



ST. CLAIR CATHOLIC
DISTRICT SCHOOL BOARD

Lighting the Way ~ Rejoicing in Our Journey

TENDER NUMBER: 725-CP1904

Ursuline College Library Unit Ventilator Replacement

Ursuline College Chatham

85 Grand Ave. W., Chatham, ON N7L 1B6

Submission Deadline and Location:

Wednesday, March 13, 2019

2:00:00 PM Local Time

Reception Desk, Catholic Education Centre

420 Creek Street, Wallaceburg, ON N8A 4C4

1. BID SUBMISSION

The St. Clair Catholic District School Board (Board) is seeking a Contractor to provide all of the necessary materials, equipment and labour to complete the replacement of three unit ventilators in the library at Ursuline College Chatham, 85 Grand Avenue West, Chatham, ON.

Bids shall be submitted with the project clearly identified on the sealed envelope:

Bid Package #: 725-CP1904 – Ursuline College Chatham – Library Unit Ventilator Replacement

The sealed Bid Submission must be returned to:

Catholic Education Centre, 420 Creek St. Wallaceburg, ON N8A 4C4

Attention: Mr. Tony Prizio, Supervisor - Procurement

No later than Wednesday March 13, 2019 @ 2:00:00 p.m.

Any bid submissions received after the deadline will be returned unopened to the bidder. (No extensions to Bid Closing date are anticipated. Bidders are encouraged to act immediately to prepare their submissions!)

Bids by telephone or fax will not be accepted.

After bid closing all submissions will be reviewed by the Board's evaluation team.

Supplier's Bid Submission, all Bid Documents and Purchase Order will form the agreement.

2. SCOPE OF WORK

Removal of four unit ventilators in the library at Ursuline College Chatham and supply and installation of three new unit ventilators as per drawings and specifications prepared by Vanderwesten & Rutherford Associates.

The specific scope of work, specifications, and drawings are shown in Appendix D – Scope of Work & Specifications.

3. BID DOCUMENTS

Instructions to Bidders, Bid Form, Specifications & Drawings, Supplementary Conditions, Appendices & Tender Specific Requirements, and Addenda will form the Bid Documents.

Bid Documents are available on the Board's Website www.st-clair.net under Bid Opportunities or on Biddingo www.biddingo.com.

The Board assumes no responsibility for the bidder's failure to examine all of the Bid Documents.

4. BID ACCEPTANCE

It shall be understood by all bidders, that the bid shall be valid and subject to acceptance by the Board, and that no adjustments shall be made to the Bid amounts for a period of up to and including sixty (60) days from the Bid Closing Date.

The Board reserves the right to determine the successful bidder by any combination of base bid, separate prices, requested alternate prices and voluntary alternate prices submitted with the bid. The Board is not obligated to select the bid with the lowest price and may cancel a bid prior to award without liability to any bidder.

5. BID INELIGIBILITY

Bids that are unsigned, improperly signed or sealed, conditional, illegible, obscure, contain arithmetical errors, erasures, alterations, or irregularities of any kind may, at the discretion of the Owner, be declared informal.

Bids with Bid Forms and enclosures which are improperly prepared may, at the discretion of the Owner, be declared informal.

Bids based on prices seeming to be so unbalanced as to adversely affect the interests of the Owner may, at the discretion of the Owner, be declared informal.

Bids based upon an unreasonable period of time for completion of the Work may, at the discretion of the Owner, be declared informal.

6. AWARD

The Board has the right to reject any or all bids. The lowest Bid will not necessarily be accepted. The invitation to bid does not constitute an offer by the Contractor to enter into a contract. Acceptance of the bid and/ or award is subject to the approval of the St. Clair Catholic District School Board.

7. ENTITLEMENT TO A DEBRIEFING

In accordance with the Broader Public Sector Procurement Directive unsuccessful Bidders are entitled to a debriefing, during which they will be provided with feedback regarding their Tender. In order to be debriefed, unsuccessful Bidders must contact the Owner representative identified on the Communications Notice in writing to request a debriefing within sixty (60) days from the date of the notification of award.

8. BID DISPUTE PROCEDURE

In the event that a Bidder wishes to review the decision of the Board in respect of any material aspect of the Request For Tender process, the Bidder shall submit a protest in writing to the Board to the attention of the Supervisor – Procurement within ten (10) days of the closing date of the Tender.

Any protest in writing shall include the following:

- a) a specific identification of the provision and/or procurement procedure that is alleged to have been breached;
- b) a specific description of each act alleged to have breached the procurement process;
- c) a precise statement of the relevant facts;
- d) an identification of the issues to be resolved;
- e) the Bidder's arguments and supporting documentation;
- f) the Bidder's requested remedy.

9. PAYMENT

The Board shall pay by electronic funds transfer (EFT), P-Card, or cheque within thirty (30) days after the

receipt of a proper invoice. Invoices will be reviewed and certified by the Board's Consultant, if applicable, before the invoice is processed for payment. Invoices must include all back-up material for time and material charges, disbursements, and other fees. Please make reference to the Purchase Order number on the invoice.

