTM D2564.

.2 Solvent weld for ABS: to ASTM D2235.

2.3 EXPANSION

.1 Provide solvent welded expansion joints as required by manufacturer’s recommendations.

2.4 VENT FLASHINGS

.1 Thaler Stack Jack spun aluminum complete with insulation, cap, and rubber gasket.

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction. Install in accordance with manufacturer's instructions.

.2 Installation of underground pipe

- .1 Provide all excavation, bedding, backfill, and compaction.
- .2 Install materials in accordance with Manufacturer's instructions.
- .3 Use jacks to make-up gasketed joints.
- .4 Stabilize unstable trench bottoms.
- .5 Bed pipe true to line and grade with continuous support from firm base.
  - .1 Bedding depth - 100 mm to 150 mm (4" to 6").
  - .2 Material and compaction to meet ASTM standard noted above.
- .6 Excavate bell holes into bedding material so pipe is uniformly supported along its entire length. Blocking to grade pipe is forbidden.
- .7 Trench width at top of pipe -
  - .1 Minimum 450 mm (18") or diameter of pipe plus 300 mm (12"), whichever is greater.
  - .2 Maximum - Outside diameter of pipe plus 600 mm (24").
- .8 Piping and joints shall be clean and installed according to manufacturer's recommendations. Break down contaminated joints, clean seats and gaskets and reinstall.
- .9 Do not use back hoe or power equipment to assemble pipe.
- .10 Initial backfill shall be 300 mm (12") above top of pipe with material specified in referenced ASTM standard.

.3 Place Cleanouts

- .1 Where shown on Drawings and near bottom of each stack and riser.
- .2 At every 90 degree change of direction for horizontal lines.
- .3 Every 15 m (50 ft) of horizontal run.
- .4 Extend clean out to accessible surface. Do not place cleanouts in carpeted floors. In such locations, use wall type cleanouts

.4 Each fixture and appliance discharging water into sanitary sewer or building sewer lines shall have a seal trap in connection with a complete venting system so gases pass freely to atmosphere with no pressure or syphon condition on water seal.

.5 Before piping is covered, conduct tests in presence of Consultant and correct leaks or defective work. Conduct test prior to placing floor slab but after backfill is placed.

- .1 Fill waste and vent system a minimum of 1.8 m (6 ft) above finished floor with water and show no leaks for 2 hours.
- .2 Conduct ball test in presence of consultant to ensure proper grade and clear of obstructions.

.6 Install solvent welded expansion joints as per manufacturer's recommendation. Care is to taken to accommodate ambient temperatures at time of install.

END OF SECTION

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Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 National Air Duct Cleaners Association (NADCA): “Assessment, Cleaning & Restoration of HVAC Systems (ACR).

.3 National Air Duct Cleaners Association (NADCA): “Understanding Microbial Contamination in HVAC Systems”.

.4 National Air Duct Cleaners Association (NADCA): “Introduction to HVAC System Cleaning Services”.

.5 National Air Duct Cleaners Association (NADCA): Standard 05 “Requirements for the Installation of Service Openings in HVAC Systems”.

.6 Underwriters’ Laboratories (UL): UL Standard 181.

.7 American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE): Standard 62, "Ventilation for Acceptable Indoor Air Quality".

.8 Environmental Protection Agency (EPA): "Building Air Quality".

.9 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA): “HVAC Duct Construction Standards - Metal and Flexible”.

.10 North American Insulation Manufacturers Association (NAIMA): "Cleaning Fibrous Glass Insulated Air Duct Systems".

1.2 SPECIAL PROVISIONS

.1 Qualification of the HVAC System Cleaning Contractor

.2 Membership: The HVAC system cleaning contractor shall be a certified member of the National Air Duct Cleaners Association (NADCA), or shall maintain membership in a nationally recognized non-profit industry organization dedicated to the cleaning of HVAC systems.

.3 Certification: The HVAC system cleaning contractor shall have a minimum of one (1) Air System Cleaning Specialist (ASCS) certified by NADCA on a full time basis, or shall have staff certified by a nationally recognized certification program and organization dedicated to the cleaning of HVAC systems.

.4 Supervisor Qualifications: A person certified as an ASCS by NADCA, or maintaining an equivalent certification by a nationally recognized program and organization, shall be responsible for the total work herein specified.

.5 Experience: The HVAC system cleaning contractor shall submit records of experience in the field of HVAC system cleaning as requested by the owner. Bids shall only be considered from firms, which are regularly engaged in HVAC system maintenance with an emphasis on HVAC system cleaning and decontamination.

.6 Equipment, Materials and Labor: The HVAC system cleaning contractor shall possess and furnish all necessary equipment, materials and labour to adequately perform the specified services.

.1 The contractor shall assure that its employees have received safety equipment training, medical surveillance programs, individual health protection measures, and manufacturer's product and material safety data sheets (MSDS) as required for the work by the U.S. Occupational Safety and Health Administration, and as described by this specification. For work performed in countries outside of the U.S.A., contractors should comply with applicable national safety codes and standards.

.2 The contractor shall maintain a copy of all current MSDS documentation and safety certifications at the site at all times, as well as comply with all other site documentation requirements of applicable OSHA programs and this specification.

.3 Contractor shall submit to the owner all Material Safety Data Sheets (MSDS) for all chemical products proposed to be used in the cleaning process.

.7 Licensing: The HVAC system cleaning contractor shall provide proof of maintaining the proper license(s), if any, as required to do work in this state. Contractor shall comply with all Federal, state and local rules, regulations, and licensing requirements.

1.3 STANDARDS

.1 NADCA Standards: The HVAC system cleaning contractor shall perform the services specified here in accordance with the current published standards of the National Air Duct Cleaners Association (NADCA).

.2 All terms in this specification shall have their meaning defined as stated in the NADCA Standards.

.3 NADCA Standards must be followed with no modifications or deviations being allowed.

1.4 DOCUMENTS

.1 Mechanical Drawings: The owner shall provide the HVAC system cleaning contractor with one copy of the following documents:

.2 Project drawings and specifications.

.3 Approved construction revisions pertaining to the HVAC system.

.4 Any existing indoor air quality (IAQ) assessments or environmental reports prepared for the facility.

Part 2 Products

2.1 SCOPE OF WORK

.1 This section defines the minimum requirements necessary to render HVAC components clean, and to verify the cleanliness through inspection and/or testing in accordance with items specified herein and applicable NADCA Standards.

.2 The Contractor shall be responsible for the removal of visible surface contaminants and deposits from within the HVAC system in strict accordance with these specifications.

.3 The HVAC system includes any interior surface of the facility's existing air distribution system for conditioned spaces and/or occupied zones. This includes the entire heating, air-conditioning and ventilation system from the points where the air enters the system to the points where the air is discharged from the system. The return air grilles, return air ducts to the air handling units (AHU), the interior surfaces of the AHU, mixing box, coil compartment, condensate drain pans, humidifiers and dehumidifiers, supply air ducts, fans, fan housing, fan blades, air wash systems, spray eliminators, turning vanes, filters, filter housings, reheat coils, and supply diffusers are all considered part of the HVAC system. The HVAC system may also include other components such as dedicated exhaust and ventilation components and make-up air systems.

.4 All existing ductwork within 10' of all new duct connections shall be cleaned under this section.

2.2 HVAC SYSTEM COMPONENT INSPECTIONS AND SITE PREPARATIONS

.1 HVAC System Component Inspections: Prior to the commencement of any cleaning work, the HVAC system cleaning contractor shall perform a visual inspection of the HVAC system to determine appropriate methods, tools, and equipment required to satisfactorily complete this project. The cleanliness inspection should include air handling units and representative areas of the HVAC system components and ductwork. In HVAC systems that include multiple air-handling units, a representative sample of the units should be inspected.

.2 The cleanliness inspection shall be conducted without negatively impacting the indoor environment through excessive disruption of settled dust, microbial amplification or other debris. In cases where contamination is suspected, and/or in sensitive environments where even small amounts of contaminant may be of concern, environmental engineering control measures should be implemented.

.3 Damaged system components found during the inspection shall be documented and brought to the attention of the consultant.

.4 Site Evaluation and Preparations: Contractor shall conduct a site evaluation, and establish a specific, coordinated plan which details how each area of the building will be protected during the various phases of the project.

.5 Inspector Qualifications: Qualified personnel should perform the HVAC cleanliness inspection to determine the need for cleaning. At minimum, such personnel should have an understanding of HVAC system design, and experience in utilizing accepted indoor environmental sampling practices, current industry HVAC cleaning procedures, and applicable industry standards.

2.3 GENERAL HVAC SYSTEM CLEANING REQUIREMENTS

.1 Containment: Debris removed during cleaning shall be collected and precautions must be taken to ensure that Debris is not otherwise dispersed outside the HVAC system during the cleaning process.

.2 Particulate Collection: Where the Particulate Collection Equipment is exhausting inside the building, HEPA filtration with 99.97% collection efficiency for 0.3-micron size (or greater) particles shall be used. When the Particulate Collection Equipment is exhausting outside the building, Mechanical Cleaning operations shall be undertaken only with Particulate Collection Equipment in place, including adequate filtration to contain Debris removed from the HVAC system. When the Particulate Collection Equipment is exhausting outside the building, precautions shall be taken to locate the equipment down wind and away from all air intakes and other points of entry into the building.

.3 Controlling Odors: Measures shall be employed to control odors and/or mist vapors during the cleaning process.

.4 Component Cleaning: Cleaning methods shall be employed such that all HVAC system components must be Visibly Clean as defined in applicable standards (see NADCA Standards). Upon completion, all components must be returned to those settings recorded just prior to cleaning operations.

.5 Air-Volume Control Devices: Dampers and any air-directional mechanical devices inside the HVAC system must have their position marked prior to cleaning and, upon completion, must be restored to their marked position.

.6 Service Openings: The contractor shall utilize service openings, as required for proper cleaning, at various points of the HVAC system for physical and mechanical entry, and inspection.

.7 Contractor shall utilize the existing service openings already installed in the HVAC system where possible.

.8 Other openings shall be created by this contractor where needed and they must be created so they can be sealed by this contractor in accordance with industry codes and standards.

.9 Closures must not significantly hinder, restrict, or alter the airflow within the system.

.10 Closures must be properly insulated to prevent heat loss/gain or condensation on surfaces within the system.

.11 Openings must not compromise the structural integrity of the system.

.12 Construction techniques used in the creation of openings should conform to requirements of applicable building and fire codes, and applicable NFPA, SMACNA and NADCA Standards.

.13 Cutting service openings into flexible duct is not permitted. Flexible duct shall be disconnected at the ends as needed for proper cleaning and inspection.

.14 Rigid fiberglass duct systems shall be resealed in accordance with NAIMA recommended practices. Only closure techniques that comply with UL Standard 181 or UL Standard 181a are suitable for fiberglass duct system closures.

.15 All service openings capable of being re-opened for future inspection or remediation shall be clearly marked and shall have their location reported to the consultant in project report documents.

.16 Ceiling sections (tile): The contractor may remove and reinstall ceiling sections to gain access to HVAC systems during the cleaning process.

.17 Air distribution devices (registers, grilles & diffusers): The contractor shall clean all air distribution devices.

.18 Air handling units, terminal units (VAV, Dual duct boxes, etc.), blowers and exhaust fan: The contractor shall ensure that supply, return, and exhaust fans and blowers are thoroughly cleaned. Areas to be cleaned include blowers, fan housings, plenums (except ceiling supply and return plenums), scrolls, blades, or vanes, shafts, baffles, dampers and drive assemblies. All visible surface contamination deposits shall be removed in accordance with NADCA Standards. Contractor shall:

.19 Clean all air handling units (AHU) internal surfaces, components and condensate collectors and drains.

.20 Assume that a suitable operative drainage system is in place prior to beginning wash down procedures.

.21 Clean all coils and related components, including evaporator fins.

.22 Duct Systems: This Contractor shall:

.1 Create service openings in the system as necessary in order to accommodate cleaning of otherwise inaccessible areas. Provide access doors specified in duct accessories to replace openings.

.2 Mechanically clean all duct systems to remove all visible contaminants, such that the systems are capable of passing Cleaning Verification Tests (see NADCA Standards).

2.4 HEALTH AND SAFETY

.1 Safety Standards: Cleaning contractors shall comply with applicable federal, state, and local requirements for protecting the safety of the contractor's employees, building occupants, and the environment. In particular, all applicable standards of the Occupational Safety and Health Administration (OSHA) shall be followed when working in accordance with this specification.

.2 Occupant Safety: No processes or materials shall be employed in such a manner that they will introduce additional hazards into occupied spaces.

.3 Disposal of Debris: All Debris removed from the HVAC System shall be disposed of in accordance with applicable federal, state and local requirements.

2.5 MECHANICAL CLEANING METHODOLOGY

.1 Source Removal Cleaning Methods:

.2 The HVAC system shall be cleaned using Source Removal mechanical cleaning methods designed to extract contaminants from within the HVAC system and safely remove contaminants from the facility. It is the contractor's responsibility to select Source Removal methods that will render the HVAC system Visibly Clean and capable of passing cleaning verification methods (See applicable NADCA Standards) and other specified tests, in accordance with all general requirements. No cleaning method, or combination of methods, shall be used which could potentially damage components of the HVAC system or negatively alter the integrity of the system.

.1 All methods used shall incorporate the use of vacuum collection devices that are operated continuously during cleaning. A vacuum device shall be connected to the downstream end of the section being cleaned through a predetermined opening. The vacuum collection device must be of sufficient power to render all areas being cleaned under negative pressure, such that containment of debris and the protection of the indoor environment are assured.

.2 All vacuum devices exhausting air inside the building shall be equipped with HEPA filters (minimum efficiency), including hand-held vacuums and wet-vacuums.

.3 All vacuum devices exhausting air outside the facility shall be equipped with Particulate Collection including adequate filtration to contain Debris removed from the HVAC system. Such devices shall exhaust in a manner that will not allow contaminants to re-enter the facility. Release of debris outdoors must not violate any outdoor environmental standards, codes or regulations.

.4 All methods require mechanical agitation devices to dislodge debris adhered to interior HVAC system surfaces, such that debris may be safely conveyed to vacuum collection devices. Acceptable methods will include those, which will not potentially damage the integrity of the ductwork, nor damage porous surface materials such as liners inside the ductwork or system components.

.3 Methods of Cleaning Fibrous Glass Insulated Components:

.1 Fibrous glass thermal or acoustical insulation elements present in any equipment or ductwork shall be thoroughly cleaned with HEPA vacuuming equipment, while the HVAC system is under constant negative pressure, and not permitted to get wet in accordance with applicable NADCA and NAIMA standards and recommendations.

.2 Cleaning methods used shall not cause damage to fibrous glass components and will render the system capable of passing Cleaning Verification Tests (see NADCA Standards).

.4 Damaged Fibrous Glass Material:

.1 Evidence of damage: If there is any evidence of damage, deterioration, delaminating, friable material, mold or fungus growth, or moisture such that fibrous glass materials cannot be restored by cleaning or resurfacing with an acceptable insulation repair coating, they shall be identified for replacement.

.2 Replacement: When requested or specified, Contractor must be capable of remediating exposed damaged insulation in air handlers and/or ductwork requiring replacement.

.3 Replacement material: In the event fiber glass materials must be replaced, all materials shall conform to applicable industry codes and standards, including those of UL and SMACNA.

.4 Replacement of damaged insulation is not covered by this specification.

.5 Cleaning of Coils:

.1 Any cleaning method may be used which will render the Coil Visibly Clean and capable of passing Coil Cleaning Verification (see applicable NADCA Standards). Coil drain pans shall be subject to Non-Porous Surfaces Cleaning Verification. The drain for the condensate drain pan shall be operational. Cleaning methods shall not cause any appreciable damage to, displacement of, inhibit heat transfer, or erosion of the coil surface or fins, and shall conform to coil manufacturer recommendations when available. Coils shall be thoroughly rinsed with clean water to remove any latent residues.

.6 Antimicrobial Agents and Coatings:

.1 Antimicrobial agents shall only be applied if active fungal growth is reasonably suspected, or where unacceptable levels of fungal contamination have been verified through testing.

.2 Application of any antimicrobial agents used to control the growth of fungal or bacteriological contaminants shall be performed after the removal of surface deposits and debris.

.3 When used, antimicrobial treatments and coatings shall be applied in strict accordance with the manufacturer's written recommendations and EPA registration listing.

.4 Antimicrobial coatings shall be applied according to the manufacturer's written instructions. Coatings shall be sprayed directly onto interior ductwork surfaces, rather than "fogged" downstream onto surfaces.

2.6 CLEANLINESS VERFICATION

.1 General:

.1 Verification of HVAC System cleanliness will be determined after mechanical cleaning and before the application of any treatment or introduction of any treatment-related substance to the HVAC system, including biocidal agents and coatings.

.2 Visual Inspection:

.1 The HVAC system shall be inspected visually to ensure that no visible contaminants are present.

.2 If no contaminants are evident through visual inspection, the HVAC system shall be considered clean; however, the consultant reserves the right to further verify system cleanliness through Surface Comparison Testing or the NADCA vacuum test specified in the NADCA standards.

.3 If visible contaminants are evident through visual inspection, those portions of the system where contaminants are visible shall be re-cleaned and subjected to re-inspection for cleanliness.

.4 NADCA vacuum test analysis shall be performed by a qualified third party experienced in testing of this nature through the HVAC commissioning contract.

.3 Verification of Coil Cleaning:

.1 Cleaning must restore the coil pressure drop to within 10 percent of the pressure drop measured when the coil was first installed. If the original pressure drop is not known, the coil will be considered clean only if the coil is free of foreign matter and chemical residue, based on a thorough visual inspection (see NADCA Standards).

2.7 PRE-EXISTING SYSTEM DAMAGE

.1 Contractor is not responsible for problems resulting from prior inappropriate or careless cleaning techniques of others.

2.8 POST-PROJECT REPORT

.1 At the conclusion of the project, the Contractor shall provide a report to the consultant indicating the following:

.1 Success of the cleaning project, as verified through visual inspection and/or gravimetric analysis.

.2 Areas of the system found to be damaged and/or in need of repair.

Part 3 Execution

Not Applicable.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 ANSI/ASME B31.1, Power Piping.

.3 ANSI/ASME Boiler and Pressure Vessel Code:

.1 Section 1: Power Boilers.

.2 Section V: Nondestructive Examination.

.3 Section IX: Welding and Brazing Qualifications.

.4 CSA W47.2, Certification of Companies for Fusion Welding of Aluminum.

.5 CSA W48, Filler Metals and Allied Metals for Arc Welding.

.6 CSA B51, Boiler, Pressure Vessel and Pressure Piping Code.

.7 CAN/CSA-W117.2, Safety in Welding, Cutting and Allied Processes.

.8 CSA W178.1, Certification of Welding Inspection Organizations.

.9 CSA W178.2, Certification of Welding Inspectors.

.10 AWS B2.1, Specification for Welding Procedure and Performance Qualification.

.11 AWS C1.1, Recommended Practices for Resistance Welding.

.12 AWS W1, Welding Inspection.

.13 ANSI/AWWA C206, Field Welding of Steel Water Pipe.

1.2 WELDERS QUALIFICATIONS

.1 Welding qualifications to be in accordance with CSA B51.

.2 Use qualified and licensed welders possessing certificate for each procedure to be performed from authority having jurisdiction.

.3 Furnish welder's qualifications to Consultant.

.4 Each welder to possess identification stamp issued by authority having jurisdiction.

.5 Certification of companies for fusion welding of aluminum to be in accordance with CSA W47.2.

1.3 INSPECTORS QUALIFICATIONS

.1 Inspectors to be qualified to CSA W178.2.

1.4 WELDING PROCEDURES

.1 Registration of welding procedures in accordance with CSA B51.

.2 Copy of welding procedures to be available for inspection at all times.

.3 Safety in welding, cutting and allied processes to be in accordance with CAN/CSA-W117.2.

Part 2 Products

2.1 ELECTRODES

.1 Electrodes: in accordance with CSA W48 Series.

Part 3 Execution

3.1 WORKMANSHIP

.1 Welding to be in accordance with ANSI/ASME B31.1, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and applicable requirements of provincial authority having jurisdiction.

.2 Protect all adjacent areas.

3.2 INSTALLATION REQUIREMENTS

.1 Identify each weld with welder's identification stamp.

.2 Backing rings:

.1 Where used, fit to minimize gaps between ring and pipe bore.

.2 Do not install at orifice flanges.

.3 Fittings:

.1 NPS 50 mm (2") and smaller: install welding type sockets.

.2 Branch connections: install welding tees or forged branch outlet fittings.

3.3 INSPECTION AND TESTS - GENERAL REQUIREMENTS

.1 Review all weld quality requirements and defect limits of applicable codes and standards with Consultant before any work is started.

.2 Formulate "Inspection and Test Plan" in co-operation with Consultant.

.3 Do not conceal welds until they have been inspected, tested and approved by inspector.

.4 Provide for inspector to visually inspect all welds during early stages of welding procedures in accordance with AWS W1. Repair or replace all defects as required by codes and as specified herein.

3.4 SPECIALIST EXAMINATIONS AND TESTS

.1 General:

.1 Perform examinations and tests by specialist qualified in accordance with CSA W178.1 and CSA W178.2 and approved by Consultant.

.2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.

.3 Inspect and test 25% of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and magnetic particle (hereinafter referred to as "particle") tests and/or full gamma ray radiographic (hereinafter referred to as "radiography") tests as specified.

.2 Hydrostatically test all welds to requirements of ANSI/ASME B31.1.

.3 Visual examinations: include entire circumference of weld externally and (wherever possible) internally.

.4 Failure of visual examinations:

.1 Upon failure of any weld by visual examination, perform additional testing as directed by Consultant of a total of up to 10% of all welds, selected at random by Consultant by radiographic tests.

3.5 DEFECTS CAUSING REJECTION

.1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.

.2 In addition, hydronic water systems:

.1 Undercutting greater than 0.8 mm (1/32") adjacent to cover bead on outside of pipe.

.2 Undercutting greater than 0.8 mm (1/32") adjacent to root bead on inside of pipe.

.3 Undercutting greater than 0.8 mm (1/32") at combination of internal surface and external surface.

.4 Incomplete penetration and incomplete fusion greater than total length of 40 mm (1 1/2") in any 1500 mm (60") length of weld depth of such defects being greater than 0.8 mm (1/32").

.5 Repair all cracks and defects in excess of 0.8 mm (1/32") in depth.

.6 Repair defects whose depth cannot be determined accurately on the basis of visual examination or particle tests.

3.6 REPAIR OF WELDS WHICH FAILED TESTS

.1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

3.7 CLAIMS AGAINST OWNER FOR DELAYS

.1 Claims against Owner for delays in completion of project will not be entertained for reasons of failures of welds to pass examinations.

3.8 OCCUPIED AREAS

.1 Do not do any “Hot Work” in occupied areas.

.2 Obtain “Hot Work” permits for working in existing building.

END OF SECTION

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Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 51-GP-52Ma-[89], Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.3 Underwriters Laboratories of Canada (ULC).

.1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

.4 American Society for Testing and Materials (ASTM).

.1 ASTM C177 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Proprieties by Mean of the Guarded Hot-Plate Apparatus.

.2 ASTM C518 Standard Test Method for Steady-State Thermal Transmission Proprieties by Means of the Heat Flow Meter Apparatus.

.3 ASTM C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.

.4 ASTM C1729 Standard Specification for Aluminum Jacketing for Insulation.

.5 ASTM C1290 Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.

.6 ASTM C1393 Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes And Tanks.

.7 ASTM C553, Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.8 ASTM C612, Mineral Fiber Block and Board Thermal Insulation.

.9 ASTM C 411, Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.

.10 ASTM C 795, Specification for Thermal Insulation for Use with Austenitic Stainless Steel.

.11 ASTM C 921, Practice for Determining the Properties of Jacketing Materials for Thermal Insulation.

.5 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).

.1 ASHRAE Standard 90.1.

.6 Manufacturer's Trade Associations.

.1 Thermal Insulation Association of Canada (TIAC)

.2 North American Commercial and Industrial Insulation Standards.

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with general requirements.

.2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.

.3 Submit completed detail plates from the North American Commercial and Industrial Insulation Standards manual, applicable to installation types required by this specification section.

1.3 INSTALLATION INSTRUCTIONS

.1 Submit manufacturer's installation instructions in accordance with general requirements.

.2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.4 QUALIFICATIONS

.1 Installer to have successfully completed apprenticeship program.

.2 Installer to be specialist in performing work of this section and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.

.2 Protect from weather and construction traffic.

.3 Protect against damage from any source.

.4 Store at temperatures and conditions required by manufacturer.

1.6 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as defined herein.

.3 "ASJ+" – All Service Jacket – vapor retarder laminate of aluminium foil inner layer, reinforced with fiberglass scrim, bonded to a bleached kraft paper, with outer poly film leaving no paper exposed.

.4 "ASJ" – All Service Jacket (no outer film) – vapor retarder laminate of aluminium foil inner layer, reinforced with fiberglass scrim, bonded to a bleached kraft paper outer layer.

.5 “FSK” – Foil Scrim Kraft – vapor retarder laminate of aluminium foil outer layer, reinforced with fiberglass scrim, bonded to a natural kraft paper inner layer.

.2 Insulation systems - insulation material, fasteners, jackets, and other accessories.

1.7 QUALITY ASSURANCE

.1 Products shall not contain formaldehyde, asbestos, lead, mercury or mercury compounds or PBDE fire retardants.

.2 **Products shall be Certified UL GREENGUARD Gold or Indoor Advantage Gold and formaldehyde free.**

.3 **Recycled content: Mineral fiber products will contain a minimum of 50% recycled glass content certified and UL validated, and are to be constructed using bio-based thermosetting binder.**

Part 2 Products

2.1 LIMITATION ON MATERIALS

.1 Products shall not contain formaldehyde, asbestos, lead, mercury or mercury compounds or PBDE fire retardants.

.2 Materials shall be: "**Certified Asthma and allergy friendly" and "verified Healthy Air."**

2.2 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.3 INSULATION

.1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C (75°F) mean temperature when tested in accordance with ASTM C177 or ASTM C518.

.3 Type C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket meeting the requirement of ASTM C1136 Type II and IV (FSK):

.1 Jacket: to ASTM C1136 Type II and IV (FSK)

.2 Maximum "k" value: .033 W/M•°C (.23 BTU•IN/HR•FT^2•°F)

.4 Type C-2: Mineral fibre blanket to ASTM C553 Type I, II, and III, ASTM C1136 Type II and IV, and ASTM C1290 Type III:

.1 Jacket: to ASTM C1136, Type II and IV.

.2 Maximum "k" value: 042 W/M•°C (.29 BTU•IN/HR•FT^2•°F)

.5 Manufacturers:

.1 All materials must be supplied by the same manufacturer.

.2 Acceptable Materials:

.1 Johns Manville **(with proof of Asthma and allergy friendly certification)**

.2 Knauf

.3 Manson

2.4 JACKETS

.1 Canvas:

.1 220 g/m² (6 oz/sq.yd.) cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

.2 Lagging adhesive: Compatible with insulation.

.2 Prefinished Steel

.1 To ASTM with moisture barrier as scheduled in PART 3 of this section.

.2 Thickness: 0.5 mm (26 gauge) sheet.

.3 Finish: Smooth/Galvanised.

.4 Jacket banding and mechanical seals: 15 mm (1/2") wide, 0.50 mm (26 gauge) thick stainless steel.

2.5 ACCESSORIES

.1 Vapour retarder lap adhesive:

.1 Water based, fire retardant type, compatible with insulation.

.2 Indoor Vapour Retarder Finish:

.1 Compatible with insulation.

.3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.

.4 ULC Listed Canvas Jacket:

.1 220 g/m² (6oz/yd^2) cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.

.5 Tape: self-adhesive, aluminum, reinforced, 75 mm (3") wide minimum.

.6 Contact adhesive: quick-setting Childers CP-82 or equal.

.7 Canvas adhesive: washable.

.8 Tie wire: 1.5 mm (16 gauge) stainless steel.

.9 Facing: 25 mm (1") stainless steel hexagonal wire mesh stitched on one face of insulation

.10 Fasteners: weld pins, length to suit insulation, with 40 mm (1½") diameter clips.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

.1 Pressure testing of ductwork systems to be complete, witnessed, and certified.

.2 Surfaces to be clean, dry, free from foreign material.

3.2 INSTALLATION

.1 Install in accordance with North American Commercial and Industrial Insulation Standards.

.2 Apply materials in accordance with manufacturers instructions and this specification.

.3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports to be outside vapour retarder jacket.

.4 Supports, Hangers in accordance with general requirements.

.1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.

.5 Fasteners: At 300 mm (12") oc. in horizontal and vertical directions, minimum two rows each side.

.6 Provide rigid insulation for exposed ductwork.

.7 **Use two layers with staggered joints when required nominal thickness exceeds 75 mm (3").**

3.3 DUCTWORK INSULATION SCHEDULE

.1 Insulation types and thicknesses conform to following table:

Application	Type	Thickness
Rectangular supply air ducts	C-1	25 mm (1")
Round supply air ducts	C-2	25 mm (1")
Supply, return and fan exhaust ducts exposed (visible) in space being served	none	
Energy/Heat Recovery Ventilator Exhaust Ducts	C-1	25 mm (1”)
Outdoor air intake ductwork and plenums	C-1	50 mm (2")
Exhaust plenums dampers and louvres	C-1	25 mm (1")
Interior acoustically lined ducts	none	
Last 1.5m of Exhaust duct	C-1	25 mm (1")
Indoor AHU relief air ducts	C-1	25 mm (1")

.2 Exposed round ducts 600 mm (24") and larger, smaller sizes where subject to abuse:

.1 Use TIAC code C-1 insulation, scored to suit diameter of duct.

.2 C-6 insulation is also acceptable. Same thickness, schedule, and facing to be used as C-1 material.

.3 Finishes: Conform to following table:

Application	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed	Canvas	Canvas

END OF SECTION

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Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulating Pipes, Vessels, and Round Ducts.

.3 Underwriters Laboratories of Canada (ULC)

.1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

.4 American Society for Testing and Materials (ASTM)

.1 ASTM C547, Type I and IV Standard Specification for Mineral Fiber Pipe Insulation.

.2 ASTM C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Proprieties by Means of the Guarded-Hot-Plate Apparatus.

.3 ASTM C518, Standard Test Method for Steady-State Thermal Transmission Proprieties by Means of the Heat Flow Meter Apparatus to recognize the correct thermal insulation performance testing for blanket.

.4 ASTM C1393, Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks

.5 ASTM C1695, Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service.

.6 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Pipe Insulation.

.7 ASTM C 921, Practice for Determining the Properties Jacketing Materials for Thermal Insulation.

.8 ASTM C1729 Standard Specification for Aluminium Jacketing for Insulation.

.9 ASTM C553, Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

.10 CGSB 51-GP-52Ma, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.

.5 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).

.1 ASHRAE Standard 90.1.

.6 Manufacturer's Trade Associations

.1 Thermal Insulation Association of Canada (TIAC)

.2 North American Commercial and Industrial Insulation Standards

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with general requirements.

.2 Submit properly completed detail plates from the North American Commercial and Industrial Insulation Standards manual, applicable to installation types required by this specific section.

.3 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves, and jointing recommendations.

1.3 INSTALLATION INSTRUCTIONS

.1 Submit manufacturer's installation instructions in accordance with general requirements.

.2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.4 QUALIFICATIONS

.1 Installer to have successfully completed apprenticeship program.

.2 Installer to be specialist in performing work of this section and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.2 Protect from weather, construction traffic.

.3 Protect against damage from any source.

.4 Store at temperatures and conditions required by manufacturer.

1.6 DEFINITIONS

.1 For purposes of this section:

.1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.

.2 "EXPOSED" - will mean "not concealed" as defined herein.

.3 "ASJ+" – All Service Jacket – vapor retarder laminate of aluminium foil inner layer, reinforced with fiberglass scrim, bonded to a bleached kraft paper, with outer poly film leaving no paper exposed.

.4 "ASJ" – All Service Jacket (no outer film) – vapor retarder laminate of aluminium foil inner layer, reinforced with fiberglass scrim, bonded to a bleached kraft paper outer layer.

.5 “FSK” – Foil Scrim Kraft – vapor retarder laminate of aluminum foil outer layer, reinforced with fiberglass scrim, bonded to a natural kraft paper inner liner.

.6 “PSK” – Poly Scrim Kraft – vapor retarder laminate of polypropylene outer layer, reinforced with fiberglass scrim, bonded to a natural kraft paper inner layer.

.7 "PVC" – Poly Vinyl Chloride – polymer used to manufacture a non-metallic final protective finish jacket over insulation systems.

1.7 QUALITY ASSURANCE

.1 Products shall not contain formaldehyde, asbestos, lead, mercury or mercury compounds or PBDE fire retardants.

.2 **Products shall be Certified UL GREENGUARD Gold or Indoor Advantage Gold and formaldehyde free.**

.3 **Recycled content: Mineral fiber products will contain a minimum of 50% recycled glass content certified and UL validated and are to be constructed using bio-based thermosetting binder.**

Part 2 Products

2.1 MATERIAL LIMITATIONS

.1 Products shall not contain formaldehyde, asbestos, lead, mercury or mercury compounds or PBDE fire retardants.

2.2 FIRE AND SMOKE RATING

.1 In accordance with CAN/ULC-S102:

.1 Maximum flame spread rating: 25.

.2 Maximum smoke developed rating: 50.

2.3 INSULATION

.1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.

.2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C (75°F) mean temperature when tested in accordance with ASTM C335, ASTMC177 or ASTM C518.

.3 Type A-1: Rigid moulded or wound mineral fibre with factory applied vapour retarder jacket.

.1 Mineral fibre: to ASTM C547 Type I and IV.

.2 Jacket: to ASTM C1136, Type I, II, III, IV, X.

.3 Maximum "k" factor: to ASTM C547.

.4 Type A-3: Tubular flexible elastomeric closed cell foam:

.1 Insulation to ASTM C534 Type I.

.2 Maximum "k" factor: to ASTM C534.

.3 To be certified by manufacturer to be free of potential stress corrosion cracking corrodents.

.5 Materials:

.1 All materials must be supplied by the same manufacturer.

.2 Acceptable Materials:

.1 Knauf

.2 Manson

.3 Owens Corning

2.4 INSULATION SECUREMENT

.1 Tape: Self-adhesive, aluminum, reinforced, 50 mm (2") wide minimum.

.2 Contact adhesive: Quick setting.

.3 Canvas adhesive: Washable.

.4 **Bands: Stainless steel, 20 mm (3/4") wide, 0.5 mm (0.020") thick.**

2.5 CEMENT

.1 Thermal insulating and finishing cement:

.1 Air drying on mineral wool, to ASTM C 449M.

.2 Hydraulic setting on mineral wool, to ASTM C165

2.6 VAPOUR RETARDER LAP ADHESIVE

.1 Water based, fire retardant type, compatible with insulation.

2.7 INDOOR VAPOUR RETARDER FINISH

.1 Compatible with insulation.

2.8 OUTDOOR VAPOUR RETARDER FINISH

.1 Compatible with insulation.

.2 Reinforcing fabric: Open weave fibreglass fabric, with maximum weave of 10 x 10 squares per inch.

2.9 JACKETS

.1 Polyvinyl Chloride (PVC):

.1 Minimum thickness: 20mil (0.020")

.2 One-piece moulded type [and sheet] to CAN/CGSB-51.53 with pre-formed shapes as required.

.3 Colours: white.

.4 Minimum service temperatures: -29°C (-20°F).

.5 Maximum service temperature: 65°C (150°F).

.6 Moisture vapour transmission: 0.05 perm.

.7 Fastenings:

.1 Use solvent weld adhesive compatible with insulation to seal laps and joints.

.2 Tacks (not to be used on below-ambient temperature systems)

.3 Pressure sensitive vinyl tape of matching colour.

.2 Aluminum:

.1 To ASTM C1729.

.2 Thickness: 0.50 mm (0.020") sheet.

.3 Finish: Smooth.

.4 Joining: Longitudinal and circumferential slip joints with 50 mm (2") laps.

.5 Fittings: 0.50 mm (0.020") thick die-shaped fitting covers with factory-attached protective liner.

.6 Metal jacket banding and mechanical seals: stainless steel, 20 mm (3/4") wide, 0.50 mm (0.020") thick at 300 mm (12") spacing.

2.10 CAULKING FOR JACKETS

.1 Caulking: Silicone clear caulking.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENT

.1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed, and certified.

.2 Surfaces to be clean, dry, free from foreign material.

3.2 INSTALLATION

.1 Install in accordance with North American Commercial and Industrial Insulation Standards.

.2 Provide continuous insulation for complete systems including all valves, air separators, fittings, and other equipment.

.3 Apply materials in accordance with manufacturers' instructions and this specification.

.4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.

.1 Hangers, supports to be outside vapour retarder jacket.

.5 Supports, Hangers:

.1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

.6 **Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm (3").**

.7 Below ambient/chilled water installation:

.1 All pipes, fittings, valves, strainers, flanges, unions, and other pipe system components and specialties must be properly insulated with correctly completed vapor retarded applied.

.2 All insulation material must have properly installed and sealed vapor retarding jacket, including circumferential and longitudinal seams.

.3 All penetrations, tears, and punctures must be repaired and sealed with a vapor retarding material with a .02 or lower perm rating.

.4 Vapor stops must be installed at 18' intervals, at all pipe insulation termination points, including fittings, flanges, and other changes in direction or other types of piping specialities.

.5 All fitting insulation must be of the same type, thickness, and density of the pipe insulation, be premoulded insulation covers or fabricated from the same material as the pipe insulation. Full thickness must be factory-applied, vapor-retarder facing is unacceptable.

.6 A complete vapor retarder must be installed on insulation over fittings before applying final finish. Vapor retarder must extend onto and be sealed to the vapor retarder or pipe insulation.

.7 Additional fitting covers, PVC or metal, must have a vapor retarder seal applied to all longitudinal and circumferential seams in addition to the vapor retarder applied to the fitting insulation.

.8 Additional field applied jackets must not use staples, screws, tacks or rivets for attachment, to avoid puncturing vapor retarder underneath.

.9 Insulating support inserts are to be high compressive strength insulation with a rigid shield. No calcium silicate is to be used for insulation on below-ambient operation piping.

3.3 REMOVABLE, PREFABRICATED, INSULATION AND ENCLOSURES

.1 Application: At expansion joints, valves, primary flow measuring elements, flanges, and unions at equipment.

.2 Flexible removable insulation covers are not acceptable for below-ambient (cold) operation piping systems. Rigid removable insulation jackets that are vapor retarder exterior material that can be vapor sealed at the seams, are acceptable on below-ambient (cold) operation piping systems.

.3 Insulation:

.1 Insulation, fastenings, and finishes: same as system.

.2 Jacket: As per adjacent insulation.

3.4 PIPING INSULATION SCHEDULES

.1 Includes valves, valve bonnets, strainers, flanges, air separators, and fittings unless otherwise specified.

.2 Install insulator and jackets to applicable TIAC codes.

.3 Insulate ends of capped piping with type and thickness indicated for capped service.

.4 Thickness of insulation to be as listed in following table.

.1 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Type	Pipe sizes through (NPS) and insulation thickness mm (")				
		to 25 (1")	32 (1¼") 40 (1½")	50 (2") 80 (3")	105 (4") 150 (6")	200 (8") & over
Condensate	A-1	40 (1½")	40 (1½")	50 (2")	50 (2")	50 (2")
Hot Water Heating	A-1	40 (1½")	50 (2")	50 (2")	50 (2")	50 (2")
Glycol Heating	A-1	40 (1½")	50 (2")	50 (2")	50 (2")	50 (2")
Refrigerant piping	A-3	25 (1")	25 (1")	25 (1")	25 (1")	25 (1")
Cooling Coil cond. Drain	A-1	25 (1")	25(1")	25 (1")	25 (1")	25 (1")

.5 Finishes: Conform to the following table:

Application	Piping	Valves & Fittings
Exposed indoors	PVC	PVC
Exposed in mech. rooms	PVC	PVC
Concealed indoors	N/A	PVC
Exterior refrigerant piping	Aluminum	Aluminum

.6 Connection: To appropriate TIAC code.

.7 Finish attachments: SS bands, @ 150 mm (6") oc. seals: closed.

END OF SECTION

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Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 Canadian Standards Association (CSA).

.1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

.3 American Society for Testing and Materials (ASTM).

.1 ASTM A47/A47M, Specification for Ferritic Malleable Iron Castings.

.2 ASTM A278/A278M, Specification for Gray Iron Castings for Pressure-Containing Parts for Temperatures up to 650°F (350°C).

.3 ASTM A516/A516M, Specification for Pressure Vessel Plates, Carbon Steel, for Moderate - and Lower - Temperature Service.

.4 ASTM A536, Specification for Ductile Iron Castings.

.5 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.

.4 American Society of Mechanical Engineers (ASME).

.1 ANSI/ASME, Boiler and Pressure Vessels Code (BPVC).

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with general requirements.

.2 Indicate on manufacturers' catalogue literature the following:

.1 Sizes, orientation, capacities, performance, etc.

.2 Accessories

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in general requirements.

Part 2 Products

2.1 COMBINATION LOW PRESSURE RELIEF AND REDUCING VALVE

.1 Adjustable pressure setting: 206 kPa (30 psi) relief, 55 to 172 kPa (8.0 to 25 psi) reducing.

.2 Low inlet pressure check valve.

.3 Removable strainer.

2.2 PIPELINE STRAINER

.1 Pipeline strainer shall provide a means of mechanically removing solids from a flowing fluid. This is accomplished by utilizing a perforated metal mesh.

.2 Strainers shall be installed in pipelines to protect downstream mechanical equipment such as condensers, heat exchangers, pumps, compressors, meters, spray nozzles, turbines, and steam traps from the detrimental effect of sediment, rust, pipe scale, or other extraneous debris.

.3 Types of strainers: Provide strainers that are Y strainer and/or basket strainer.

.4 Strainer end connections shall match the piping specification.

.1 NPS 15 mm to 50 mm (1/2" to 2"): bronze body to ASTM B62, screwed connections.

.2 NPS 65 mm to 300 mm (2 1/2" to 12"): cast steel body to ASTM A278M, Class 30, flanged connections.

.3 NPS 50 mm to 300 mm (2" to 12"): T type with malleable iron body to ASTM A47M, grooved ends.

.5 Strainer components shall include a cover, perforated plate, mesh, wedge wire, gasket, and cover fasteners.

.1 Perforated Plate/Mesh/Wedge Wire: Stainless steel (various grades available).

.2 Gaskets: to suite fluid application.

.3 Fasteners: to match body material.

.6 Mesh sizing: An extremely important consideration in the selection of a strainer is the size of the perforations, mesh or wire opening used in the fabrication of the straining element. Select holes that are actually needed for the application and specified by the equipment manufacturer’s request that is being protected.

The following tables illustrate mesh and their respective straining capability. The main criteria for choosing hole and mesh size is the size and quantity of particles which can pass through downstream equipment without causing damage.

Mesh (Openings/In.)	Wire Diameter (In.)	Opening		Percent Open Area
		Inches	Micron	
10	0.032	0.068	727	56.3
16	0.018	0.045	1130	50.7
18	0.017	0.036	979	48.3
20	0.015	0.035	889.0	49.0
30	0.011	0.0223	566.4	44.8
40	0.009	0.0156	396.2	40.2
50	0.009	0.011	279	30.3
60	0.0065	0.0102	259.1	37.3
80	0.005	0.0075	190.5	36.0
100	0.0045	0.0055	139.7	30.3
120	0.0035	0.0048	123	30.1
150	0.0026	0.0041	103	37.2
170	0.0024	0.0035	79	35.1
200	0.0020	0.0030	76.2	33.6
250	0.0016	0.0024	61	36.0
300	0.0012	0.0021	54.2	29.7
325	0.0012	0.0019	47.7	30.0
400	0.0011	0.0014	35.6	36.0

.7 Capacity: The capacity ratio or open area ratio (OAR) of a strainer influences such operating characteristics as the length of time it can operate without cleaning and the created pressure loss. The OAR is the relationship between internal cross sectional area (flow area) of the pipe and the open flow area of the material which makes up the straining element.

The OAR for wye strainers shall not be less than 2.5:1.

The OAR for basket strainers shall not be less than 7:1.

When considering the OAR of a straining element, there are two accepted methods of analysis used by various specifying agencies and manufacturers. One method maintains "line of sight" reasoning and uses the multiple of the open areas for elements in series. In this method, a 60% open area material in series with a 40% open area material has a resultant combined open area of 24% (i.e. as in accordance with Military Standards). An alternative method allows the open area of the more restrictive element in series to be used. This would be 40% for the example above (i.e. as in accordance with Underwriter Laboratories' Standards). The method used influences the estimated operating pressure drop, as well as design decisions such as sizing.

.8 Strainers are made with various dimensions and configurations, manufacturers have tested and published pressure drop results.

Provide strainers designed for reasonable velocities that permit approximately 2 psi pressure drop across the strainer.

Provide basket strainers designed for reasonable velocities that permit approximately 0.5 psi pressure drop across the strainer.

.9 To allow the manufacturer to make selection or recommendations for a particular strainer, as much as possible, the following information should be provided by the Contractor to the Supplier:

- .1 Physical Characteristics
  - .1 Pipe size and schedule
  - .2 Strainer type required.
  - .3 End connections.
  - .4 Material (body, screen, bolting, gaskets).
  - .5 Pressure rating (design/operating — including shock).
  - .6 Temperature rating (design, operating, minimum).
  - .7 Straining element opening size.
  - .8 Capacity:
    - .1 Net effective open area required.
    - .2 Method of net open area calculation.
  - .9 Special requirements (hinged cover, vent tapping, jacketed, etc.).
  - .10 Applicable specifications (military specifications, special nondestructive tests or other quality control requirements).

.2 Flow Data

.1 Liquid:

.1 Description of fluid.

.2 Rate of flow – gallons per minute (gpm) or pounds per hour (lbs/hr).

.3 Viscosity – SSU.

.4 Specific gravity or density.

.5 Temperature.

.6 Concentration (if acid or other corrosive).

.2 Gas:

.1 Description of Gas.

.2 Rate of flow – standard cubic feet per minute (scfm) or actual cubic fee per minute (cfm).

.3 Specific gravity.

.4 Temperature and pressure.

.5 Molecular weight.

.3 Steam:

.1 Rate of flow-pounds per hour (lbs/hr).

.2 Temperature.

.3 Pressure.

.4 Density.

.5 State of flow.

.10 Blowdown connection: NPS 25 mm (1").

.11 Screens at pumps: stainless steel with 1.19 mm (50 mil) perforations (16 mesh).

.12 Working pressure: 860 kPa (125 psi).

Part 3 Execution

3.1 GENERAL

.1 Install as indicated and to manufacturer's recommendations.

.2 Run drain lines (and blow off connections) to terminate above nearest drain.

.3 Maintain proper clearance to permit service and maintenance.

.4 Should deviations beyond allowable clearances arise, request, and follow Consultant's directive.

.5 Check shop drawings for conformance of all tappings for ancillaries and for equipment operating weights.

3.2 STRAINERS

.1 Install in horizontal or down flow lines.

.2 Ensure clearance for removal of basket.

.3 Install ahead each of the following components:

.1 Temperature control valves

.2 Condensers

.3 Additional locations where indicated on the drawings.

.4 Provide proper mesh strainers for the proper application.

.5 Provide proper mesh strainers as recommended by the manufacturer's product being protected.

.6 Provide basket strainers ahead of all plate heat exchanger or equipment with plate heat exchanger when piping is 100 mm (4") and larger.

.7 The strainer must be installed such that the debris chamber is located at the lowest possible position. A Y strainer in vertical piping must be placed with its screen in the downward position to trap the sediment in the debris collection chamber.

.8 Provide with a blowdown so the element can be flushed out by opening and closing the blowdown valve. This shall be accomplished without flow stoppage or disassembling any piping.

3.3 PRESSURE SAFETY RELIEF VALVES

.1 Run discharge pipe to terminate above nearest drain.

END OF SECTION

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Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 Canadian Standards Association (CSA).

.1 CSA W47.1, Certification of Companies for Fusion Welding of Steel.

.3 American National Standards Institute (ANSI).

.1 ANSI/ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.

.2 ANSI/ASME B16.3, Malleable-Iron Threaded Fittings, Classes 150 and 300.

.3 **ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings: NPS½ through NPS24 Metric/Inch.**

.4 **ANSI/ASME B16.9, Factory-Made Wrought Steel Buttwelding Fittings.**

.5 **ANSI B18.2.1, Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).**

.6 **ANSI/ASME B18.2.2, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).**

.7 **ANSI/AWWA C111/A21.11, Rubber Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.**

.4 American Society for Testing and Materials (ASTM).

.1 ASTM A47/A47M, Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

.3 ASTM A536, Specification for Ductile Iron Castings.

.4 ASTM B61, Specification for Steam or Valve Bronze Castings.

.5 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.

.6 **ASTM E202, Test Method for Analysis of Ethylene Glycols and Propylene Glycols.**

.5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).

.1 MSS-SP-67, Butterfly Valves.

.2 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.

.3 MSS-SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.

.4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

.5 MSS-SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with general requirements.

.2 Indicate on manufacturers' catalogue literature the following:

.1 Piping

.2 Valves

.3 Accessories

1.3 CLOSEOUT SUBMITTALS

.1 Provide maintenance data for incorporation into manual specified in general requirements.

Part 2 Products

2.1 STEEL PIPE

.1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:

.1 NPS 150 mm (6") and smaller: Schedule 40.

.2 Final connection to copper heating elements.

.1 Type "L" copper with 95/5 solder joints and dielectric couplings. Maximum length 600 mm (24").

.3 Pipe Joints

.1 NPS 50 mm (2") and under: screwed fittings with pulverized lead paste.

.2 NPS 65 mm (2½") and over: welding fittings and flanges to CSA W47.1.

.3 Flanges: plain or raised face, slip-on.

.4 Flange gaskets: suitable for hydronic heating up to 110°C (220°F).

.5 Pipe thread: taper.

.6 Bolts and nuts: to ANSI B18.2.1 and ANSI/ASME B18.2.2.

.4 Fittings

.1 Screwed fittings: malleable iron, to ANSI/ASME B16.3, Class 150.

.2 Pipe flanges and flanged fittings:

.1 Cast iron: to ANSI/ASME B16.1, Class 125.

.2 Steel: to ANSI/ASME B16.5.

.3 Butt-welding fittings: steel, to ANSI/ASME B16.9.

.4 Unions: malleable iron, to ASTM A47/A47M and ANSI/ASME B16.3.

2.2 VALVES

.1 Connections:

.1 NPS 32 mm (1 1/4") and smaller: screwed ends.

.2 NPS 50 mm (2") and smaller: screwed ends.

.3 NPS 65 mm (2 ½") and larger: flanged ends.

.2 Gate valves: Application: Isolating equipment, control valves, pipelines:

.1 NPS 50 mm (2") and under:

.1 Mechanical Rooms: Class 125, rising stem, solid wedge disc.

.2 Elsewhere: Class 125, non-rising stem, solid wedge disc.

.2 NPS 65 mm (2 1/2") and over:

.1 Mechanical Rooms:

.1 Rising stem, solid wedge disc, bronze trim.

.1 Operators: handwheel.

.2 Non-rising stem, solid wedge disc, bronze trim.

.1 Operators: handwheel.

.3 Butterfly valves: Application: Isolating each cell or section of multiple component equipment and where indicated.

.1 NPS 32 mm (1 1/4") and smaller: screwed ends.

.2 NPS 50 mm (2") and smaller: screwed ends.

.3 NPS 65 mm (2 1/2") and over: Flanged ends.

.4 Globe valves: Application: Throttling, flow control, emergency bypass:

.1 NPS 50 mm (2") and under:

.1 With PFTE disc, as specified. Bronze.

.2 NPS 65 mm (2 1/2") and over:

.1 With solid bronze disc, bronze trim, cast iron body.

.5 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, with chain and cap.

.6 Swing check valves:

.1 NPS 50 mm (2") and under:

.1 Class 150, swing, with PFTE disc, as specified. Bronze. Jenkins 4475TJ.

.2 NPS 65 mm (2 1/2") and over:

.1 Flanged or Grooved ends, Bronze trim, Cast Iron: Gate, Globe, Check.

.7 Ball valves:

.1 NPS 80 mm (3") and under:

.1 Body and cap: cast high tensile bronze to ASTM B62.

.2 Pressure rating: Class 125, 860 kPa (125 psi) steam, WP = 1.4 MPa (203 psi) WOG.

.3 Connections:

.1 NPS 50 mm (2") and under screwed ends to ANSI B1.20.1 and with hex. shoulders.

.2 NPS 65 mm (2½") and over flanged.

.4 Stem: stainless steel tamperproof ball drive.

.5 Ball and seat: replaceable stainless steel solid ball and teflon seats.

.6 Operator: removable lever handle.

.7 Extended handles on chilled water valves.

.8 Full port.

.8 All valves shall be of commercial grade and of same manufacturer.

.9 Acceptable Manufacturers:

.1 Newman Hattersley Canada Ltd.

.2 Jenkins/Crane

.3 Milwaukee

.4 Toyo

.5 Kitz

2.3 BALANCING VALVES

.1 Size 15 mm (1/2") to 50mm (2"): Bronze body, brass ball, NPT connections and variable orifice.

.2 Size 65 mm (2 1/2") to larger: Cast iron body, raised flange connections, glove style with brass plug.

.3 Differential pressure readout ports with internal EPT inserts and check values, 6 mm (¼")NPT tapped drain/purge ports, memory stop and calibrated nameplate.

.4 Acceptable materials:

.1 Bell & Gossett Circuit Setters

.2 Armstrong

.3 Taco

.4 Tour & Anderson

.5 Oventrop

2.4 AUTOMATIC AIR VENT

.1 Industrial float vent: cast iron body and NPS 15 mm (1/2") connection and rated at 860 kpa (125 psi) working pressure.

.2 Float: solid material suitable for 115°C (240°F) working temperature.

.3 Plastic vents are not acceptable.

.4 Acceptable materials:

.1 Maid-O-Mist No. 67

.2 Spirax Sarco

Part 3 Execution

3.1 PIPING INSTALLATION

.1 Installation shall be by a licensed pipe fitter.

.2 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.

.3 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.

.4 Slope piping in direction of drainage and for positive venting.

.5 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.

.6 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.

.7 Ream pipes, clean scale and dirt, inside and outside, before and after assembly.

.8 Assemble piping using fittings manufactured to ANSI standards.

.9 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main. Hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding saddle.

3.2 VALVE INSTALLATION

.1 Install rising stem valves in upright position with stem above horizontal.

.2 Install butterfly valves on chilled water and condenser water lines only.

.3 Install gate or ball valves at branch take-offs and to isolate each piece of equipment, and as indicated.

.4 Install globe valves for balancing and in by-pass around control valves as indicated.

.5 Provide silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.

.6 Provide swing check valves in horizontal lines as indicated.

.7 Install chain operators on valves NPS 65 mm (2½") and over where installed more than 2400 mm (96") above floor in Boiler Rooms and Mechanical Equipment Rooms.

.8 Provide ball valves for glycol service.

3.3 AIR VENTS

.1 Install at high points of systems.

.2 Install ball valve on automatic air vent inlet.

.3 Extend vent lines in Mechanical Room with screwdriver stop at 1.8 m AFF.

3.4 CIRCUIT BALANCING VALVES

.1 Install flow measuring stations and flow balancing valves as indicated.

.1 On return side of all heating devices (convectors, panels, force flows, radiation, coils, etc.).

.2 On return side of all water or glycol cooling coils.

.3 On return side of all reverse return piping loops and/or branch circuits.

.2 Install to manufacturers requirements.

.3 Minimum valve size shall be one pipe size smaller than piping or 20 mm (¾"), whichever is larger.

.4 Refer to Testing Adjusting and Balancing Section for applicable procedures.

3.5 FILLING OF SYSTEM

.1 Refill system with clean water adding water treatment as specified.

.2 Co-ordinate filling of system with HVAC water treatment contractor.

.3 Refill glycol heating system with 40% propylene glycol solution as specified.

3.6 TESTING

.1 Test system in accordance with Mechanical General Requirements Section.

.2 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair any leaking joints, fittings or valves.

3.7 FLUSHING AND CLEANING

.1 Scope:

.1 Drain and flush entire existing system and new piping.

.2 Refer to Water Treatment Section.

.3 Procedure:

.1 Flushing and cleaning should only take place after successful piping pressure testing.

.2 Terminal device (reheat coils, heat pumps, perimeter radiation, etc.), air handling unit coils and their associated control and balancing valves should be bypassed during the preliminary flushing and cleaning process.

.3 Instruments such as flow meters, flow metering valves and orifice plates should only be installed after flushing and cleaning.

.4 Timing:

.1 The overall construction schedule identifies piping flushing and cleaning with realistic time allotments.

.2 The mechanical contractor is required to provide a detailed report outlining the processes and procedures for flushing and cleaning per piping system at least 4 to 6 weeks in advance of work.

.3 As a minimum, at least one piping flushing and cleaning procedure shall be witnessed, by the consultant and/or commissioning agent.

.5 The mechanical contractor shall to utilize a qualified water treatment specialist to supervise the flushing and cleaning process and provide the certified water analysis report certifying that the piping systems are clean.

.6 Coordinate flushing and cleaning of mechanical systems with HVAC water treatment contractor and HVAC systems commissioning contractor.

.7 Flush and clean new piping system in presence of Consultant.

.8 Flush after pressure test for a minimum of 4 hrs.

.9 Fill system with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8 hrs.

.10 Thoroughly flush all new mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Chemicals to inhibit corrosion of various system materials and be safe to handle and use.

.11 During circulation of cleaning solution, periodically examine and clean filters and screens and monitor changes in pressure drop across equipment.

.12 Refill system with clean water. Circulate for at least 2 hours. Clean out strainer screens/baskets regularly. Then drain.

.13 Drainage to include drain valves, dirt pockets, strainers, every low point in system.

.14 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.

.15 Re-install strainer screens/baskets only after obtaining Consultant's approval and approval from HVAC water treatment contractor.

.16 Repeat system drain and flush as often as necessary to have a clean system.

.17 Disposal of cleaning solutions to be approved by authority having jurisdiction.

.18 Isolate new piping system from existing system as required for system cleaning.

.19 After hydronic system is cleaned, refill with clean water and chemical as per chemical supplier treatment.

.20 After glycol piping system is cleaned, refill with 40% glycol solution.

3.8 EXISTING SYSTEM DISPOSAL

.1 Disposal of existing system shall be to the requirements of the local and/or provincial regulations.

END OF SECTION

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Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 ANSI/ASME B16.22, Wrought Copper Alloy and Copper Alloy Solder - Joint Pressure Fittings: Classes 150, 300, 600, 900, 1500, and 2500.

.3 ANSI/ASME B16.24, Cast Copper Pipe Flanges and Flanged Fittings.

.4 ANSI/ASME B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.

.5 ANSI/ASME B31.5, Refrigeration Piping and Heating Transfer Components.

.6 ASTM A307, Specification for Carbon Steel Bolts and Studs, 413.5 mPa (60,000 psi) Tensile Strength.

.7 ASTM B280, Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.8 CSA B52, Mechanical Refrigeration Code.

.9 EPS 1/RA/2, Environmental Code of Practice for Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

Part 2 Products

2.1 TUBING

.1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.

- .1 Hard copper: to ASTM B280, Type ACR-B.
- .2 Refer to Part 3 for allowed applications.

2.2 FITTINGS

.1 Service: design pressure 2070 kPa (300 psi) and temperature 121°C (250°F).

.2 Brazed:

- .1 Fittings: wrought copper to ANSI/ASME B16.22.
- .2 Joints: silver solder, 45% Ag-15% Cu or copper-phosphorous, 95% Cu-5%P and non-corrosive flux.

.3 Flanged:

- .1 Bronze or brass, to ANSI/ASME B16.24, Class 150 and Class 300.
- .2 Gaskets: suitable for service.
- .3 Bolts, nuts and washers: to ASTM A307, heavy series.

.4 Flared:

- .1 Bronze or brass, for refrigeration, to ANSI/ASME 16.26.

2.3 PIPE SLEEVES

.1 Hard copper or steel, sized to provide 6 mm (1/4") clearance all around between sleeve and uninsulated pipe or between sleeve and insulation.

2.4 VALVES

.1 22 mm (7/8") and under: Class 500, 3.5 MPa (500 psi), globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.

.2 Over 22 mm (7/8"): Class 375, 2.5 MPa (375 psi), globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

2.5 FILTER-DRIER

.1 On lines 20 mm (3/4") outside diameter and larger, filter-drier shall be replaceable core type with Schraeder type valve.

.2 On lines smaller than 20 mm (3/4") outside diameter, filter-drier shall be sealed type using flared copper fittings.

.3 Size shall be full line size.

.4 Approved manufacturers:

.1 Mueller

.2 Parker

.3 Sporlan

.4 Virginia

2.6 SIGHT GLASS

.1 Combination moisture and liquid indicator with protection cap.

.2 Sight glass shall be full line size.

.3 Sight glass connections shall be solid copper or brass, no copper-coated steel sight glasses allowed.

.4 Approved manufacturers:

.1 Mueller

.2 Henry

.3 Parker

.4 Superior

2.7 SUCTION LINE TRAP

.1 Manufactured standard one-piece traps.

2.8 EXPANSION VALVES

.1 For pressure type distributors, externally equalized with stainless steel diaphragm, and same refrigerant in thermostatic elements as in system.

.2 Size valves to provide full rated capacity of cooling coil served. Co-ordinate selection with evaporator coil and condensing unit.

.3 Approved manufacturers:

.1 Henry

.2 Mueller

.3 Parker

.4 Sporlan

2.9 FLEXIBLE CONNECTORS

.1 Designed for refrigerant service with bronze seamless corrugated hose and bronze braiding.

.2 Approved manufacturers:

.1 Anaconda “Vibration Eliminators” by Anamet

.2 Vibration Absorber Model VAF by Packless Industries

.3 Vibration Absorbers by Superior Valve Co

.4 Style “BF” Spring-flex freon connectors by Vibration Mountings.

2.10 PREFABRICATED PIPE ENTRY DOGHOUSE

.1 Dog House and cover shall be fabricated from 2mm thick aluminum with UV protected powder coated finish is also acceptable.

.2 Cover shall be gasketed to ensure air and water tightness.

.3 Mount in curb shall be full insulated and supplied with Doghouse.

.4 Curb shall be 610 mm (24") high with 89 mm (3.5") wide flange pre-punched for securement to roof deck.

.5 Curb shall be insulated with 50 mm (2") thick glass fibre insulation.

.6 Pipe entry openings shall be provided by the pipe entry chase manufacturer and be specifically made for the application. Minimum acceptable standard:

.1 Sigrist Exit Seal

.2 Vault Exit Seal

.7 Cover shall be removable and be fastened to the curb/body with vandal resistant fasteners. Hardware shall be zinc plated or stainless steel.

.8 Size: To suite required penetrations.

.9 Acceptable Manufacturers

.1 Sigrist Alta Pipe Chase Housing

.2 Vault Roof Penetration Housing

.3 Other Acceptable Manufacturers if approved by Consultant prior to tender close.

2.11 PIPING SUPPORT ASSEMBLY

.1 All channel members shall be fabricated from structural grade steel conforming to one of the following ASTM specifications: A1011/A1011M, A653/A653M.

.2 All fittings shall be fabricated from steel conforming to one of the following ASTM specifications: A575, A36/A36M or A635/A635M.

.3 Electro galvanized cush clamps with shoulder bolt and molded thermoplastic cushion, size to suit pipe.

.4 Acceptable materials:

.1 Unistrut

.2 Or equal

Part 3 Execution

3.1 GENERAL

.1 Install in accordance with CSA B52, EPS 1/RA/2 and ANSI/ASME B31.5.

.2 Connect to equipment with isolating valves and unions.

.3 Provide space for servicing, disassemble, and removal of equipment and components all as recommended by manufacturer.

.4 Protect all openings in piping against entry of foreign material.

.5 Provide all necessary equipment including thermal expansion valve, sight glass, solenoid valve, filter dryer, etc., for a complete installed system. Pipe system as per manufacturer's recommendation and requirements.

.6 Provide number of refrigerant circuits and appropriate corresponding piping as per manufacturer's recommendations and requirements.

3.2 APPLICATION

.1 Hard Copper shall be used as follows:

.1 For all other systems/applications.

.2 For all exterior piping.

3.3 PIPING THROUGH FLOORS

.1 Refrigerant piping systems containing refrigerants that pass through floors not served by the system shall be installed as per the requirements of CSA B23-2023:

.1 Refrigerant piping shall be installed through a rigid and tight, continuous fire-resisting pipe (stainless steel, cast iron or similar) without openings into any floors not served by the system.

.2 The pipe shall be vented to the floor served by the system.

.3 Soft copper may be used when the shaft extends beyond two (2) storeys in length.

3.4 BRAZING PROCEDURES

.1 Bleed inert gas into pipe during brazing.

.2 Remove valve internal parts, solenoid valve coils, sight glass.

.3 Do not apply heat near expansion valve and bulb.

3.5 PIPING INSTALLATION

.1 General:

.1 Hard drawn copper tubing: do not bend. Minimize use of fittings.

.2 Soft drawn copper: install in a neat manner without excessive bends or twists. Minimize use of fittings.

.3 Fittings, joints and other connections to equipment shall be minimized in all inaccessible areas, including but not limited to areas above drywall ceilings, shafts etc.

.4 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.

.5 Provide trap at base of risers greater than 2.4m (8') high and at each 7.6m (25'-0") thereafter.

.6 Provide inverted deep trap at top of each riser.

.7 Provide double risers for compressors having capacity modulation.

.1 Large riser: install traps as specified above.

.2 Small riser: size for 5.1 m/s (1000 ft/min) at minimum load. Connect upstream of traps on large riser.

3.6 PRESSURE AND LEAK TESTING

.1 Close valves on factory charged equipment and other equipment not designed for test pressures.

.2 Leak test to CSA B52 before evacuation to 2 MPa (290 psi) and 1 MPa (145 psi) on high and low sides respectively.

.3 Test Procedure: Build pressure up to 35 kPa (5 psi) with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

.4 Testing shall be completed to the standards of CSA B52, section 5.10 so that the exemption contained in Annex N (N.1.2) allowing areas (such as those above fully enclosed drywall ceilings) to have joints and connections installed within them is met.

3.7 DEHYDRATION AND CHARGING

.1 Close service valves on factory charged equipment.

.2 Ambient temperatures to be at least 13°C (55°F) for at least 12 h before and during dehydration.

.3 Use copper lines of largest practical size to reduce evacuation time.

.4 Use 2-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5 Pa (0.02" WC) absolute and filled with dehydrated oil.

.5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.

.6 Triple evacuate all system components containing gases other than correct refrigerant or having lost holding charge as follows:

.1 Twice to 14 Pa (0.056" WC) absolute and hold for 4 h.

.2 Break vacuum with refrigerant to 14 kPa (0.056" WC).

.3 Final to 5 Pa (0.02" WC) absolute and hold for at least 12 h.

.4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.

.5 Submit all test results to Consultant.

.7 Charging:

.1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.

.2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.

.3 Re-purge charging line if refrigerant container is changed during charging process.

.8 Checks:

.1 Make all checks and measurements as per manufacturer's operation and maintenance instructions.

.2 Record and report all measurements to Consultant.

3.8 INSTRUCTIONS

.1 Post instructions in frame with glass cover in accordance with Operation and Maintenance Manual Section and CSA B52.

3.9 PREFABRICATED PIPE CHASE

.1 Install on prefabricated, insulated roof curb.

.2 Install pipe chase and pipe entry to manufacturers installation instructions.

.3 Provide field installed insulation on roof deck to match roof insulation thickness.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Plumbing Specialties and Accessories.

.2 Hydronic Systems – Steel.

1.2 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 American Society of Mechanical Engineers (ASME).

.3 ANSI/ASME Boiler and Pressure Vessel Code, Section VI.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with general requirements.

1.4 CLOSEOUT SUBMITTALS

.1 Submit operation and maintenance data for incorporation into manual specified in general requirements

.2 Include following:

.1 Log sheets as recommended by manufacturer.

.2 Test reports.

Part 2 Products

2.1 MANUFACTURER

.1 Equipment, chemicals, service by one supplier.

.2 Acceptable manufacturer:

.1 Rochester Midland Corporation
Contact: Chris Kilgour
Phone Number: (289) 314-0264

.2 Cambium Inc.
Contact: Stew Dolstra
Phone Number: (705) 742-7900

.3 MK Services and Consulting Inc.
Phone Number: (289) 771-2770

2.2 POT FEEDER

.1 Welded steel, pressure rating 1200 kPa (175 psi). Temperature rating: 90°C (194°F).

2.3 CHEMICAL FEED PIPING

.1 Resistant to chemicals employed. Pressure rating: 1200 kPa (175 psi).

2.4 SHIPPING/ FEEDING CHEMICAL CONTAINERS

.1 High density moulded polyethylene, with liquid level graduations, cover.

.2 Agitators: as required by manufacturer.

2.5 WATER TREATMENT FOR HYDRONIC SYSTEMS

.1 Ten (10) Micron filter for each pot feeder:

.1 Capacity 2% of pump recirculating rate at operating pressure.

.2 Six (6) sets of filter cartridges for each type, size of micron filter.

.2 Balancing valve set for 2% pump capacity.

.3 Glycol solution shall be Dowfrost HD inhibited propylene glycol based fluid as manufactured by Dow Chemical. Temperature range (-50°F to 325°F).

2.6 CHEMICALS

.1 Provide 1 year's supply.

2.7 TEST EQUIPMENT

.1 Provide one set of test equipment for each system to verify performance.

.2 Complete with carrying case, reagents for chemicals, all specialized or supplementary equipment.

2.8 CLEANING CHEMICALS

.1 Provide as required to make system clean.

.2 Cleaner chemical: compatible and of the same manufacturer of the water treatment supplier.

2.9 RECORD MANAGEMENT

.1 Provide cards and card holder mounted on wall adjacent to each pot feeder.

Part 3 Execution

3.1 INSTALLATION

.1 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.

.2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

3.2 CHEMICAL FEED PIPING

.1 Install crosses at all changes in direction. Install plugs in all unused connections.

3.3 WATER TREATMENT SERVICES

.1 After entire new and existing system is cleaned as specified elsewhere, provide monthly water treatment monitoring and consulting services for period of one year after system start-up. Provide written report to consultant after each visit. Service to include:

- .1 Initial water analysis and treatment recommendations.
- .2 System start-up assistance.
- .3 On site system testing and recording of treated hydronic system.
- .4 Operating staff training.
- .5 Visit plant every 7 days during first month of operation and as required until system stabilizes, and advise consultant in writing on treatment system performance.
- .6 Provide monthly visits with reports after system has stabilized to the satisfaction of the owner.
- .7 Provide necessary monthly recording charts and log sheets for one year operation.
- .8 Provide necessary laboratory and technical assistance.
- .9 Instructions and advice to operating staff to be clear, concise and in writing.

3.4 START-UP

.1 Start up water treatment systems in accordance with manufacturer's instructions.

3.5 SYSTEM COMMISSIONING AND TRAINING

.1 Commissioning and training shall be provided by installing water treatment sub-contractor and water treatment supplier.

.2 Timing:

- .1 After start-up deficiencies rectified.
- .2 After start-up and before TAB of connected systems.

.3 Pre-commissioning Inspections:

- .1 Verify:
  - .1 Presence of test equipment, reagents, chemicals, details of specific tests to be performed, operating instructions.
  - .2 Suitability of log book.
  - .3 Currency and accuracy of initial water analysis.
  - .4 Required quality of treated water.

.4 Commissioning procedures - applicable to all Water Treatment Systems:

- .1 Establish, adjust as necessary and record all automatic controls and chemical feed rates.
- .2 Monitor performance continuously during commissioning of all connected systems and until acceptance of project.
- .3 Establish test intervals, regeneration intervals.

.4 Record on approved report forms all commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.

.5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.

.6 Visit project at monthly intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).

.7 Advise Engineer in writing on all matters regarding installed water treatment systems.

.5 Commissioning procedures - Closed Circuit Hydronic Systems:

.1 Analyse water in system.

.2 Based upon an assumed rate of loss approved by Engineer, establish rate of chemical feed.

.3 Record types, quantities of chemicals applied.

.4 Provide written verification of glycol solution concentration.

.6 Training:

.1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.

.2 Train O&M personnel in softener regeneration procedures.

.7 Certificates:

.1 Upon completion, furnish certificates confirming satisfactory installation and performance.

.8 Commissioning Reports:

.1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, all other data required by Consultant.

.9 Commissioning activities during Warranty Period:

.1 Check out water treatment systems on regular basis and submit written report to Consultant.

3.6 CLEANING OF MECHANICAL SYSTEM

.1 Coordinate cleaning of mechanical systems with mechanical contractor.

.2 Provide copy of recommended cleaning procedures and chemicals for approval by Consultant.

.3 Procedure:

.1 Flushing and cleaning should only take place after successful piping pressure testing.

.2 Terminal device (reheat coils, heat pumps, perimeter radiation, heat exchangers etc.), air handling unit coils and their associated control and balancing valves should be bypassed during the preliminary flushing and cleaning process.

.3 Instruments such as flow meters, flow metering valves and orifice plates should only be installed after flushing and cleaning.

.4 Timing:

.1 The overall construction schedule identifies piping flushing and cleaning with realistic time allotments.

.2 The mechanical contractor is required to provide a detailed report outlining the processes and procedures for flushing and cleaning per piping system at least 4 to 6 weeks in advance of work.

.3 As a minimum, at least one piping flushing and cleaning procedure shall be witnessed, by the consultant and/or commissioning agent.

.5 The mechanical contractor shall to utilize a qualified water treatment specialist to supervise the flushing and cleaning process and provide the certified water analysis report certifying that the piping systems are clean.

.6 Coordinate flushing and cleaning of mechanical systems with HVAC water treatment contractor.

.7 Flush and clean new piping system in presence of Owner

.8 Flush after pressure test for a minimum of 4 hrs.

.9 Fill system with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8 hrs.

.10 Thoroughly flush all new mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Chemicals to inhibit corrosion of various system materials and be safe to handle and use.

.11 During circulation of cleaning solution, periodically examine and clean filters and screens and monitor changes in pressure drop across equipment.

.12 Refill system with clean water. Circulate for at least 2 hours. Clean out strainer screens/baskets regularly. Then drain.

.13 Drainage to include drain valves, dirt pockets, strainers, every low point in system.

.14 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.

.15 Reinstall strainer screens/baskets only after obtaining Owner's approval and approval from HVAC water treatment contractor and board chemical treatment technician.

.16 Repeat system drain and flush as often as necessary to have a clean system.

.17 Disposal of cleaning solutions to be approved by authority having jurisdiction.

.18 Isolate new piping system from existing system as required for system cleaning.

3.7 WARRANTY

.1 Warranty Start Date:

.1 Warranty period starts as of the date of Ready for Takeover.

.2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.

.2 Warranty Duration:

One (1) year warranty period applies.

.3 Warranty Coverage:

.1 Applies to parts and labour.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

.3 SMACNA HVAC Duct Leakage Test Manual.

.4 ASTM A480/A480M, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.

.5 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process. (Metric).

.6 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.

.7 ANSI/NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.

.8 CSA B228.1, Pipe Ducts and Fittings for Residential Type Air Conditioning Systems.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section general requirements.

.2 Indicate following:

- .1 Sealants
- .2 Tape
- .3 Proprietary Joints
- .4 Fittings

1.3 CERTIFICATION OF RATINGS

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

Part 2 Products

2.1 DUCTWORK

.1 Galvanized Steel:

.1 Galvanized steel with Z90 designation zinc coating lock forming quality: to ASTM A653/A653M.

.2 Thickness:

Size Type	Class A Gauge	Class B Gauge	Class C Gauge
Square and Rectangular			
Up to 600 mm (24")	22	24	24
625 mm to 1000 mm (25" to 40")	20	22	24
1025 mm to 1800 mm (41" to 72")	18	20	22
Round and Oval			
Up to 300 mm (12")	24	24	24
325 mm to 600 mm (13" to 24")	22	24	24
625 mm to 900 mm (25" to 36")	20	22	24

*****Following SMACNA for low pressure ductwork.

.3 All ductwork between HVAC unit connections and 3.0 m (10'-0") downstream or to silencers shall be 1.4 mm (18 gauge).

2.2 DUCT CONSTRUCTION

.1 Round and oval:

.1 Ducts: factory fabricated, spiral wound, with matching fittings and specials to SMACNA.

.2 Transverse joints up to 900 mm (36"): slip type with tape and sealants.

.3 Transverse joints over 900 mm (36"): Ductmate or Exanno Nexas Duct System.

.2 Square and rectangular:

.1 Ducts: to SMACNA.

.2 Transverse joints, longest side:

up to and including 750 mm (30"): SMACNA proprietary duct joints.

.3 Ducts with sides over 750 mm (30") to 1200 mm (48"), transverse duct joint system by Ductmate/25, Nexus, or WDCI (Lite) (SMACNA “E” or “G” Type connection). Weld all corners.

.1 Acceptable materials:

.1 Ductmate Canada Ltd.

.2 Nexus, Exanno Corp.

.3 WDCI

.4 Ducts 1200 mm (48") and larger, Ductmate/35, Nexus, or WDCI (heavy) (SMACNA “J” Type connection). Weld all corners.

.1 Acceptable materials:

.1 Ductmate Canada Ltd.

.2 Nexus, Exanno Corp.

.3 WDCII.

2.3 FITTINGS

.1 Fabrication: to SMACNA.

.2 Radiused elbows:

.1 Rectangular: standard radius and or short radius with single thickness turning vanes Centreline radius: 1.5 times width of duct.

.2 Round:

.1 In exposed areas one-piece smooth radius, 1.5 times diameter.

.2 In concealed areas 3-piece adjustable, 1.5 times diameter.

.3 Mitred elbows, rectangular:

.1 To 400 mm (16"): with double thickness turning vanes.

.2 Over 400 mm (16"): with double thickness turning vanes.