10. TAXES

Include in Bid all Taxes and all other Customs Duties and Excise Taxes which are in force at Bid date as detailed in General Conditions. Harmonized Sales Tax (H.S.T.) is **not** to be included in the bid. The H.S.T. amount and the Bidder's **H.S.T. Registration Number** are to be indicated on the Bid Form in the spaces provided.

11. ADDENDA

Bidders finding discrepancies, ambiguities or omissions in the bid documents or having doubt as to the meaning or intent thereof, shall immediately notify the Procurement Department who may issue instructions and/or clarifications by Addendum to all Bidders. Bidders may also, during the Bidding Period, be advised by Addendum of any additions, deletions or alterations to bid documents. All such Addenda shall become part of the Bid Documents.

All questions to be addressed in writing to: Mr. Tony Prizio, Supervisor - Procurement
St. Clair Catholic District School Board
E-mail: tony.prizio@st-clair.net
CC: victoria.iaccino@st-clair.net

Questions must be received by Thursday March 7, 2019 @ 12:00 pm. Answers will be provided by way of addendum no later than Friday March 8, 2019.

If an addendum is issued, the document(s) will be made available to bidders through the same platform that the original bid document were issued. Bidders are responsible for verifying before submitting its response that it has received all addenda that may have been issued.

12. CHANGE NOTICES, CHANGE ORDERS

The following fee percentage and overhead charges shall be applied to additional work ordered by the Board:

- For work carried out by the Contractor's own forces – 10% Overhead & Profit
- For work involving a subcontractor, the subcontractor may charge a maximum 10% fee. The General Contractor may charge a maximum of 5% in addition to subcontractor's fee.

13. EXAMINATION OF SITE & SITE VISIT

Location: Ursuline College Chatham Catholic Secondary School, 85 Grand Avenue West, Chatham, ON.

Date: Tuesday February 26, 2019 at 3:00 pm

Contact: Paul Lernout Cell: 519-360-6262

This is a MANDATORY SITE VISIT. Only contractors who attend the site visit will be permitted to submit a bid response. Attendance will be taken.

In submitting a bid, it will be assumed that the bidders have carefully examined the drawings and have included in the bid price the complete cost of the work contemplated by the drawings and specifications and other bid documents.

14. TIMING OF PROJECT

The schedule for the completion of the project is:

- Commencement July 1, 2019.
- Completion no later than July 31, 2019.

15. PROJECT SPECIFIC REQUIREMENTS

Any and all damages to facilities while under the control of the contractor shall be repaired at the contractor's cost. Please be advised that the Owner has a No Smoking Requirement on the Owners' property. Contractors are requested to ensure that employees and suppliers are advised of the Requirement. Contractor shall remove rubbish and debris from the site on a daily basis or as directed by the Board. On completion of the work, all debris shall be removed; the floor shall be thoroughly cleaned and swept; the site shall be left in a tidy condition (construction clean). Do not use the Board's equipment or facilities for cleaning or for any reason.

16. INSURANCE

Contractor must maintain, at the Contractor's expense for the entire term of the Contract or as otherwise required. All insurance as set out below:

- The successful Contractor shall provide the Board with proof of insurance for Comprehensive General Liability and Property Damage with a limit of not less than **\$2,000,000.00 (two million dollars)** inclusive prior to commencing work.
- The successful Contractor shall provide the Board with proof of insurance for Motor Vehicle Public Liability and Property Insurance on all owned and rented equipment with a limit of not less than **\$2,000,000.00 (two million dollars)** inclusive prior to commencing work.
- The Contractor agrees to indemnify, hold harmless, and defend the Board from and against any and all liability for loss, damage and expense, which the Board may suffer or for which the Board may be held liable by reason of injury (including death) or damage to any property arising out of negligence on the party of the proponent or any of its representatives, employees, or subcontractors in the execution of the work performed or by way of ownership or operation of an automobile.
- The successful Contractor shall provide the Board with a complete certified copy of all policies. Copies of renewed policies must be provided to the Board on or before the policy renewal date for projects that extend past the original policy term or for multi-year contracts.
- The successful Contractor must name the St. Clair Catholic District School Board as additional insured on their insurance policies.

17. WORKPLACE SAFETY INSURANCE BOARD (WSIB)

Contractor must furnish a copy of Workplace Safety and Insurance Board Clearance Certificate of good standing, "Section 748" of the Workplace Safety and Insurance Act before an award is made.

18. PERMITS

Contractor to obtain all permits as required to complete the project, including but not limited to ESA, hot

work permit etc.

19. MEETINGS

A Post Bid Meeting may be convened and chaired by the Board who will invite Contractor and his major Subcontractors to review the Contract Documents and Bid submitted. This meeting will be prior to the Board issuing a Letter of Intent or Contract. This meeting does not constitute or infer any contract award to the proposed contractor or any other contractor, nor that will the project proceed.

During the course of Work, scheduled progress meetings may be required at the call of the Project Leader.

20. GUARANTEE

The guarantee shall be for a period of 1 year from and after completion of the entire job and acceptance thereof by the Board unless a different period of time is specified with the Board's approval. The Contractor's guarantee shall cover all work under the Contract whether or not any portion or trade has been sublet.