.4 Branches:

.1 Rectangular main and branch: with 45º entry on branch.

.2 Round main and branch: enter main duct at 45º with conical connection.

.3 Provide volume control damper in branch duct near connection to main duct.

.4 Main duct branches: with splitter damper.

.5 Diffuser connection to main:

.1 90º round spin in collars with balancing damper and locking quadrant.

.6 Transitions:

.1 Diverging: 20º maximum included angle.

.2 Converging: 30º maximum included angle.

.7 Offsets:

.1 Full short radiused elbows.

.8 Obstruction deflectors: maintain full cross-sectional area.

2.4 SEAL CLASSIFICATION

.1 Classification as follows:

Maximum Pressure Pa (" w.c.)	SMACNA Seal Class	Acceptable Leakage Classification (Rectangular)	Acceptable Leakage Classification (Round)
2500 (10")	A	4	2
1500 (6")	A	4	2
1000 (4")	A	4	2
750 (3")	A	8	4
500 (2")	B	16	8
250 (1")	B	16	8
125 (0.5")	C	16	8

.2 Seal classification:

.1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.

.2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.

.3 Class C: transverse joints and connections made air tight with gaskets, or sealant or combination thereof. Longitudinal seams sealed with foil tape or sealant.

2.5 SEALANT

.1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of -30°C (-22°F) to plus 93°C (199°F).

.2 Flame-spread rating not more than 25.

.3 Smoke developed classification not more than 50.

.4 Acceptable materials:

.1 Duro Dyne S-2

.2 Foster

2.6 TAPE

.1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm (2") wide.

.1 Acceptable material:

.1 Duro Dyne FT-2

2.7 DUCT LEAKAGE

.1 In accordance with SMACNA HVAC Duct Leakage Test Manual.

2.8 FIRESTOPPING

.1 40 mm x 40 mm x 3 mm (1½" x 1½" x 16ga) retaining angles all around duct, on both sides of fire separation.

.2 Firestopping material and installation must not distort duct.

.3 All ductwork passing through partition walls shall be firestopped.

2.9 WATERTIGHT DUCT

.1 Provide watertight duct for:

.1 Fresh air intake.

.2 As indicated.

.2 Form bottom of horizontal duct without longitudinal seams. Solder or weld joints of bottom and side sheets. Seal all other joints with duct sealer.

2.10 HANGERS AND SUPPORTS

.1 Band hangers: use on round and oval ducts only up to 500 mm (20") diameter, of same material as duct but next sheet metal thickness heavier than duct.

.2 Trapeze hangers: ducts over 500 mm (20") diameter or longest side, to ASHRAE and SMACNA.

.3 Hangers: galvanized steel angle with black steel rods to ASHRAE and SMACNA following table:

Duct Size mm (")	Angle Size mm (")	Rod Size mm (")
up to 750 (30)	25 x 25 x 3 (1 x 1 x 1/8)	6 (1/4)
>750 to 1050 (>30 to 42)	40 x 40 x 3 (1½ x 1½ x 1/8)	6 (1/4)
>1050 to 1500 (>42 to 60)	40 x 40 x 3 (1½ x 1½ x 1/8)	10 (3/8)
>1500 to 2100 (>60 x 84)	50 x 50 x 3 (2 x 2 x 1/8)	10 (3/8
>2100 to 2400 (>84 x 96)	50 x 50 x 5 (2 x 2 x 1/8)	10 (3/8)
>2400 (96) and over	50 x 50 x 6 (2 x 2 x ¼)	10 (3/8)

.4 Upper hanger attachments:

.1 For concrete: manufactured concrete inserts.

.1 Acceptable material:

.1 Myatt fig. 485

.2 For steel joist: manufactured joist clamp or steel plate washer.

.1 Acceptable material:

.1 Grinnell fig. 61 or 60

.3 For steel beams: manufactured beam clamps:

.1 Acceptable material:

.1 Grinnell Fig. 60

Part 3 Execution

3.1 GENERAL

.1 The following systems shall conform to these requirements:

System	Class	Material
VAV Supply	A	Galvanized steel
HVAC Supply and Return General Exhaust Ventilation Plenum Exhaust Plenum	B B B B	Galvanized steel Galvanized steel Galvanized steel Galvanized steel
Individual Exhaust	C	Galvanized steel

.2 Do work in accordance with ASHRAE and SMACNA.

.3 Do not break continuity of insulation vapour barrier with hangers or rods.

.4 Support risers in accordance with ASHRAE and SMACNA.

.5 Install breakaway joints in ductwork on each side of fire separation.

.6 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.

.7 Manufacture duct in lengths to accommodate installation of acoustic duct lining.

3.2 HANGERS

.1 Strap hangers: install in accordance with SMACNA.

.2 Angle hangers: complete with locking nuts and washers.

.3 Hanger spacing: in accordance with ASHRAE, SMACNA and as follows:

Duct Size mm (")	Spacing mm (")
to 1500 (60")	3000 (120")
over 1500 (60")	2500 (100")

.4 Do not support ductwork over 250 mm x 250 mm (10" x 10") from roof deck.

3.3 WATERTIGHT DUCT

.1 Slope horizontal branch ductwork down towards hoods served. Slope header ducts down toward risers.

.2 Fit base of riser with 150 mm (6") deep drain sump and 25 mm (1") drain connected, with deep seal trap and valve and discharging to open funnel drain.

3.4 SEALING

.1 Apply sealant to outside of joint to manufacturer's recommendations.

.2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

3.5 LEAKAGE TESTS

.1 Co-ordinate leakage testing with TAB contractor. TAB contractor will be responsible for all duct testing.

.2 Duct to be tested in accordance with SMACNA HVAC Duct Leakage Test Manual.

.3 Leakage tests to be done in sections.

.4 Trial leakage tests to be performed as instructed to demonstrate workmanship.

.5 Install no additional ductwork until trial test has been passed.

.6 Test section to be minimum of 15 m (50'-0") long with not less then 3 branch takeoffs and two 90º elbows. Maximum test length and area to be determined by BAS testing equipment. Allow for twelve (12) tests.

.7 Complete test before insulation or concealment.

.8 Provide all necessary end caps and fittings as required for the TAB contractor. Remove same after successful completion of duct test.

.9 Pressure test ductwork to 1½ times operating pressure (minimum pressure 500 Pa (2" wc) all systems).

3.6 CLEANING

.1 Keep ducts clear from dust and debris

.2 Keep duct liner clean from dust, debris, and moisture.

.3 At completion of project vacuum ducts if dirt or dust is present.

.4 Where new systems connect into existing systems the existing systems shall be cleaned and vacuumed prior to reconnection.

.5 Ensure all systems are clean prior to start up.

3.7 INSTALLATION REQUIREMENTS

.1 All ductwork is to be protected from the weather and precipitation. The top and sides of all ductwork are to be completely covered with 6mil poly to the satisfaction of the consultant. Maintain protection of the ductwork until the building is made watertight and hollow cores drained. Tape all joints.

END OF SECTION

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Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

.3 ASTM C423, Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

.4 ASTM E90, Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

.5 ASTM E477, Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.

1.2 SHOP DRAWINGS

.1 Submit shop drawings in accordance with general requirements.

.2 Provide separate shop drawings for each piece of attenuation equipment complete with product data.

1.3 PERFORMANCE RATING DATA

.1 Provide performance rating data, certified by an accredited test laboratory and supported by calculations and verified by test results in accordance with referenced standards as follows:

.1 Silencer: insertion loss, pressure drop at design conditions, generated noise level.

.2 Acoustic plenums: transmission loss and acoustical absorption.

Part 2 Products

2.1 ABSORPTION AND INSULATING MEDIA

.1 Acoustical performance measurements to be made in accordance with ASTM E477, ASTM E90 and ASTM C423, except where specified otherwise.

.2 Acoustic quality, glass fibre, free of shot and odor; bacteria and fungus resistant; free of corrosion causing or accelerating agents; packed to density to meet performance requirements; and meet NBC fire requirements or requirements of authority having jurisdiction for duct lining.

2.2 PREFABRICATED PLENUMS

.1 Panels: tongue and groove connection type, designed for individual panel removal for equipment access without major dismantling of plenum.

.1 Outer sheet: 1.3 mm (18 gauge) thick galvanized steel to ASTM A653/A653M, with coating designation Z90.

.2 Inner sheet: 0.085 mm (22 gauge) thick galvanized steel to ASTM A653/A653M, with coating designation Z90 with 2 mm (79 mil) diameter clean cut perforations on 5 mm (3/16") staggered centres.

.3 Fully framed with 1.3 mm (18 gauge) thick galvanized steel channels.

.4 Horizontal stiffeners: 0.85 mm (22 gauge) minimum galvanized steel on 800 mm (32") centres to control media settlement.

.5 Access panels: sized for equipment removal; two handles per panel; screw at 100 mm (4") maximum centres; perimeter neoprene sponge gasket; materials same as standard panel.

.6 Deflection: not to exceed 1/240 of unsupported panel span at design pressure differential of 2500 Pa (10" w.c.).

.7 Connections: as indicated.

.2 Doors: access doors with minimum 510 mm x 1375 mm (20" x 54") opening.

.1 Construction same as standard panel except interiors to be solid.

.2 Two butt-type nylon bushed hinges, two cam-type latches with inside and outside handles.

.3 Neoprene gasket seal.

.4 Zinc plated hardware.

.5 Open against air pressure.

.3 Windows: inspection windows, 300 mm x 300 mm (12" x 12"), double glazed with 6 mm (1/4") wire reinforced glass mounted in neoprene "U" channels].

.4 Assembly: base sections and flashings 1.3 mm (18 gauge) minimum galvanized steel.

.1 Panel and flashing joints externally sealed with 6 mm (1/4") diameter bead of non sag, non hardening sealant. Floor channel to floor connection sealed with 3 mm x 15 mm (1/8" x 1/2") monolastomeric tape.

.2 Factory cut and frame openings where greatest dimension exceeds 300 mm (12"). Smaller panel openings, to be site located and cut 50 mm (2") larger in diameter, sleeved with 0.7 mm (22 gauge) minimum galvanized steel.

.3 Fill space between pipe or conduit and sleeve with acoustic media, covered and mastic sealed in accordance with manufacturer's instructions.

.4 No sensory leakage at design pressure differential of 1000 KPa (145 psi).

.5 Assembly RSI not less than 1.2 m2°C/W (6.81 ft2°F/Btuh) at 10°C (50°F).

.6 Certified acoustical performance:

.1 Transmission loss to ASTM E90.

.2 Acoustical absorption to ASTM C423.

Octave bands, (Hz)	125	250	500	1000	2000	4000
Transmission loss, dB	[21]	[28]	[39]	[50]	[53]	[56]
Absorption coefficient	[0.7]	[0.9]	[.99]	[.99]	[0.9]	[0.9]

.7 Acceptable materials:

.1 Vibron

.2 BVA Systems

.3 VAW Systems

.4 IAC Acoustics

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturer's instructions.

.2 Noise flanking: where indicated, install in wall sleeve with uniform clearance all around to ensure no contact of silencer with wall sleeve. Pack with flexible, non hardening caulking on both sides of sleeves.

.3 Instrument test ports: install at inlet and outlet to permit measurement of insertion loss and pressure loss.

.4 Suspension: to manufacturer's instructions.

3.2 SITE VISIT

.1 Supplier of equipment to visit site to ensure installation is in accordance with manufacturer's instructions and submit report to Consultant

.2 Make adjustments and corrections in accordance with written report.

.3 Provide Consultant with notice 48h in advance of visit.

END OF SECTION

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Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

.3 ANSI/NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.

.4 CSA B228.1, Pipes, Ducts and Fittings for Residential Type Air Conditioning.

1.2 PRODUCT DATA

.1 Submit product data in accordance with general requirements.

.2 Indicate the following:

.1 Flexible connections.

.2 Duct access doors.

.3 Turning vanes.

.4 Instrument test ports.

1.3 CERTIFICATION OF RATINGS

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

Part 2 Products

2.1 GENERAL

.1 Manufacture in accordance with CSA B228.1.

2.2 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 -40°C (-40°F) to plus 90°C (194°F), density of 1.3 kg/m.

2.3 ACCESS DOORS IN DUCTS

.1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm (25 gauge) thick complete with sheet metal angle frame.

.2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm (24 gauge) thick complete with sheet metal angle frame and 25 mm (1") thick rigid glass fibre insulation.

.3 Gaskets: neoprene

.4 Hardware:

.1 Up to 300 mm (12"): 2 sash locks

.2 301 mm to 450 mm (13" to 18"): 4 sash locks Complete with safety chain.

.3 451 mm to 1000 mm (19" to 40"): piano hinge and minimum 2 sash locks.

.4 Doors over 1000 mm (40"): piano hinge and 2 handles operable from both sides.

.5 Hold open devices.

.5 Acceptable materials:

.1 Nailor

.2 E. H. Price

.3 Titus

2.4 TURNING VANES

.1 Factory or shop fabricated double thickness, to recommendations of SMACNA and as indicated.

.2 Acceptable materials:

.1 Duro Dyne

.2 Ductmate

2.5 INSTRUMENT TEST PORTS

.1 1.6 mm (16 gauge) thick steel zinc plated after manufacture.

.2 Cam lock handles with neoprene expansion plug and handle chain.

.3 28 mm (1 1/8") minimum inside diameter. Length to suit insulation thickness.

.4 Neoprene mounting gasket.

.5 Acceptable material:

.1 Duro Dyne IP1 or IP2

.2 Duct mate

2.6 SPIN-IN COLLAR

.1 Construction: galvanized straight or conical spin-in collar complete with spin-in bead and crimped collar connection.

.2 Provide balancing damper where indicated.

.3 Acceptable materials:

.1 Ecco Manufacturing

.2 Flex Master

Part 3 Execution

3.1 INSTALLATION

.1 Flexible connections:

.1 Install in following locations:

.1 Inlets and outlets to supply air units and fans. (Unless internally isolated)

.2 Inlets and outlets of exhaust and return air fans.

.3 As indicated.

.2 Length of connection: 100 mm (4").

.3 Minimum distance between metal parts when system in operation: 75 mm (3").

.4 Install in accordance with recommendations of SMACNA.

.5 When fan is running:

.1 Ducting on each side of flexible connection to be in alignment.

.2 Ensure slack material in flexible connection.

.2 Access doors and viewing panels:

.1 Size:

.1 600 mm x 600 mm (24" x 24") for person size entry.

.2 600 mm x 1000 mm (24" x 40") for servicing entry.

.3 300 mm x 300 mm (12" x 12") for viewing.

.4 As indicated.

.2 Location:

.1 At fire and smoke dampers.

.2 At control dampers.

.3 At devices requiring maintenance.

.4 At locations required by code.

.5 At inlet and outlet of reheat coils.

.6 Elsewhere as indicated.

.7 Inlet and outlet of duct mounted coils.

.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 At ducted inlets to roof and wall exhausters.

.2 At inlets and outlets of other fan systems.

.3 At 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 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.

.2 Install on supply ducts only.

3.2 WARRANTY

.1 Warranty Start Date:

.1 Warranty period starts as of the date of Ready for Takeover.

.2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.

.2 Warranty Duration:

.1 One (1) year warranty period applies.

.3 Warranty Coverage:

.1 Applies to parts and labour.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

1.2 PRODUCT DATA

.1 Submit product data in accordance with general requirements

.2 Indicate the following: performance data.

Part 2 Products

2.1 GENERAL

.1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

.1 Of same material as duct, but one sheet metal thickness heavier. V-groove stiffened, minimum 1.6 mm (16 gauge).

.2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm (4").

.3 Shaft extension to accommodate insulation thickness and locking quadrant.

.4 Inside and outside nylon end bearings.

.5 Channel frame of same material as adjacent duct, complete with angle stop.

2.3 MULTI-BLADED DAMPERS

.1 Factory manufactured of material compatible with duct.

.2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.

.3 Maximum blade height:

.1 50 mm (2") up to 375 mm (15") high duct.

.2 100 mm (4") max 400 mm (16") high duct and over.

.4 Bearings: self-lubricating nylon.

.5 Linkage: shaft extension with locking quadrant.

.6 Channel frame of same material as adjacent duct, complete with angle stop.

.7 Shaft extension to accommodate insulation thickness and locking quadrants.

.8 Acceptable materials:

.1 Duro Dyne
.2 E.H. Price
.3 Nailor
.4 T.A. Morrison
.5 Tamco
.6 Ruskin
.7 Ventex/Alumavent
.8 United Enertech

2.4 LOCKING QUADRANTS

.1 6 mm (1/4") dial regulator with square bearing shaft.

.1 18 gauge oval frame, cadmium plated, clearly shows damper position.
.2 18 gauge formed handle for easy adjustment.
.3 Bolt and wing nut lock damper securely.
.4 Offset mounting holes avoid interference with damper movement and mechanical fastening to duct.

.2 9 mm (3/8") and larger: clamp quadrant with square bearing shaft.

.1 Accommodates and securely locks square rod, bearing fitting and adaptor pins.
.2 Heavily ribbed 16 gauge steel frame, 3 mm (1/8") thick formed steel handle, cadmium-plated.
.3 By tightening nut, bearing is securely locked in handle, preventing slippage and rattle.
.4 Neoprene and steel washer assembly seals bearing opening to eliminate air-leakage.
.5 Screw holes for mechanically fastening to ductwork.

.3 High pressure system locking quadrant:

.1 Airtight, rattle-proof regulator, designed for ZERO leakage at high pressure. Use for applications up to 500°F constant temperature.
.2 Handle design for easy recognition of damper position.
.3 Heavy-gauge, zinc-plated steel, 2 high temperature rubber seals and washers, end bearing support, and 2 end bearings. Pressure loss and damper rattle in ductwork has been a constant annoyance for as long as HVAC ductwork has been installed. Now, a truly air-tight, rattle-proof regulator is available. The SPEC-SEAL regulator utilizes a special high-temperature rubber seal to eliminate leakage and rattle even at many times the pressure found in high pressure.
.4 Soft, comfortable grip handle with a highly-visible, plastic cover which indicates the damper position.
.5 Handle to accommodate 9 mm (3/8") or 12 mm (1/2") to match damper shaft size, square and round bearing shafts.

.4 Acceptable manufacturers:

.1 Duro Dyne

.2 Ductmate

.3 Pottorff

Part 3 Execution

3.1 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.

.3 For supply, return and exhaust systems, locate balancing dampers in each branch duct.

.1 Single blade dampers up to 200 mm (8").

.2 Multi-blade dampers over 200 mm (8").

.4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.

.5 All dampers to be vibration free.

.6 Leave all dampers in open position for T.A.B.

.7 Fasten locking quadrants to ductwork and shaft.

.8 Place locking quadrants on standoffs where ductwork insulated.

.9 Lock down quadrant arm in the open position.

3.2 WARRANTY

.1 Warranty Start Date:

.1 Warranty period starts as of the date of Ready for Takeover.

.2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.

.2 Warranty Duration:

.1 One (1) year warranty period applies.

.3 Warranty Coverage:

.1 Applies to parts and labour.

END OF SECTION

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Part 1 General

1.1 GENERAL

.1 This section applies to operating dampers not specified in Controls Section.

1.2 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

1.3 PRODUCT DATA

.1 Submit product data in accordance with general requirements.

.2 Indicate the following:

.1 Performance data.

1.4 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into manual specified in general requirements.

1.5 CERTIFICATION OF RATINGS

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency.

Part 2 Products

2.1 MOTORIZED DAMPERS

.1 Opposed blade type.

.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 Operator: Refer to BAS Section.

.6 Performance:

.1 Leakage: in closed position to be less than 2% of rated air flow at 250 Pa (1" w.c.) differential across damper.

.2 Pressure drop: at full open position to be less than 10 Pa (0.04" w.c.) differential across damper.

.7 Insulated aluminum dampers:

.1 Frames: insulated with extruded polystyrene foam with R factor of 5.0.

.2 Blades: constructed from aluminum extrusions with internal hollows insulated with polyurethane or polystyrene foam, R factor of 5.0.

.3 Use on services to the exterior.

.4 Acceptable materials:

.1 Honeywell

.2 Johnson

.3 T. A. Morrison

.4 E.H. Price

.5 Tamco

.6 Ruskin

.7 Nailor

.8 Henderson Industrial

.9 Ventex/Alumavent

.10 Pottorff

2.2 DISC TYPE DAMPERS

.1 Frame: brake formed, welded, 1.6 mm (16 gauge) thick, Type Z90 galvanized steel to ASTM A653/A653M.

.2 Disc: spin formed, 1.6 mm (16 gauge) thick, Type Z90 galvanized steel to ASTM A653/A653M.

.3 Gasket: extruded neoprene, field replaceable.

.4 Bearings: roller self lubricated and sealed.

.5 Operator: compatible with damper, linear stroke operator, spring loaded actuator, zinc-aluminum foundry alloy casting cam follower.

.6 Performance:

.1 Leakage: in closed position to be less than 0.001% of rated air flow at 100 kPa (15 psi) pressure differential across damper.

.2 Pressure drop: at full open position to be less than 100 kPa (15 psi) differential across damper.

.7 Acceptable material:

.1 Duro Dyne

.2 Henderson Industrial

.3 Pottorff

2.3 BACK DRAFT DAMPERS

.1 Automatic gravity operated, multi leaf, aluminum construction with nylon bearings, centre pivoted or counterweighted, as indicated.

.2 Acceptable materials:

.1 T.A. Morrison
.2 Tamco Series 7000
.3 Ruskin
.4 Nailor
.5 E.H. Price
.6 Henderson Industrial
.7 Ventex/Alumavent
.8 Pottorff

2.4 RELIEF DAMPERS

.1 Automatic multi-leaf aluminum dampers with ball bearing centre pivoted and counter-weights set to open at 100 Pa (0.4" w.c.) static pressure, (adjustable).

.2 Acceptable material:

.1 T. A. Morrison
.2 Henderson Industrial
.3 Ventex/Alumavent
.4 Pottorff

Part 3 Execution

3.1 INSTALLATION

.1 Install where indicated.

.2 Install in accordance with recommendations of SMACNA and manufacturer's instructions.

.3 Seal multiple damper modules with silicon sealant.

.4 Install access door adjacent to each damper. See Duct Accessories Section.

.5 Insulated dampers on all outside air intake and exhaust damper.

.6 Non-insulated dampers on all interior motorized dampers not exposed to outside air.

3.2 WARRANTY

.1 Warranty Start Date:

.1 Warranty period starts as of the date of Ready for Takeover.
.2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.

.2 Warranty Duration:

.1 One (1) year warranty period applies.

.2 Disk type dampers gasket: Ten (10) years warranty.

.3 Warranty Coverage:

.1 Applies to parts and labour.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 CAN/ULC-S110, Standard Methods of Test for Air Ducts.

.3 UL 181, Factory Made Air Ducts and Air Connectors.

.4 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.

.5 ANSI/NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.

.6 SMACNA HVAC Duct Construction Standards - Metal and Flexible.

1.2 PRODUCT DATA

.1 Submit product data in accordance with general requirements.

.2 Indicate the following:

- .1 Thermal properties.
- .2 Friction loss.
- .3 Acoustical loss.
- .4 Leakage.
- .5 Fire rating.

1.3 CERTIFICATION OF RATINGS

.1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

Part 2 Products

2.1 GENERAL

.1 Factory fabricated to CAN/ULC S110.

.2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.

.3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 METALLIC –INSULATED

.1 Spiral wound flexible aluminum with factory applied, 25 mm (1") thick flexible glass fibre thermal insulation with vapour barrier and vinyl jacket, Class 1 duct material.

.2 Performance:

.1 Factory tested to 2.5 kPa (10" w.c.) without leakage.

.2 Maximum relative pressure drop coefficient: 3.

.3 Operating pressure: 300 mm (12").

.3 Acceptable materials:

.1 Flexmaster T/L – VT

.2 Ductmate

Part 3 Execution

3.1 DUCT INSTALLATION

.1 Install in accordance with: SMACNA.

.2 Maximum length of flexible duct: 1.8 m (6' 0").

.3 Minimum length of acoustical ductwork; 1.5 m (5' 0") with minimum of 1 bend.

.4 Provide support at centre of flexible duct with 25 mm (1") wide galvanized hanger.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

.3 ASTM C1071 Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).

.4 ASTM C916 Standard Specification for Adhesive for Duct Thermal Insulation.

.5 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.

.6 ANSI/NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.

.7 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

1.2 PRODUCT DATA

.1 Submit product data in accordance with general requirements.

Part 2 Products

2.1 RECTANGULAR/SQUARE DUCT LINER

.1 General:

.1 Acoustical duct liner to be fibreglass duct liner meeting or exceeding requirements of ASTM C1071, Type I, Flexible or Type II, Rigid, and NFPA 90A/90B.

.2 Bonded with formaldehyde free bio-based binder

.3 Mat faced airstream surface

.4 Factory applied edge coating

.5 Shall not contain formaldehyde, PBDE's, asbestos, mercury, mercury compounds, lead, contain 50% or greater recycled glass content.

.6 Thermal conductivity, ASTM C177/C518/C1114 .24BTU (sf•hr•°F) @ 75°F mean temp).

.7 Noise Reduction Coefficient (NRC) 1.5 PCF 1" = .70, 1 ½ " = .80, 2" =.95
ASTM C423, Type A mounting.

.8 Noise Reduction Coefficient (NRC) 2.0 PCF 1/2" = .50, 1" = .70, 1 ½ " = .85
ASTM C423, Type A mounting

.9 Corrosiveness/corrosion, ASTM C665/C1617. Does not accelerate/pass.

.10 Mold and mildew growth/fungi resistance, ASTM C1338, ASTM G21/G22, UL2824. Pass/resistant to mold.

.11 Maximum service temperature, ASTM C411, 250°F (121°C).

.12 Maximum rate air velocity, ASTM C1071, 6,000 ft./min. (30.5 m/sec.)

.13 Water vapor sorption, ASTM C1104, less than 3%.

.14 Surface burning characteristics, ASTM E84, UL 273, CAN/ULC S102, 20/50 flame spread/smoke development.

.15 Acceptable material:

.1 Knauf Atmosphere Duct Liner

.2 Manson

.3 Johns Manville

.4 Owen Corning

.2 Rigid:

.1 Use on flat surfaces.

.2 25 mm (1") thick, to CGSB 51-GP-10M, fibrous glass rigid board duct liner.

.3 Density: 96 kg/m^3 (6 lb/ft^3).

2.2 ADHESIVE

.1 Meet requirements of ASTM C916.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range -29°C (-20°F) to 93°C (200°F).

.3 Acceptable material:

.1 Duro Dyne 1A-22

.2 Ductmate

2.3 FASTENERS

.1 Weld pins 2.0 mm (14 gauge) diameter, length to suit thickness of insulation. Metal retaining clips, 32 mm (1¼") square.

.2 Acceptable material:

.1 Duro Dyne

.2 Ductmate

2.4 JOINT TAPE

.1 Poly-Vinyl treated open weave fiberglass membrane 50 mm (2") wide.

.2 Acceptable materials:

.1 Duro Dyne FT2

.2 Ductmate

2.5 SEALER

.1 Meet requirements of ANSI/NFPA 90A and ANSI/NFPA 90B.

.2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range -68°C (-90F) to 93°C (200°F).

.3 Acceptable materials:

.1 Duro Dyne 1A-94

.2 Ductmate

Part 3 Execution

3.1 GENERAL

.1 Do work in accordance with recommendations of MAIMA Fibrous Glass Duct Liner Standards (FGDLS) or SMACNA duct liner standards.

.2 Line inside of ducts where indicated.

.3 Duct dimensions, as indicated, are clear inside duct lining.

.4 Provide an interior of ductwork from fans from minimum distance of 3 m (10'-0").

3.2 DUCT LINER

.1 Install in accordance with manufacturer's recommendations, and as follows:

.1 Fasten to interior sheet metal surface with 100% coverage of adhesive.

.2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 300 mm (12") on centres.

.2 Weld pins are to have cupped or beveled heads to prevent damage to lining surface.

.3 Store foam liners away from sunlight.

3.3 JOINTS

.1 Seal all butt joints, exposed edges, weld pin and clip penetrations and all damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's recommendations, and as follows:

.1 Bed tape in sealer.

.2 Apply 2 coats of sealer over tape.

.2 Replace damaged areas of liner at discretion of Consultant.

.3 Protect leading and trailing edges of each duct section with sheet metal nosing having 15 mm (1/2") overlap and fastened to duct.

END OF SECTION

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Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 AMCA 99, Standards Handbook.

.3 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Certified Aerodynamics Performance Rating.

.4 AMCA 300, Revised 1987, Reverberant Room Method for Sound Testing of Fans.

.5 AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.6 ANSI/ASHRAE 51, Laboratory Methods of Testing Fans for Certified Aerodynamics Performance Rating.

.7 ANSI/NFPA 96 – Ventilation Control and Fire Protection of Commercial Cooking Operations.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with general requirements.

.2 Product data to include fan curves and sound rating data.

1.3 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into manual specified in general requirements.

1.4 CERTIFICATION OF RATINGS

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.

.2 Provide confirmation of testing.

Part 2 Products

2.1 FANS GENERAL

.1 Capacity: flow rate, total static pressure Pa, r/min, W (" w.c., r/min, bhp) model and size and sound ratings as indicated on schedule.

.2 Statically and dynamically balanced. Constructed in conformity with AMCA 99.

.3 Sound ratings: comply with AMCA 301, tested to AMCA 300.

.4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51.

.5 Bearings: sealed lifetime of self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 80,000 100,000 h in accordance with AFBMA L10 life standard. Bearings to be rated and selected in accordance with AFBMA 9 and AFBMA 11.

.6 Provide vibration isolation hangers/pads for all fans.

.7 Electrical components and motors within the airstream shall be classified for use in a Class I, Zone 2 system (as defined by the Electrical Safety Code) when connected to ductwork systems served by refrigerant containing air handling systems.

.8 Acceptable materials:

.1 Greenheck

.2 Penn-Barry

.3 Cook

.4 Jenco (S & P)/Jenn

.9 Provide factory mounted speed control for all direct drive motors.

2.2 CABINET FANS – IN-LINE

.1 Fan characteristics and construction: as centrifugal fans.

.2 Casing floor mounted or cabinet hung single inlet aluminum wheel in factory fabricated casing complete with vibration isolators and seismic control measures, motor, V-belt drive and guard inside or outside casing as indicated.

.3 Fabricate casing of zinc coated or phosphate treated steel reinforced and braced for rigidity. Provide removable panels for access to interior. Uncoated, steel parts shall be painted over with corrosion resistant paint to CAN/CGSB 1.181. Internally line cabinet with 25 mm (1") thick rigid acoustic insulation, pinned and cemented bell mouth inlet cone.

.4 Size, type, and capacity: as indicated.

2.3 EXISTING EXHAUST AIR FANS

.1 Refurbish existing exhaust air fans as follows:

.1 Vacuum entire unit interior.

.2 Lubricate all bearings.

.3 Replace fan belt(s).

.4 Rebalance to capacity indicated.

Part 3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturer’s instructions.

.2 Provide flexible duct connection for all fans.

.3 Provide backdraft damper at building exterior penetration.

.4 Provide and install vibration isolation.

.5 Provide and install roof curb for all roof mounted fans.

.6 Provide and install sleepers for utility set style roof mounted fans; provide roof curb for duct penetration.

3.2 WARRANTY

.1 Warranty Start Date:

.1 Warranty period starts as of the date of Ready for Takeover.

.2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.

.2 Warranty Duration:

.1 One (1) year warranty period applies.

.3 Warranty Coverage:

.1 Applies to parts and labour.

END OF SECTION

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Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 ASTM E90, Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions, and Elements.

1.2 PRODUCT DATA

.1 Submit product data in accordance with general requirements.

.2 Indicate the following:

.1 Pressure drop.

.2 Face area.

.3 Free area.

.4 Colour and finish.

1.3 CERTIFICATION OF RATINGS

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

1.4 TEST REPORTS

.1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

Part 2 Products

2.1 FIXED LOUVRES – ALUMINUM

.1 Construction: welded with exposed joints ground flush and smooth.

.2 Material: extruded aluminum alloy 6063-T5.

.3 Blade: stormproof pattern with centre watershed in blade, reinforcing bosses and maximum blade length of 1500 mm (60").

.4 Frame, head, sill and jamb: 100 mm (4") deep one piece extruded aluminum, minimum 3 mm (1/8") thick with approved caulking slot, integral to unit.

.5 Mullions: at 1500 mm (60") maximum centres.

.6 Fastenings: stainless steel (Society of Automotive Engineers) SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.

.7 Screen: 15 mm (1/2") exhaust 20 mm (3/4") intake mesh, 2 mm (5/64") diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.

.8 Finish:
Powder Coated
Colour: to Consultant's approval.

.9 Acceptable materials:

.1 Greenheck

.2 Construction Specialties

.3 E.H. Price

.4 Krueger

.5 Ruskin

.6 Ventmaster

.7 Ventex

.8 Nailor

Part 3 Execution

3.1 INSTALLATION

.1 In accordance with manufacturers and SMACNA recommendations.

.2 Reinforce and brace air vents, intakes and goosenecks as indicated.

.3 Anchor securely into opening.

.4 Seal with caulking all around to ensure weather tightness.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 All codes, standards, etc. as referenced shall be the latest edition.

.2 ANSI/NFPA-90A, Installation of Air Conditioning and Ventilating Systems.

.3 AMCA 99 – Standard Handbook.

.4 AMCA 210 – Laboratory Methods of Testing Fans for Rating Purposes.

.5 ARI 270, Standard for Sound Rating of Outdoor Unitary Equipment.

.6 ANSI/AHRI 340/360 – Performance Rating of Commercial and Industrial Unitary Air Conditioning and Heat Pump Equipment.

.7 AMCA 500 – Test Methods for Louvers, Dampers, and Shutters.

.8 AHRI 260 – Sound Rating of Ducted Air Moving and Conditioning Equipment.

.9 NFPA 90A – Installation of Air Conditioning and Ventilation Systems.

.10 UL-1995 – Standard for Safety for Heating and Cooling Equipment.

.11 C.1 CSA B52-2023, Mechanical Refrigeration Code

.12 C.2 CAN/CSA-C22.2 No 60335 Safety of Household and similar electrical appliances – Heat Pumps, Air-conditioners and dehumidifiers

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section general requirements.

1.3 MAINTENANCE DATA

.1 Provide maintenance data for incorporation into manual specified in general requirements.

1.4 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with general requirements.

1.5 UNIT ASSEMBLY

.1 Unless stated otherwise, air handling units are to be shipped to the job in one piece, factory assembled. It is the responsibility of the Contractor to ensure units can fit through openings provided prior to shipping. All equipment shall be factory tested prior to shipment.

.2 It is the responsibility of the Contractor and/or Air Handling Unit Manufacturer to determine which units shall be delivered in sections and assembled on site in place. It is the responsibility of the Contractor to install the units in place to the standards of the Manufacturer.

.3 Where units are required to be constructed in place assemble units to manufacturer's requirements. TAB Contractor shall pressure test air units which are constructed in place. Refer to Section 20 06 11.

1.6 MANUFACTURED ITEMS

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards in force.

.2 The air handling units and major components shall be products of manufacturers regularly engaged in the production of such equipment and with a minimum of fifteen continuous years of proven production experience.

.3 Manufacturer shall have a fully implemented and auditable quality assurance program, equal to the ISO-9002 Quality Standard.

1.7 PERFORMANCE RATINGS

.1 Unit certification: Units shall conform to CSA-C746-2006 and ARI 340/360-2007 and shall be listed by NRCan as approved for sale in Canada and be compliant with the SB-10 Supplement of the Ontario Building Code. Testing shall be completed by a third party, certified lab.

Part 2 Products

2.1 GENERAL

.1 Field Factory assembled components to form units supplying air at design conditions as indicated and specified.

.2 Acceptable materials:

.1 Engineered Air
.2 Haakon
.3 Bousquet
.4 Daikin
.5 ICE Western

2.2 UNIT CONSTRUCTION (AHU-1)

.1 Unit casing shall be of minimum 1.2 mm (18 gauge) satin coat galvanized sheet metal. Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two part acid based etching primer. Finish coat shall be an electrostatically applied enamel, to all exposed surfaces. All unprotected metal and welds shall be factory coated.

.2 All high pressure 1250 Pa (5" w.c.) to 2250 Pa (9" w.c.) fan sections shall be constructed of 2 mm (14 gauge) metal. Continuous high pressure sealant shall be provided between all panels.

.3 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 and roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water resistant sealant.

.4 The following components shall be provided with a 0.85 mm (22 gauge) solid, or 0.70 mm (24 gauge) 40% free area perforated galvanized metal liner over insulated areas:

	Solid Liner	Perf. Liner
Fan Sections	____	_X_
Coil Sections	_X_	___
Filter Sections	_X_	___
Mixing Sections	_X_	___

.5 Units shall be provided with gasketed access doors to the following components: fans and motors; filters; dampers and operators; access plenums and humidifiers/wet cells. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable.

.6 Provide hinged access doors, fully lined, with zinc plated piano hinges and brass pins, Leverlock handles, operable from both sides for all units.

Whenever possible, hinged access doors to areas of negative pressure shall open out, and to areas of positive pressure shall open in. Where space constrictions require the use of outward opening doors to an area of positive pressure, a clear warning label must be affixed.
Hinged access doors shall be provided with tie back clips.

.7 Casings shall be supported on formed 200 mm (8") high (minimum) galvanized steel channel or structural channel supports, designed and welded for low deflections. Integral lifting lugs shall be provided for hoisting.

.8 All units shall be internally insulated with 50 mm (2") thick 24 kg/cu.m. (1 1/2 lb./cu.ft.) density, injected foam. Drain pans and all floor areas shall be insulated on the underside.

.9 Unit casing floors in walk in sections shall be fabricated with 2.0 mm (14 gauge) galvanized checker plate steel. Provide reinforcing channels under floor to minimize deflection.

.10 Cooling unit drain pans shall be an integral part of the floor panelling, a minimum of 50 mm (2") deep, with welded corners. Drain pans shall extend a minimum of 300 mm (6") downstream of coil face and be provided with a 25 mm (1") M.P.T. drain connection. Drain pans must be sloped and pitched such that there is no standing water. Intermediate drain pans shall be provided between cooling coils above 1650 mm (65"). Extend drain under complete fan section where fan is downstream of humidifier. Drain pans shall be stainless steel.

2.3 UNIT CONSTRUCTION (AHU-2)

.1 Unit casing shall be of minimum 0.911 mm (20 gauge) satin coat galvanized sheet metal. Surfaces shall be cleaned with a degreasing solvent to remove oil and metal oxides and primed with a two part acid based etching primer. Finish coat shall be an electrostatically applied enamel, to all exposed surfaces. All unprotected metal and welds shall be factory coated.

.2 All high pressure 1250 Pa (5" w.c.) to 2250 Pa (9" w.c.) fan sections shall be constructed of 2 mm (14 gauge) metal. Continuous high pressure sealant shall be provided between all panels.

.3 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 and roof joints broken out (exposed) for rigidity. All joints shall be caulked with a water resistant sealant.

.4 The following components shall be provided with a 0.85 mm (22 gauge) solid, or 0.70 mm (24 gauge) 40% free area perforated galvanized metal liner over insulated areas:

	Solid Liner	Perf. Liner
Fan Sections	_____	_X_
Coil Sections	__X__	___
Filter Sections	__X__	___
Mixing Sections	__X__	___

.5 Units shall be provided with gasketed access doors to the following components: fans and motors; filters; dampers and operators; access plenums and humidifiers/wet cells. Access doors shall be large enough for easy access. Removal of screwed wall panels will not be acceptable.

.6 Provide hinged access doors, fully lined, with zinc plated piano hinges and brass pins, Leverlock handles, operable from both sides for all units.

Whenever possible, hinged access doors to areas of negative pressure shall open out, and to areas of positive pressure shall open in. Where space constrictions require the use of outward opening doors to an area of positive pressure, a clear warning label must be affixed.
Hinged access doors shall be provided with tie back clips.

.7 Casings shall be supported on formed 200 mm (8") high (minimum) galvanized steel channel or structural channel supports, designed and welded for low deflections. Integral lifting lugs shall be provided for hoisting.

.8 All units shall be internally insulated with 50 mm (2") thick 24 kg/cu.m. (1 1/2 lb./cu.ft.) density, injected foam. Drain pans and all floor areas shall be insulated on the underside.

.9 Unit casing floors in walk in sections shall be fabricated with 2.0 mm (14 gauge) galvanized checker plate steel. Provide reinforcing channels under floor to minimize deflection.

.10 Cooling unit drain pans shall be an integral part of the floor panelling, a minimum of 50 mm (2") deep, with welded corners. Drain pans shall extend a minimum of 300 mm (6") downstream of coil face and be provided with a 25 mm (1") M.P.T. drain connection. Drain pans must be sloped and pitched such that there is no standing water. Intermediate drain pans shall be provided between cooling coils above 1650 mm (65"). Extend drain under complete fan section where fan is downstream of humidifier. Drain pans shall be stainless steel.

2.4 STARTERS AND CONTACTORS

.1 Provide unit mounted starters for all fans. Locate starters in unit control panel. All fans and starters shall be internally wired for single point connection.

.2 Starters shall conform to CSAC22.2 No. 14 (latest edition) and EEMAC E14-1.

.3 Control transformers shall conform to CSAC22.2 No. 66 (latest edition). Control transformer shall be suitable for controlling function. Coordinate with Building Automation Contractor.

.4 Wire fan motors to external unit mounted junction box complete with terminal strip.

.5 Run all wiring in conduit to standards of Division 16.

2.5 KAIC RATING

.1 Kilo Ampere Interrupting Capacity (kAIC) Rating

.1 Equipment shall be rated a interrupting capacity rating of 25 kAIC.

.2 All products supplied to the site shall meet or exceed this kAIC rating.

.3 The kAIC rating may be lowered to match or exceed the available fault current indicated on the Short Circuit Co-ordination Study completed by the electrical trade.

2.6 FANS

.1 Centrifugal fans shall be rated in accordance with AMCA Standard Test Code, Bulletin 210. Fan manufacturer shall be a member of AMCA. All fans and fan assemblies shall be dynamically balanced during factory test run. Fan shafts shall be selected for stable operation at least 20% below the first critical RPM. Fan shafts shall be provided with a rust inhibiting coating.

.2 Single low pressure forward curved fans of 450 mm (18") or less diameter, shall be equipped with permanently lubricated cartridge ball bearings, supported by a 3 point "spider" bearing bracket in the fan inlets. All other forward curved fan assemblies shall be equipped with greaseable pillow block bearings, supported on a rigid structural steel frame.

.3 Airfoil and BI fans shall be equipped with greaseable, self aligning ball or roller type pillow block bearings.

.4 Airfoil and BI fans shall be plenum type configuration where noted in schedules. Plenum fan assemblies shall be encapsulated by an open wire mesh protective screen. Removable screens at access doors are not acceptable. Thrust restraint isolators shall be provided at shaft centreline when required to minimize axial movement and bending movements of the blower assembly(s). Drive side bearings on Plenum fans shall be adapter style to ensure even clamping of the bearing sleeve to the shaft.

.5 Drives shall be adjustable on fans with motors 3.73 kW (5 hp) or smaller. On fans with larger motors, fixed drives shall be provided. All drives shall be provided with a rust inhibiting coating. The air balancer shall provide for drive changes (if required) during the air balance procedure.

.6 For spark resistant applications, fans shall be provided with aluminum wheels and aluminum inlet cones.

.7 Motor, fan bearings and drive assembly shall be located inside the fan plenum to minimize bearing wear and to allow for internal vibration isolation of the fan-motor assembly, where required. Motor mounting shall be adjustable to allow for variations in belt tension.

.8 Provide OSHA approved belt guards on all units with walk in sections over 1500 mm (60") high.

.9 Fan-motor assemblies shall be provided with vibration isolators. Isolators shall be bolted to steel channel welded to unit floor, which is welded to the structural frame of the unit. The isolators shall be neoprene-in-shear type for single 225mm (9") to 375mm (15") forward curve fans. All other fans shall incorporate vertical spring type isolators with levelling bolts, bridge bearing waffled pads with minimum 25 mm (1") static deflection designed to achieve high isolation efficiency. Fans shall be attached to the discharge panel by a polyvinyl chloride coated polyester woven fabric, with a sealed double locking fabric to metal connection.

.10 Single phase belt drive motor applications shall include rubber isolation for motors .19kW (1/4 hp) through 1.1kW (1 1/2 hp). Provide internal spring isolation for motors over 1.1 kW (1 1/2hp)

.11 Provide extended grease lines terminating outside the serviceable side of the unit.

.12 Fan motors shall be ODP high efficiency induction motor.

2.7 COILS

.1 Coils shall be direct coil, Ultrafin and/or Superfin, constructed of copper tube, aluminum fin, copper headers with schedule 40 steel pipe connectors, male N.P.T. Fins constructed of aluminum shall be rippled for maximum heat transfer and shall be mechanically bonded to the tubes by mechanical expansion of the tubes. The coils shall have a galvanized steel casing. All coils shall be factory tested with air at 2070 kPa (300 psig) while immersed in an illuminated water tank.

.2 Headers shall be outside the air handling unit for maximum serviceability. The non-headered end of the coil shall be fully concealed. Provide auxiliary drain pan complete with 15 mm (1/2") MPT drain connection at headered end of cooling coils.

.3 Provide an insulated header cover to conceal exposed headers.

.4 Coils shall be removable from the unit at the header end, unless shown otherwise on the drawings. All water coils shall be equipped with a capped vent tapping at the top of the return header, and a capped drain tapping at the bottom of the supply header.

.5 Coils shall be cleanable type provided with brass fittings and removable plugs for each tube at the return end.. Cast iron headers must have brass plugs to prevent oxidization.

.6 Water and glycol coils shall be circuited to provide adequate tube velocities to meet design requirements. Internal turbulators are not acceptable.

.7 Water coils shall be A.R.I. Certified.

.8 Refrigerant evaporator type coils shall be equipped with distributors connected to the coil by copper tubes. Where a hot gas bypass is required, the inlet shall be at the refrigerant distributor. Solenoid valves, expansion valves, and related accessories are to be provided and installed by the refrigeration contractor.

.9 Refrigerant coils with multiple compressors shall be alternate tube circuited in order to distribute the cooling effect over the entire coil face at reduced load conditions. Provision for use of thermal expansion valves must be included for variable air volume and/or make-up air applications.

2.8 FILTERS

.1 Filter sections shall be provided with adequately sized access doors to allow easy removal of filters. Filter removal shall be from one side as noted on the drawings.

.2 For units with filter banks 1829 mm (72") high or less, the filter modules shall be designed to slide out of the unit. Side removal filters shall slide into a formed metal track, sealing against metal spacers at each end of the track.

Bag or cartridge type filters shall slide into an extruded aluminum track against a gasketted sealer strip. Associated 50 mm (2") prefilters shall slide into an integral track in the aluminum extrusion.

.3 50 mm (2") Pleated Panel Disposable Filters: Non-woven re-inforced cotton/poly fabric media with a metal support grid and heavy duty beverage board enclosing frame. The filter media shall have an average efficiency of 30-35%+ on ASHRAE Standard 52.1.

.4 Rigid Self-Supporting Extended Surface Disposable Filters: Filters shall consist of high density synthetic media, media support grid, metal contour stabilizers, metal diagonal support bracing and enclosing frame. Media shall be 3 ply, dual stage synthetic. Pre-filter layer of coarse 7-10 micron synthetic fibers; secondary ply of progressively structured spun bonded polypropylene fibers blended with filaments from 1 to 6.7 microns; and final ply of spun bonded polypropylene backing with strength to support filtering stages. The media shall withstand 100% humidity and be non-shedding. Media shall have an average atmospheric efficiency of 85-90% with an average arrestance of 96 to 100% when tested to ASHRAE 52.1 - 1992. Media shall be quality certified by ISO-9002.

.5 Media support shall be expanded, electro-galvanized grid with an effective open area of not less than 97%. The expanded metal grid shall be bonded to the filter media, eliminating the possibility of media oscillation and pullaway. Contour stabilizers of galvanized steel shall be installed on both air entering and exiting sides of the media pack. The filter shall be capable of withstanding 2.49 kPa (10" w.c.) pressure drop without noticeable distortion of the media pack. The enclosing frame shall be 0.55 mm (26 gauge) steel with the media pack mechanically and chemically bonded to the inside periphery.

.6 Filter media shall meet U.L. Class 2 standards.

.7 Provide filter bank with "Dwyer 2000 magnehelic" air filter gauge, complete with static pressure tips and aluminum tubing, all factory installed. Filter gauge to have a range of 0- 500 Pa (0-2" w.c.). Where two or more filter banks are connected to a single gauge, multiple gauge kit with manual shut-off cocks in the air tubing shall be provided.

.8 Where the filter gauges are provided on outdoor units they shall be mounted inside of a weatherproof enclosure with viewing window.

2.9 DAMPERS

.1 Damper frames shall be u-shaped galvanized metal sections securely screwed or welded to the air handling unit chassis. Pivot rods of 15 mm (1/2") aluminum, shall turn in bronze bushings, fabricated from self- oiling bronze. Rods shall be secured to the blade by means of straps and set screws.

.2 Blades shall be 1.3 mm (18 gauge) galvanized metal with two breaks on each edge and three breaks on centreline for rigidity. The pivot rod shall "nest" in the centreline break. Damper edges shall interlock. Maximum length of damper between supports shall be 1070 mm (42"). Damper linkage brackets shall be constructed of galvanized metal.

.3 Dampers shall be:

Low leak dampers shall include blade ends sealed with an adhesive backed foamed polyurethane gasketting. Interlocking blade edges shall include an all weather PVC seal, fastened with a positive lock grip and pliable overlap edges on both the entering and leaving air sides. Pivot rods extend the full length of damper blades and are interlocked on the side through crank arms.
Certified low leak dampers shall be tested and certified under AMCA Standard 500-89 by an accredited test laboratory. These dampers include: rigidly formed galvanized steel frame with corner reinforcing brackets; heavy duty galvanized damper blades secured with bolts to continuous 15 mm (1/2") aluminum drive rods; all weather PVC double seal blade gasket; tempered aluminum alloy blade end seal, epoxy enamel coated; oil impregnated bronze bushings; and non-corrosive smooth acting linkage.

.4 Certified low leak, dampers shall also be provided for return air dampers, exhaust (relief) air dampers.

.5 Mixing dampers shall be parallel blade type.

.6 Two position inlet dampers shall be parallel blade type.

.7 Face and bypass dampers shall be opposed blade type.

.8 Multizone dampers shall be parallel blade type with the hot deck dampers set at right angles to the cold deck dampers.

.9 Motorized relief dampers shall be opposed blade type.

.10 Provide satin coated steel mixers downstream of mixing box to provide thorough air mixing to prevent stratification.

.11 Damper operators will be supplied by the temperature controls contractor and factory installed by the unit manufacturer.

2.10 COMPONENTS

.1 Incorporate the following components to provide a complete system.

.1 Return air blower (remote)
.2 Mixing section
.3 Filter section
.4 Heating coil section
.5 Cooling coil section
.6 Supply air blower

2.11 ACCESSORIES

.1 Dead front disconnect.

.2 Internal wiring to terminal strip in Nema 1 enclosure with “soft start”. Provide space for DDC controller. All units shall be internally wired for a single point connection.

.3 Belt guards.

.4 Second (2nd) coat of finish paint (standard colour).

.5 Full perimeter roof curb.

.6 Steel filter frames with disposable filter media.

2.12 CAPACITY

.1 Provide unit capacity indicated.

2.13 REMOTE CONDENSING UNITS

.1 General:
Factory-assembled, single piece, air-cooled condensing unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, compressor, holding charge and special features required prior to field start-up. Unit shall be rated in accordance with ARI Standard and be CSA approved.
Condensing units shall be designed for a minimum of 8°C (15°F) liquid subcooling. Multiple compressor/condenser circuits shall be separate from each other. Suction and liquid lines shall be extended to the outside of the cabinet. Service ports fitted with Schraeder fittings shall be connected to the suction and discharge lines for charging or pressure gauge readings. Controls for compressor units shall include compressor and condenser fan motor contactors, control circuit transformer, cooling relays, non-recycling pumpdown relays, ambient compressor lockout, manual reset high pressure controls and automatic reset low pressure controls. Head pressure actuated fan cycling control shall be provided on all multiple condenser fan units.
Provide five minute anti-cycle timers.
Provide interstage time delay timers.
Provide hot gas bypass connection on the lead compressor.
Provide low ambient controls.
Provide separate compressor compartment complete with 25 mm (1") 24 kg/m3 (1.5 lb/ft3) insulation and hinged access doors.
Refrigeration specialties such as solenoid valves, TX valves, etc., to be supplied and installed by refrigeration contractor.

.2 Unit Cabinet:

.1 Unit cabinet shall be constructed of galvanized steel, bonderized and coated with a prepainted baked enamel finish.

.2 A heavy gage roll-formed perimeter base rail with forklift slots and lifting holes shall be provided to facilitate rigging.

.3 Fans:

.1 Condenser fans shall be direct driven, propeller-type, discharging air vertically upward.

.2 Fan blades shall be balanced.

.3 Condenser fan discharge openings shall be equipped with PVC coated steel wire safety guards.

.4 Condenser fan and motor shaft shall be corrosion resistant.

.5 Condenser fans shall be direct driven propeller type arranged for vertical draw through air flow. Motors shall be weather resistant type, with integral overload protection and designed for vertical shaft condenser fan applications. Fan and motor assemblies shall be mounted on a formed orifice plate for optimum efficiency with minimum noise level.

.4 Compressor:

.1 Compressor shall be of the scroll type.

.2 Compressor shall be mounted on vibration isolators.

.3 Compressors shall include overload protection.

.5 Condenser Coil:

.1 Condenser coil shall be air-cooled and circuited for integral subcooler.

.2 Coil shall be constructed of aluminum fins mechanically bonded to internally grooved seamless copper tubes which are then cleaned, dehydrated, and sealed.

.6 Controls and Safeties:

.1 Minimum control functions shall include:

.1 Control wire terminal blocks.

.2 Five-minute recycle protection to prevent compressor short-cycling.

.3 Compressor lockout on auto-reset safety until reset from thermostat.

.2 Minimum Safety devices which are equipped with automatic reset (after resetting first at thermostat), shall include:

.1 High discharge pressure cutout.

.2 Loss-of-charge cutout.

.7 Kilo Ampere Interrupting Capacity (kAIC) Rating

.1 Equipment shall be rated a interrupting capacity rating of 25 kAIC.

.2 All products supplied to the site shall meet or exceed this kAIC rating.

.3 The kAIC rating may be lowered to match or exceed the available fault current indicated on the Short Circuit Co-ordination Study completed by the electrical trade.

.8 Acceptable manufacturer:

.1 To match AHU supplier.

2.14 REFRIGERATION LEAK DETECTION SYSTEM

.1 The Refrigerant detection system shall meet the requirements of CSA B52 and have the following functionality:

.1 Utilize a set point, nonadjustable in the field, to generate a digital output signal to initiative mitigation actions to both internal safeties and external components in the ductwork (dampers, electric coils etc.). Signal shall be generated in not more than 30 seconds from sensor exposure to refrigerant concentration of 25% LFL (+0$, -1%)

.2 Sensor within the equipment, near potential source of leaks.

.3 Field calibration of the system is not allowed.

.4 Be capable of detecting the refrigerant used in the system.

.5 Have self diagnostics

.6 Energize fans upon failure of a self-diagnostic check

.7 Activate refrigerant safety shut off valves in the event of a leak being detected.

Part 3 Execution

3.1 INSTALLATION

.1 Fabricate to provide smooth air flow through all components. Limit air leakage to 1% of rated air flow at 2.5 kPa (10" w.c.) suction pressure.

.2 Apply sealer into all seams prior to assembly. Secure toe angles continuous along entire length of assembly.

.3 Install to manufacturers requirements.

3.2 FANS

.1 Provide sheaves and belts required for final air balance.

.2 Suspension for hung units: install four part hanger type, ceiling flange, top hanger, bottom hanger and vibration isolator with takeup for leveling.

.3 Install flexible connections at fan outlets. Ensure metal bands of connectors are parallel and not touching when fan is running and when fan is stopped. Ensure that fan outlet and duct are aligned when fan is running.

3.3 DRAIN PAN

.1 Install deep seal P trap on drain lines. Depth of water seal to be 2.5 times static pressure at this point.

3.4 START-UP/COMMISSIONING

.1 Unit manufacturer shall perform start-up and commissioning.

3.5 SPARE PARTS

.1 Two (2) complete sets of filters.

.2 One (1) set of spare belts.

3.6 REFRIGERANT LEAK DETECTION SYSTEM

.1 This contractor shall provide all wiring between leak detection systems installed within the provided equipment and system components in the spaces served and ductwork system.

.2 Specifically, the following shall occur for each independent system on registration of a refrigerant leak:

.1 Open all zone dampers in the affected system.

.2 Disable all electric reheat coils within the affected system.

.3 Activate field installed safety shut off valves within the affected refrigeration system.

.4 Energize all fans within the affected ductwork system.

.5 Activate and refrigerant leak system specific ventilation systems.

.6 De-energize any other potential sources of ignition within the affected system.

.3 All interlocks between field installed detection systems and associated safety system components shall be tested and verified to operate as per the requirements of CSA B52.

3.7 TRAINING

.1 Provide 2 hours training to owner's staff on the care, maintenance and operation of the equipment. Dedicated visit to site is required as it will not be paired with equipment startup.

3.8 WARRANTY

.1 Warranty Start Date:

.1 Warranty period starts as of the date of Ready for Takeover.

.2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.

.2 Warranty Duration:

.1 One (1) year warranty period applies.

.2 One (1) year on parts and labour on all components.

.3 Ten (10) years on heat exchanger

.3 Warranty Coverage:

.1 Applies to parts and labour.

END OF SECTION

Part 1 General

1.1 GENERAL

.1 This section is to read in conjunction with Division 1, the general condition, and the General Requirements of the mechanical trades.

1.2 REFERENCES

.1 Tested to ANSI/UL Standard 508.

.2 UL-508 certified for the building and assembly.

.3 CSA or C-UL stickers shall be applied to both the VFD and option panels.

.4 Manufacturers shall be ISO 9001 certified facilities.

1.3 SUBMITTALS

.1 Submit manufacturer’s performance data including dimensional drawings, power circuit diagrams, installation and maintenance manuals, warranty description, VFD's FLA rating, certification agency file numbers and catalogue information.

.2 The specification lists the minimum VFD performance requirements for this project. Each supplier shall list any exceptions to the specification. If no departures from the specification are identified, the supplier shall be bound by the specification.

.3 Harmonic filtering. The manufacturer shall, with the aid of the buyer’s electrical power single line diagram, providing the data required by IEEE-519, perform an analysis to initially demonstrate the supplied equipment will met the IEEE standards after installation. If, as a result of the analysis, it is determined that additional filter equipment is required to meet the IEEE recommendations, then the cost of such equipment shall be included in the bid. A harmonic analysis shall be submitted with the approval drawings to verify compliance with the latest version of IEEE-519 voltage and current distortion limits as shown in table 10.2 and 10.3 at the point of common coupling (PCC). The PCC shall be defined as the consumer–utility interface or primary side of the main distribution transformer.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Danfoss Graham.

.2 ABB.

2.2 GENERAL

.1 The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC motors. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump and fan control and to eliminate the need for motor derating.

.2 With the motor's rated voltage applied to the VFD input, the VFD shall allow the motor to produce full rated power at rated amps, RMS fundamental volts, and speed without using the motor's service factor. VFD's utilizing sine weighted/coded modulation (with or without 3rd harmonic injection) must provide data verifying that the motors will not draw more than full load current during full load and full speed operation.

.3 Include an input full-wave bridge rectifier and maintain a fundamental power factor near unity regardless of speed or load.

.4 Provide DC link reactors on both the positive and negative rails of the DC bus to minimize power line harmonics. VFD's without DC link reactors shall provide a minimum 5% impedance line reactor.

.5 Full load amp rating shall meet or exceed NEC Table 430-150. The VFD shall be able to provide full rated output current continuously, 110% of rated current for 60 seconds and 160% of rated current for up to 0.5 second while starting.

.6 Provide full torque at any selected frequency from 28 Hz to base speed to allow driving direct drive fans without derating.

.7 An automatic energy optimization selection feature shall be provided in the VFD. This feature shall automatically and continually monitor the motor's speed and load and adjust the applied voltage to maximize energy savings and provide up to an additional 3% to 10% energy savings.

.8 Input and output power circuit switching shall be able to be accomplished without interlocks or damage to the VFD. Switching rate may be up to 1 time per minute on the input and unlimited on the output.

.9 An automatic motor adaptation test algorithm shall measure motor stator resistance and reactance to optimize performance and efficiency. It shall not be necessary to run the motor or de-couple the motor from the load to run the test.

.10 Galvanic and/or optical isolation shall be provided between the VFD's power circuitry and control circuitry to ensure operator safety and to protect connected electronic control equipment from damage caused by voltage spikes, current surges, and ground loop currents. VFD's not including either galvanic or optical isolation on both analog I/O and discrete I/O shall include additional isolation modules.

.11 VFD shall minimize the audible motor noise through the use of an adjustable carrier frequency. The carrier frequency shall be automatically adjusted to optimize motor and VFD efficiencies while reducing motor noise.

.12 VFD's operating 600/3/60 motors not designed to meet Nema MG1 Part 31 should include Output dv/dt (LC) Reactors.

2.3 PROTECTIVE FEATURES

.1 VFD shall be provided with an integral disconnect and Integral Fast Blow Semi-Conductor fuses sized as specified by ULC. Fuses shall be Bussman JJS type or equivalent.

.2 A minimum of Class 20 I2t electronic motor overload protection for single motor applications and thermal-mechanical overloads for multiple motor applications shall be provided.

.3 Protection against input transients, loss of AC line phase, output short circuit, output ground fault, over-voltage, under-voltage, VFD over-temperature and motor over-temperature. The VFD shall display all faults in plain English. Codes are not acceptable.

.4 Protect VFD from sustained power or phase loss. The VFD shall provide full rated output with an input voltage as low as 90% of the nominal.

.5 The VFD shall incorporate a motor preheat circuit to keep the motor warm and prevent condensation build up in the stator.

.6 To prevent breakdown of the motor winding insulation, the VFD shall be designed to comply with IEC Part 34-17. Motors shall have inverter rated insulation (1600V).

.7 VFD shall include a “signal loss detection” circuit to sense the loss of an analog input signal such as 4 to 20 mA or 2 to 10 V DC, and shall be programmable to react as desired in such an instance.

.8 VFD shall function normally when the keypad is removed while the VFD is running and continue to follow remote commands. No warnings or alarms shall be issued as a result of removing the keypad.

.9 VFD shall catch a rotating motor operating forward or reverse up to full speed.

.10 VFD shall be rated for 100,000 amp interrupting capacity (AIC).

.11 VFD shall have externally mounted EMI electromagnetic suppressor to limit the EMI and RFI output from the VFD. VFD to be mounted in an all metal cabinet to limit radiated RFI.

.12 VFD shall include current sensors on all three output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.

.13 VFD shall continue to operate without faulting until input voltage reaches 300 V AC on 208/230 volt VFD’s, and 701V AC on 575 volt VFD’s.

.14 For remote VFD installations, provide an output filter (load side reactor) at each VFD to protect the equipment motor. Coordinate installation with equipment manufacturer.

2.4 INTERFACE FEATURES

.1 Hand/Start, Off/Stop and Auto/Start selector switches shall be provided to start and stop the VFD and determine the speed reference.

.2 The VFD shall be able to be programmed to provide a 24 V DC output signal to indicate that the VFD is in Auto/Remote mode.

.3 The VFD shall provide digital manual speed control. Potentiometers are not acceptable.

.4 Lockable, alphanumeric backlit display keypad can be remotely mounted up to 10 feet away using standard 9-pin cable.

.5 The keypads for all sizes of VFD’s shall be identical and interchangeable.

.6 To set up multiple VFD’s, it shall be possible to upload all set-up parameters to the VFD’s keypad, place that keypad on all other VFD’s in turn and download the set-up parameters to each VFD. To facilitate setting up VFD’s of various sizes, it shall be possible to download from the keypad only size independent parameters.

.7 Display shall be programmable to display in 9 languages including English, Spanish and French.

.8 The display shall have four lines, with 20 characters on three lines and eight large characters on one line.

.9 A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.

.10 A quick set-up menu with factory preset typical HVAC parameters shall be provided on the VFD eliminating the need for macros.

.11 The VFD shall include a standard RS-485 communications port for connection to a Johnson Controls N2 and Siemens FLN serial communication system. The connection shall be software selectable and addressable by the user. The option for Lonworks and BacNet communication must also be available.

.12 As a minimum, the following points shall be controlled and/or accessible:

VFD Start/Stop, Speed reference, Fault diagnostics, and Meter points as follows;

Motor power in HP, Motor power in kW, Motor kW-hr, Motor current, Motor voltage, Hours run, Feedback signal #1, Feedback signal #2, DC link voltage, Thermal load on motor, and Thermal load on VFD, Heat sink temperature.

.13 Four additional Form C 230 volt programmable relays shall be available for factory or field installation within the VFD.

.14 Two set-point control interface (PID control) shall be standard in the unit. VFD shall be able to look at two feedback signals, compare with two set-points and make various process control decisions.

.15 Floating point control interface shall be provided to increase/decrease speed in response to contact closures.

.16 Four simultaneous displays shall be available. They shall include frequency or speed, run time, output amps and output power. VFD’s unable to show these four displays simultaneously shall provide panel meters.

.17 Sleep mode shall be provided to automatically stop the VFD when its speed drops below set “sleep” level for a specified time. The VFD shall automatically restart when the speed command exceeds the set “wake” level.

.18 The sleep mode shall be functional in both follower mode and PID mode.

.19 Run permissive circuit shall be provided to accept a “system ready” signal to ensure that the VFD does not start until dampers or other auxiliary equipment are in the proper state for VFD operation. The run permissive circuit shall also be capable of sending an output signal as a start command to actuate external equipment before allowing the VFD to start.

.20 The following displays shall be accessible from the control panel in actual units: Reference Signal Value in actual units, Output Frequency in Hz or percent, Output Amps, Motor HP, Motor kW, kWhr, Output Voltage, DC Bus Voltage, VFD Temperature in degrees, and Motor Speed in engineering units per application (in GPM, CFM, etc.). VFD will read out the selected engineering unit either in a linear, square or cubed relationship to output frequency as appropriate to the unit chosen.

.21 The display shall be programmed to read in inches of water column (in-wg) for an air handler application, pressure per square inch (psi) for a pump application, and temperature (oF) for a cooling tower application.

.22 VFD shall be able to be programmed to sense the loss of load and signal a no load/broken belt warning or fault.

.23 If the temperature of the VFD's heat sink rises to 80°C, the VFD shall automatically reduce its carrier frequency to reduce the heat sink temperature. If the temperature of the heat sink continues to rise the VFD shall automatically reduce its output frequency to the motor. As the VFD's heat sink temperature returns to normal, the VFD shall automatically increase the output frequency to the motor and return the carrier frequency to its normal switching speed.

.24 The VFD shall have temperature controlled cooling fans for quiet operation and minimized losses.

.25 The VFD shall store in memory the last 10 faults and related operational data.

.26 Eight programmable digital inputs shall be provided for interfacing with the systems control and safety interlock circuitry.

.27 Two programmable relay outputs, one Form C 240 V AC, one Form A 30 V AC, shall be provided for remote indication of VFD status.

.28 Three programmable analog inputs shall be provided and shall accept a direct-or-reverse acting signal. Analog reference inputs accepted shall include two voltage (0 to 10 V DC, 2 to 10 V DC) and one current (0 to 20 mA, 4 to 20 mA) input.

.29 Two programmable 0 to 20 mA analog outputs shall be provided for indication of VFD status. These outputs shall be programmable for output speed, frequency, current and power. They shall also be programmable to provide a selected 24 V DC status indication.

.30 Under fire mode conditions, the VFD shall be able to be programmed to automatically default to a preset speed.

.31 A contact/relay shall be provided to shut the fans down upon fire alarm signal.

2.5 ADJUSTMENTS

.1 VFD shall have an adjustable carrier frequency in steps of not less than 0.1 kHz to allow tuning the VFD to the motor.

.2 Sixteen preset speeds shall be provided.

.3 Four acceleration and four deceleration ramps shall be provided. Accel and decel time shall be adjustable over the range from 0 to 3,600 seconds to base speed. The shape of these curves shall be automatically contoured to ensure no-trip acceleration and deceleration.

.4 Four current limit settings shall be provided.

.5 If the VFD trips on one of the following conditions, the VFD shall be programmable for automatic or manual reset: under-voltage, over-voltage, current limit and inverter overload.

.6 The number of restart attempts shall be selectable from 0 through 20 or infinitely and the time between attempts shall be adjustable from 0 through 600 seconds.

.7 An automatic “on delay” may be selected from 0 to 120 seconds.

2.6 SERVICE CONDITIONS

.1 Unit shall operate in ambient temperature of -10 to 40°C (14 to 104°F).

.2 Unit shall operate in 0 to 95% relative humidity, non-condensing.

.3 Operate in elevation up to 3,300 feet without derating.

.4 Maximum AC line voltage variation, -10 to +10% of nominal with full output.

.5 No side clearance shall be required for cooling of any units. All power and control wiring shall be done from the bottom.

2.7 FACTORY TESTING

.1 To ensure quality and minimize infantile failures at the jobsite, the manufacturer shall test the complete VFD. The VFD shall operate a dynamometer at full load and speed and shall be cycled during the test.

.2 All optional features shall be functionally tested at the factory for proper operation.

2.8 BYPASS SWITCH

.1 Bypass Controller - Automatic transfer to line power via contactors. When in the “Drive” mode, the bypass contactor is open and the drive output contactor is closed. In the “Bypass” position, the drive output contactor is open, and the bypass contactor is closed via Start/stop command. Start/stop via customer supplied maintained contact shall be Dry type 115V compatible and shall function in both the “Drive” and “Bypass” modes. The design shall include single-phase protection in both the VFD and bypass modes.

Part 3 Execution

3.1 START-UP SERVICE

.1 The manufacturer shall provide start-up and commissioning of the VFD and its optional circuits by a factory certified service technician who is experienced in start-up and repair services. Sales personnel and other agents who are not factory certified shall not be acceptable as commissioning agents. Start-up services shall include checking for verification of proper operation and installation for the VFD, its options and its interface wiring to the building automation system.

3.2 EXAMINATION

.1 Contractor to verify that job site conditions for installation meet factory recommended and code-required conditions for VFD installation prior to start-up, including clearance spacing, temperature, contamination, dust, and moisture of the environment. Separate conduit installation of the motor wiring, power wiring, and control wiring, and installation per the manufacturer's recommendations shall be verified.

3.3 INSTALLATION

.1 Install to manufacturer’s recommendations.

.2 Install to the requirements of the local Hydro codes. Obtain hydro permits and pay all fees.

.3 Install in an accessible location and proper service height from floor.

.4 Install in clean, dry, and conditioned environment.

.5 The VFD is to be covered and protected from installation dust and contamination until the environment is cleaned and ready for operation. The VFD shall not be operated while the unit is covered.

.6 Wiring of devices to be to the standards of Electrical Division.

.7 Provide one manufacturer of VFD’s throughout the project.

3.4 WARRANTY

.1 Warranty Start Date:

.1 Warranty period starts as of the date of Ready for Takeover.

.2 Warranty start dates based on shipment date, start up date, substantial completion date, etc. are not applicable.

.2 Warranty Duration:

.1 The VFD shall be warranted by the manufacturer for a period of five (5) years from date of Ready for Takeover. The warranty shall include parts, labour, travel costs and living expenses incurred by the manufacturer to provide factory authorized on-site service. The warranty shall be provided by the VFD manufacturer.

END OF SECTION

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Part 1 GENERAL

1.1 GENERAL NOTES

.1 This Section is to be read in conjunction with Division 1, the General Conditions and Section 20 05 11, the General Requirements of the Mechanical Trades, and the documents required by the BIDDING REQUIREMENTS and CONDITIONS OF THE CONTRACT sections.

1.2 BAS CONTROL

.1 General

.1 This project is an upgrade of an existing DDC control system. The work shall include an upgrade to the existing and provision of a new BAS system including design, supply, installation, and commissioning a complete microprocessor based automatic control system to achieve the performance specified in the following clauses.

.2 The control system shall be installed by the control subcontractor but as an integral part of the mechanical sub-contract. The system shall be installed by trade certified electricians regularly employed by the control sub-contractor.

.3 The controls contractor will specifically read all mechanical and electrical drawings, specifications, and addenda and determine the controls work provided by the mechanical contractor, his subcontractors, and the electrical contractor. The controls contractor is expected to have the expertise to coordinate the work of other contractors and to make a completely coordinated Building Automation Control System (BAS) for the mechanical systems. The controls specifications are specifically written to coordinate the mechanical and electrical systems. Where others are specifically specified to allow for controls work, then the BAS contractor will not allow for that work. This clause is not intended to make the controls contractor responsible for work not specified, but to make the BAS contractor responsible for examining the specifications for contradictions and overlap.

.4 All work indicated in the plumbing drawings and associated with the fire protection or plumbing systems will be the responsibility of the mechanical contractor unless specifically indicated in the controls sequence of operation or points list.

.5 The BAS contractor shall provide the necessary engineering, installation, supervision, commissioning and programming for a complete and fully operational system. The contractor will provide as many trips to the job site for installation, supervision, and commissioning as are necessary to complete the project to the satisfaction of the consultant and/or SCDSB project supervisor.

.6 The system shall consist of all operator interfaces, microprocessor-based controllers, sensors, wells, automatic control valves, control dampers, transducers, and relays, automatic control valves, and damper actuators.

.2 Scope

.1 This project scope shall include, but not be limited to, the following work:

.1 Preparation of control shop drawings for review and approval. See Submittals.

.2 Supply and install a network of Building Automation Control System (BAS) panels and field devices. See Hardware, Software and Field Devices.

.3 Supply and install customized graphics software to SCDSB standards, system software, and third party software as specified. See Software.

.4 Install, wire and label all BAS control system components. See Installation.

.5 Calibrate and commission the installed control system. See Commissioning.

.6 Provide maintenance manuals and as-built drawings. See As-Built Documentation.

.7 Provide customized training for SCDSB operations, maintenance and technical staff. See Training.

.3 Approved System

.1 Bids for the BAS contract will only be accepted from authorized vendors/installers of the Reliable Controls product:

.1 Set Point Building Automation Inc.
347 Pido Road
Peterborough, Ontario
K9J 6X1
Tel: (705) 745-1600
Contact: Mr. Matthew Jewell

.4 Submittals

.1 Submit the six (6) copies of following information to the consultant and/or the SCDSB project supervisor for review and approval:

.2 Control Schematics

.3 Detailed sequence of operation for each control schematic or controlled system.

.4 System Architecture indicating the proposed interconnection and location of all BAS panels, network connections and key peripheral devices (workstations, modems, printers, repeaters, etc.)

.5 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).

.6 Wiring diagrams including complete power system, interlocks, control and data communications.

.7 Manufacturers' data / specification sheets for all material supplied.

.5 Related Work

.1 Unless otherwise specified, the following work shall be furnished by others.

.2 The mechanical sub-contractor shall provide:

.1 Water treatment system mechanical wiring.

.3 The BAS contractor shall provide:

.1 AHU freeze stats and high limit

.4 .4 The mechanical sub-contractor under the supervision of the controls subcontractor shall provide:

.1 Installation of control dampers including duct transitions, assembly and inter-connection of multiple section dampers.

.2 Supply and installation of sheet metal baffles as required to eliminate air stratification.

.3 Supply and installation of access panels for service and installation of control equipment.

.4 Installation of automatic valves, wells, flow switches, and other pipe related control devices.

.6 System Hardware

.1 The system architecture will be comprised of an Operator Workstation, PCUs (Primary Control Units), PACs (Programmable Application Controllers) and ASCs (Application Specific Controllers) networked together to provide a system of connected controllers that operate as a single BAS for the entire project.

.2 Supply PCUs, PACs, and ASCs as required to interface to all specified equipment.

.3 Allow minimum 25% spare program and trend memory capacity in each PCU and PAC.

.4 Primary Control Units (PCU)

.1 Use only Primary Control Units namely Reliable Mach-Global, Mach 2 or Mach 1 to directly control any major mechanical equipment. Major mechanical equipment includes air handling units, and other critical equipment.

.2 Every installation shall have a minimum of one (1) Reliable Mach-Global Panel.

.3 Each PCU shall provide an RS-232 port for direct connection to a PC.

.4 Each PCU shall contain a real time clock and sufficient memory to store its own application database, operating parameters, user programs and trend data storage.

.5 Battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours to eliminate operating data reload in case of power failure.

.6 Each PCU output shall include a Hand/Off/Auto (HOA) selector switch for all analogue and digital outputs used to control major equipment as described above.

.7 Each PCU shall have a minimum of 10% spare input channels and 10% spare output channels installed onboard the panel and ready for connection at the completion of the project.

.8 The PCU shall have a minimum of eight (8) inputs and eight (8) outputs.

.5 Programmable Application Controllers (PAC)

.1 PACs are fully programmable controllers namely Mach 1 panels, used for controlling distributed equipment such as radiation, reheat coils, exhaust fans and other distributed equipment. PACs interface to the Primary Control Units via on a sub-network.

.2 PACs shall not be used for controlling major mechanical equipment as described above.

.3 Each PAC shall contain a real time clock and sufficient RAM to store its own application database, operating parameters, user programs and trend data storage.

.4 Battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours to eliminate operating data reload in case of power failure.

.5 Each PAC output shall include a Hand/Off/Auto (HOA) selector switch for all analogue and digital outputs used to control major equipment as described above.

.6 The PAC shall have a minimum of eight (8) inputs and eight (8) outputs.

.6 Application Specific Controllers (ASC)

.1 Application Specific Controllers are pre-programmed controllers namely Reliable Mach-Air panels, used to control typical equipment such as rooftop units.

.2 ASCs shall not be used to control major mechanical equipment or non-typical equipment.