The Contractor agrees to correct promptly, at the Contractor's own expense, defects or deficiencies in the Work which appear prior to and during the period of guarantee, or such longer periods as may be specified for certain products or work.

If the Contractor fails to make any replacements or repairs required hereunder, after notice from the Board and reasonable opportunity to do so, the Board may have such work done at Contractor's expense, including all necessary labour costs in connection therewith. Board shall inform Contractor in advance of the approximate cost of such work to be done by the Board.

21. SCHEDULE

The Contractor will be required to perform the work in accordance with the Schedule dates provided in 14. Timing of Project. Ordering of major and long delivery items shall begin immediately upon successful bidder's receipt of contract award. The Contractor will provide a construction schedule within five (5) days of being awarded the project.

Time is of the essence. Bidders are to include adequate manpower, overtime and shift work necessary to meet or improve the schedule, and to make up any time lost to weather or normal delays. Include travel, room and board costs for out of town workers, shop overtime and other premiums to expedite material and equipment, shipping premiums and any incentive costs required to meet the schedule.

22. CONTRACTED SERVICES PROGRAM

Contractors performing work on Board property must complete the Contracted Services Program. The Contracted Services Program is a joint program with Lambton Kent District School Board. This program has three basic components that **must** be met before the bid is awarded. Contractors who cannot meet the minimum requirements of this program will not be awarded this tender. Program information can be found on the Board's web site at www.st-clair.net or through the Board contact identified previously in this document. If the contractor has already been pre-qualified by LKDSB they must provide proof of completion. Identification badges can be used on SCCDSB or LKDSB property. All Insurance and WSIB certificates must be up to date under the Contracted Services Program.

23. HEALTH and SAFETY

The Occupational Health and Safety Act describes the responsibilities of an employer. The Board requires Contractors to maintain procedures, training, and enforcement so that the responsibilities are carried out in the workplace. The Contractor shall abide by and strictly adhere to the regulations and conditions set out and laid down by the most current versions of the Occupational Health and Safety Act. All staff employed or hired by the Contractor and working on the Board's premise MUST be trained in WHMIS in accordance with Occupational Health and Safety Act and Regulations. They MUST adhere to all of the Board's Health and Safety Procedures and Guidelines and to Municipal By-Laws.

Contractor will submit proof of its health and safety program, procedures and training as detailed above upon request by the Board.

The Contractor shall appoint a Competent Person as the Supervisor of this project. The Competent Person shall be as defined in Section 1 of the Occupational Health and Safety Act.

The successful Contractor shall conform to the Ontario "Occupational Health and Safety Act" and all regulations made under said act and assume full responsibility for contraventions of same.

All workplace injuries or accidents on Board property MUST be reported by the Contractor to the Board's representative within 24 hours.

Any workplace injury that is defined under the Occupational Health and Safety Act as a "Critical Injury" must be reported to the Board's representative IMMEDIATELY.

24. SAFE SCHOOL PROCEDURES

Contractor's staff is required to report to the main office of the site where work will be carried out during regular school hours and notify the school office staff of the purpose of the visit. The Contractor is required to adhere to all school specific procedures if applicable.

It is the responsibility of the Contractor's staff to sign in and sign out of the Log Book, which is located in the main office area, while performing their duties.

The following information must be recorded in a legible manner:

- Date
- Company Name
- Employee Name
- Employee Signature
- Reason for Visit
- Time Entering Building
- Time Leaving Building

25. HOISTING, SCAFFOLDS, ELEVATED WORK PLATFORMS

The Contractor is responsible for all hoisting and other equipment necessary to facilitate their work.

26. TEMPORARY POWER

A source of electric power will be designated by the Board. The Board will allow a tie-in connection with fuse or breaker protection for the Contractor's estimated load requirements. The Contractor must provide the power connections and all extensions from the point to the job site. All electrical connections and

extensions must meet ESA requirements and must be approved by the Board. The Contractor's estimated load requirements must not be exceeded without the Owner's permission.

27. NOISE AND TRAFFIC CONTROL

Bidders shall comply with all applicable **noise by-laws** (or local requirements governing same) and traffic routing that may be in effect during the life of the Project.

This **may** limit some activities to restricted time periods. Where the schedule requires for after hour work, the Contractor shall include all costs associated with obtaining the necessary permits to work such time periods.

The Contractor shall be responsible for all costs associated with providing a traffic officer as necessary to facilitate construction.

28. SITE ACCESS AND EGRESS

Contractors will be required to sign out a master key and will be assigned an access code for the alarm system. Successful Contractor will be responsible for building security during working hours and locking up the facility at night, which includes setting the alarm.

Any false alarms generated by the Contractor's workforce will result in a back charge for the costs incurred to the Board.

29. PARKING

Contractors must park within the designated areas and allow for provisions to and from the designated parking area onto the job site.