.7 Operator's Work Station

.1 Supply and install all operating software and dynamic system graphics on the Operator's Workstation. Workstation to be supplied by SCDSB.

.2 Supply licenses for all supplied software directly to the SCDSB Project Supervisor.

.8 System Remote Access

.1 WAN Access

Provide necessary interface and cabling to connect the BAS to the SCDSB WAN. Obtain the particular WAN system details from the Engineer or SCDSB Project Supervisor.

WAN IP address to be supplied by SCDSB.

.2 Alarms

.1 Provide and wire a dedicated input to monitor alarming and disarming of the building security system.

.3 Local PC Ports (RS-232)

.1 Where BAS points (4 or more) are located in a mechanical room that does not have a local BAS panel installed, a remote serial port connector (9-pin female) shall be provided to allow for local interface to the BAS via the portable maintenance interface.

.2 Mount the serial connector in a hinged metal enclosure with key-lock set and lamicoid ID label.

.7 Mechanical Room Control

.1 Provide space sensor to control motorized damper, exhaust fans, and unit heater.

.2 On rise in space temperature the exhaust fan(s) and/or motorized damper where installed are energized.

.3 On drop in space temperature the unit heater is energized.

.8 System Software

.1 Operators Workstation Software and Graphical Interface.

.1 The Operators Workstation software shall be the latest version of the manufacturers product (RC-Studio) and original software disks / CD's shall be provided to SCDSB.

.2 The software shall provide access to all controllers, points programs and systems.

.3 The Graphical User Interface shall be installed and dynamically updated.

.4 The Graphics shall be installed as per the SCDSB standards specified in section 15900-16 of this document.

.2 Trend Data

.1 Provide trend logs for every hardware input and output.

.2 All trends should be accessible via the graphical interface.

.3 Trends should contain all related variables of a control loop (i.e. setpoint, measured variable and control output) and have the ability to be plotted simultaneously on the same graph. Field Devices Individual trends should provide an appropriate "snapshot" of the variable. Slow reacting variables such as space temperatures should be sampled every 30 - 60 minutes while other variables such as mixed air or boiler water temperatures should be sampled every 5 to 10 minutes. Trends should contain a minimum of 72 hours worth of trend data.

.4 The primary input sensor for all control loops must connect to the same panel containing the control loop output.

.5 Trend data storage must be in the same panel as the hardware or logical points being trended.

.3 User Access

.1 The remote connection to the BAS will be configured to allow for the same user commands and functionality as the local front-end connection. The modem connection will allow a remote user to perform panel database uploads/downloads on all BAS panels in the system.

.2 The system will be configured so that a remote user (dial-in or LAN) and local user can be logged onto the BAS simultaneously, and be able to access all controllers, points, and programs in the system.

.4 Alarms

.1 The BAS will be configured to provide for remote alarm capabilities. The BAS shall be capable of dialling out to a minimum of three separate telephone numbers. Designated alarms will be capable of being sent to one or more telephone numbers.

.2 Alarms will be sent in ASCII text format.

.3 The controls vendor will verify that the designated remote workstation successfully receives a series of test alarms

.4 Provide and wire a dedicated output to interface to a designated building security/surveillance. This output will be programmed to initiate whenever specified system alarms are active.

.9 Field Devices

.1 Automatic Control Valves

.1 Submit a valve schedule for all valves supplied under this contract. The valve schedule will contain the following information for each valve:

.2 Valve type, size, manufacturer, model number, flow coefficient, design flow, pressure drop across valve, max. close-off pressure, actuator manufacturer and model number and maximum torque.

.3 Zone valves shall have a design pressure drop of approximately 1.0 psi. HVAC control valves shall have a design pressure drop between 3 and 5 psi. The minimum allowable CV shall be 0.8 regardless of pressure drop.

.4 Valves used for throttling applications shall have a linear percentage-to-flow characteristic.

.5 Ball valves are the preferred valve type for zone and HVAC control valves. Globe and butterfly valves shall be used where required to provide the desired pressure drop and CV.

.6 Automatic Control valves shall be manufactured by Belimo.

.2 Control Valve Actuators

.1 Size control valve actuators to provide a tight close off against system head pressures and pressure differentials.

.2 Valve actuators shall accept a 0-10VDC control voltage for all proportional applications.

.3 Floating-point control of valves are not acceptable under any circumstances.

.4 Heating valves shall spring-return fail open and cooling valves shall spring-return fail closed. Non-spring-return control valves may be used for terminal reheat coils and large HVAC control valves requiring a higher close off pressure.

.3 Damper Actuators

.1 Actuators shall be direct coupled for either modulating or two-position control. Actuators shall be powered by an overload-proof synchronous motor. Provide 0-10 VDC control voltage for all proportional applications and either line or low voltage actuators for all two-position applications.

.2 Damper actuators are to be manufactured by Belimo.

.3 Duct temperature sensors shall be installed in the airflow down stream of every duct mounted reheat coil.

.4 Duct temperature sensors shall be installed downstream of all variable air volume boxes with reheat coils installed.

.4 Automatic Control Dampers

.1 All automatic control dampers not furnished with packaged equipment shall be supplied by the controls subcontractor and installed by the sheet metal subcontractor. All dampers in a mixing application shall be opposed blade. Parallel blade shall be permitted in other applications. Dampers shall be a tight closing, low leakage type with replaceable extruded vinyl seals on all outdoor and exhaust applications.

.5 Room Sensors/Thermostats

.1 Mount sensors at a height of 5'-6" unless otherwise indicated.

.2 10 k ohm type-3 thermistors only shall be used and shall have end-to-end accuracy +/- 0.3 deg C over the entire operating range.

.3 Provide stainless steel plate sensors for public areas such as stairways, vestibules, lobbies, and gymnasiums.

.4 Room sensors will not normally have setpoint adjustment. Provide an external setpoint adjustment only when specified for specific offices or meeting rooms.

.5 Mount thermostats and space sensors as noted on the drawing. Do not mount on outside walls without permission of consultant.

.6 Supply and install heavy-duty thermostats for unit heaters, electric radiation or fan coil units where specified.

.6 Current Switches (Digital)

.1 Provide BAS status for fan and pump motors using a mosfet type digital switch. Acceptable manufactures are ACI, Enercorp, Greystone and Veris, and Elkor.

.7 Pressure Transmitters

.1 Technical Performance - Solid State design, operating on capacitance principle, with non-interactive fine resolution, zero and span adjustments. End-to-end accuracy +/- 2% of full-scale pressure range, including temperature compensation. 4-20mA or 0-5 VDC output.

.2 Standard of Acceptance – ACI, Enercorp, Greystone, Modus

.8 Duct Temperature Sensor

.1 Probe - Technical Performance – 10 k ohm thermistor sensor encapsulated in a 200mm long, 6mm OD copper or stainless steel probe. Operating range 0-60°C. End-to-end accuracy +/- 0.3 deg C. Assembly complete with wiring housing and mounting flange.

.2 Averaging - Technical Performance - 10 k ohm thermistor constructed of FT6 plenum rated cable or soft copper tubing, incorporating numerous temperature sensors encapsulated at equal distances along the length of the element. The assembly acts as a single sensor reporting the average temperature form all individual sensors. End-to-end accuracy +/- 0.3 deg C. Assembly complete with wiring housing and mounting flange. Mount in a zigzag manner to provide continuous coverage of the entire duct cross-sectional area.

.9 Outdoor Air Temperature Sensor

.1 Two outdoor air temperature sensors shall be installed and shall be programmed to check each other for accuracy. In the event of sensor failure the sensor deemed to be accurate should be used to control the systems. The outdoor air sensors shall be located on a north wall if possible and a minimum of three (3) feet from any opening in the building envelope, which could affect the sensor readings. The back face of the sensor enclosure shall be insulated to prevent temperature pick up from the building wall.

.2 Technical Performance, 10 k ohm thermistor -50C to 50C in a weatherproof enclosure mounted on north exposure. End accuracy of +/- 0.3 deg Cover the entire operating range.

.10 Pipe Temperature Sensor

.1 Well - Technical Performance - 10k ohm thermistor sensor encapsulated in a 6mm OD, 50mm long probe, with screw fitting for insertion into a standard thermowell. Operating range -10 - +100°C. End-to-end accuracy +/- 0.3 deg C over the entire operating range. Comes complete with brass thermowell. Use conductive gel when mounting the sensor in thermowell. Use heat transfer paste when mounting the sensor in thermowell. No surface mount strap on temperature sensors shall be used to monitor fluid temperature unless approved by the engineer.

.11 C02 Detector

.1 Technical Performance – Infrared CO2 monitor c/w 4-20mA or 0-5 VDC output, accuracy of +/- 40 ppm +3% reading.

.2 Standard of Acceptance – Vulcain 90DM4DT-C-2000 duct mount, Vulcain 90DM4ASM wall mount.

.10 Installation Standards

.1 Power Sources and Wiring Methods

.1 All wiring line and low voltage shall be installed in EMT conduit unless specifically specified otherwise.

.2 In accessible ceilings wiring from BAS controllers to sensors and actuators, control system network and low voltage wiring only may be installed with yellow jacket LVT cable. Where the ceiling is used as a return air plenum install plenum rated yellow jacket cable instead of LVT.

.3 BX or flex conduit may only be used for the final (approximately one meter) run to controls devices, where the controls equipment is mounted on vibrating machinery.

.4 Install EMT and cable at right angles to building lines, securely fastened, and in accordance with the standards set out in Division 16.

.5 No wire smaller than 18 gauge wire is to be used on the project except for: wiring between terminal computer devices, wire in standard communication cables, such as printers and short haul modems, wire used in communication networks, i.e. any cable transferring digital data, using twisted shielded pairs.

.6 All wiring from panels to devices shall be without splicing.

.7 Provide wells for all specified temperature sensors in hydronic piping system. Strap-on sensors may be only be used where a well installation is not possible. Obtain approval of Engineer for the use of strap-on sensors.

.8 Power for control system shall not be obtained by tapping into miscellaneous circuits that could be inadvertently be switched off.

.9 Mount transformers and other peripheral equipment in panels located in serviceable areas. Provide line side breakers/fuses for all transformers.

.10 .All 120 VAC power for any controls equipment shall be from dedicated circuits. Provide a breaker lock for each breaker used to supply the control system. Update the panel circuit directory.

.11 The controller may be powered from the equipment that it is directly controlling (i.e. heat pump, roof-top unit) only if the controller controls no other equipment and the power supply to the controller remains energized independently of unit operation or status.

.12 All BAS control panels shall be provided with UPS in the power supply except for Application Specific Controllers (ASC).

.13 All BAS control wiring shall be yellow jacket for identification purpose.

.14 The breaker or power isolation location shall be clearly marked on the inside door of each BAS panel enclosure.

.2 Equipment Location

.1 All distributed equipment such as VAV boxes, Roof top units, unit ventilators, fan coil units, etc. that utilize dedicated BAS controllers, shall have locally mounted controllers, in accessible locations within the building envelope. All locally mounted controllers shall be installed in enclosures suitable for that location. BAS controllers for mechanical equipment other than those listed above shall be mounted in mechanical rooms as noted below, unless specifically approved by the Engineer for this project.

.2 All other BAS controllers, and interface devices that require regular inspection or that serve multiple HVAC systems shall be located in mechanical rooms, or in pre-approved storage rooms, or janitor closets.

.3 All BAS panels shall be located within the building envelope, and shall be enclosed in a metal locking enclosure, as specified elsewhere herein.

.4 All equipment located in mechanical rooms, storage rooms or janitor closets shall be installed in metal cabinets with hinged, lockable covers. Provide an SCDSB-standard #549 key/lock set for each cabinet.

.5 Transformers or power supplies shall not be located in ceiling spaces unless approved by the engineer for terminal control valves, actuators or zone controllers. When transformers are installed above ceilings, transformers shall be installed in metal enclosures, and the location shall be clearly labelled on the t-bar ceiling to indicate power transformer location.

.6 A 120 VAC duplex receptacle for laptop power shall be provided if the cabinet is located further than 1500 mm (5’) laterally from the nearest outlet.

.11 Identification and Labelling of Equipment

.1 All panels must have a lamicoid tag (min. 3"x1") affixed to the front face indicating panel designation and function (i.e. “BAS Panel 1” or “Relay Panel 3").

.2 All field sensors or devices must have a lamicoid tag (min. 3"x1") attached with tie-wrap or adhesive indicating the point software name and hardware address (i.e. AHU1_MAT, 2.IP4).

.3 Room sensors and other sensors in finished areas do not require a device tag.

.4 All devices within a field enclosure will be identified via a label or tag.

.5 All BAS panel power sources must be identified by an adhesive label indicating the source power panel designation and circuit number on the outside of the enclosure door (i.e. “120vac fed from LP-2A cct #1).

.6 All field equipment panels fed from more than one power source must have a warning label on the front cover.

.7 All wires will be identified with self-adhesive wire labels or clip-on plastic wire markers at both ends.

.8 All rotating equipment controlled by the BAS will have a tag or label affixed indicating that the equipment may start without warning.

.9 If a phone line manager is supplied, its location should be indicated via a label affixed to the inside cover of the modem enclosure or BAS panel.

.10 All BAS panels will have a points list sheet (within a plastic sleeve) attached to the inside door. The points list will identify the following for each point: Panel number, panel location, hardware address, software name, point description, field device type, point type (i.e. AI or DO), device fail position, device manufacturer and model number or reference and wire tag reference.

.11 Where required, field panels will have wiring diagrams attached to the inside door.

.12 Provide new or modify existing equipment wiring diagrams (i.e. boilers, chillers, etc.) wherever the BAS interfaces to other equipment.

.12 Commissioning

.1 Confirm and demonstrate to the Engineer Mechanical Contractor, and the Owner's agent that that all systems are programmed and operating correctly.

.2 Submit four (4) copies of the system commissioning report to the Engineer for review and approval.

.3 Each analogue inputs (i.e. temperatures, pressure, etc.) shall be verified with an approved calibration device. All actual temperature readings should be with +/- 1C of the readings observed at the workstation.

.4 Each analogue output shall be verified by manually commanding the output channel from the operator workstation to two or more positions within the 0-100% range and verifying the actual position of the actuator or device. All devices shall operate over their entire 0-100% range from a minimum control range of 10-90%.

.5 Digital outputs shall be verified by witnessing the actual start/stop operation of the equipment under control.

.6 Digital inputs shall be verified by observing the status of the input point as the equipment is manually cycled on and off.

.7 Record all out-of-season or unverified points in the commissioning report as "uncommissioned".

.8 The BAS field panel power source shall be toggled on and off to ensure reboot functionality and power down memory retention of all parameters. During the power down test, all connected system components should go to their fail-safe state.

.9 All trends should be reviewed to ensure that setpoints are being maintained and excessive cycling of equipment is not occurring.

.10 Control loop-tuning parameters can be verified by applying a change to the current setpoint and observing the resulting trend log. Setpoint should be reached in a "reasonable" period of time without excessive cycling or hunting of the controlled device.

.13 Training

.1 At the completion of the installation and immediately following commissioning provide a ½ day training session on site for the Owner's designated maintenance personnel.

.14 Warranty

.1 Warranty all components supplied under this contract for a period of one year from substantial completion. Replace all controls equipment that fails during this period without cost to the owner.

.15 As Built Documentation

.1 Within two weeks following substantial completion of the project, update the original submittal documents to reflect the "As Built" conditions of the project and submit as many copies as are required by the consultant and/or the SCDSB Project Supervisor.

.2 Provide a separate laminated copy of the control drawings for mounting in the mechanical room or in the controls panels as directed by the consultant or the SCDSB Project Supervisor.

.3 Submit diskettes/CDs (including back-up diskettes/CDs) containing up to date copies of the programs in each controller. Provide original program disks and documentation proving registration for all software programs provided as a part of this contract including: the BAS operator interface software, and the BAS graphics (Illustrator files & bitmap files). Provide one set of original disks for every computer supplied under this contract or that the software has been loaded onto.

.4 Submit (4) printed copies of the final programs that include all point definitions, weekly and annual schedule setting, controller setpoints and tuning parameters, and documented programmed sequences of operation.

.16 Graphic Display Screens

.1 All Graphic Display Screens shall have the following common elements and functions regardless of system manufacturer. Every site shall have a graphic display screen for Site Graphic, System Architecture, each air handler, boilers, emergency generator, lighting, exhaust fans, heat reclaim, and for each room controlled by the BAS system.

The Graphic Display Screens shall follow the format to be consistent with the established SCDSB Reliable BAS Systems as displayed in Appendix “A”. All operator accessible points shall be yellow text and all information points shall be blue. The specific screens shall include the following:

.2 Graphic Screens General All Screens

.1 Navigation buttons to each major system in the building which indicate current screen display by a change in button colour.

.2 Background colour shall be black.

.3 Outdoor air temperature shall be displayed on every graphic screen.

.3 Site Graphic

.1 The SCDSB Logo on the site or opening graphic screen.

.2 Artist concept or scanned in picture of the front of the school.

.3 Access links to all global schedules or specific screens affecting entire building operation.

.4 Access buttons links to Set Time, Holiday Schedule, PD Day Schedule, Alarms, Points on Manual, Conversion °C - °F, 24 Hour Clock, Operations Manual, AutoCAD Drawings, Reliable BAS Manual, and Work Orders.

.4 System Architecture

.1 Control panel layout and network architecture.

.2 Indicating BAS panels and panel type (model).

.3 Panel locations .

.4 Systems controlled by each panel.

.5 Links to points list accessible from each panel.

.5 Floor Plans graphics

.1 Room numbers accurate as per room signage.

.2 Mechanical rooms locations & signage tags.

.3 Space temperatures for every temperature on each floor in appropriate room.

.4 Space focus pick area for individual room control where applicable shall be yellow text.

.5 Air Handler symbols indicating areas of the floor plan serviced by each air handler by a corresponding colour, as shown in Appendix “A”.

.6 Status of Air Handler by colour change Red for off status, or text indication.

.7 Supply air temperature for each air handler.

.6 Air Handler (AHU) graphic

.1 Accurate representation of the AHU design.

.2 All associated control points to be displayed.

.3 All points to be monitored for automatic mode and shall be displayed when in Manual mode.

.4 A calculated percentage of fresh air shall be indicated on the AHU graphic.

.5 Operator offset adjustment of the supply air setpoint, adjustable directly form the graphic.

.6 AHU physical location shall be indicated on the graphic.

.7 Weekly occupied time of day schedule for the associated AHU shall be Accessible directly from the graphic by selecting an icon.

.8 Weekly student time of day schedule for the associated AHU shall be accessible directly from the graphic by selecting an icon.

.9 Trend logs shall be accessible directly form the graphic by selecting an icon.

.7 Exhaust fans graphic

.1 Exhaust fans control shall be editable directly from the graphic.

.2 Exhaust fan status shall be indicated in text and a change in the exhaust fan icon.

.3 Exhaust fan physical location shall be indicated on the graphic.

.4 Area of the building being exhausted shall be indicated on the graphic.

.17 Reliable BAS Database Naming Conventions and Programs

.1 Miscellaneous Equipment Naming Conventions

.2 Network Status Panel Naming Conventions should indicate the school, panel location and panel number. The school name can be abbreviated as necessary to fit in the space.

INPUTS		OUTPUTS	
Equipment	**Point Name**	**Equipment**	**Point Name**
Exhaust Fan Status	EF # Status	Exhaust Fan Control	EF # Control

1.3 RELATED WORK SPECIFIED ELSEWHERE

.1 Plumbing & Drainage

Ventilation & Air Conditioning

Testing & Balancing

HVAC System Commissioning

Electrical

.2 Supply all necessary efforts to provide the project DDC system as specified.

1.4 DESCRIPTION OF SYSTEM

.1 This is an upgrade and/or modification of an existing DDC control system. Furnish and install all components, devices and control wiring for a fully integrated Energy Management and Environmental Control System incorporating Direct Digital Control (DDC), and equipment monitoring. The system shall control and monitor HVAC equipment, HVAC systems, and other equipment as specified in this section.

.2 Refer to demolition drawings for removal of all existing control devices. All existing exposed pneumatic tubing and equipment which is not reused shall be removed complete. All concealed existing pneumatic tubing shall be abandoned.

.3 Furnish and install all components, devices and control wiring for a fully integrated Energy Management and Environmental Control System incorporating Direct Digital Control (DDC), and equipment monitoring. The system shall control and monitor HVAC equipment, HVAC systems, and other electrical loads as specified in this section. The work shall include but is not limited to the following:

.1 Extension of the existing programmable building automation control (BAS) system.

.2 Control and monitoring of indoor space temperature.

.3 Local/remote system control/monitoring via BACnet/IP TCP/IP Ethernet LAN/WAN connections.

.4 HVAC Unit Control

.5 VVT Control

.6 Radiation Control

.7 Existing Exhaust Fan Control

.8 Building low temperature Low building temperature alarm (all spaces with sensor).

.9 All control valves, dampers, operators, etc, required under this contract.

.10 All electric wiring, switches, relays, etc., for a complete operating system.

.11 All wiring incidental to controls system.

.12 System and equipment trending and scheduling.

.13 System training.

.4 All the necessary controls, valves, motors, control wiring, conduit, control panels, instrumentation, computer software, and network access units, for the specified system shall be provided under this section. The installed system shall incorporate electronic and digital control devices to perform the control sequences and programs outlined herein. Specific control sequence requirements are as detailed in subsequent sections of this specification and on the drawings

.5 All electrical wiring, mechanical installations, and control sequences shall comply with local and provincial electrical and mechanical codes

.6 Testing, debugging, confirmation of total system operation and owner training on the complete operation of the system and the computer software shall also be provided in this section.

1.5 SYSTEM ACCEPTANCE

.1 System commissioning and interface to facilities management network shall be performed by the Building Automation contractor.

.2 On project completion, the contractor shall issue a report to the consultant stating that the system is complete, that all hardware and software functions have been verified and that the system is operating in accordance with the specifications. A demonstration of complete system operation shall then be made to the owner's authorised representative.

.3 Upon successful completion of the system demonstration, the owner's representative shall be requested to approve, in writing, the satisfactory operation of the DDC System, interface devices and accessories.

.4 The consultant shall verify through the owner’s representatives that the entire system is complete and operating to the satisfaction of the owner before final acceptance is approved.

1.6 MAINTENANCE DATA AND SERVICE

.1 Provide maintenance data for controls and instrumentation for incorporation into maintenance manual.

.2 After acceptance, seasonally check and readjust control systems for change over. Make 2 site trips. Notify Engineer of scheduled dates. Carry out any preventive maintenance required including parts and labour. Report to Engineer, in writing, results or resetting made.

.3 Provide as-built information in accordance with Section 15010, requirement.

1.7 TESTING AND BALANCING

.1 During the system testing and balancing by an independent agency fully demonstrate the operation of all sensors, dampers, actuators, controls, valves, etc. This contractor shall be present during the testing and balancing and make adjustments as often as necessary to satisfy the testing and balancing agency.

Part 2 PRODUCTS

2.1 ELECTRICAL AND MECHANICAL DEVICES

.1 All electric switch devices shall be selected for the applied load and UL listed and labeled for the application and environment to which they are applied. Miscellaneous, electric, and mechanical devices shall include:

.2 Provide any automatic control dampers not specified to be integral with other equipment. Frames shall not be less than 2.5 mm (13 gauge) galvanized steel. Blades shall not be over 200 mm (8") wide nor less than 1.6 mm (16 gauge) galvanized steel roll formed. Bearings shall be oilite, ball bearing or nylon with steel shafts. Side seals shall be stainless steel of the tight-seal spring type. Dampers and seals shall be suitable for temperature ranges of –40°C to 93°C (-40°F to 200°F).

.1 All proportional control dampers shall be opposed or parallel blade type as hereinafter specified and all two-position dampers shall be parallel blade types.

.2 Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 150 mm (6").

.3 Dampers shall be minimum leakage type to conserve energy and the temperature control manufacturer shall submit leakage data for all control dampers with the temperature control submittal. Maximum leakage for dampers in excess of sixteen inches square shall be 152 l/s/m^2 (30 cfm/ft^2) at static pressure of 25 mm (1") of w.c.

.4 Where ultra-low leakage dampers are specified the blade edges shall be fitted with replaceable, snap-on, inflatable seals to limit damper leakage to 2.8 l/s/m^2 (6 cfm/ft^2) for dampers in excess of sixteen inches square at 25 mm (1") of w.c.

.3 Automatic control valves 65 mm (2½") and smaller shall be screwed type, and valves 80 mm (3") and larger shall be flanged. Valves shall be ANSI-rated to withstand the pressures and temperatures encountered. Valves shall have stainless-steel stems and spring loaded Teflon packaging with replaceable discs

.1 All modulating straight-through water valves shall be provided with equal-percentage contoured throttling plugs. All three-way valves shall be provided with linear throttling plugs such that the total flow through the valve shall remain constant regardless of the valve's position. Valves shall be sized for a pressure drop equal to the coil they serve but not to exceed 34 kPa (5 psi).

.2 Unitary valves shall provide precision flow control of hot or chilled water in various heating or cooling applications. The unitary valves shall consist of a valve body and replaceable characterized cartridge assembly and shall be compatible with a valve actuator that meets the requirements of UL94-5V fire retardancy for mounting in return air plenums. The actuators shall have conformally coated printed circuit boards for humidity resistance.

The actuators shall de-energize when the valve is not in motion to extend service life. The unitary valves shall provide proportional flow in modulating, diverting or mixing applications. They shall operate silently and resist water hammer.

The unitary valve and actuator assembly shall be equipped with a manual opener and position indicator.

.4 All automatically controlled devices, unless specified otherwise elsewhere, shall be provided with actuators sized to operate their appropriate loads with sufficient reserve power to provide smooth modulating action or two-position action and tight close-off. All actuators (valves, dampers etc.) shall be by this contractor.

Acceptable Material

.1 Belimo

.5 Digital wall or ceiling mounted occupancy sensor system

.1 Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor. Furnish the Company’s system which accommodates the square-foot coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors and accessories which suit the lighting and electrical system parameters.

.2 Digital Occupancy Sensors shall provide calibration and electronic documentation for the following features:

.3 Digital calibration and pushbutton programming for the following variables:

.4 Sensitivity – 0-100% in 10% increments

.5 Time delay – 1-30 minutes in 1 minute increments

.6 Test mode – Five second time delay

.7 Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.

.8 Walk-through mode

.9 Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.

.10 Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.

.11 Device Status LEDs including:

- .1 PIR Detection
- .2 Ultrasonic detection
- .3 Configuration mode
- .4 Load binding
- .5 Manual override of controlled loads.
- .6 One or two RJ-45 port(s) for connection to DLM local network.

.12 Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.

.13 WattStopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

Part 3 Execution

3.1 GENERAL

.1 The DDC controls project shall be performed in accordance with the general conditions of the contract. The contractor shall conduct all on-site work in conjunction with building operating staff to streamline the new system startup.

.2 The summary of input/output channels describe the DDC system points. It is the responsibility of the Contractor to ensure compatibility of the mechanical systems, devices, and actuators with the DDC system.

.3 All digital output control points located in unconditioned spaces shall be relocated to an accessible ventilated indoor location. All control devices, DDC panels; other shall be located inside the conditioned space of the building envelope

.4 All DDC system equipment will become the property of the Owner.

3.2 ON SITE TESTING

.1 Provide Engineer-approved operation and acceptance testing of the complete system. The Consultant/Owner will witness all tests.

.2 Field Test: When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed on-line. The installer shall complete all testing, calibrating, adjusting and final field tests. Provide a detailed cross-check of each sensor within the system by making a comparison between the reading at the sensor and a standard traceable to the National Bureau of Standards.

.3 Provide a cross-check of each control point within the system by making a comparison between the control command and the field-controlled device. Verify that all systems are operable from local controls in the specified failure mode upon panel failure or loss of power. Submit the results of functional and diagnostic tests and calibrations to the Engineer for final system acceptance.

.4 Compliance Inspection Checklist: Submit in the form requested, the following items of information to the Owner's Representative and Consultant for verification of compliance to the project specifications. Failure to comply with the specified information shall constitute non-performance of the contract. The contractor shall submit written justification for each item in the checklist that he is unable to comply with. The Owner's Representative and the Consultant will initial and date the checklist to signify contractor's compliance before acceptance of system.

.1 Verify to the Owner's Representative and Consultant in letterform that supplier has in-place support facility. Letter shall show location of support facility, name and titles of technical staff, engineers, supervisors, fitters, electricians, managers and all other personnel responsible for the completion of the work on this project.

User Date Consultant Date

.2 Manually generate an alarm at a remote DDC Controller as selected by the Consultant to demonstrate the capability of the workstation and alarm printer to receive alarms within 5 seconds.

User Date Consultant Date

.3 Disconnect an operator workstation in the central control room and manually generate an alarm at a remote DDC Controller to demonstrate the capability of the system printer to receive alarms when the workstation is disconnected from the system.

User Date Consultant Date

.4 Disconnect one DDC Controller from the network to demonstrate that a single device failure shall not disrupt or halt peer-to-peer communication. Panel to be disconnected shall be selected by the Consultant.

User Date Consultant Date

.5 At a DDC Controller of the Consultant’s choice, display on the portable operator's terminal:

.1 At least one temperature set point and at least one status condition, i.e., on or off for a system or piece of equipment attached to that panel as well as for points at another DDC Controller on the network.

.2 The diagnostic results as specified for a system or piece of equipment attached to that panel as well as for a system or piece of equipment attached to another DDC Controller.

.3 The ability to add a new point to the DDC Controller with the POT and have it automatically uploaded to the workstation to modify that panel's stored database.

User Date Consultant Date

3.3 INSTALLATION

.1 Install systems and related controls in accordance with approved shop drawings and manufacturer's recommendations using factory-trained journeymen certified by the Province of Ontario.

.2 Locate room sensors, etc., at height and as required per Ontario Building Code.

.3 Secure approval for damper motor locations and supports. Submit detail of damper motor location and support for approval.

.4 Provide dampers, for installation by the sheet metal contractor.

.5 Provide valves for installation by the piping contractor.

3.4 POINT DESCRIPTION

.1 Adopt and utilize a consistent naming convention in order to identify points and facilitate wild-card calling of all points, systems, and programs to the standards of the school board.

3.5 SYSTEM OPERATION

.1 General

Where Optimum Start Stop (OSS) is specified, equipment shall start-up based on global outdoor temperature, space temperature, and system response to assure that comfort conditions are reached at scheduled occupancy time (occupancy schedules are defined under time programs) and operate in both heating and cooling cycles. In all cases, the optimum start program shall operate fully stand-alone in the local GPC.

OSS shall include a Night Cycle program applying to (heating cycle only) (both heating and cooling cycle) with the outdoor air dampers closed. The space temperature shall be used to determine the “fan on” and/or “supply heat” command to maintain a low limit of *50-55* degrees for the heating cycle and the “fan on” and “supply cooling” command to maintain 82 degrees for the cooling cycle.

Where an Economizer Cycle (EC) is specified, it shall automatically enable the economizer mode based upon an enthalpy comparison of outdoor air and return air of each AHU.

.2 Data Control (D/C) and Graphics Summary

All hardware, custom software, application software, graphics, etc., necessary to accomplish the control sequences and display the graphics specified shall be provided as part of this contract. Provide all controllers, inputs, outputs, valves, dampers, actuators and flow meters required to provide the control and graphic data described. Provide software setpoints required for display in logical groups and graphics.

Each digital output shall have a software-associated monitored input. Any time the monitored input does not track it's associated command output within a programmable time interval, a "command failed" alarm shall be reported.

Where calculated points (such as CFM) are shown, they shall appear in their respective logical groups.

Unless otherwise specified or approved prior to bidding, the primary analog input and the analog output of each DDC loop shall be resident in a single remote panel containing the DDC algorithm, and shall function independent of any primary or UC communication links. Secondary (reset type) analog inputs may be received from the primary network, but approved default values and/or procedures shall be substituted in the DDC algorithm for this secondary input if network communications fail or if the secondary input becomes erroneous or invalid.

In addition to the Unitary DDC Controller data points specified to be presented on colourgraphic displays, technical data for each zone mechanical apparatus shall be presented to operators on the OWS in full English menu text displays including the apparatus name; heating and cooling PID loop P, I and D gains; primary CFM airflow (if measured); damper position (% open); reheat status/value; cooling setpoint; heating dead-band; minimum and maximum CFM setpoints; reheat CFM setpoint; unoccupied temperature setpoint; temperature sensor calibration offset; bypass push button time, in minutes; smoke purge mode damper position; smoke pressurization mode damper position; smoke depressurization mode damper position; and morning warm-up mode damper position. All such points shall be presented in complete and direct read-write (command) format, unless they are provided in commandable colourgraphic displays.

In addition to Graphics of building systems with dynamic data points as noted in the following Data and Control and Graphic Summary, the following additional graphics shall be provided:

Facility layout (showing buildings, streets, etc.)

Individual area layouts or isometrics

Any other graphics necessary for logical penetration

Individual HVAC systems graphics

Sequences of operation

Flowcharts for critical DDC loops

Supervisor graphics

System configuration

.3 Application Requirements

.1 Software

The microprocessor-based control system shall rely on software for non-critical interlocks and time delays. Where required by the specifications, these functions shall be provided by separate thermostats, relays, and delay timers.

.2 Interlocks

Safety and other interlocks may require relays depending on the specific devices being used. Some devices may require a special power supply as shown in the wiring details. Safeties shall be hardwired into the control circuit and shall also be monitored by the BMCS.

.3 Sensors

Select duct insertion sensors to suit the application. For large ducts, use sensors with longer probe lengths. For heating and cooling coil freeze protection, use a long capillary type sensor. For mixed air and coil discharge temperature sensing, use averaging capillary type sensors.

.4 Valves

Ensure that actuators meet all the job requirements (i.e., control signal, close off, action, etc.). Control valves shall be selected to suit both the medium and the specified configuration (i.e., Straight-thru, 3-way, screwed, flanged, etc.).

.5 Damper Actuators

The total number of actuators may vary depending on the damper size. Consult the actuator's application literature to determine sizing requirements and use no less than 30% of the minimum number of actuators recommended.

.6 Graphics

The system graphics shall include operator control panels to facilitate working with the AHU:

.1 The Warm-up Panel shall permit the operator to monitor the status of the warm-up mode (on or off), and to change the setpoint of the warm-up temperature.

.2 The Unoccupied Cycle control panel shall permit the operator to monitor the status of the mode (occupied or unoccupied), and to change the unoccupied periods setpoints.

.3 The Mixed Air Dampers control panel shall permit the operator to monitor the economizer mode (on or off), monitor the damper position, and to change the minimum position setpoint.

.4 The Optimum Start/Stop control panel shall permit the operator to monitor and change optimum start/stop program parameters.

.5 The Reset Schedule control panel shall permit the operator to monitor and change reset schedule program parameters.

It is not acceptable to monitor and change these modes of control in a manner other than that specified. Having to edit, compile and reload application programs to achieve monitoring and control of these modes is not acceptable.

.6 Provide the text of the control sequence so that it may be displayed on the operator screen by clicking on the Sequence control button on the system graphic. The sequence will incorporate all parameter values and setpoints, and will update them dynamically as they change or are changed.

.7 Graphic Display Screens

All Graphic Display Screens shall have the following common elements and functions regardless of system manufacturer. Every site shall have a graphic display screen for Site Graphic, System Architecture, each air handler, boilers, emergency generator, lighting, exhaust fans, heat reclaim, and for each room controlled by the BAS system. The Graphic Display Screens shall follow the format to be consistent with the established SCDSB Reliable BAS Systems as displayed in Appendix "A". All operator accessible points shall be yellow text and all information points shall be blue. The specific screens shall include the following:

.1 Graphic Screens General All Screens

.1 Navigation buttons to each major system in the building which indicate current screen display by a change in button colour.

.2 Background colour shall be black.

.3 Outdoor air temperature shall be displayed on every graphic screen.

.4 Site Graphic.

.5 The SCDSB Logo on the site or opening graphic screen.

.6 Artist concept or scanned in picture of the front of the school.

.7 Access links to all global schedules or specific screens affecting entire building operation.

.8 Access buttons links to Set Time, Holiday Schedule, PD Day Schedule, Alarms, Points on Manual, Conversion °C - °F, 24 Hour Clock, Operations Manual, Autocad Drawings, Reliable BAS Manual, and Work Orders shown in Appendix "A".

.2 System Architecture

.1 Control panel layout and network architecture.

.2 Indicating BAS panels and panel type (model).

.3 Panel locations room number text on screen.

.4 Systems controlled by each panel.

.5 Links to points list accessible from each panel.

.3 Architecture Panel Layout (Locations on Floor Plans)

.1 Locations of each panel on each floor plan level.

.2 Panel types indicated by different icon.

.3 Controls transformers locations.

.4 Main network wiring and sub-network wiring layout.

.4 Floor Plans Graphics

.1 Room numbers accurate as per room signage.

.2 Mechanical rooms locations and signage tags.

.3 Space temperatures for every temperature on each floor in appropriate room.

.4 Space focus pick area for individual room control where applicable shall be yellow text.

.5 Air Handler symbols indicating areas of the floor plan serviced by each air handler by a corresponding colour, as shown in Appendix “A”.

.6 Status of Air Handler by colour change Red for off status, or text indication.

.7 Supply air temperature for each air handler.

.5 HVAC Unit Graphic

.1 Accurate representation of the HVAC design.

.2 All associated control points to be displayed.

.3 All points to be monitored for automatic mode and shall be displayed when in Manual mode.

.4 A calculated percentage of fresh air shall be indicated on the HVAC graphic.

.5 Operator offset adjustment of the supply air setpoint, adjustable directly from the graphic.

.6 HVAC physical location shall be indicated on the graphic.

.7 Weekly occupied time of day schedule for the associated HVAC shall be accessible directly from the graphic by selecting an icon.

.8 Weekly student time of day schedule for the associated HVAC shall be accessible directly from the graphic by selecting an icon.

.9 Trend logs shall be accessible directly from the graphic by selecting an icon.

.6 Exhaust Fans Graphic

.1 Exhaust fans control shall be editable directly from the graphic.

.2 Exhaust fan status shall be indicated in text and a change in the exhaust fan icon.

.3 Exhaust fan physical location shall be indicated on the graphic.

.4 Area of the building being exhausted shall be indicated on the graphic.

.4 Design Requirements

.1 Safeties: Smoke detector or high temperature interlocks will be hard-wired to the supply fan starter. These points will be assigned addresses in the DDC controller for alarm annunciation purposes only. AHUs with flows greater than 15,000 CFM will require a smoke detector or high temperature detector in the supply and return air ducts.

.2 Schedules: Time schedules will default to 6AM to 6PM, Monday through Friday.

.3 Actuators: Actuator output points will display as follows:

.1 0% = 2-way valve, closed.

.2 0% = 3-way valve, closed to the coil.

.3 0% = Mixed air dampers, full return air position.

.4 100% = 2-way valve, open.

.5 100% = 3-way valve, open to the coil.

.6 100% = Mixed air dampers, full fresh air.

.7 These requirements shall be the case no matter how the actuator is sequenced or whether it is a reverse or direct acting valve.

.4 Valves: Heating coil valves shall fail open to the coil. Mixed air dampers shall fail to the full return air position.