30. CONTRACTOR'S PERSONNEL

The Contractor shall, at its own expense, provide all the personnel required to take a proactive role in managing the project as it relates to their work and its coordination with other trades. This will include but is not limited to the following:

- Competent supervision of the work of the Contract and coordination with the work of other Subcontractors. This includes being responsible for and properly supervising any subcontractors of this subcontractor.
- All layout work required to complete the work of the trade contract.
- Competent supervision of the work of the trade contract to ensure work is done in accordance with the OHSAA and any other applicable regulations.
- Expediting the procurement of material and equipment to ensure delivery by their required dates.
- Submission of Requests for Information where required in a timely manner and wherever possible providing the Board with information to assist in the answering of these requests.
- Submission in a timely manner of all required shop drawings and samples and assistance to the Board required to obtain approvals to suit the schedule. All shop drawings are to be reviewed by the Contractor prior to submitting for approval.
- Attendance at all construction coordination meetings when requested by the Board.
- Provision of all necessary information requested by the Board for cost control and billing purposes.

- Inspection of the work of the Trade Contract for defects and deficiencies and cooperation with the Board and other inspection authorities to allow their inspections to take place.
- Submission of pricing for all changes to the work within five (5) working days after receipt of change documentation including the breakdown and backup necessary to allow checking and approval.

31. ACCESSIBILITY FOR ONTARIANS WITH DISABILITIES ACT

The Purchaser is committed to the highest possible standards for accessibility. Proponent(s) must be capable to recommend and deliver, as appropriate for each Deliverable, accessible and inclusive Services consistent with the Ontario Human Rights Code (OHRC), the Ontarians with Disabilities Act, 2001 (ODA) and Accessibility for Ontarians with Disabilities Act, 2005 (AODA) and its regulations in order to achieve accessibility for Ontarians with disabilities.

In accordance with Ontario Regulation 429-07 made under the Accessibility for Ontarians with Disabilities Act, 2005 (Accessibility Standards for Customer Service), the Purchaser has established policies, practices and procedures governing the provision of its services to persons with disabilities.

Proponents are required to comply with the Purchaser's accessibility standards, policies, practices, and procedures, which may be in effect during the Term of the Agreement and which apply to the Deliverables to be provided by the Proponent.

32. CANADA'S ANTI-SPAM LEGISLATION

Please note that vendors are required to comply with all applicable laws, including CASL, in providing goods or services to the Board. This also extends to communications sent on the Boards behalf. The successful proponent(s) will be required to indemnify the Board for any failure by the successful proponent(s) to comply with CASL, to the extent that the successful proponent(s) action, or inaction, could expose the Board to liability.

33. WORKPLACE HAZARDOUS MATERIALS INFORMATION SYSTEM

The Proponent should provide Workplace Hazardous Materials Information System (WHMIS) material safety data sheets (MSDS) for all Services. Additionally, the Proponent should provide the Purchaser's personnel WHMIS training, as it relates to the Services, in accordance with the Ontario Occupational Health and Safety Act.

34. VENDOR PERFORMANCE

Where the Contractor fails to comply with any of its obligations under the Contract, the Board may issue a notice setting out the manner and time-frame for rectification. Within seven (7) Business Days of receipt of that notice or in a timeframe as otherwise agreed to, the Contractor shall either: (a) comply with that rectification notice; or (b) provide a rectification plan satisfactory to the Board. If the Contractor fails to either comply with that rectification notice or provide a satisfactory rectification plan, the Board may immediately terminate the Contract. Where the Contractor has been given a prior rectification notice, the same subsequent type of non-compliance by the Contractor may allow the Board to immediately terminate the Contract and result in the suspension of bidding privileges to the Board for up to two years at the sole unfettered discretion of the Board.

END OF INSTRUCTIONS TO BIDDERS

APPENDIX A: Agreement of Terms

I hereby acknowledge and agree that I have read and completed all the preceding Contract Terms and Conditions and Appendices.

I understand it is the SCCDSB's intention that this tender and the successful proponent(s)'s returned tender submission will form the basis of the proposed contract. All of the terms and conditions of this Tender must be accepted by the proponent(s) and incorporated into the proponent(s) Tender submission. It is the SCCDSB's intention to use a Purchase Order when establishing a contract with the successful proponent(s).

Acknowledgement of Addenda _____ through _____

This page must be signed below and returned with your submission for your tender to be accepted.

I/We the undersigned are duly authorized to execute this Bid Submission on behalf of:

NAME: _____

TITLE: _____

SIGNATURE: _____

COMPANY: _____

ADDRESS: _____

EMAIL: _____

TELEPHONE: _____

FAX: _____

Please refer to Appendix C: Bidder's Response Guide to ensure you include all necessary documentation with your bid submission

APPENDIX B: Bid Form

Company Name: _____

Having examined the Bid Documents in this Bid Package, and having visited the site and being aware of all conditions under which the work will be undertaken, we hereby offer to enter into a Contract to perform the work required by the bid documents, **and as listed in the Instructions to Bidders, including all taxes except H.S.T., which is excluded**, all for the stipulated price of:

(\$ _____)

H.S.T. amount **not** included in the Bid (\$ _____)

Contract Price Fixed: Note that subject to changes in the Contract Price made in accordance with the Contract, the Contract Price is fixed and constitutes the total compensation payable to the Contractor for providing the work. The Contract Price includes all labour, material, equipment, freight, taxes (**excluding HST**), currency exchange costs, insurances required, and **all** other costs and expenses of any kind respecting the work and materials to be provided. In lawful money of Canada (**H.S.T. excluded**) if notified of the acceptance of the offer within sixty (60) days from the time set for the opening of bids.

SEPARATE PRICES:

It is accepted that the intent of separate prices is to allow the Owner to add work outlined below, at the Owner's discretion.

The following prices have not been included in the base bid amount. The following prices include labour, material, tools, equipment, overhead and profit, but exclude HST.

Separate Price #1

Provide unit ventilator integration with existing BAS Delta system including all associated graphics. All work to be completed by Durrell Controls.

\$ _____

CASH ALLOWANCES:

1. Include Stipulated Sum of Three Thousand Dollars (\$3,000) to cover costs associated with existing pipe freezing.

Time and Materials rates to be applied against Cash Allowance work. Final reconciliation will adjust the cash allowance as credit the SCCDSB for unexpended amounts and extra to the contractor for over expenditure.

SUBCONTRACTORS:

No changes to the list of subcontractors will be allowed without express written permission of the owner or consultant. The bidder submits that in proposing the listed subcontractors, he has consulted each and has ascertained to his complete satisfaction that those named are fully acquainted with the extent and nature of the work involved and of the proposed construction schedule, and that they will execute their work to conform to the requirements of the Contract Documents.

Mechanical

Electrical

Controls

We recognize the right of St. Clair Catholic District School Board to accept any bid at the prices submitted or to reject any or all bids.

APPENDIX C: Bidder's Response Guide

Each bid submission should be structured using only the criteria identified in this bid document.

1. A signed copy of APPENDIX A: Agreement of Terms **must** be included for your bid submission to be accepted
2. A completed copy of APPENDIX B: Bid Form **must** be included in your bid submission.
3. Proof of WSIB Coverage and proof of insurance **must** be supplied before an award is made.
4. Bidders **must** provide one signed copy of the bid documents.
5. Supplemental material will not qualify as substitutes for direct responses to the bid's requirements, except for specifically requested material.
6. The successful contractor must be prequalified under the contracted services program before an award is made.
7. The work shall conform to the latest standards and codes listed in the Ontario School Code, National School Code, and all applicable provincial and municipal codes as of the date of this project in case of conflict or discrepancy; the most stringent requirement shall apply.
8. Contractor shall apply for and obtain all required SCCDSB or Provincial licenses as necessary.
9. Contractor shall apply for ESA (Electrical Safety Authority) permit before any work starts. NOTE: requirement for special "Retrofitted Luminaires Application" will be required for all retrofitted fixtures requiring internal modifications (bracket kits) where applicable.
10. Pay all fees and obtain all permits. Provide authorities with plans and information for acceptance certificates. Provide inspection certificates as evidence that work conforms to requirements of Authority having jurisdiction.

ISSUED FOR TENDER

**MECHANICAL &
ELECTRICAL
SPECIFICATIONS
FOR
Ursuline College
Chatham
Unit Ventilator
Replacement
V&R PROJECT #18-125
December 14, 2018**

Vanderwesten & Rutherford Associates Inc.

Consulting Mechanical & Electrical
Engineers
7242 Colonel Talbot Road
London, ON N6L 1H8



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1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Read and meet requirements of:
 - .1 The Contract CCDC 2-2008, Stipulated Price Contract as amended.
 - .2 Division 01 requirements and documents referred to therein.
- .2 Section 20 01 01 applies to and governs the work of all Sections of Mechanical Divisions 20, 21, 22, 23 and 25.
- .3 The technical Sections of this Division are generally divided into units of work for the purpose of ready reference. The division of the work among subcontractors is not the Consultant's responsibility and the Consultant assumes no responsibility to act as an arbiter and/or to establish subcontract limits between any Sections of the work.
- .4 The specifications are integral with the drawings which accompany them. Neither is to be used alone. Any item or subject omitted from one but implied in the other is fully and properly required.
- .5 Wherever differences occur in the tender documents, the most onerous condition governs. Base the bid on the most costly arrangement.

1.2 WORK INCLUDED

- .1 Products and methods mentioned or shown in the Contract Documents complete with incidentals necessary for a complete operating installation. Provide all tools, equipment and services required to do the work.
- .2 Identification of equipment, piping, ductwork, valves and controllers.
- .3 Concrete equipment base and housekeeping pads
- .4 Motors required for equipment supplied under Mechanical Divisions 20, 21, 22, 23.
- .5 Internal wiring, relays, contactors, switches, transformers, motor starters, and all controls necessary for the intended operation, furnished with terminals and external controls suitable for connection to power source at a single easily accessed location for equipment items that are supplied with motors and/or electrical or electronic components under Mechanical Divisions 20, 21, 22, 23, 25.
- .6 Take such measures and include in Bid Price for the proper protection of the existing building and its finishes at all times during alterations and construction of the new addition. Coordinate this protective work with all trades.
- .7 Refer to Mechanical/Electrical Equipment Schedule for extent of wiring and electrical characteristics.
- .8 Verify the correct operation of each equipment item provided and/or altered and each system in total and obtain the Owner's approval before starting and/or returning to operation.