.5 Outdoor Sensors: Outdoor air temperatures and humidities (where applicable) are assumed to be Global points transferred to DDC controllers. If the BMCS system lacks global point capability, global points shall be replaced by hardware points connected to specific controllers; the I/O capacity of the controller being used must be checked to make sure the added points will fit in the controller and upgraded in point capacity if necessary.

3.6 SEQUENCE OF OPERATION

.1 Sequence of Control

.1 General

.1 The control programs shall be modular and structured in order to provide specific control operation of all HVAC components indicated.

.2 All control programs shall provide a minimum of 20% spare memory for expansion.

.3 Each control program shall contain "REM" statements which explain the program operation.

.4 Each control program shall open with a list of the I/O points used and controlled in the program.

.2 DDC Sensors and Devices are listed in the Points Summary that is part of this specification. Provide 5% spare I/O capacity.

Implement the following control program concepts in full, or partial as required, to provide complete HVAC equipment control. The programs shall perform all control strategies on the basis of protecting equipment operation, saving operational energy costs, and indicating alarm conditions.

Programs, which increase the system energy consumption or cause equipment failures, will be refused and resolved by the contractor accordingly at not additional cost to Owner.

.3 Where Optimum Start Stop (OSS) is specified, equipment shall start-up based on global outdoor temperature, space temperature, and system response to assure that comfort conditions are reached at scheduled occupancy time (occupancy schedules are defined under time programs), and operate in both heating and cooling cycles. In all cases, the optimum start program shall operate fully stand-alone in the local GPC.

OSS shall include a Night Cycle program applying to (heating cycle only) (both heating and cooling cycle) with the outdoor air dampers closed. The space temperature shall be used to determine the "fan on" and/or "supply heat" command to maintain a low limit of 50-55 degrees for the heating cycle and the "fan on" and "supply cooling" command to maintain 82 degrees for the cooling cycle.

.4 Where an Economizer Cycle (EC) is specified, it shall automatically enable the economizer mode based upon an enthalpy comparison of outdoor air and return air of each AHU.

.5 System Architecture: The control sequences will be performed by DDC controllers arranged as indicated in the following architecture diagram:

.1 Boiler Graphic (glycol Loop Similar)

.1 Graphic piping layout shall be accurate as per piping layout.

.2 All associated control points for the boiler system to be displayed.

.3 Operator offset adjustment of the scheduled water setpoint, adjustable directly form the graphic.

.4 Lead boiler and boiler stages shall be indicated.

.5 Lead pump shall be indicated.

.6 Boiler status shall be indicated graphically.

.7 Pump status shall be indicated graphically.

.8 Calculated scheduled water setpoints to be displayed.

.9 Operator offset editable directly from the graphic screen.

.10 Weekly time of day schedule for the building occupied schedule shall be accessible directly from the graphic by selecting an icon.

.11 Trend logs shall be accessible directly from the graphic by selecting an icon.

.2 Building Low Temperatures

.1 All space sensors shall be capable of indicating building low temperature. Alarm building low temperatures at OWS.

.3 Radiation Heating Control

.1 A space temperature sensor operating through a DDC ASC shall modulate the incremental heating valve to maintain the space temperature setpoint.

.4 Room VAV Control

.1 General

.1 Controls logic to be provided to meet ASHRAE Guideline 36, High-Performance Sequences of Operation for HVAC Systems. A summary of this standard follows, but BAS contractor remains responsible for the full implementation of the standard along with any additional notes indicated below.

.2 Design flow rates are indicated on the VAV Schedule on the drawings. Controls contractor shall calculate all required airflow settings as indicated elsewhere in this section. All settings shall be independently adjustable by the operator.

.3 Supply air temperature shall be monitored and displayed at the OWS.

.4 Supply air volume shall be monitored and displayed at the OWS.

.5 All set points shall be adjustable. Refer to schedules for maximum and minimum airflows in different operating modes.

.2 Safeties and Limits

.1 The discharge air temperature shall be controlled to be no greater than 30 degrees F above the space set point.

.2 Upon signal from the associated HVAC unit's leak detection system:

.1 Fully open zone dampers within the ductwork system/close bypasses.

.2 Energize all fans within the duct system/general exhaust fans in area affected.

.3 System Start/Stop. Not applicable. Refer to multizone AHU sequences of operation.

.4 Control Strategy

.1 Active maximum and minimum air flow set points shall vary depending on the mode of the zone group the VAV is a part of.

Set Point	Occupied	Cool down	Warm-Up	Unoccupied
Cooling Maximum	Vcool-max	Vcool-max	0	0
Cooling Minimum	Vcool-min	0	0	0
Minimum	Vmin	0	0	0
Heating Minimum	Larger of Vheat-min or Vmin	Heating Minimum	Heating Maximum	0
Heating Maximum	Larger of Vheat-max or Vmin	Heating Maximum	Cooling Maximum	0

.2 Maximum and minimum airflows shall be set as follows:

.1 Vcool-max: Design airflow, plus 30%.

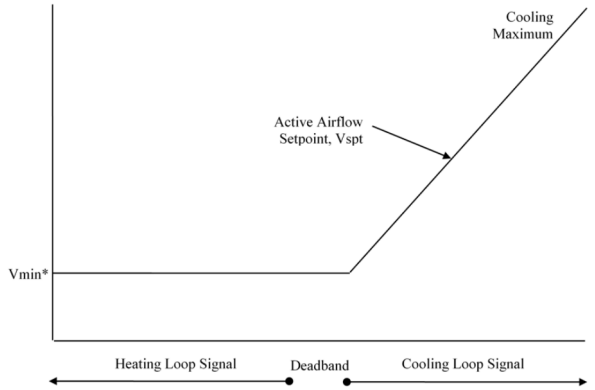
.2 Vcool-min: 30% of design airflow.

.3 Vheat-max: 80% of design airflow.

.4 Vheat-min: 0 cfm.

.5 Vmin: 30% of design airflow.

.3 Control logic is depicted schematically in the figure below and described in the following sections.



.4 Cooling Zone State: The cooling loop output shall be mapped to the airflow set point from the cooling minimum to the cooling maximum set points. Heating coil is disabled unless discharge air temperature is below the minimum set point. Note that if the supply air temperature from the air handler is greater than room temperature, cooling supply airflow set point shall be no higher than the minimum.

.5 Deadband Zone State: The active airflow set point shall be the minimum airflow set point.

.6 Heating Zone State: The active airflow set point shall be the minimum airflow set point.

.7 System Requests

.1 Cooling SAT reset requests

.1 If the zone temperature exceeds the zone's cooling set point by 3°C (5°F) for 2 minutes, send 3 requests.

.2 Else if zone temperature exceeds the zone's cooling set point by 2°C (3°F) for 2 minutes, send 2 requests.

.3 Else if the cooling loop is greater than 95%, send 1 request until the loop is less than 85%.

.4 Else if the cooling loop is less than 95%, send 0 requests.

.5 Repress requests for 5 minutes after a reset to the SAT.

.2 Static Pressure reset requests

.1 If the measured airflow is less than 50% of set point while set point is greater than zero and the damper position is greater than 95% for 1 minute, send 3 requests.

.2 Else if the measured airflow is less than 70% of set point while set point is greater than zero and the damper position is greater than 95% for 1 minute, send 2 requests.

.3 Else if the damper position is greater than 95%, send 1 request until the damper position is less than 85%.

.4 Else if the damper is less than 95%, send 0 requests.

.5 Repress requests for 5 minutes after a reset to the static pressure.

.8 CO2 Control

.1 Space CO2 level shall be monitored. Reset minimum damper position from the value shown on the schedules to 50% of design airflow as CO2 varies between 800 and 1000 ppm. Utilize reheat coil to maintain space temperature if necessary.

.5 Alarms

.1 Low Airflow

.1 Measured airflow is less than 70% of set point for 5 minutes (while set point is greater than 0).

.2 Measured airflow is less than 50% of set point for 5 minutes (while set point is greater than 0).

.3 If a zone has an importance-multiplier of 0 for it's static pressure reset control loop, low airflow alarms shall be suppressed.

.2 Airflow Sensor Calibration: If the fan serving the zone has been off for 10 minutes and the airflow sensor reading is above 10% of the cooling maximum airflow set point.

.3 Leaking Damper: If the damper position is 0% and airflow sensor is above 10% of the cooling maximum airflow set point for 10 minutes while the fan serving the zone is on.

.6 Points List

Name	AI	AO	DI	DO
Damper Command		X		
Airflow Volume	X			
Temperature Control Valve Command		X		
Space Temperature	X			

.5 Exhaust Fans

.1 Provide programmable start/stop control at the OWS.

.2 Provide dual voltage relays for exhaust fans rated for 120V/1/60. Install dual voltage relays in accessible ceiling space adjacent to exhaust fan.

.3 Wire through dual voltage relay or magnetic starters as indicated. Magnetic starters will be provided by Electrical Division.

.6 Existing Systems Control

.1 Provide new DDC control and components for the existing systems indicated.

.1 Existing Roof Mounted Exhaust Fans.

.7 Indoor Air Handling Units

.1 General

.1 Sequences are to meet ASHRAE Standard 36, High Performance Sequences of Operation for HVAC Systems. The BAS Contractor is responsible for full integration of the sequences, along with any additional requirements listed below.

.2 Time delays shall be provided to prevent unit short cycling.

.3 Fan status shall be reported.

.4 Units shall have a staggered start delay programmed into them for start-up on power failure.

.5 Provide the following testing and commissioning overrides via software switches: (note to writer, consider removing)

.1 Force HW valve full open if there is a hot-water coil.

.2 Force HW valve full closed if there is a hot water coil.

.2 Safeties and Limits

.1 Freeze Protection: Provide programming to ASHRAE Guideline 36 standard. There are three levels of freeze protection to be programmed into the software:

.1 If supply air temperature drops below 4.4°C (40°F) for 5 minutes, enable heating plant, override outdoor air damper position to minimum, and modulate the heat to maintain a supply air temperature of at least 6°C (42°F). Disable this function once the supply air temperature rises above 7°C (45°F) for 5 minutes.

.2 If supply air temperature drops below 3.3°C (38°F) for 5 minutes, fully close both the economizer/outdoor air damper for 1 hour and set an alarm at the OWS. After 1 hour the unit shall resume minimum outdor air ventilation and entre the previous stage of freeze protection.

.3 If supply air temperature drops below 3.3°C (38°F) for 15 minutes or below 1°C (34°F) for 5 minutes, shut down supply and return fans, close outdoor air damper, open both the chilled water valves and energize both pumping systems. Also ensure heating plant is enabled, and modulate the heating valve to maintain the higher of the supply air temperature or mixed air temperature at 27°C (80°F), and send an alarm to the OWS. The freeze protection shall remain in place until reset by a software switch at the OWS.

.4 Provide a hardwired freeze stat that must be manually reset as a final safety.

.3 System Start/Stop

.1 The unit fan may run in any mode except for unoccupied mode.

.2 The unit shall only run in setback mode if there is a perimeter zone without perimeter radiation, or after the perimeter radiation has failed to maintain set point for a minimum of 15 minutes.

.3 Provide an override switch at the OWS to enable the unit for 3 hours.

.4 Monitor units' refrigeration leak detection system. Upon signal from system:

.1 Disable any electric reheat or other sources of ignition in the ductwork system.

.2 Fully open zone dampers within the ductwork system/close bypasses.

.3 Energize all fans within the duct system/general exhaust fans in area affected.

.2 Control Strategy

.1 Provide a summation of total airflow from the VAV boxes on the graphic for the unit.

.2 Determination of AHU Mode of Operation

.1 AHU system modes are the same as the zone groups served by the system. When zone groups served by an air-handling system are in different modes, the following hierarchy applies:

.1 Occupied mode

.2 Cool down mode

.3 Setup mode

.4 Warm-up mode

.5 Setback mode

.6 Freeze Protection setback mode

.7 Unoccupied mode

.3 Static Pressure Control

.1 Static Pressure Reset. Provide static pressure reset using Trim and Respond Set-Point Logic to ASHRAE Standard 36, High-Performance Sequences of Operation. All parameters shall be adjustable by the operator at the OWS.

.2 BAS shall modulate the VFD of the supply and return fans to maintain the static pressure set point.

.3 The speed AO sent to the VFDs shall be configured such that 0% speed corresponds to 0 Hz, and 100% speed corresponds to maximum speed configured at the VFD. This does not necessarily correspond to 60 Hz.

.4 Supply Air Temperature Control

.1 The Supply Air temperature control loop is enabled at all times that the supply air fan is proven on, and disabled and output set to deadband (no heating, outdoor air damper closed) otherwise. For units with hot water heat, ensure valve is left at a minimum position of 10% open when OAT is below 4°C.

.2 Supply Air Temperature Set Point. Supply Air Temperature is to be reset and controlled to ASHRAE Guideline 36, using Trim and Respond logic. Design variables are as follows:

.1 Minimum Cooling Supply Air Temperature: 12°C (55°F)

.2 Maximum Cooling Supply Air Temperature: 18°C (65°F)

.3 OAT Minimum: 16°C (60°F)

.4 OAT Maximum: 21°C (70°F)

.3 All Trim and Respond variables and set points shall be adjustable from the OWS.

.4 During occupied mode and setup mode, the SAT set point shall be reset from Minimum Cooling Supply Air Temperature when the OAT is at OAT maximum and above, proportionally up to a maximum temperature, T-max when the outdoor air temperature is at OAT minimum and below.

.5 T-max shall be reset using Trim and Respond Logic between the minimum cooling supply air temperature and the maximum cooling supply air temperature.

.6 See controls diagram from ASHRAE Guideline 36 below:

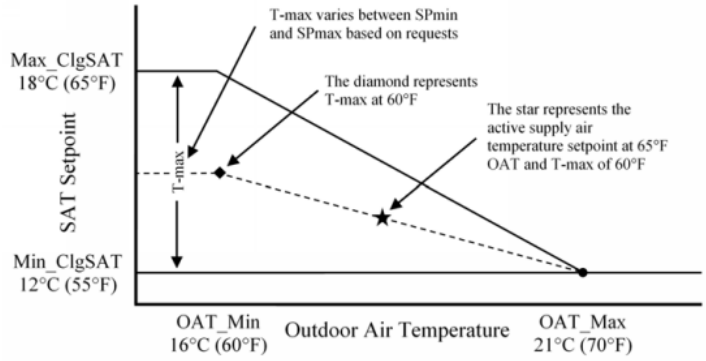


Figure 5.16.2.2 Example supply air temperature reset diagram.

.7 During the cooldown mode, the set point shall be the minimum cooling supply air temperature.

.8 During the warm-up and setback modes the set point shall be:

.1 35°C (95°F) for systems with zones without reheat.

.2 21°C (70°F) for systems with VAV reheat or perimeter heat in all zones.

.9 The supply air temperature shall be controlled to set point using a control loop whose output is mapped to sequence the heating coil, outdoor air damper, return air damper and cooling coil. The control loop shall follow ASHRAE Guideline 36 as indicated in the figure below:

.1 Economizer damper maximum position is limited for economizer high-limit lockout. Refer to high-limit logic sequences section.

.2 Modulate return and OA damper between maximum and minimum positions to control minimum outdoor air volume. Refer to minimum outdoor air logic sequences for further detail.

.3 Modulate the heating valve and cooling valve as required, without overlap to meet SAT setpoint.

.4 A graphic of the control loop is provided below. The points of transition along the x-axis are representative. Separate gains shall be provided for each section of the control map (heating coil, economizer, cooling coil) that is determined by the contractor to provide stable control. Alternatively, the contractor shall adjust the precise value of the x-axis thresholds shown to provide stable control.

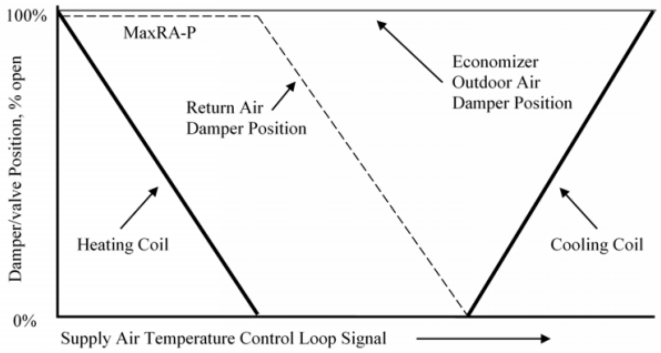


Figure 5.16.2.3-3 SAT loop mapping with return-fan control with direct building pressure controls.

.5 Minimum Outdoor Airflow Control

.1 ASHRAE Guideline 36 logic shall be modified to allow for CO2 demand control ventilation based on a CO2 reading in the return air duct.

.2 Provide a minimum outdoor air control loop which is enabled whenever the AHU is in operation and in occupied mode. Set output to zero otherwise.

.3 During occupied times:

.1 The outdoor air damper, recirculation air damper and exhaust/return fan shall modulate to maintain a ventilation set point of 1000 ppm CO2. The outdoor air damper will remain closed until a preset value of 1000 ppm is reached. Beyond that value the damper shall modulate open until a minimum value of 800 ppm is reached.

.2 In the event of CO2 reading failure the damper shall open to allow no more than 30% outdoor air (adj)

.3 Reset the CO2 setpoint up by 200 ppm with the mechanical cooling is in operation.

.4 For all other operating modes, the outdoor air damper shall be fully closed and the unit shall operate in recirculating mode.

.5 The demand for economizer operation shall override the outdoor air damper position and exhaust/return fan control.

.6 Control loop mapping shall be as follows:

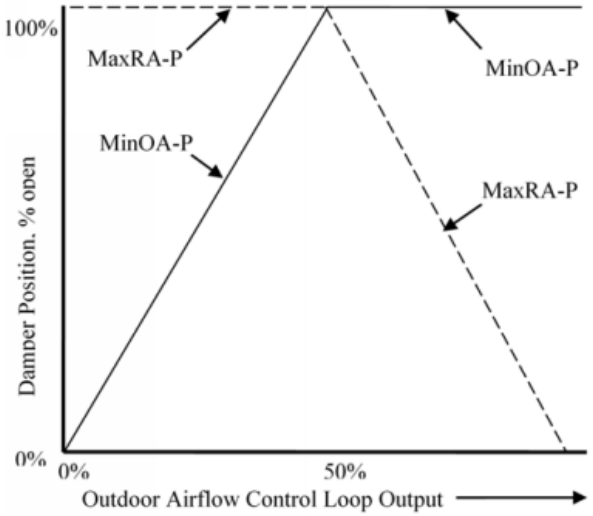


Figure 5.16.6.3 Minimum outdoor airflow control mapping with single damper.

.6 Air Side Economizer

.1 Economizer shall be disabled whenever the outdoor air dry bulb exceeds the economizer high-limit set point **of 21°C (70°F).**

.2 Economizer High Limit Lockout

.1 When the economizer is enabled, maximum outdoor air damper position is equal to 100%.

.2 Once the economizer has been disabled, it shall not be re-enabled within 10 minutes, and vice versa.

.3 When the economizer is disabled:

.1 Return air damper shall be fully opened

.2 Wait 15 seconds, then set the maximum outdoor air damper position equal to the minimum outdoor air damper position.

.3 Wait 3 minutes, then release return air damper for minimum outdoor air control.

.7 Return Fan and Building Pressure control

.1 Return fan shall operate whenever the associated supply fan is proven on, and shall be off otherwise.

.2 Return fan shall be controlled to maintain return fan discharge static pressure at set point.

.3 Exhaust dampers shall only be enabled when the associated supply and return fans are proven to be on, and the minimum outdoor air damper is open. The exhaust dampers shall be closed otherwise.

.4 The building static pressure shall be time averaged with a sliding 5-minute window to dampen fluctuations. The averaged value shall be that displayed and used for control.

.5 When exhaust dampers are enabled, a control loop shall modulate exhaust dampers in sequence with the return fan static pressure set point as indicated below to maintain the building pressure at a set point of 12 Pa (0.05 in. of water):

.1 From 0% to 50%, the building pressure control loop shall modulate the exhaust dampers from 0% to 100% open.

.2 From 51% to 100%, the building pressure control loop shall reset the return-fan discharge static pressure set point from its minimum to maximum. Static set points to be provided by the balancer.

.3 Alarms

.1 Maintenance interval alarm once fan has operated for 1500 hrs.

.2 Supply fan status/command mismatch (1 minute delay)

.3 Return fan status/command mismatch (1 minute delay)

.4 Freeze stat alarms as listed under Limits and Safeties section.

.5 Supply air temperature above 35°C (5 minute delay)

.6 Return air temperature is more than 5 degrees from space set point (5 minute delay)

.7 Unit is running and return air CO2 levels are above 800 ppm (1 hour delay)

.8 Heat wheel or other alarm is received from unit controller (immediate)

.9 Unit not cooling when commanded, as indicated by SAT (5 minute delay)

.10 Unit not heating when commanded, as indicated by SAT (5 minute delay)

.11 High Building Pressure (more than 25 Pa (0.10 in. of water)

.12 Low Building Pressure (less than 0 Pa (0.0 in of water)

.4 Points List

Name	AI	AO	DI	DO
Supply Fan Command				X
Supply Fan Speed Modulation		X		
Supply Fan Status	X			
Supply Fan Alarm			X	
Duct Static Pressure	X			
Return Fan Command				X
Return Fan Speed Modulation		X		
Return Fan Status	X			
Return Fan Alarm			X	
Hot Water Valve Modulation		X		
DX Cooling (multiple stages where required)				X
Supply Air Flow Volume	X			
Supply Air Temperature	X			
Supply Air Humidity	X			
Return Air Temperature	X			
Return Air CO2	X			
Mixed Air Temperature	X			
Mixed/Return/OA Air Damper Command		X		
Freeze Stat Status			X	
Heat Recovery Command (AHU-1 only)				X
Heat Recovery Entering Air Temp (AHU-1)	X			
Heat Recovery Leaving Air Temp (AHU-1)	X			

.8 Room VVT Control

A room sensor provides local room control.

Ventilation Mode:
The VVT damper is normally held to a minimum of 80% airflow measured by the air flow sensor adjacent to each damper, in the ventilation mode as long as the supply air temperature from the unit is within the ventilation band of the room temperature. As the room temperature goes further off setpoint (heating/cooling) the demand signal broadcast to the rooftop unit increases to request heating or cooling.

Heating Mode:
If the temperature in an individual room falls below the room heating set point and modulate the heating valve, the damper modulates open 100% to anticipate a heating demand. All other zones will also be commanded open until the heating setpoint is exceeded. Above the setpoint the VVT dampers will modulate to a minimum position (30%) to prevent overheating and heating valve modulate close. The VVT dampers are returned to the minimum of 80% airflow when the room is satisfied.

Where a reheat coil and/or radiant panel is installed, on a call for heat, the temperature control valves are energized together and modulate to maintain room set point.

Cooling Mode:
If the temperature in an individual room rises above the room cooling set point and the rooftop is supplying cooling the damper modulates open 100% to anticipate a cooling demand. All other zones will also be commanded open until the cooling setpoint is satisfied. Below the setpoint the VVT dampers will modulate to a minimum position to prevent overcooling. The VVT damper is returned to the minimum of 80% airflow when the rooftop unit's supply air temperature increases to within 3ºC (adjustable) of the ventilation band of the room temperature.

Static pressure control: the bypass damper will be modulated to maintain the static pressure (0.5" WG adjustable) as its setpoint. Mount pressure sensor at 2/3 length of supply air duct.

Provide VVT system in graphic package by systems.

Provide a duct sensor in the VAV discharge duct.

Safeties/Alarms

If the zone temperature is above or below the alarm levels (adjustable), an alarm will be sent to the BAS.

.9 Trap Primer Solenoid Valve Control

.1 Energize solenoid valve for five minutes (adj) each 24 hour period (adj) during unoccupied times.

.2 Sequence valves so that no more than two (2) valves operate at the same time.

3.7 ELECTRICAL

.1 Rules and Regulations: The entire installation shall conform to Division 16 and shall comply with the Canadian Electrical Code and all local and Provincial codes. The contractor shall obtain an ESA certificate for his work.

.2 Refer to equipment wiring schedule or electrical drawings for wiring responsibilities.

.3 Arrange for all the necessary inspections and approvals of built-up and modified control systems and relay panels by governing authorities. All electrical equipment , material , and its installation shall conform to the current requirements of the following authorities:

.1 C.S.A

.2 Ontario Hydro Safety Authority

.3 O.B.C. Building Codes / Fire Codes.

.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.

.5 Wiring: All electric wiring in connection with this project shall be furnished and installed under this section.

.1 The Contractor shall be aware that cables carrying high currents run through ceiling and wall cavities. Signal interference or sensor inaccuracy or failure caused by existing cable runs shall be the responsibility of the Contractor and shall be covered under the warranty. The Contractor shall select sensors and use shielded cable or transmitters as necessary to prevent electrical interference with the control system operation.

.2 The Contractor shall coordinate fully the interconnection of factory assembled portions of system controls, field installed control systems and the electrical power system to provide a complete working installation.

.3 Power for control equipment shall not be taken from equipment motor leads. Power shall be from circuits dedicated for controls only.

.4 Transformers shall be sized for 150% of engineered capacity.

.5 All wires are to be numbered using wire labels at each end. These labels shall correspond to wire identification on the shop drawings and "as-built" drawings.

.6 All wiring concealed in walls and chases and all exposed wiring shall be run in conduit.

.6 Electrical Isolation of I/O Points: To prevent serious damage to the field panels from surges, or RFI electrically induced spikes, protection in the following form shall be provided, as a minimum:

.1 Digital outputs singularly or collectively shall be galvanically isolated from the main panel processor.

.2 Analog outputs shall be galvanically isolated from each other and the main panel processor.

.3 Digital inputs shall be galvanically isolated from the main panel processor.

.7 Panel Documentation: Mount an input/output layout sheet within each controller field panel. This sheet shall include the name of the points connected to each controller channel.

.8 Conduits: All wiring in finished areas shall be concealed. All exposed wiring, whether for power, sensors, actuators, or data communications, shall be in metallic conduit. This includes all wiring runs in and around rooftop HVAC units. All conduits shall have a minimum inside diameter of 13mm.

.1 All conduits shall be installed out of the way in traffic areas, and parallel to the lines of the building. Flexible conduit may be used only in areas of vibration or expansion joints. All conduits shall be supported at least every 4 feet.

Supports shall be located at each connector end of each conduit. High and low voltage wire shall not be run in the same conduit.

Only wires of similar purpose shall be run in the same conduit; i.e. sensor or control, power, and communication wire shall be in separate conduit.

.9 Pull Boxes and Junction Boxes: Pull boxes shall be located at a minimum spacing of 30m. The contractor is responsible for getting approvals from the Owner for locating pull boxes. Pull boxes shall comply with the Canadian Electrical Code. All boxes shall be clearly marked as part of the automated control system.

.10 Enclosures: All enclosures shall be mounted such that the doors can open fully without interference with new or existing equipment. Except where expressly permitted in writing by the Owner or Engineer, enclosures shall be mounted in easily accessible locations where a technician can clearly see and easily access all components inside without a stool or ladder.

.11 Power Protection: During the warranty period, the Contractor shall be responsible for parts and labour to repair or replace any system equipment damaged by power quality problems (spikes, sags, waveform anomalies, etc.). with that in mind, the Contractor shall provide appropriate power protection.

.12 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.

.13 It is the responsibility of this contractor to provide dedicated 120 V, power from the spare breaker for the automation system from the nearest electrical panel. Provide typewritten information on panel directory.

3.8 RELIABLE BAS DATABASE NAMING CONVENTIONS AND PROGRAMS

.1 Programs Architecture

.1 All BAS programs shall be created in each panel in logical order as determined by the equipment being controlled by each panel on the network. The Outdoor Air Temperature Program shall be in its own program named OAT PG.

.2 The programs shall be created in the following order:

.1 Air Handlers Example: Common for all air handlers and rooftop air handlers.

AH # Start PG – contains all start stop parameters for the air handler.

AH # Setpoint PG – contains all setpoint calculations for the specific air handler.

AH # Control PG – contains all control points for the air handler for both occupied and unoccupied modes.

AH # Zone Setpoint PG – contains all setpoint calculations and limitations for zones serviced by the air handler.

AH # Zone Feedback PG – contains calculation of zone temperature averages, coldest and warmest spaces.

All Rooftop air handlers shall start with the letters RT in the naming conventions.

.2 Boilers, Pumps, and Hydronic Heating Systems Examples:

Heating Enable PG – contains all enable/disable calculations for the entire heating system.

Heating Setpoint PG – contains all setpoint calculations for scheduled water temperatures for both occupied and unoccupied periods.

Heating Control PG – contains control strategies for all heating equipment controlled from the panel.

Pump Control PG – contains control strategies for circulation pumps including pump cycle when heating system is not enabled.

.3 Specialty and Miscellaneous Equipment Programs – specialty equipment with more than three (3) control points, shall be controlled in a separate program and shall be named according to the devices the program controls. The programs for specialty equipment shall be named the following the examples for air handlers and Heating equipment. Miscellaneous equipment with less than three (3) control points may be placed in a program called Misc. PG, and should contain all control parameters in the programs.

.4 Alarm Programs – Each Panel shall have an alarm program for General Warning alarms named P# Alarm PG, and an alarm program for Critical Alarms, named P# Critical PG. The alarms being sent to central monitoring shall be in the panel where the output is connected to the security panel and the programming to activate the Remote Alarm shall be in its own program named Remote Alarm PG.

.5 Point Naming Inputs & Outputs – The listings indicated below are the most common inputs and outputs used in system. Equipment not listed should always indicate clearly the equipment system, function and location in the name if possible. Point naming conventions shall be in upper and lower case for easier readability.

.1 Air Handler Systems Name Conentions

INPUTS **OUTPUTS**

Equipment	Point Name		Equipment	Point Name
Supply Fan Status	AH# SF Status		Supply Fan Control	AH# SF Control
Return Fan Status	AH# RF Status		Return Fan Control	AH# RF Control
Supply Fan Speed Status	AH# SF Spd St		Supply Fan Speed Control	AH# SF Spd Ctrl
Return Fan Speed Status	AH# RF Spd St		Return Fan Speed Control	AH# RF Spd Ctrl
Supply Air Temperature	AH# Supply Temp		Damper Control	AH# Mixed Air Dmpr
Return Air Temperature	AH# Return Temp		Coil Heating Valve Control	AH# Heating Valve
Mixed Air Temperature	AH# Mixed Temp		Cooling Coil Valve Control	AH# Cooling Valve
Return Air C02	AH# Return C02		DX Cooling Stage Control	AH# DX# Control
Air Handler Coil Pump Status	AH# P# Status		Air Handler Coil Pump Control	AH# P# Control
Air Handler Filter Status	AH# Filter		Reclaim Damper Control	AH# Reclaim Dmpr
Air Handler Freezestat Status	AH# Freeze		Reclaim Valve Control	AH# Reclaim Vlv
Reclaim Pump Status	AH# RclP# Stat		Reclaim Pump Control	AH# RclP# Ctrl
Reclaim Temperature Air Entering	AH# Rcl In Temp			
Reclaim Temperature Air Leaving	AH# Rcl Out Temp			
Reclaim Supply Fluid Temperature	AH# Rcl SW Temp			
Reclaim Return Fluid Temperature	AH# Rcl RW Temp			
Duct Pressure	AH# Duct Press			
Building Pressure	Bldg Pressure			

.2 Heating Systems Naming Conventions

INPUTS **OUTPUTS**

Equipment	**Point Name**		**Equipment**	**Point Name**
Boiler Status	Blr# Status		Boiler Control	Blr# Control
Outdoor Air Temperature 1	OAT1		Boiler Stage Control	Blr# Stg# Ctrl
Outdoor Air Temperature 2	OAT2		Boiler Modulation	Blr# Modulation
Boiler Pump Status	Blr P# Status		Boiler Pump Control	Blr# P# Control
Heating Pump Status	Heating P# Status		Heating Pump Control	Heating P# Control
Glycol Pump Status	Glycol P# Status		Glycol Pump Control	Glycol P# Control
Heating System Pressure	Htg Pressure		Heating Valve Control	Htg Valve Ctrl
Glycol System Pressure	Gly Pressure			
Heating Supply Water Temperature	Htg Supply Temp			
Heating Return Water Temperature	Htg Return Temp		Heating Differential Pressure Valve	Heating DP Valve
Glycol Supply Water Temperature	Gly Supply Temp		Heat Exchanger Control Valve	HX Vlv Control
Glycol Return Water Temperature	Gly Return Temp			

.3 Lighting Equipment Naming Conventions

INPUTS			OUTPUTS	
Equipment	**Point Name**		**Equipment**	**Point Name**
Outdoor Photocel	Outdoor Light Levels		Outdoor Light Control	Outdoor Ltg Ctrl
Outdoor Light Override	O/S Lgt Override			
Room Motion Sensor	Rm# Motion		Room Lighting Control	Rm# Ltg Ctrl
Corridor Motion Sensor	Corr# Motion		Corridor Lighting Control	Corr# Ltg Ctrl

.4 Miscellaneous Equipment Naming Convetions

INPUTS			OUTPUTS	
Equipment	**Point Name**		**Equipment**	**Point Name**
Exhaust Fan Status	EF# Status		Exhaust Fan Control	EF# Control
Domestic Hot Water Recirc Pump Status	DHW P# Status		Dom Hot Water Pump Control	DHW P# Control
Urinal Motion Detector	Ur Rm# Motion		Urinal Flush Control	Ur Rm# Control
Electrical Meter	Elect Meter			
Water Meter	Water Meter		Main Water Valve Control	Main Water Vlv
Gas Meter	Gas Meter			
Sump Level Alarm	Sump Alarm			
Area Water Flush Flow	East DWater Flow		Area Domestic Water Flush Control	East DW Flush Ctrl
			Area Flush Flow Alarm Light	East Flush Alarm
Building Security Status	Bldg Security		Building Remote Alarm	Bldg Remote Alarm
Building Override	Bldg Override			

.5 Network Status Panel Naming Conventions should indicate the school, panel location, and panel number. The school name can be abbreviated as necessary to fit the space.

3.9 POINTS LIST

.1 The points list appended here to shall be read in conjunction with the drawings and specification. Should the control functions be indicated in the specification and not indicated on the points list or indicated in the points list and not in the specification, it does not relieve in the contractor in provide a complete system. It is the contractor's responsibility to ensure the BAS system is installed and operates as specified.

END OF SECTION

Lydia Trull PS Points List							
CONTROL POINTS	**DEVICE**	**DO**	**DI**	**AO**	**AI**	**Override Switch**	**Location**
SF-1 Control	On/Off	1					Mechanical Room
SF-1 Status	On/Off		1				Mechanical Room
SF-1 Speed Reference	2-10 VDC Control			1			Mechanical Room
SF-1 Alarm	On/Off		1				Mechanical Room
RF-1 Control	On/Off	1					Mechanical Room
RF-1 Status	On/Off		1				Mechanical Room
RF-1 Speed Reference	2-10 VDC Control			1			Mechanical Room
RF-1 Alarm	On/Off		1				Mechanical Room
OA Damper	2-10 VDC Control			1			Mechanical Room
RA Damper	2-10 VDC Control			1			Mechanical Room
EA Damper	2-10 VDC Control			1			Mechanical Room
Heat Recovery Damper	2-10 VDC Control			2			Mechanical Room
Freeze Stat Sensor	Averaging Sensor		1				Mechanical Room
Space Temperature Sensor	Duct Temp Sensor				1		Mechanical Room
Heating Control Valve (EOC)	2-10 VDC Control			1			Mechanical Room
Cooling Stages	On/Off	6					Roof
Space Sensor	Space Sensor				1		Refer to Plan
Space CO2 Sensor	Space CO2 sensor				1		Refer to Plan
SF-2 Control	On/Off	1					Mechanical Room
SF-2 Status	On/Off		1				Mechanical Room
SF-2 Speed Reference	2-10 VDC Control			1			Mechanical Room
SF-2 Alarm	On/Off		1				Mechanical Room
RF-2 Control	On/Off	1					Mechanical Room
RF-2 Status	On/Off		1				Mechanical Room
RF-2 Speed Reference	2-10 VDC Control			1			Mechanical Room
RF-2 Alarm	On/Off		1				Mechanical Room

Lydia Trull PS Points List							
CONTROL POINTS	**DEVICE**	**DO**	**DI**	**AO**	**AI**	**Override Switch**	**Location**
OA Damper	2-10 VDC Control			1			Mechanical Room
RA Damper	2-10 VDC Control			1			Mechanical Room
EA Damper	2-10 VDC Control			1			Mechanical Room
Freeze Stat Sensor	Averaging Sensor		1				Mechanical Room
Space Temperature Sensor	Duct Temp Sensor				1		Mechanical Room
Heating Control Valve (EOC)	2-10 VDC Control			1			Mechanical Room
Cooling Stages	On/Off	6					Roof
Space Sensor	Space Sensor				1		Refer to Plan
Space CO2 Sensor	Space CO2 sensor				1		Refer to Plan
SF-3 Control	On/Off	1					Mechanical Room
SF-3 Status	On/Off		1				Mechanical Room
SF-3 Speed Reference	2-10 VDC Control			1			Mechanical Room
SF-3 Alarm	On/Off		1				Mechanical Room
RF-3 Control	On/Off	1					Mechanical Room
RF-3 Status	On/Off		1				Mechanical Room
RF-3 Speed Reference	2-10 VDC Control			1			Mechanical Room
RF-3 Alarm	On/Off		1				Mechanical Room
OA Damper	2-10 VDC Control			1			Mechanical Room
RA Damper	2-10 VDC Control			1			Mechanical Room
EA Damper	2-10 VDC Control			1			Mechanical Room
Freeze Stat Sensor	Averaging Sensor		1				Mechanical Room
Space Temperature Sensor	Duct Temp Sensor				1		Mechanical Room
Heating Control Valve (EOC)	2-10 VDC Control			1			Mechanical Room
Cooling Stages	On/Off	6					Roof
Space Sensor	Space Sensor				1		Refer to Plan
Space CO2 Sensor	Space CO2 sensor				1		Refer to Plan
Mechanical Room Outdoor Air damper	On/Off	1					Mechanical Room

Division 26 Common Requirements for Electrical

Division 28 Electronic Safety and Security

END OF SECTION

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Part 1 General

1.1 INSTRUCTIONS TO BIDDERS

.1 The Electrical Supplemental Tender Form must be submitted to the consultant (admin@deiassociates.ca) within 2 hours of tender closing. Electrical contractors shall identify all sub-contractors he/she intends to use and must complete all information requested. The requisite information shall be given at the office of the Consultant. Contractor shall sign and date this page and initial and date each page thereafter.

.2 Should the Electrical Supplemental Form not be submitted then the contractor shall use Basis of Design manufacturers as listed.

.3 CONTRACTOR

I/We certify that I/We have the authority to bind the company.

COMPANY NAME	AUTHORIZED SIGNATURE
ADDRESS	PRINTED SIGNATURE
CITY	TITLE
TELEPHONE NUMBER	DATE
FAX	

.4 SUB-CONTRACTORS

The Contractor shall state below the name of the Public Address, Security, Co-ordination Study, Computer Network, Life Safety Systems Commissioning Agent Sub-contractor he intends to use, which shall not be changed without the consent of the Consultant.