1.3 RELATED WORK

- .1 Power wiring, conduit and connections for motors under Mechanical Divisions 20, 21, 22, 23 will be by Electrical Division 26.

1.4 SUBMITTALS

- .1 Approval Drawings: Prepare and submit drawings necessary for approval to any authority having jurisdiction, and obtain two (2) copies of approved drawings for retention by Consultant before commencement of work under Mechanical Divisions 20, 21, 22, 23, 25.
- .2 Shop Drawings: Prepare and submit one (1) electronic copy of shop drawings of major equipment items (including those items specifically indicated under Part 1: General of each Section), to the Consultant for review. The Consultant will return one electronic copy, marked with comments and his review stamp as he deems appropriate. Prepare the necessary number of copies of the returned set and distribute to the Owner, the Prime Consultant, the General Contractor, the site, and to subcontractors and suppliers.
 - .1 Clearly indicate manufacturer's and supplier's names, catalogue model numbers, details of construction, accurate dimensions, capacities and performance. Before submission check and certify as correct, shop drawings and data sheets. Do not order equipment until a copy of the shop drawings, reviewed by Consultant, has been returned to Contractor.
 - .2 Clearly indicate the weight, location, method of support and anchor point forces and locations

- for each piece of equipment on shop drawings.
- .3 The Consultant will not review shop drawings that fail to bear the Contractor's stamp of approval or certification.
- .4 Read the following in conjunction with the wording on the shop drawing review stamp applied to each and every drawing submitted:
"This review by the Consultant is for the sole purpose of ascertaining conformance with general design concept. This review shall not mean that the Consultant approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of his responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub trades."
- .3 Composite Wiring Diagrams: Prepare and submit one (1) copy of complete composite wiring diagrams of each specific mechanical system. Indicate all electrical equipment and wiring, both internal and external, for review and coordination of trades.
- .4 Contractor's Material and Test Certificates: Prepare and submit certificates for each system installed. Where certificates are prescribed by regulations, codes or standards ensure they meet the requirements of those documents (eg. NFPA-Standards). Include a copy of each certificate in the Operation and Maintenance manual. Certificates shall include the following:
- .1 Description of the system (description and type),
- .2 Description of the tests conducted and results observed, including re-testing, where necessary,
- .3 Description of any corrective measures undertaken,
- .4 Description of materials used (pipe and fittings),
- .5 List of witnesses for each test conducted,
- .6 Date system left ready for service,
- .7 Signature of Installing Contractor.
- .5 Directories & Schematics
- .1 Submit a copy of a neat directory indicating the valve number, related service, and location of each valve under Mechanical Divisions 20, 21, 22, 23, 25.
- .2 Submit a copy of system control schematics for each mechanical system indicating relative locations of equipment and control devices.
- .6 Maintenance Data and Operating Instructions
- .1 Submit one (1) copy of Operation and Maintenance Manual individually bound in hard backed three-ring binders and one (1) PDF format on USB Flash Drive clearly marked and labelled accordingly.
- .2 Ensure the binder spines have typewritten lettering as follows:
OPERATION & MAINTENANCE MANUAL
for
[Insert name of project]
[Insert date of submission]
[Insert Division Title]
- .3 Provide a list of names, addresses and telephone numbers of equipment suppliers, installing contractors, general contractors, architect and Consultant. Include special telephone numbers for service departments on normal and emergency call basis.
- .4 Provide descriptive literature (shop drawings) of each manufactured item. Include a bill of material with purchase order numbers and vendor's identification of equipment orders for each item.
- .5 Include copies of start-up reports and checklists and all certificates issued with respect to this contract.
- .6 Ensure operating instructions include the following:
- .1 General description of each mechanical system.
- .2 Step by step procedure to follow in putting each piece of equipment into service.
- .7 Ensure maintenance instructions include the following:
- .1 Manufacturer's maintenance instructions for each item of mechanical equipment installed under this Division. Instructions shall include installation instructions, parts

- .2 numbers and lists, name of supplier and maintenance and lubrication instructions.
- .2 Summary list of each item of mechanical equipment requiring lubrication, indicating the name of the equipment item, location of all points of lubrication, type of lubricant recommended, and frequency of lubrication.
- .3 Equipment directory indicating name, model, serial number and nameplate data of each item of equipment supplied, and system with which it is associated.
- .4 Balancing and testing reports.
- .5 Copy of valve directory.
- .7 As-Built Records: Prepare and submit complete as-built records before Substantial Performance of the Contract. Refer to Division 1 for requirements.
- .8 Requests for Shut-Down: Obtain permission for systems shut-down and/or service interruption from the Owner before disruption of any system or service in use by the Owner. Employ the Owner's standard form of request where available. Refer to Division 01 for additional requirements.
- .9 Requests for Start-up: Obtain permission from the Owner to start-up or to return to service any item of equipment, system or service installed new or previously shut-down. Refer to Division 1 for additional requirements.