Life Safety Systems Commissioning Agent _____

.5 The Stipulated Bid Sum shall be for the basis of design manufacturer or supplier equipment only, unless otherwise indicated. Where a choice of this equipment is given, this Contractor shall indicate the supplier or manufacturer he intends to use. Where no choice is indicated, the basis of design supplier or equipment shall be used.

.6 Equipment or materials manufactured by firms named in the following listing only shall be deemed equal to the equipment or material specified, provided the equipment or material will have capacity, performance, rating, construction, physical dimensions, accessories and features which, in the opinion of the Consultant, are equal to those of the specified equipment or material. The Electrical Contractor shall not indicate equipment, materials or suppliers which are not listed.

.7 Where modifications to the work of other trades are required as a result or part of the alternative offered, include the cost of said modifications in the work.

.8 Submit the following list of basis of design and alternative suppliers in accordance with the bid requirements:

Spec. Reference Section	**Equipment**	**Basis of Design**	**Acceptable Alternate Manufacturer**	**Indicate Manufacturer Or Supplier**
26 29 13.13	Starters and Contactors	Schneider Electric	Allen Bradley Siemens Eaton Klockner-Moeller	
26 28 16	Disconnect Switches	Schneider Electric	Siemens Eaton	
26 28 13	Fuses – Low Voltage	Mersen	GEC Littlefuse	
28 31 24	Fire Alarm System (addressable panel with conventional devices)	Existing Simplex 4100U addressable panel		

.9 LABOUR RATES

.1 The following labour rates shall apply for calculating the cost of credit or extras on Change Notices. The rates shall include any employee benefits. The labour rates do not include overhead and profit.

Apprentice Electrician	$_____/hr
Journeymen Electrician	$_____/hr

END OF SECTION

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Part 1 General

1.1 GENERAL

.1 This Section covers items common to Electrical Division 26, as well as Division 27 and Division 28.

.2 This section supplements requirements of Division 1.

.3 Furnish labour, materials, and equipment necessary for completion of work as described in contract documents.

1.2 INTENT

.1 Mention herein or indication on Drawings of articles, materials, operations, or methods requires: supply of each item mentioned or indicated, of quality, or subject to qualifications noted; installation according to conditions stated: and, performance of each operation prescribed with furnishing of necessary labour, equipment, and incidentals for electrical work.

.2 Where used, words “Section” and “Division” shall also include other Subcontractors engaged on site to perform work to make building and site complete in all respects.

.3 Where used, word “supply” shall mean furnishing to site in location required or directed complete with accessory parts.

.4 Where used, word “install” shall mean secured in place and connected up for operation as noted or directed.

.5 Where used, word “provide” shall mean supply and install as each is described above.

1.3 TENDERS & BONDING

.1 Complete Supplemental Tender Form including list of equipment and materials to be used on this project and forming part of tender documents.

.2 Submit Supplemental Tender Form as noted.

.3 Submit tender based on specified described equipment or Alternates listed.

.4 State in Tender, names of all Subcontractors proposed for work under this Division.

1.4 LIABILITY INSURANCE

.1 This contractor must maintain and produce at the request of the consultant proof of proper insurance to fully protect the owner, the consultant and the contractor from any and all claims due to accidents, misfortunes, acts of God, etc.

1.5 ELECTRICAL SAFETY AUTHORITY

.1 The contractor is to determine general inspection fees with Electrical Safety Authority and include as part of tender.

.2 A submission has been made (if required by this scope of project) by the consultant to the Electrical Safety Authority for review of this project. The payment of the required review costs will be coordinated by the consultant. A copy of the Electrical Safety Authority review report will be forwarded to the successful contractor for information and action. Contractor will not be responsible for these review costs.

1.6 DRAWINGS

.1 Electrical Drawings do not show structural and related details. Take information involving accurate measurement of building from building drawings, or at building. Make, without additional charge, any necessary changes or additions to runs of conduits and ducts to accommodate structural conditions. Location of conduits and other equipment may be altered by the consultant without extra charge provided change is made before installation and does not necessitate major additional material.

.2 As work progresses and before installing fixtures and other fittings and equipment which may interfere with interior treatment and use of building, provide detail drawings or obtain directions for exact location of such equipment and fitments.

.3 Electrical drawings are diagrammatic. Where required work is not shown or only shown diagrammatically, install same at maximum height in space to conserve head room (minimum 2200 mm (88") clear) and interfere as little as possible with free use of space through which they can pass. Conceal wiring, conduits and ducts in furred spaces, ceilings and walls unless specifically shown otherwise. Install work close to structure so furring will be small as practical.

.4 Before commencing work, check and verify all sizes, locations, grades, elevations, levels and dimensions to ensure proper and correct installation. Verify existing/municipal services.

.5 Locate all electrical equipment in such a manner as to facilitate easy and safe access to and maintenance and replacement of any part.

.6 In every place where there is indicated space reserved for future or other equipment, leave such space clear, and install services so that necessary installation and connections can be made for any such apparatus. Obtain instructions whenever necessary for this purpose.

.7 Relocate equipment and/or material installed but not co-ordinated with work of other Sections as directed, without extra charge.

.8 Where drawings are done in metric and product not available in metric, the corresponding imperial trade size shall be utilized.

1.7 INTERFERENCE AND CO-ORDINATION DRAWINGS

.1 Prepare interference and equipment placing drawings to ensure that all components will be properly accommodated within the constructed spaces provided.

.2 Prepare drawings to indicate co-ordination and methods of installation of a system with other systems where their relationship is critical. Ensure that all details of equipment apparatus, and connections are co-ordinated.

.3 Ensure that clearances required by jurisdictional authorities and clearances for proper maintenance are indicated on drawings.

.4 Upon consultant's request submit copies of interference drawings to the consultant.

.5 Due to the nature of the building and the complexity of the building systems provide the following:

.1 Interference drawings, showing coordination of architectural, structural, mechanical, and electrical systems for the consultant's review prior to fabrication.

.2 Detailed equipment room drawings clearly showing all distribution equipment.

.3 Detailed layout drawings clearly showing conduit/feeder runs 78mm diameter or larger, including hangers or tray.

.6 Provide CAD drawings (minimum file version AutoCAD 2013) in addition to hard copies.

1.8 QUALITY ASSURANCE

.1 The installations of the division must conform to the latest edition of the Electrical Safety Code as well as its supplemental bulletins and instructions. Provide materials and labour necessary to comply with rules, regulations, and ordinances.

.2 Complete underground systems in accordance with CSA C22.3 No. 7-94 except where specified otherwise.

.3 Abbreviations for electrical terms: to CSA Z85-1983.

.4 In case of differences between building codes, provincial laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Promptly notify consultant in writing of such differences.

1.9 ALTERNATES AND SUBSTITUTIONS

.1 Throughout these sections are lists of "Alternate Equipment" manufacturers acceptable to consultant if their product meets characteristics of specified described equipment.

.2 Each bidder may elect to use "Alternate Equipment" from lists of Alternates where listed. Include for any additional costs to suit Alternated used. Prices are not required in Tender for Alternates listed except where specifically noted as "Separate Price". Complete the Supplementary Tender Form.

.3 When two or more suppliers/manufacturers are named in the Bid Documents, only one supplier/manufacturer of the products named will be acceptable; however, it is the responsibility of this Division to ensure "Alternate Equipment" fits space allocated and gives performance specified. If an "Alternate Equipment" unit is proposed and does not fit space allotted nor equal specified product in consultant's opinion, supply of specified described equipment will be required without change in Contract amount. Only manufacturers listed will be accepted for their product listing. All other manufacturers shall be quoted as substitution stating conditions and credit amount.

.4 If item of material specified is unobtainable, state in Tender proposed substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after Contract has been awarded.

1.10 EXAMINATION

.1 Site Reviews

.1 Examine premises to understand conditions, which may affect performance of work of this Division before submitting proposals for this work.

.2 No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.

.2 Drawings:

.1 Electrical Drawings show general arrangement of fixtures, power devices, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.

.2 Consider Architectural, Mechanical, and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over Electrical Drawings.

.3 Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.

.3 Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.

1.11 SEQUENCING AND SCHEDULING

.1 It is understood that while Drawings are to be followed as closely as circumstances permit, this Division will be held responsible for installation of systems according to the true intent and meaning of Contract Documents. Anything not clear or in conflict will be explained by making application to consultant. Should conditions arise where certain changes would be advisable, secure consultant's approval of these changes before proceeding with work.

.2 Coordinate work of various trades in installing interrelated work. Before installation of electrical items, make proper provision to avoid interferences in a manner approved by consultant. Changes required in work specified in these sections caused by neglect to do so shall be made at no cost to owner.

.3 Arrange fixtures, conduit, ducts, and equipment to permit ready access to junction boxes, starters, motors, control components, and to clear openings of doors and access panels.

.4 Furnish and install inserts and supports required by these sections unless otherwise noted. Furnish sleeves, inserts, supports, and equipment that are an integral part of other Divisions of the Work to Sections involved in sufficient time to be built into construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location or installation of items above shall be borne by the electrical trade.

.5 Adjust locations of ducts, conduits, equipment, fixtures, etc, to accommodate work from interferences anticipated and encountered. Determine exact route and location of each conduit and duct prior to installation.

.1 Make offsets, transitions, and changes in direction of ducts, and electrical raceways as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.

.2 Supply and install pull boxes, etc, as required to effect these offsets, transitions, and changes in direction.

1.12 REQUEST FOR INFORMATION (RFI) PROCEDURES

.1 RFIs shall be submitted to the consultant minimum two (2) weeks prior to answer being required. Failure to submit and RFI in a timely manner will forfeit delay claims and schedule extension requests by the contractor.

.2 All RFIs will be submitted with the following information:

.1 RFI number

.2 Name of project

.3 Date of initiation

.4 Date response required by (minimum two (2) weeks)

.5 Subject

.6 Submitter's name

.7 Drawing/specification reference

.8 Photograph of the issue (if applicable)

.9 Description of the issue

.10 Contractor's proposed resolution

1.13 DRAW BREAKDOWN

.1 This contractor MUST submit a breakdown of the tender price into classifications to the satisfaction of the consultant, with the aggregate of the breakdown totaling the total contract amount. **Each item must be broken out into material and labour costs.** Progress claims, when submitted are to be itemized against each item of the draw breakdown. This shall be done in table form showing contract amount, amount this draw, total to date, % complete and balance.

.2 Breakdown shall be as follows:

.1 Permits and fees

.2 Mobilization (maximum 1%)

.3 Demolition

.4 Branch conduits

.5 Feeder cables

.6 Branch wiring

.7 Fire alarm system

.8 Starters, contactors and control devices

.9 Wiring for mechanical equipment

.10 Integrated Life Safety System Testing

.11 Electrical contractor closeout requirements (minimum of 3% but not less than $5,000.00)

.3 The breakdown must be approved by the consultant prior to submission of the first draw.

.4 Breakdowns not complying to the above will not be approved.

.5 Breakdown must indicate total contract amount.

.6 Mobilization amount may only be drawn when all required shop drawings have been reviewed by the consultant.

1.14 SHOP DRAWINGS AND PRODUCT DATA

.1 General

.1 Furnish complete catalog data for manufactured items of equipment to be used in the work to consultant for review within 14 days after award of Contract.

.2 Upon receipt of reviewed shop drawing, product is to be ordered immediately.

.3 Provide a complete list of shop drawings to be submitted prior to first submission.

.4 Before submitting to the consultant, review all shop drawings to verify that the products illustrated therein conform to the Contract Documents. By this review, the contractor agrees that it has determined and verified all field dimensions, field construction criteria, materials, catalogue numbers, and similar data and that it has checked and coordinated each shop drawing with the requirements of the work and of the Contract Documents. The contractor's review of each shop drawings shall be indicated by stamp, date and signature of a qualified and responsible person possessing by the appropriate authorization.

.5 If material or equipment is not as specified or submittal is not complete, it will be rejected by consultant.

.6 Additional shop drawings required by the contractor for maintenance manuals, site copies etc., shall be photocopies of the "reviewed" shop drawings. All costs to provide additional copies of shop drawings shall be borne by the contractor.

.7 **Submit all shop drawings for the project as a package. Partial submittals will not be accepted**.

.8 Catalog data or shop drawings for equipment, which are noted as being reviewed by consultant or his engineer shall not supersede Contract Documents.

.9 Review comments of consultant shall not relieve this Division from responsibility for deviations from Contract Documents unless consultant's attention has been called to such deviations in writing at time of submission, nor shall they relieve this Division from responsibility for errors in items submitted.

.10 Check work described by catalog data with Contract Documents for deviations and errors.

.11 Shop drawings and product data shall show:

.1 Mounting arrangements.

.2 Operating and maintenance clearances. e.g. access door swing spaces.

.12 Shop drawings and product data shall be accompanied by:

.1 Manufacturer test data where requested.

.2 Manufacturer to certify as to current model production.

.3 Certification of compliance to applicable codes.

.13 State sizes, capacities, brand names, motor HP, accessories, materials, gauges, dimensions, and other pertinent information. List on catalog covers page numbers of submitted items. Underline applicable data.

.14 If a shop drawing is returned "reviewed as noted" this contractor must provide written indication that the comments have been complied with.

.15 A partial list of shop drawings includes:

.1 Fire alarm system

.2 Starters, contactors and control devices

.3 Firestopping materials

.4 Fuses

.5 Roof cone

.6 Integrated Life Safety System Testing Plan (ITP)

.2 Submissions shall be submitted electronically as per the following directions:

.1 Electronic Submissions:

.1 Electronically submitted shop drawings shall be prepared as follows:

.1 Use latest software to generate PDF files of submission sheets.

.2 Scanned legible PDF sheets are acceptable. Image files are not acceptable.

.3 PDF format shall be of sufficient resolution to clearly show the finest detail.

.4 PDF page size shall be standardized for printing to letter size (8.5"x11"), portrait with no additional formatting required by the consultant. Submissions requiring larger detail sheets shall not exceed 11"x17".

.5 Submissions shall contain multiple files according to section names as they appear in Specification.

.6 File names shall include consultant project number and description of shop drawing section submitted.

.7 Each submission shall contain an index sheet listing the products submitted, indexed in the same order as they appear in the Specification. Include associated PDF file name for each section.

.8 On the shop drawing use an “electronic mark” to indicate what is being provided.

.9 **Each file shall bear an electronic representation of the “company stamp” of the contractor. If not stamped the file submission will not be reviewed.**

.2 Email submissions shall include subject line to clearly identify the consultants’ project number and the description of the shop drawings submitted.

.3 Electronic attachments via email shall not exceed 10MB. For submissions larger than 10MB, multiple email messages shall be used. Denote related email messages by indicating “1 of 2” and “2 of 2” in email subject line for the case of two messages.

.4 Electronic attachments via web links (URL) shall directly reference PDF files. Provide necessary access credentials within link or as username/password clearly identified within body of email message.

.5 On site provide one copy of the “reviewed” shop drawings in a binder as noted above.

.6 Contractor to print copies of “reviewed” shop drawings and compile into maintenance manuals in accordance with requirements detailed in this section.

1.15 CARE, OPERATION AND START-UP

.1 Instruct consultant and operating personnel in the operation, care and maintenance of equipment.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.16 VOLTAGE RATINGS

.1 Operating voltages: to CAN3-C235-83.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.17 PERMITS, FEES AND INSPECTION

.1 A submission has been made (if required by this scope of project) by the consultant to the Electrical Safety Authority for review of this project. The payment of the required review costs will be co-ordinated by the consultant. A copy of the Electrical Safety Authority review report will be forwarded to the successful contractor for information and action.

.2 The contractor is required to include in his tender all required inspection costs by the Electrical Safety Authority. Permit application is the responsibility of the contractor.

.3 Reproduce drawings and specifications required by Electrical Safety Authority at no cost.

.4 Notify consultant of changes required by Electrical Safety Authority prior to making changes.

.5 Furnish Certificates of Acceptance to consultant from Electrical Safety Authority and other authorities having jurisdiction upon completion of work.

.6 This contractor must furnish any certificates required to indicate that the work completed conforms with laws and regulations of authorities having jurisdiction.

1.18 ADDITIONAL INSTALLED EQUIPMENT

.1 The electrical contractor is to review all specification sections forming part of the electrical bid documents and include additional equipment or components, as well as all associated installation costs and testing costs as noted, in the electrical bid price.

1.19 MATERIALS AND EQUIPMENT

.1 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Safety Authority.

.2 Factory assemble control panels and component assemblies.

1.20 ELECTRIC MOTORS, EQUIPMENT, AND CONTROLS

.1 Supplier and installer responsibility is indicated in the Equipment Wiring Schedule on electrical drawings.

.2 Control wiring and conduit is specified in the Electrical specifications except for conduit, wiring and connections below 50 V, which are related to control systems specified in the Mechanical specifications.

1.21 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint indoor switchgear and distribution enclosures light grey.

.2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

.3 Clean and prime exposed non-galvanized hangers, racks, fastenings, and conduits etc. to prevent rusting.

1.22 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates as follows:

.2 Nameplates:

.1 Lamicoid 3 mm (1/8") thick plastic engraving sheet, black face, white core, mechanically attached with self tapping screws.

NAMEPLATE SIZES

Size 1	9 mm x 50 mm (3/8" x 2")	1 line	3 mm (1/8") high letters
Size 2	12 mm x 70 mm (1/2" x 2 1/2")	1 line	5 mm (3/16") high letters
Size 3	12 mm x 70 mm (1/2" x 2 1/2")	2 lines	3 mm (1/8") high letters
Size 4	20 mm x 90 mm (3/4" x 3 1/2")	1 line	9 mm (3/8") high letters
Size 5	20 mm x 90 mm (3/4" x 3 1/2")	2 lines	5 mm (3/16") high letters
Size 6	25 mm x 100 mm (1" x 4")	1 line	12 mm (1/2") high letters
Size 7	25 mm x 100 mm (1" x 4")	2 lines	6 mm (1/4") high letters

.3 Wording on nameplates labels to be approved by consultant prior to manufacture.

.4 Allow for average of twenty-five (25) letters per nameplate.

.5 Identification to be English.

.6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.7 Nameplates for disconnects, starters and contactors must indicate equipment being controlled and voltage.

.8 Nameplates for transformers must indicate transformer label as indicated and capacity, primary, and secondary voltages.

1.23 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour code: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

1.24 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m (45') intervals.

.3 Colour bands must be 25 mm (1") wide.

	Prime
up to 208 V	yellow
209 to 600 V	white
Fire alarm	red

.4 This contractor must paint all system junction boxes and covers in conformance with the above schedule.

1.25 PROTECTION OF OPENINGS

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

1.26 WIRING TERMINATIONS

.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

1.27 MANUFACTURERS AND CSA LABELS

.1 All labels must be visible and legible after equipment is installed.

1.28 WARNING SIGNS

.1 To meet requirements of Electrical Safety Authority and consultant.

.2 Provide porcelain enamel signs, with a minimum size of 175 mm x 250 mm (7" x 10").

1.29 LOCATION OF OUTLETS

.1 Do not install outlets back-to-back in wall; allow minimum 150 mm (6") horizontal clearance between boxes.

.2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3 m (10'), and information is given before installation.

.3 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

1.30 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise. Coordinate with block coursing (if applicable).

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.

.1 Local switches: 1100 mm (43.3").

.2 Wall receptacles:

.1 General: 400 mm (16").

.2 Above top of continuous baseboard heater: 200 mm (8").

.3 Above top of counters or counter splash backs: 100 mm (4").

.4 In mechanical rooms: 1200 mm (48").

.3 Voice/Data outlets: At height of adjacent outlet or at 400 mm (16").

.4 Thermostat: 1200 mm (3'-11").

1.31 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete shall be schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm (2") beyond either side.

.2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

1.32 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings as indicated on drawings or as determined from co-ordination study.

.2 Electrical connections to all equipment requiring connection to the electrical distribution system as part of this electrical tender have been specified according to the anticipated equipment manufacturer electrical requirements and the applicable sections of the OESC. This contractor must coordinate electrical connections to all equipment specified to be connected as part of this electrical tender.

.3 Prior to submitting electrical distribution shop drawings to the consultant, review all shop drawings for all equipment specified for connection to the electrical distribution system to verify that the product electrical connection requirements listed by the manufacturer conform to the equipment electrical connections specified on the electrical design drawings and specifications. Make necessary revisions to breaker ratings associated with the review of all product shop drawings and identify such changes as part of the electrical distribution equipment shop drawing submission.

.4 Prior to making final equipment connections, this electrical contractor shall examine equipment nameplates at the project site to confirm voltage and phase requirements, minimum circuit ampacity and maximum overcurrent protection values, and bring to the attention of the consultant in writing any connection requirements which may vary from the designed connections or approved electrical distribution shop drawings. No subsequent allowance for time or money for changes to breaker or wire and conduit sizes will be considered for any consequence related to failure to examine site conditions.

1.33 GUARANTEE AND WARRANTY

.1 At ready for takeover of this project this Contractor must provide a written guarantee indicating that any defects, not due to ordinary wear and tear or improper use which occur within the first year from the date of ready for takeover will be corrected at the contractors expense.

.2 If the electrical sub-contractor's office is 50 kilometers (30 miles) or more from the project site, the sub-contractor is to provide a service/warranty work agreement for warranty period with a local electrical sub-contractor approved by consultant. Include copy of service/warranty agreement in warranty section of operation and maintenance manual.

.3 Warranty period shall start from date of ready for takeover completion.

.4 Refer to individual specification sections for information on any special manufacturer's equipment warranties.

1.34 SYSTEM START UP

.1 Provide consultant with written notice verifying all equipment operation and installation is complete prior to scheduled start-up period.

.2 Start up shall be in presence of the following: owner or representative, contractor, and manufacturer's representative. Each person shall witness and sign off each piece of equipment. Consultant's attendance will be determined by consultant.

.3 Arrange with all parties and provide 72 hours notice for start up procedure.

.4 Simulate system start up and shut down and verify operation of each piece of equipment.

.5 These tests are to demonstrate that the systems and equipment installed are operational as specified.

.6 The contractor must describe during the start up session the required maintenance for each piece of equipment according to the manufacturer.

.7 The contractor must provide all necessary tools (including a digital multimeter) to successfully complete the start up procedure.

1.35 OPERATION AND MAINTENANCE MANUAL

.1 Provide operation and maintenance data for incorporation into manual as specified in other Sections of this Division.

.2 Operation and maintenance manual to be approved by, and final copies deposited with, consultant before final inspection.

.1 Submit 1 copy of Operation and Maintenance Manual to consultant for approval. Submission of individual data will not be accepted unless so directed by consultant. Submission can be done electronically in pdf format.

.1 Electronic submission/pdf file is required to be bookmarked. Any submission received without bookmarking will be immediately returned as unacceptable.

.2 Make changes as required and re-submit as directed by consultant.

.3 Each manual must include (in "tabbed" sections) the following:

.1 Index

.2 List of General, Mechanical, Electrical Contractors and all associated sub-contractor names, addresses and contact numbers.

.3 List of suppliers and equipment wholesalers local to the project.

.4 Letter of contractor's warranty and guarantee for all parts, equipment and workmanship.

.5 List of manufacturers, spare parts list and source.

.6 Copy of typewritten schedules for all new and renovated panels.

.7 Copy of all substantial performance final certificates.

.8 Copy of electrical shop drawings which have been stamped and reviewed by consultant.

.9 Electrical As-built drawings including contractor company's as built stamp.

.10 Certificate of completion from all associated sub-contractors.

.11 System commissioning certificate and report.

.4 Final Submittals:

.1 Electronic submission/pdf file is required.

1.36 AS-BUILT DRAWINGS

.1 Site records:

.1 Contractor shall provide 2 sets of reproducible electrical drawings. Provide sets of white prints as required for each phase of the work. Mark thereon all changes as work progresses and as changes occur. This shall include field and contract changes to electrical systems.

.2 On a weekly basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.

.3 Use different colour waterproof ink for each service.

.4 Make available for reference purposes and inspection at all times.

.2 As-built drawings:

.1 Identify each drawing in lower right hand corner in letters at least 3 mm (1/8") high as follows: - "AS-BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW ELECTRICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).

.2 Electronic submission/pdf file is required.

.3 Once approved, submit completed reproducible paper as-built drawings as well as a scanned pdf file copy with Operating and Maintenance Manuals.

1.37 DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTIONS

.1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

.2 Manufacturers or their representatives are to provide demonstrations and instructions.

.3 Use operation and maintenance manual, As-built drawings, audio visual aids, etc. as part of instruction materials.

.4 Instruction duration time requirements as specified in appropriate sections.

.5 Where deemed necessary, consultants may record these demonstrations on video tape for future reference.

1.38 OCCUPANCY REQUIREMENTS

.1 The contractor shall provide the following documentation to the consultant's satisfaction prior to receiving occupancy. Failure to provide the proper documentation will result in the occupancy not being granted. List of required documentation:

.1 Final Certificates (required prior to consultant's release of conformance letter).

.1 Electrical Safety Authority.

.2 Integrated Life Safety Systems Commissioning.

.3 Fire Alarm Verification Certificate.

1.39 READY FOR TAKEOVER

.1 Complete the following to the satisfaction of the consultant prior to request for ready for takeover.

.1 As-built Drawings.

.2 Maintenance Manuals.

.3 System Start up.

.4 Instructions to Owners.

1.40 TRIAL USAGE

.1 Consultant or owner may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

1.41 REVISION TO CONTRACT

.1 Provide the following for each item in a given change notice:

.1 Itemized list of material with associated costs.

.2 Labour rate and itemized list of labour for each item.

.3 Copy of manufacturers/suppliers invoice if requested.

1.42 EQUIPMENT SUPPORTS

.1 Equipment supports supplied by equipment manufacturer: shall be installed by the electrical contractor.

.2 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of - Structural Steel Section. Submit structural calculations with shop drawings if necessary.

.3 Mount base mounted equipment on chamfered edge housekeeping pads, minimum of 100 mm (4") high and 150 mm (6") larger than equipment dimensions all around. This installation of this pad shall be the responsibility of the electrical contractor.

1.43 SLEEVES

.1 Pipe sleeves: at points where pipes pass through masonry, concrete, or fire rated assemblies and as indicated.

.2 Schedule 40 steel pipe.

.3 Sleeves with annular fin continuously welded at midpoint:

.1 Through foundation walls.

.2 Where sleeve extends above finished floor.

.4 Sizes: minimum 6 mm (1/4") clearance all around, between sleeve and conduit.

.5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25 mm (1") above other floors.

.6 Through foundation walls PVC sleeves are acceptable.

.7 Fill voids around pipes:

.1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof fire retardant non-hardening mastic.

.2 Where sleeves pass through walls or floors, provide space for firestopping. Where pipes/ducts pass through fire rated walls, floors and partitions, maintain fire rating integrity.

.3 Fill future-use sleeves with easily removable filler.

1.44 FIRESTOPPING

.1 Firestopping material and installation within annular space between conduits, ducts, and adjacent fire separation.

.2 Provide materials and systems capable of maintaining effective barrier against flame, smoke, and gases.

.3 Comply with the requirements of CAN4-S115-M35, and do not exceed opening sized for which they have been tested.

.4 Systems to have an F or FT rating (as applicable) not less than the fire protection rating required for closures in a fire separation.

.5 Provide “firewrap” blanket around services penetrating firewalls. Extent of blanket must correspond to ULC recommendations. In general wrap individual conduits with approved firewrap materials on each side of firewall. Refer to architectural drawings for FT ratings. Provide 1 and/or 2 layers of firewrap with transverse and longitudinal seams overlapped and/or butted (second layer offset from first layer). Cut edges are to be sealed with aluminum foil tape. Provide 50 mm stainless steel banding at 200 mm intervals. Install firewrap to manufacturers’ recommendations for proper FT rating. Acceptable manufacturers are 3M Firemaster ductwrap or approved equal.

.6 The firestopping materials are not to shrink, slump or sag and be free of asbestos, halogens and volatile solvents.

.7 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.

.8 Firestop materials are to be capable of receiving finish materials in those areas, which are exposed and scheduled to receive finishes.

.9 Firestopping shall be inspected and approved by local authority prior to concealment or enclosure.

.10 Install material and components in accordance with ULC certification, manufacturers instructions and local authority.

.11 Submit product literature and installation material on firestopping in shop drawing and product data manual.

.12 Acceptable manufacturers:

.1 Rectorseal Corporation (Metacaulk)

.2 Proset Systems

.3 3M

.4 Hilti

.5 STI Firestop

Note: Fire stop material must conform to requirements of local authorities having jurisdiction. Contractor to confirm prior to application and ensure material used is compatible with that used by other trades on site.

.13 Ensure firestop manufacturer representative performs on site inspections and certifies installation. Submit inspection reports/certification at time of ready for takeover.

1.45 PAINTING

.1 Refer to Section Interior Painting and specified elsewhere.

.2 Apply at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.

.3 Prime and touch up marred finished paintwork to match original.

.4 Restore to new condition, or replace equipment at discretion of consultant, finishes which have been damaged too extensively to be merely primed and touched up.

1.46 ACCESS DOORS

.1 Supply access doors to concealed electrical equipment for operating, inspecting, adjusting and servicing.

.2 Flush mounted 600 mm x 600 mm (24" x 24") for body entry and 300 mm x 300 mm (12" x 12") for hand entry unless otherwise noted. Doors to open 180º, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.

.3 Material:

.1 Special areas such as tiled or marble surfaces: use stainless steel with brushed satin or polished finish as directed by consultant.

.2 Remaining areas: use prime coated steel.

.3 Fire rated areas: provide ULC listed access doors

.4 Installation:

.1 Locate so that concealed items are accessible.

.2 Locate so that hand or body entry (as applicable) is achieved.

.3 Installation is specified in applicable sections.

.5 Acceptable materials:

.1 Le Hage

.2 Zurn

.3 Acudor

.4 Nailor Industries Inc.

1.47 DELIVERY STORAGE & HANDLING

.1 Follow Manufacturer's directions in delivery, storage, and protection, of equipment and materials. Contractor to include all costs associated with delivery storage and handling in tender price.

.2 Deliver equipment and material to site and tightly cover and protect against dirt, water, and chemical or mechanical injury, but have readily accessible for inspection. Store items subject to moisture damage (such as controls) in dry, heated space.

1.48 REPAIR, CUTTING, CORING AND RESTORATION

.1 Be responsible for required digging, cutting, and patching incident to work of this Division and make required repairs afterwards to satisfaction of consultant. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns, or trusses.

.2 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.

.3 Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.

.4 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.

.5 Slots, cores and openings through floors, walls, ceilings, and roofs shall be provided by this contractor but performed by a trade specializing in this type of work. This Division shall see that they are properly located and do any cutting and patching caused by its neglect to do so.

1.49 EXISTING SYSTEMS

.1 Connections into existing systems to be made at time approved by consultant. Request written approval of time when connections can be made.

.2 Be responsible for damage to existing plant by this work.

1.50 CLEANING

.1 Clean interior and exterior of all electrical equipment provided including light fixture lenses.

.2 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition.

1.51 ASBESTOS

.1 If asbestos is suspected or identified cease all work in the immediate area in accordance with OHSA and notify consultant.

.2 Each contractor and on site employee of the contractor shall have “asbestos awareness training”.

.3 The contractor shall ensure that employees who may come into contact with asbestos due to the nature of the work that they perform, have received training that enables them to recognize asbestos and that enables them to react in accordance with the Occupational Health and Safety Act and regulations thereto should contact with asbestos occur during the course of their work.

.4 It is the responsibility of the contractor to review the asbestos book in the building prior to starting any work.

.5 Existing occupied buildings (depending upon their age) may contain asbestos in thermal insulating materials and some manufactured products, such as vinyl asbestos floor tile. Any insulating materials, on pipes, fittings, boilers, tanks, ductwork, etc. may contain asbestos and shall not be disturbed.

.6 **A survey of each building documenting the location and condition of asbestos-containing materials is available for your mandatory review prior to commencing any work on premises.**

1.52 DISCONNECTION AND REMOVAL

.1 Disconnect and/or remove equipment as indicated.

.2 Cap and conceal all redundant and obsolete connections.

.3 Provide a list of equipment to be removed to the owner, for his acceptance of same. Remove all equipment from site, which the owner does not retain.

.4 Store equipment to be retained by owner on site where directed by consultant.

1.53 OWNER SUPPLIED EQUIPMENT

.1 Connect to equipment supplied by the owner and make operable.

.2 Design drawings are diagrammatic and do not necessarily indicate all specific final connection requirements. For the purposes of bidding, electrical trade shall include but not be limited to provision of a junction box to connect equipment wiring tail, provision of suitable disconnecting means, and flexible connection directly to equipment.

1.54 ENCLOSURES

.1 This contractor must ensure that all electrical equipment mounted in sprinklered areas is provided with an enclosure in conformance with the Electrical Safety Code.

1.55 INTEGRATED LIFE SAFETY SYSTEM TESTING

.1 The Integrated Life Safety System Testing Coordinator (ITC) shall be hired by the electrical trade as indicated in specification section 26 01 20.

.2 This electrical contractor shall work with the project Integrated Life Safety System Testing Coordinator (ITC) and participate in all phases of the Integrated Life Safety Systems testing process as specified within CAN/ULC S1001-11 (2024 Rev2 updates) as well as the electrical and architectural specifications.

.3 During the ***Planning Phase*** of the Integrated Life Safety Systems Testing process this electrical contractor shall review the Integrated Testing Plan (ITP) and give written confirmation of this review and acknowledgement of affected systems under his responsibility as required by the electrical specifications per the shop drawing submittal process.

.4 Prior to the building Integrated Life Safety Systems Testing this electrical contractor shall startup/commission/verify the operation of all systems under the responsibility of this electrical trade. This electrical trade shall give written indication of completed systems and provide copies of all inspection reports, start-up reports, commissioning reports, verification reports, etc. when requested by the ITC during the ***Implementation Phase***.

.5 Upon completion of the building Integrated Life Safety Systems Testing this electrical contractor shall rectify all deficiencies related to all systems under his responsibility during the ***Testing Phase*** in due time for the ITC to verify and document for the project team.

1.56 EXISTING CONCRETE SLAB X-RAY/SCANNING

.1 This contractor shall retain the services of a qualified company to provide and X-ray and/or scan of the existing buried services in walls and/or floors prior to starting any work in the affected area.

.2 Failure to locate existing piping, conduit, rebar etc., shall not relieve this contractor of repair of same prior to installing his service.

.3 This contractor shall be responsible for all repairs and/or replacement of existing services caused by cutting the existing concrete slabs and/or walls.

END OF SECTION

Part 1 General

1.1 GENERAL PROVISIONS

.1 Conform to the General Provisions of Division 1 and Electrical General Requirements Section.

.2 This project is one of a retrofit nature in part, and which will require extensive demolition.

.3 Allow for all remedial work in areas indicated on the drawings and as generally defined in the relevant sections of the specifications.

1.2 SCOPE OF WORK

.1 The scope of work is essentially the selected disconnection and/or removal of services and/or equipment, devices etc. as indicated or required to complete the work.

.2 The reference drawings indicate some of the services which shall remain, and some may have to be retained through construction and a phased changeover to help construction i.e. electrical service, phone service, winter heat, and temporary construction services i.e. washroom facility. This co-ordination remains the responsibility of the contractors.

Part 2 Products

2.1 GENERAL

.1 This Division is to liaise with the Owners or Consultant for equipment being removed that may be suitable for reuse to that specified or handed over to the owner.

.2 This Division to take full responsibility for any special tools or equipment required to disassemble or remove material from building.

Part 3 Execution

3.1 GENERAL

.1 The general requirements are indicated on the drawings and on the outline specification in Division 1.

.2 The general execution of the demolition is to be carried out in a clean and efficient manner.

.3 Demolition of existing ceiling, walls etc., to facilitate removal of existing services or equipment or installation of new to be kept to a minimum and then restored to match existing.

.4 All openings or holes created by removal of existing electrical systems which are not being reused are to be patched with the same material surrounding surfaces.

.5 All new holes and openings to facilitate electrical systems are to be patched to match surrounding surfaces.

.6 Protect all existing furnishings materials and equipment. Any damage occurring as a result of the work of this Division shall be repaired or replaced at the expense of this Division.

.7 Where work involves breaking into or connecting to existing services, carry out work at times directed by the Owners in an expedient manner with minimum disruption to the facility and systems downtime.

.8 Where unknown services are encountered immediately advise Consultant and confirm findings in writing.

.9 Where the location of any services has been shown on the plans, such information is not guaranteed. It is this Division's responsibility to verify locations, etc., immediately after moving on site. Should for any reason the information obtained necessitates changes in procedure or design, advise the Consultant at once. If verification of existing conditions is not done at the outset and any problems arise, the responsibility for same is entirely this Division's.

.10 Disconnect and/or remove equipment, devices, cabling, services, etc. as indicated.

.11 Remove all redundant and obsolete systems, connections, and wiring.

.12 Provide a list of equipment to be removed to the owner, for their acceptance of same. Remove all equipment from site that the owner does not retain.

.13 Maintain equipment to be retained by owner on site where directed by consultant.

END OF SECTION

Part 1 General

1.1 INTENT

.1 Life safety and fire protection systems are to be installed to comply with the provisions of the current Ontario Building and Fire Codes. As a result, testing of these integrated systems must be performed as a whole to ensure the proper operation and inter-relationship between systems (functional testing).

.2 The testing is to provide functional verification and documented confirmation that these building systems satisfy the intent of the Building Code.

.3 These systems as applicable to any given project include but are not limited to fire alarm, smoke and carbon monoxide alarms, sprinkler system and associated valves, standpipe, smoke control, ventilation, and pressurization systems, door hold open devices, elevator recalls, smoke, fire shutters, and dampers, emergency power generator, fire pump assemblies, and emergency lighting.

1.2 GENERAL

.1 This testing process is the responsibility of the Integrated Testing Firm as a sub-contractor to the electrical trade. Electrical trade to include all costs associated with the Integrated Testing Coordinator in contract.

.2 This process must be co-ordinated with suppliers and sub-contractors associated with these systems (mechanical and/or electrical).

.3 This process must be co-ordinated with the project construction schedule and be completed, including all associated documentation, prior to the consultant's certification of the project for occupancy.

.4 All applicable contractors, sub-contractors, and suppliers are to include all required costs in their respective tender costs.

.5 All work is to be performed in accordance with CAN/ULC S1001-2011. Special consideration is to be given to the Sample Integrated Testing Plan (ITP), the review of life safety system design documents, and the provision of test plans and reports.

.6 The work to be performed by this contractor is also described in CAN/ULC S1001-2011.

.7 Refer to CAN/ULC S1001-11 Rev1-2019 Informative Annex (C) for Sample Integrated Testing Plan (ITP).

1.3 QUALITY ASSURANCE

.1 The following criteria must be met in order to be considered an acceptable Integrated Testing Coordinator for this project:

.1 Manufacturers: Firms regularly engaged in functional testing and implementation of life safety and fire protection systems for not less than five years.

.2 Qualifications: Firms with at least five years of successful experience in facility construction, inspection, acceptance testing or commissioning as it relates to fire protection and life safety and equipment similar to that required for this project.

.3 The Contractor shall be an established commissioning contractor that has had and currently maintains a locally run and operated business for at least five years.