1.5 QUALITY ASSURANCE

- .1 Meet the requirements or better of provincial and local codes, where existing, and to requirements of local inspection authorities for execution of work under this Division.
- .2 Ensure materials supplied under this Division meet the requirements and recommendations or better of applicable standards of the following:
 - .1 AABC Associated Air Balance Council
 - .2 AMCA Air Moving and Conditioning Association
 - .3 ANSI American National Standards Institute
 - .4 ASA American Standards Association
 - .5 ASHRAE American Society of Heating, Refrigerating, and Air Conditioning Engineers
 - .6 ASME American Society of Mechanical Engineers
 - .7 ASSE American Society of Sanitary Engineers
 - .8 ASPE American Society of Plumbing Engineers
 - .9 ASTM American Society of Testing and Materials
 - .10 AWWA American Water Works Association
 - .11 CAN2 National Standard of Canada (Published by CGSB)
 - .12 CAN3 National Standard of Canada (Published by CSA)
 - .13 CGSB Canadian General Standards Board
 - .14 CSA Canadian Standards Association
 - .15 EEMAC Electrical & Electronic Manufacturer's Association of Canada
 - .16 NBC National Building Code of Canada
 - .17 NEBB National Environmental Balancing Bureau
 - .18 NFPA National Fire Protection Association
 - .19 NEMA National Electrical Manufacturers Association
 - .20 OBC Ontario Building Code
 - .21 OFC Ontario Fire Code
 - .22 OFM Ontario Fire Marshall
 - .23 SMACNA Sheet Metal & Air Conditioning Contractors National Association
 - .24 TIAC Thermal Insulation Association of Canada
 - .25 ULC Underwriter's Laboratories of Canada Ltd.
 - .26 UL Underwriter's Laboratories (including cUL)
- .3 Use latest editions and amendments in effect on date of Bid call subject to requirements of OBC.
- .4 Arrange and pay for permits and inspections by authorities having jurisdiction, required in the undertaking of this Division. Make modifications required by authorities.
- .5 All tradesmen employed on the project shall hold valid trade certificates/licenses and shall make a copy available for review by the Consultant and/or Owner when requested.
- .6 All welding and brazing shall be executed by certified welders in accordance with registered procedures.
- .7 All refrigeration work shall be executed only by mechanics with valid ODP cards.

1.6 PRODUCT DELIVERY, HANDLING AND STORAGE

- .1 Immediately after letting of contract, review material and equipment requirements for this work, determine supply and delivery dates for all items, and notify Consultant of any potential delays in completion of this project in order that remedial action may be taken.
- .2 Store neatly out of the way and protected from damage and theft, materials and equipment supplied under Mechanical Divisions 20, 21, 22, 23, 25 that are received at the site by respective Division.

1.7 JOB CONDITIONS

- .1 Visit site and examine existing conditions which may affect work of this Mechanical Divisions 20, 21, 22, 23, 25.
- .2 Examine all Contract Documents to ensure that work of respective Division may be satisfactorily completed.
- .3 Notify Consultant upon discovery of conditions which adversely affect work of Mechanical Divisions 20, 21, 22, 23, 25. No allowance will be made after letting of contract for any expenses incurred through failure to do so. No extras will be granted due to lack of a thorough preliminary investigation of the site.
- .4 Remove and replace existing ceiling tile to inspect ceiling space for existing Mechanical, Electrical and Structural obstructions. Include cost of all necessary changes in Bid Price. No extras will be granted due to lack of a thorough preliminary investigation of accessible ceiling spaces. Obtain permission from the Owner before removing any ceiling tiles.
- .5 Submission of a bid confirms that the Contract Documents and site conditions are accepted without qualifications, unless exceptions are specifically noted in the Bid.

1.8 WARRANTY

- .1 Refer to General Conditions. Arrange with each manufacturer/supplier to extend warranties as necessary to coincide with warranty period or those periods specified.
- .2 Make submissions necessary to register product warranties to the benefit of the Owner.
- .3 Submit to Consultant, before Substantial Performance of the Contract, manufacturer's written warranties covering periods longer than one year or offering greater benefits than required in specifications and in the Owner's name.

1.9 DEFINITIONS

- .1 The following are definitions of words found in this specification and on associated drawings under this Division:
 - .1 "Concealed" - locations hidden from normal sight in furred spaces, shafts, ceiling spaces, walls, and partitions.
 - .2 "Exposed" - mechanical work normally visible to building occupants.
 - .3 "Furnish" - (and its derivatives) has the same meaning as the term "Supply".
 - .4 "Install" - (and its derivatives) - receive, store and handle at the site, mount and support and connect all required services. Includes adjustment and calibration, testing, commissioning, inspection by authorities having jurisdiction and documentation.
 - .5 "Provide" - (and its derivatives) - supply, install in place, connect the associated required services ready for operation, adjust and calibrate, test, commission, warrant, and document. Includes inspection by authorities having jurisdiction.
 - .6 "Supply" - (and its derivatives) purchase and deliver to the site for installation. Includes submittals, manufacturer's field inspection and warranty.
 - .7 "Wet" - locations exposed to moisture, requiring special materials and arrangement.