.4 The Contractor shall show satisfactory evidence, upon request, that he maintains a fully equipped service organization capable of furnishing adequate inspection and service to the systems.

.2 For bidder information only, experienced Life Safety Systems Testing Firms include these listed below or local branches of the companies noted in the vicinity of this project:

.1 ITC Solutions
20 Hanson Ave Unit 3
Kitchener, ON, N2C 2E2

.2 Troy Life and Fire Safety
805 Boxwood Dr., Unit #201
Cambridge, Ontario N3E 1A4

.3 Lonergan Engineering
3A-235 Industrial Parkway South
Aurora, Ontario L4G 3V5
NOTE: This agent must be a third party firm NOT associated with this project in any way and be under contract with the electrical sub-contractor not the fire alarm supplier.

.3 It is the intended that the project testing firm be one of the firms noted above.

1.4 GENERAL REQUIREMENTS

.1 The Commissioning Process shall generally encompass and co-ordinate the following key areas:

.1 Integrated systems testing planning.

.2 Integrated systems testing implementation (functional testing).

.3 Integrated systems testing documentation

1.5 RESPONSIBILITIES

.1 General Contractor:

.1 The general contractor shall verify completeness of the building envelope, perimeter and interior items which affect proper operation of the noted systems.

.2 The general contractor will assure participation and co-operation of Sub-Contractors and Specialty Contractors (mechanical, electrical, building management, etc.) under the General Contractor's jurisdiction as required for the commissioning process.

.2 Mechanical Contractor:

.1 Verify Functional performance of associated mechanical systems for compliance with design intent as specified in the appropriate Specification sections.

.2 Provide the documentation with standard Functional performance reports on completion of the testing.

.3 Verify submissions for system operation and maintenance manuals, as-built documents, spare parts listing, special tools listing, and other items as may be specified.

.3 Electrical Contractor:

.1 The Integrated Life Safety Systems Testing Coordinator (ITC) is being retained by the electrical contractor, however; this contractor's work to satisfy the ITC requirements shall be included in the tender price.

.2 Verify Functional performance of electrical systems for compliance with design intent as specified in the appropriate Specification sections.

.3 Provide the documentation with standard Functional performance reports on completion of the testing.

.4 Verify submissions for electrical system operation and maintenance manuals, as-built documents, spare parts listing, special tools listing, and other items as may be specified.

.5 As a minimum this contractor must include for:

.1 Providing the ITC with documentation of design and shop drawings.

.2 Provide documents for sequence of operation and maintenance of system.

.3 Testing of all components and accessories to confirm Alarm/Supervisory/Trouble at the fire panel.

.4 Testing and operation of any generator (s) as applicable to the project.

.5 Other items that may be requested by the ITC.

.6 Re-commissioning of any items that may have failed.

.7 Re-setting of the system to proper operation after tests are completed.

.8 Provide written confirmation that life safety systems are installed in accordance with applicable codes and standards, as well as the scope of the project engineering documents.

.4 Equipment Manufacturers:

.1 The equipment manufacturers shall be responsible for providing labour, material, equipment, etc., required within the scope of the respective equipment to facilitate the commissioning process.

.2 The equipment manufacturers will perform Pre-Functional and Functional Performance Tests required by the commissioning process.

.5 Design Engineer:

.1 The design engineer shall review and provide written confirmation of acceptance of the Integrated Testing Pan (ITP).

.2 The design engineer shall observe Functional Performance Testing, at his discretion.

.3 The design engineer shall provide technical capabilities for resolution of deficiencies, where required.

.4 The design engineer shall provide necessary information to assist Integrated Test Coordinator including written confirmation of life safety systems installation in accordance with project engineering documents and are ready for integrated testing.

Part 2 Commissioning Process

2.1 OPERATIONS AND MAINTENANCE MANUALS

.1 Furnish Final, reviewed Operation and Maintenance Manuals to the Consultant fourteen (14) days prior to scheduled Functional Performance Tests.

2.2 FUNCTIONAL PERFORMANCE TEST

.1 The contractor shall be responsible for the Functional Performance Tests. These tests ensure that all equipment and systems are installed in accordance with the Specifications, Drawings and manufacturers' requirements.

.2 The contractor shall be responsible for co-ordinating schedule for Functional tests of various equipment and systems.

.3 In the Functional Test, all noted systems and sub-systems shall be checked for the following:

.1 Verify that each element has been properly installed, properly identified, and that all connections have been made correctly.

.2 Verify that tests, meter readings, and specific mechanical/electrical performance characteristics agree with those required by equipment or system manufacturer.

.3 Re-commission any item(s) that may have failed.

.4 Notify the consultant in writing, at least fourteen (14) days prior to the date of Functional Performance Testing. Schedule the Functional performance tests over a period of consecutive business days.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CSA C22.2 No.0.3-92, Test Methods for Electrical Wires and Cables.

.2 CAN/CSA-C22.2 No.131-M89(R1994), Type TECK 90 Cable.

1.2 PRODUCT DATA

.1 Submit product data in accordance with Electrical General Requirements Section.

Part 2 Products

2.1 BUILDING WIRES

.1 Conductors: stranded for 10 AWG and larger.

.2 Minimum size: 12 AWG.

.3 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material 90°C (194ºF) rated T90 for indoor above grade installations and RW90 for below grade installations.

2.2 TECK CABLE

.1 Cable: to CAN/CSA-C22.2 No.131.

.2 Conductors:

- .1 Grounding conductor: copper.
- .2 Circuit conductors: copper, size as indicated.

.3 Inner jacket: polyvinyl chloride material.

.4 Armour: aluminum.

.5 Overall covering: polyvinyl chloride material.

.6 Fastenings:

- .1 One hole steel zinc straps to secure surface cables 50 mm (2") and smaller. Two hole steel straps for cables larger than 50 mm (2").
- .2 Channel type supports for two or more cables at 1500 mm (60") centres.
- .3 Threaded rods: 6 mm (1/4") diameter to support suspended channels.

.7 Connectors must be suitable for:

- .1 Installed environment and approved for use with TECK cable.

2.3 ARMOURED CABLES

.1 Conductors: insulated, copper minimum size as indicated above.

.2 Type: AC90 (minimum size 12 AWG).

.3 Armour: interlocking type fabricated from aluminum strip.

.4 Connectors must be suitable for installed environment and approved for use with armoured cable.

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

.1 Install wiring from source to load through raceways as specified.

.2 Provide separate neutral conductors for all lighting circuits and circuits originating from surge protected panels. Size raceways accordingly.

3.2 INSTALLATION OF TECK CABLE 0 - 1000 V

.1 Group cables wherever possible on channels.

.2 Terminate cables in accordance with Wire and Box Connectors - 0 - 1000 V Section.

3.3 INSTALLATION OF ARMOURED CABLES

.1 Group cables wherever possible.

.2 Terminate cables in accordance with Wire and Box Connectors - 0 - 1000 V Section.

.3 These cables are to be installed in concealed locations only. These concealed locations are considered to be stud walls and “drops” to stud walls, lighting fixtures, and ceiling mounted devices.

.4 These “drops’ shall not be permitted to exceed 2.4 m (8'-0"). To limit these “drops” to lengths noted above provide additional branch wiring in conduit.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data for cabinets in accordance with Electrical General Requirements Section.

Part 2 Products

2.1 MATERIALS

.1 Splitters must conform to CSA C22.2 No. 76 (latest edition).

.2 Junction and pull boxes must conform to CSA C22.2 No. 40 (latest edition)

2.2 JUNCTION AND PULL BOXES

.1 Welded steel construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm (1") minimum extension all around, for flush-mounted pull and junction boxes.

Part 3 Execution

3.1 JUNCTION AND PULL BOXES INSTALLATION

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Install junction and pull boxes so as not to exceed 30 m (100') of conduit run between pull boxes and in conformance with the Electrical Safety Code.

3.2 IDENTIFICATION

.1 Provide equipment identification in accordance with General Electrical Requirements Section.

.2 Install size 2 identification labels indicating system name, voltage and phase.

END OF SECTION

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Part 1 General

1.1 REFERENCES

.1 Outlet boxes, conduit boxes, and fittings must conform to CSA C22.2 No. 18 (latest edition).

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm (4") square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 mm x 50 mm x 64 mm (3" x 2" x 2½") or as indicated. 102 mm (4") square outlet boxes when more than one conduit enters one side with extension and plaster rings as required. Iberville 1104 Series.

.2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit **in utility rooms**, minimum size 102 mm x 57 mm x 38 mm (4" x 2¼" x 1½"). Iberville 1110 Series.

2.3 CONCRETE BOXES

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.4 CONDUIT BOXES

.1 Cast FS or FD feraloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle **in areas (other than utility rooms) where surface conduit is used.**

2.5 FITTINGS- GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm (1- 1/4") and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

.4 Outlets if unwired are to be provided with blank coverplates to suit related sections of this specification.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CSA C22.2 No.65-1956(R1965) Wire Connectors.

Part 2 Products

2.1 MATERIALS

.1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as indicated.

.2 Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Clamps or connectors for armoured cable, mineral insulated cable, and flexible conduit, as required.

Part 3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.

.2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.

.3 Install fixture type connectors and tighten. Replace insulating cap.

END OF SECTION

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Part 1 General

Not Applicable.

Part 2 Products

2.1 MATERIALS

.1 Grounding equipment must conform to CSA C22.2 No 41 (latest edition).

2.2 EQUIPMENT

.1 Clamps for grounding of conductor: size as required to electrically conductive underground water pipe and electrically conductive metal gas piping.

.2 Insulated grounding conductors: green with insulation type that matches specified phase conductors. Gauge shall be in conformance with the latest edition of the Electrical Safety Code to suit required installation conditions.

.3 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.

.2 Protective type clamps.

.3 Bolted type conductor connectors.

.4 Bonding jumpers, straps.

.5 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. **Where EMT is used, run ground wire in conduit.**

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Use mechanical connectors for grounding connections to equipment provided with lugs.

.5 Soldered joints not permitted.

.6 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

3.2 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, frames of motors, starters, control panels and distribution panels.

3.3 COMMUNICATION SYSTEMS

.1 Install grounding connections for fire alarm system as indicated.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Electrical General Requirements Section.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA)

- .1 CAN/CSA C22.2 No.18-92, Outlet Boxes, Conduit Boxes, and Fittings.
- .2 CSA C22.2 No.45-M1981(R1992), Rigid Metal Conduit.
- .3 CSA C22.2 No.56-1977(R1977), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 CSA C22.2 No.83-M1985(R1992), Electrical Metallic Tubing.
- .5 CSA C22.2 No.211.2-M1984(R1992), Rigid PVC (Unplasticized) Conduit.
- .6 CAN/CSA C22.2 No.227.3-M91, Flexible Nonmetallic Tubing.

Part 2 Products

2.1 CONDUITS

.1 Electrical metallic tubing (EMT) with couplings: to CSA C22.2 No.83.

.2 Rigid PVC conduit: to CSA C22.2 No.211.2.

.3 Flexible metal conduit: to CSA C22.2 No.56, aluminum and liquid-tight flexible metal.

2.2 CONDUIT FASTENINGS

.1 One hole steel straps to secure surface conduits 53 mm (2") and smaller. Two hole steel straps for conduits larger than 53 mm (2").

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at 1.5 m (5'0") oc.

.4 Threaded rods, 6 mm (1/4") diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

.1 EMT fittings shall be set screw style (zinc alloy).

.2 Flexible metal conduit fittings shall be screw-in type.

.3 Liquid type flexible metal conduit fittings shall be sealtite type.

.4 Coating: same as conduit.

.5 Factory "ells" where 90° bends are required for 27 mm (1") and larger conduits.

.6 Where bushings are noted to be provided they must be “screwed” type fastened to a conduit connector. Push-fit or glued in place bushings will NOT be accepted.

2.4 FISH CORD

.1 Nylon twine.

Part 3 Execution

3.1 INSTALLATION

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical/ electrical service rooms and in unfinished areas.

.3 Use electrical metallic tubing (EMT) for all branch circuits unless specified otherwise.

.4 Use flexible metal conduit for connection to motors in dry areas, connection to recessed fixtures without a prewired outlet box, connection to surface or recessed fixtures, work in movable metal partitions.

.5 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations and for connections to kitchen equipment.

.6 Conduits terminating at electrical equipment in sprinklered areas are to be provided with insulated compression style connectors equal to Thomas & Betts Cat. #TC8XXSC or approved equal.

.7 **Minimum conduit size for branch circuits shall be 21 mm (3/4").** Single drops from ceiling mounted junction boxes down to a light switch or duplex receptacle may be reduced to 16 mm (½").

.8 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.9 Mechanically bend steel conduit over 27 mm (1") diameter.

.10 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.11 Install fish cord in empty conduits.

.12 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

.13 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m (5') clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended or surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm (3") parallel to steam or hot water lines with minimum of 25 mm (1") at crossovers.

.7 Do not fasten surface conduit to roof deck. Provide standoffs or supports as manufactured by Caddy or use unistrut trapeze fastened to structure.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Electrical General Requirements Section.

Part 2 Products

2.1 SWITCHES

.1 Line Voltage Wall Switches

- .1 AC switches must conform to CSA C22.2 No. 111 (latest edition).
- .2 AC switches with following features:
  - .1 Terminal holes approved for No. 10 AWG wire.
  - .2 Silver alloy contacts.
  - .3 Urea or melamine molding for parts subject to carbon tracking.
  - .4 Suitable for back and side wiring.
  - .5 Toggle style (Rocker style) (architect to select colour).
- .3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .4 AC Switches of one manufacturer throughout project.
- .5 Provide 2 keys per keyed switch.
- .6 Occupancy sensor switches shall be dual technology style (PIR and Ultrasonic) where noted on the drawings.
- .7 Acceptable Materials:
  - .1 Single Pole : Hubbell Cat #HBL1201
  - .2 Motor Rated: Hubbell Cat. #HBL1221PL
- .8 Acceptable toggle switch alternate manufacturers include:
  - .1 Pass & Seymour
  - .2 Leviton.

2.2 RECEPTACLES

.1 Receptacles, plugs, and other similar wiring devices must conform to CSA 22.2 No 42 (latest edition).

.2 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, with following features (20A where noted):

- .1 Urea molded housing (Colour by architect).
- .2 Suitable for No. 10 AWG for back and side wiring.
- .3 Break-off links for use as split receptacles.
- .4 Eight back wired entrances, four side wiring screws.

.5 Triple wipe contacts and rivetted grounding contacts.

.3 Receptacles of one manufacturer throughout project.

.4 Acceptable materials:

.1 Standard Devices

.1 Tamper resistant receptacle: Hubbell Cat # BR15TR

.2 Tamper resistant T-slot receptacle: Hubbell Cat. #BR20TR

.2 Decora Style Devices

.1 Ground fault protected T-slot receptacles: Hubbell Cat. # GF20L A

.5 Acceptable alternate manufacturers include:

.1 Pass & Seymour

.2 Leviton

2.3 COVER PLATES

.1 Cover plates from one manufacturer throughout project.

.2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.3 Stainless steel, brushed, 1 mm (1/32") thick cover plates for wiring devices mounted in flush-mounted outlet box.

.4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.5 Weatherproof cover plates complete with gaskets and “heavy-duty in use” covers in conformance with the Electrical Safety Authority. Provide product equal to Intermatic Cat. #WP5100C.

.6 Provide p-touch labels on cover plates for all receptacles. Labels shall include source panel and branch circuit.

Part 3 Execution

3.1 INSTALLATION

.1 Switches:

.1 Install single throw switches with handle in "UP" position when switch closed.

.2 Install switches in gang type outlet box when more than one switch is required in one location.

.3 Mount toggle switches at height specified in Electrical General Requirements Section or as indicated.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height specified in Electrical General Requirements Section or as indicated.

.3 Where split receptacle has one portion switched mount vertically and switch upper portion.

.3 Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END OF SECTION

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Part 1 General

1.1 REFERENCES

.1 Canadian Standards Association (CSA)

.1 CSA C22.2 No.248.12/94, Low Voltage Fuses Part 12: Class R (Bi-National Standard with, UL 248-12 (1st Edition).

.2 CSA C22.2 No. 106-M92 (latest edition).

1.2 MAINTENANCE MATERIAL

.1 Three spare fuses of each type and size installed.

1.3 DELIVERY AND STORAGE

.1 Ship fuses in original containers.

.2 Store fuses in original containers in moisture free location.

Part 2 Products

2.1 FUSES GENERAL

.1 Fuses: product of one manufacturer for entire project.

.2 Fuses specified below must conform to CSA C22.2 No. 106 (latest edition). Fuses conforming to standard C22.2 No. 106-1953 will be rejected.

.3 Fuses must provide a fully co-ordinated system for both overload and fault conditions.

2.2 FUSE TYPES

.1 Class L fuses (formerly HRC-L) for ratings 601-6000 A.

.1 Time delay, capable of carrying 500% of its rated current for 10 s minimum.

.2 Fast acting as noted.

.2 Class J fuses (formerly HRCI- J).

.1 Time delay, capable of carrying 500% of its rated current for 10 s minimum.

.2 Fast acting as noted.

.3 Class R fuses (formerly HRCI- R). For UL Class RK1 fuses, peak let-through current and I^2t values not to exceed limits of UL 198E-1982, table 10.2.

2.3 ACCEPTABLE PRODUCTS

.1 Motor Protection:

1-600 A: Mersen Type AJT

601-2000 A: Mersen Type A4BT

.2 Other acceptable manufacturers:

.1 GEC

.2 Little Fuse

Part 3 Execution

3.1 INSTALLATION

.1 Install fuses in mounting devices immediately before energizing circuit.

.2 Ensure correct fuses fitted to physically matched mounting devices.

.1 Install Class R rejection clips for HRCI-R fuses.

.3 Ensure correct fuses fitted to assigned electrical circuit.

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

.1 Submit product data in accordance with Electrical General Requirements Section.

Part 2 Products

2.1 DISCONNECT SWITCHES

.1 Enclosed manual air break switches must conform to CSA C22.1 No.4 (latest edition).

.2 Fuseholder assemblies must conform to CSA C22.2 No.39 (latest edition).

.3 Fusible, and/or non-fusible, horsepower rated disconnect switches, size as indicated.

.4 Provision for padlocking in off switch position by three locks.

.5 Mechanically interlocked door to prevent opening when handle in ON position.

.6 Fuses: size as indicated, to Fuses - Low Voltage Section.

.7 Fuseholders: relocatable and suitable without adaptors, for type and size of fuse indicated.

.8 Quick-make, quick-break action.

.9 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Electrical General Requirements Section.

.2 Indicate name of load controlled on size 4 nameplate.

2.3 ACCEPTABLE MANUFACTURERS

Manufacturer	General Purpose	Weather Proof
Eaton	IHD Series	3HD Series
Schneider Electric	Type A Series	Type R Series
Siemens	ID Series	NFR/FR Series

Part 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

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Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings in accordance with Electrical General Requirements Section.

.2 Indicate:

- .1 Mounting method and dimensions.
- .2 Starter/contactor size and type.
- .3 Layout of identified internal and front panel components.
- .4 Enclosure types.
- .5 Wiring diagram for each type of starter.
- .6 Interconnection diagrams.

1.2 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for incorporation into manual specified in Electrical General Requirements Section.

.2 Include operation and maintenance data for each type and style of starter/contactor.

1.3 MAINTENANCE MATERIALS

.1 Provide maintenance materials in accordance with Electrical General Requirements Section.

.2 Provide listed spare parts for each different size and type of starter:

- .1 1 operating coil.
- .2 3 fuses.
- .3 10% indicating lamp bulbs used.

Part 2 Products

2.1 MATERIALS

.1 Starters: must conform to CSAC22.2 No. 14 (latest edition) and EEMAC E14-1.

.2 Control transformers must conform to CSAC22.2 No. 66 (latest edition).

.3 Auto-transformers must conform to CSAC22.2 No 47 (latest edition).

.4 Contactors must conform to CSA C22.2 No. 14 (latest edition).

.5 Half size starters will not be accepted. NEMA and IEC rated starters are acceptable.

2.2 MANUAL MOTOR STARTERS

.1 Single and Three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break.

.2 One or Three overload heaters, manual reset, trip indicating handle.

.3 Toggle switch: standard duty labeled “on”/“off”.

.4 Indicating light: standard duty type and red colour.

.5 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 FULL VOLTAGE MAGNETIC STARTERS

.1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:

.1 Contactor solenoid operated, rapid action type.

.2 Motor overload protective device in each phase, manually reset from outside enclosure.

.3 Wiring and schematic diagram inside starter enclosure in visible location.

.4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.2 Combination type starters to include fused disconnect switch with operating lever on outside of enclosure to control disconnect, and provision for:

.1 Locking in "OFF" position with up to 3 padlocks.

.2 Independent locking of enclosure door.

.3 Provision for preventing switching to "ON" position while enclosure door open.

.3 Accessories:

.1 Pushbuttons Selector switches standard duty labeled as indicated.

.2 Indicating lights: standard duty type and color as indicated.

.3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

.4 1 red pilot light for “stop” or “off” and 1 green light for “start” or “on”.

2.4 CONTROL TRANSFORMER

.1 Single phase, dry type, control transformer with primary voltage as indicated and secondary voltage to suit remote control device, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

2.5 CONTACTORS

.1 Electrically held and controlled by pilot devices as indicated and rated for type of load controlled.

.2 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.

.3 Mount in CSA Enclosure 1 unless otherwise indicated.

.4 Include following options in cover:

.1 Red indicating lamp.

.2 Hand - Off - Auto selector switch.

.5 Control transformer: mounted in contactor enclosure.

.6 Contactors must be definite purpose.

2.6 FINISHES

.1 Apply finishes to enclosure in accordance with Electrical General Requirements Section.

2.7 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Electrical General Requirements Section.

.2 Manual starter designation label: black plate, white letters, size 1, engraved as indicated.

.3 Magnetic starter designation label: black plate, white letters, size 2, engraved as indicated.

.4 Contactor designation label:

black plate, white letters, size 4, indicating name of load controlled.

2.8 ACCEPTABLE MANUFACTURERS

.1 The acceptable manufacturers are as follows:

.1 Allen Bradley

.2 Eaton

.3 Siemens

.4 Group Schneider

.5 Klockner Moeller

Part 3 Execution

3.1 INSTALLATION

.1 Install starters, connect power and control as indicated.

.2 Ensure correct fuses and overload devices elements installed.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Electrical General Requirements Section.

.2 Operate switches, contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

.5 Install contactors and connect auxiliary control devices.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CAN/ULC-S524 (latest edition), Installation of Fire Alarm Systems.

.2 ULC-S525 (latest edition), Audible Signal Appliances for Fire Alarm Systems.

.3 CAN/ULC-S526 (latest edition), Visual Signal Appliances, Fire Alarm.

.4 CAN/ULC-S527 (latest edition), Control Units, Fire Alarm.

.5 CAN/ULC-S528 (latest edition), Manual Pull Stations.

.6 CAN/ULC-S529 (latest edition), Smoke Detectors.

.7 CAN/ULC-S530 (latest edition), Heat Actuated Fire Detectors, Fire Alarm.

.8 CAN/ULC-S531 (latest edition), Smoke Alarms.

.9 CAN/ULC-S536 (latest edition), Inspection and Testing of Fire Alarm Systems.

.10 CAN/ULC-S537 (latest edition), Verification of Fire Alarm Systems.

.11 CAN/ULC-S552 (latest edition), Inspection, Testing and Maintenance of Smoke Alarms.

.12 CAN/ULC-S553 (latest edition), Installation of Smoke Alarms.

.13 OBC-2012, Ontario Building Code.

1.2 DESCRIPTION OF SYSTEM WORK

.1 System work includes:

.1 As indicated provide new duct type Smoke detector for AHU-1 S/A and R/A, AHU-2 S/A and R/A and AHU-3 S/A and R/A w/ aux. relay for AHU units shutdown. Existing fire alarm control panel is Simplex-4100ES addressable. Provide new relays and re-connect to existing zones to carry out fire alarm and protection functions including receiving alarm signals, initiating general alarm, supervising system continuously, actuating zone annunciators, and initiating trouble signals. Refer to products section for new and replacement equipment information.

1.3 REQUIREMENTS OF REGULATORY AGENCIES

.1 This system is subject to review by local building department officials, local fire department officials. **Therefore, submission of verification certificate and field technician device verification sheets is required prior to inspection by these officials. Schedule accordingly.**

1.4 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Electrical General Requirements Section.

.2 Include:

.1 Layout of equipment.

.2 Zoning.

.3 Complete wiring diagram.

1.5 OPERATION AND MAINTENANCE DATA

.1 Provide operation and maintenance data for Fire Alarm System for incorporation into manual specified in Electrical General Requirements Section.

.2 Include:

.1 Operation and maintenance instructions for complete fire alarm system to permit effective operation and maintenance.

.2 Technical data - illustrated parts lists with parts catalogue numbers.

.3 Copy of approved shop drawings.

.4 List of recommended spare parts for system.

1.6 MAINTENANCE MATERIALS

.1 Include:

.1 10% spare glass rods for total number of manual pull box stations if applicable.

1.7 TRAINING

.1 Arrange and pay for on-site demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system. **Obtain written receipt of training session and include in maintenance manual.**

1.8 SYSTEM OPERATION

.1 Operation of any alarm initiating device to:

.1 Cause audible and visual signal devices to sound throughout building.

.2 Transmit signal to fire department via monitoring station.

.3 Cause zone of alarm device to be indicated on control panel and remote annunciator(s) (if applicable)

.4 Cause air conditioning and ventilating fans to shut down and to function so as to provide required control of smoke movement.

.5 Cause fire doors and smoke control doors if normally held open, to close automatically.

.6 Log the alarm in the historical alarm log file.

.2 System Reset

.1 It shall not be possible to reset the fire alarm system until all the alarm zones have been properly reset or cleared.

.3 System Trouble Operation

.1 A trouble initiated by the actuation of a sprinkler system supervisory trouble switch shall cause the following to occur:

.1 An audible and visual trouble signal shall sound at the main control panel Only until acknowledged by an operator.

.2 Annunciate the Supervisory Trouble Alarm at the main control panel LCD Display and all remote annunciator(s).

.3 Log the Supervisory Trouble Alarm in the Historical Trouble Log File.

.4 Cause the remote trouble indicator to activate

.2 Any system trouble shall cause the following to occur:

.1 An audible and visual trouble signal shall sound at the main control panel LCD Display Only until acknowledged by an operator.

.2 Log the trouble condition in the separate Historical Trouble Log File.

1.9 PERFORMANCE CRITERIA

.1 These specifications describe the minimum functional requirements for an electronically supervised, microprocessor based, fully integrated system. The initial installation shall include all the necessary electronic hardware, software and memory for a completely operable system in accordance with these specifications.

1.10 QUALITY ASSURANCE

.1 Each and all items of the fire alarm system shall be listed as the products of a single manufacturer under the appropriate category by the Underwriter's Laboratories of Canada and shall bear the "U.L.C." label.

.2 Each and all items of the fire alarm system shall be covered by a one year parts and labour warranty covering defects resulting from faulty workmanship and materials. The warranty shall be deemed to begin on the date the system is accepted by the Project Manager on issuance of the substantial performance certificate for the project.

.3 All control equipment must have Transient Protection Devices to comply with U.L.C. requirements.

Part 2 Products

2.1 GENERAL

.1 The fire alarm system is existing Simplex 4100ES–Addressable.

.2 The fire alarm control panel shall allow for loading or editing of special instructions and operating sequences as required. The system shall be capable of on-site programming to accommodate expansion, and changes required by local codes. All software operations shall be stored in a non-volatile programmable memory within the fire alarm control panel. Loss of primary and secondary power shall not erase the instructions stored in memory.

.3 The ability to selectively program input/output control functions based on ANDing, ORing, NOTing, Timing and Special Coded Operations is also to be incorporated in the resident software programming of the system.

.4 The system shall have the ability to manually disable and enable any device/circuit individually for maintenance or testing purposes.

.5 It shall be possible to reprogram selected or all smoke detector initiating zones for alarm verification.

.6 It shall be possible to program an adjustable time delay circuit for each waterflow initiating circuit to prevent false alarms that may be caused by erroneous pressure surges in the sprinkler system.

.7 It shall be capable of wiring existing conventional initiating devices.

.8 All on site programming changes to the fire alarm system shall be password protected.

.9 Wiring to any remote annunciator shall be supervised for open and ground conditions. A separate annunciator trouble indicator must be provided at the control panel, which shall illuminate and an audible trouble signal shall sound at the control panel upon the detection of an open or ground condition.

.10 Control Panel and Remote Annunciator Cabinet are to be properly grounded to building ground. Conduit ground will not be acceptable. The green coloured grounding loop shall be a minimum #14 AWG insulated copper conductor run in conduit. The ground loop shall be connected to building water supply to the line side of the water meter. Ground wire must not be run in the same conduit as the Fire Alarm wiring.

2.2 POWER REQUIREMENTS

.1 The control panels shall receive 120 VAC power via a dedicated overcurrent protected circuit. The incoming power to the system shall be supervised so that any power failure must be audibly and visually indicated at the control panel and the remote annunciator. A green `Power On' LED shall be displayed continuously while incoming power is present.

.2 Control Panel output power supply shall have the following operating characteristics:

.1 Rated for five Amps continuous duty

.2 24 VDC filtered and regulated

.3 Power limited with a range of 20.4 VDC to 32 VDC.

.4 Automatic "Brownout" transfer to standby batteries when supply voltage falls to 102 VAC

.3 Standby power for the system shall be produced by dual-sealed, lead acid, gelled cell batteries, series connected with sufficient Amp. Hour capacity to operate the system under supervisory conditions with AC power disconnected for 24 hours and at the end of this period operate the alarm devices for thirty consecutive minutes. The batteries shall be dual-sealed, maintenance free type.

.4 The system batteries shall be supervised so that a low battery condition or disconnection of the batteries shall be audibly and visually annunciated at the control panel.

.5 Battery charger shall have the following operating characteristics:

.1 Ability to charge a range up to 33 AH to 70% of their capacity within 12 hours.

.2 Compatible with either lead acid or nicad batteries.

.6 All circuits requiring system operating power shall be individually fused at the control panel.

.7 The system shall be modular in design to allow future expansion with a minimum of hardware additions and system interruptions.

2.3 FIRE ALARM CONTROL PANEL

.1 Existing fire alarm control panel to be modified as described herein. Re-connect existing zones for AHU-1, AHU-2 and AHU-3 units shutdown and duct type smoke detector. Existing fire alarm control panel is Simplex 4100ES. Re-connect to existing zone(s) and relays to carry out fire alarm and protection functions including receiving alarm signals, initiating general alarm, supervising system continuously, actuating zone annunciators, and initiating trouble signals. Refer to products section for new and replacement equipment information.

2.4 CONVENTIONAL AUTOMATIC ALARM INITIATING DEVICES

.1 Thermal fire detectors: fixed temperature, non-restorable, rated 57°C (135ºF) or 88°C (194ºF) as indicated.

.2 Thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57°C (135ºF) or 88°C (194ºF), rate of rise 8.3°C (15ºF) per minute.

.3 Smoke detector: ceiling mounted, photo electric type, visual alarm indicator, complete with relay base where noted.

.4 Smoke detector: photo electric type air duct type with sampling tubes with protective housing.

.1 Plug-in type with fixed base.

.2 Wire-in Wire-in base assembly with integral red alarm LED, and terminals for remote alarm LED.

2.5 END OF LINE RESISTORS

.1 End-of-line resistors for signalling circuits shall be sized to ensure the correct supervisory current flows in each circuit.

.2 End-of-line resistors shall be mounted on a stainless steel plate for mounting on a standard single gang box and bear the ULC label.

2.6 MONITOR MODULE

.1 The monitor modules shall have the following operating characteristics:

A flashing LED indicates that the module is in communication with the control panel. The LED latches steady on alarm (subject to current limitations on the loop).

.2 The monitor modules shall have the following features:

Nominal operating voltage:	15 to 32 VDC.
Maximum current draw:	5.1 mA (LED on)
Average operating current:	400 uA (LED flashing)
EOL resistance:	47K ohms.
Temperature range:	0°C to 49°C (32°F to 120°F)
Humidity range:	10% to 93% noncondensing
Dimensions:	114.3 mm (4.5") high x 101.6 mm (4") wide x 31.75 mm (1.25") deep. Mounts to a 101.6 mm (4") square x 53.975 mm (2.1/8") deep box.

2.7 ISOLATOR MODULE

.1 Fault isolator modules shall be provide to automatically isolate wire-to-wire short circuits on an SLC loop. The fault isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop. If a wire-to wire short occurs, the fault isolator module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the fault isolator module shall automatically reconnect the isolated section of the SLC loop. The fault isolator module shall not require any address-setting, and its' operations shall be totally automatic. It shall not be necessary to replace or reset a fault isolator module after its normal operation. The fault isolator module shall mount in a standard 10.16 cm (4") deep electrical box, in a surface-mounted backbox, or in the fire alarm control panel. It shall provide a single LED which shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

2.8 CONTROL MODULE

.1 Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay.

.2 The control module NACs may be wired for Style Z or Style Y (Class A/B) with up to 1 Amp of inductive A/V signal, or 2 Amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to ensure that 100% or all auxiliary relay or NACs may be energized at the same time on the same pair of wires.

.3 The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 Amps at 30 VDC.

2.9 SYSTEM WIRING

.1 The system wiring must be FSA rated in conformance with the Electrical Safety Code to suit the type of installation.

.2 Wiring shall be minimum #18 AWG twisted shielded pair in conduit. "Securex 2" armoured cable will be permitted to be used for "drops" to devices on accessible ceilings.

.3 As indicated on system riser diagram initiating device wiring shall be run in a loop with a home run from the last device to the control panel (Class 'A' configuration).Wiring from the "loop" module to conventional devices must be supervised, run in conduit, and conform to the standards of the Electrical Safety Code.

.4 Signal wiring is to be cross connected in a class 'B' configuration.

.5 Install isolator modules and end of line resistors in service rooms no higher than 2.4 M AFF. Provide location of these devices at the time of shop drawing submission.

.6 **These are the basic wiring requirements for system operation. Prior to tender close manufacturer and contractor are to confirm all necessary wiring specifications and requirements.**

2.10 APPROVED EQUIPMENT

DEVICE	**SIMPLEX**
Control Panel Existing	
	4100ES
Intelligent Devices	
Monitor Module	ZAM-Monitor 4090-9001
Control Module	ZAM-Control 4090-9002
Isolator Module	4090-9116
Conventional and Auxiliary Devices	
Duct type Smoke Detector (c/w Air Sampling Tubes.)	4098-9685C

Part 3 Execution

3.1 INSTALLATION

.1 Additional components shall be installed in accordance with CAN/ULC-S524 (latest edition) and approved manufacturers manuals and wiring diagrams. The contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for the complete installation, All wiring shall be of the type recommended by the Electrical Safety Code, approved by local authorities having jurisdiction for the purpose, and shall be installed in dedicated conduit throughout.

.2 Existing main control panel and connect to ac power supply.

.3 Locate and install manual alarm stations and connect to alarm circuit wiring.

.4 Locate and install detectors and connect to alarm circuit wiring. **Do not mount detectors within 1 m (39") of air outlets.** Maintain at least 600 mm (24") radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.

.5 Connect alarm circuits to main control panel.

.6 Locate and install signal devices and connect to signalling circuits.

.7 Connect signalling circuits to main control panel.

.8 Install end-of-line devices at end of applicable alarm and signalling circuits.

.9 **Connect duct type smoke detector outputs to monitor modules for alarm condition. Connect duct type smoke detector relay to shutdown AHU unit.**

3.2 PROTECTION

.1 Contractor is to ensure all fire protection system detectors are protected from dust, dirt, humidity, and water at all times during construction. This applies to detectors installed, stored on site or stored in storage containers. Any detectors that are damaged or dirty shall be replaced at the contractor’s expense.

3.3 FIELD QUALITY CONTROL

.1 The system shall be installed and fully tested under the supervision of trained manufacturer’s representative. The system shall be demonstrated to perform all the functions as specified.

3.4 ACCEPTABLE INSTALLER

.1 The fire alarm / life safety system specified herein shall be installed by an Authorized Electrical Contractor who is CFAA certified.

3.5 EXAMINATION

.1 Prior to the commencement of any of the work detailed herein, an examination and analysis of the area(s) where the Fire Alarm / Life Safety System and all associated components are to be installed shall be made.

.2 Any of these area(s) which are found to be outside the manufacturers' recommended environments for the particular specified products shall be noted on a Site Examination Report which shall be given to the Building Owners Representative, and the Consultant.

.3 Any shorts, opens, or grounds found on existing wiring shall be corrected prior to the connection of these wires to any panel component or field device.

3.6 DEMONSTRATION

.1 Each of the intended operations of the installed Fire Alarm / Life Safety System shall be demonstrated to the Building Owners' Representative and the Consultant.

3.7 SYSTEM TEST

.1 **Perform tests in accordance with General Electrical Requirements Section and CAN/ULC-S537-(latest edition) Standard for the Verification of Fire Alarm Systems. Include full verification of entire system to suit control panel replacement per CAN/ULC S537 including testing/inspection of unmodified portions of existing system being reconnected per CAN/ULC S536.**

.2 Fire alarm system:

.1 Test each device and alarm circuit to ensure noted devices transmit alarm to control panel and actuate general alarm and ancillary devices.

.2 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.

.3 Class A circuits.

.1 Test each conductor on all circuits for capability of providing alarm signal on each side of single open-circuit fault condition imposed near middlemost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.2 Test each conductor on all circuits for capability of providing alarm signals during ground-fault condition imposed near middlemost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.4 Class B circuits

.1 Test each conductor on all circuits for capability of providing alarm signal on line side of single open-circuit fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.3 The control panel shall continuously perform as automatic self-test routine on each sensor, which will functionally check the sensor electronics and ensure the accuracy of the valves being transmitted to the control panel.

.4 Automatic testing will occur at a rate of one sensor every four minutes.

.5 The sensor's average analogue value is the average of the last 2000 recorded analogue entries of its chamber.

.6 Any sensor that fails this test shall indicate a '**SELF-TEST ABNORMAL'** trouble condition with the sensor's address at the control panel.

.7 The system shall automatically indicate when an individual sensor needs cleaning. When the sensor's average value reaches a predetermined value, a **'DIRTY SENSOR'** trouble condition shall be audibly and visually indicated at the local control panel for that sensor. IF a **'DIRTY SENSOR'** indication is left unattended and its average value increases to a second predetermined value, an **'EXCESSIVELY DIRTY SENSOR'** trouble condition shall be indicated at the local control panel for that sensor. To prevent false alarms, these **'DIRTY'** conditions shall in no way decrease the amount of smoke obscuration necessary to generate an alarm condition.

.8 An operator having a proper access level, shall have the capability to manually access the following information from the control panel:

.1 Primary Status

.2 Device Type

.3 Present Average Value

.4 Present Sensitivity Selected*

.5 Highest Peak Detection Values (HVP)*

.6 Sensor Range (Normal, Dirty, Excessively Dirty)

* Values shall be in 'percent of smoke obscuration' format so that no interpretation is required by the operator.

.9 **Provide "Integrated Testing" of this life safety system in conformance with the noted specification section. Include all associated costs in tender.**

END OF SECTION