1.10 INTERRUPTIONS

- .1 Arrange execution of work to maintain present building operations, and to minimize the effect of work

- under Mechanical Divisions on existing operations.
- .2 Before interrupting any existing service notify the Owner and Consultant, in writing, at least 7 days in advance, and obtain written authorization. Do not interrupt any existing service without Consultant's specific authorization. Refer to Division 01 for requirements.
 - .3 Arrange time and duration of interruption through the Owner's Physical Plant Department. Include in Bid Price for all overtime or premium time hours necessary to minimize duration of service interruption.
 - .4 Test and verify the proper operation of existing equipment and systems that are shut down due to work of this project, before returning to service.
 - .5 Assume responsibility for consequential costs on failure to obtain permission to shut-down and/or start-up any item of equipment, system or service.

2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- .1 Ensure materials and equipment provided under Mechanical Divisions 20, 21, 22, 23, 25 are new and free from defects and bear labels of approval as required by codes referred to each Division and/or by inspection authorities.
- .2 Ensure apparatus and equipment provided under Mechanical Divisions 20, 21, 22, 23, 25 bears manufacturer's nameplate indicating name of manufacturer, model number or type, size, capacity, CRN, and other pertinent information. Ensure nameplates are easily read and clearly visible, with openings provided where equipment is insulated.
- .3 Ensure manufacturers and suppliers of equipment or materials under Mechanical Divisions 20, 21, 22, 23, 25 determine if their products are composed of any hazardous materials. If they are, the products are suitably labeled and supplied with Material Safety Data sheets. Obtain the Owner's approval in writing to bring hazardous materials onto the site before doing so.
- .4 When utilizing any products that are hazardous, keep Material Safety Data sheets on file at the job site and present them to anyone requesting this information. When transferring hazardous materials from original container into other containers, provide Workplace Labels on such containers.

2.2 ACCEPTABLE PRODUCTS

- .1 First item named or specified by catalogue number meets specifications regarding performance, quality of material and workmanship, and is acceptable to the Consultant.
- .2 Items, other than first named, meeting specifications regarding quality of materials and workmanship are acceptable to the Consultant, only, if they also meet performance and/or capacities specified and can be accommodated within the space allotted.
- .3 General approval indicated by inclusion of other manufacturers named is subject to final review of shop drawings, performance data and test reports.

2.3 EQUIVALENTS AND ALTERNATIVES

- .1 Suppliers wishing approval for additional equipment items as equivalent to those specified must submit complete description, technical and performance data to Consultant at least five (5) working days before Bid closing date. Such equivalent equipment, if accepted, meet the requirement specifications with regard to all details, accessories, modifications, features and performance. Deviations from specifications must be stated in writing at time of submission for approval.
- .2 Bid Prices shall include only products specified or approved equivalents. Contractors may propose unsolicited alternatives to the products specified. Alternative proposals shall be submitted in sealed envelope at time of general contract Bid submission and shall include full description and technical data, and a statement of the related increase or decrease in Bid Price should alternatives be accepted. All additional costs associated with unsolicited alternative proposals such as larger motor starters, larger power feeders, and space revisions to associated equipment, controls, etc. shall be included in alternative price. Prior approval by Consultant is not required for unsolicited alternative proposals.
- .3 Where the Contractor uses equipment other than that first named, on which the design is based, he shall be responsible for all details of installation including equipment size, arrangement, fit, and maintenance of all required clearances. Contractor shall prepare and submit revised layouts to

indicate arrangement of all affected piping, ductwork, conduit, lighting, equipment, etc. Failure by Contractor to provide such drawings will be considered indication that original arrangements and space allocations are adequate. All additional costs associated with equivalent equipment such as larger motor starters, larger power feeders, space revisions to associated equipment, controls, etc. shall be included in Bid Price.

2.4 SUBSTITUTIONS DURING PROGRESS OF WORK

- .1 If during the progress of work, specified products are not obtainable, equivalent or similar products by other manufacturers may be permitted by Consultant.
- .2 Apply, in writing, to Consultant for substitution of any products, indicating the following:
 - .1 Manufacturer's name, model number, details of construction, accurate dimensions, capacities and performance of proposed products.
 - .2 Reason for substitution.
 - .3 Any revisions to the contract price made necessary by substitution.
 - .4 Any revisions to the contract time made necessary by substitution.
 - .5 Any revisions to layout, arrangement or services made necessary by substitution.
- .3 No substitutions will be permitted without written authorization from the Consultant.

2.5 CONSULTANT'S REVIEW

- .1 The consultants will review and evaluate unsolicited alternatives and substitutions proposed by the Contractor. Such review and evaluation work will be undertaken by the Consultant on an additional fee basis. The Contractor shall reimburse the Owner for all costs associated with such reviews and evaluations.
- .2 The Contractor shall also reimburse the Owner for any and all costs incurred in updating Contract Documents to reflect such changes.

3 EXECUTION

3.1 RELATIONSHIP WITH OTHER TRADES

- .1 Cooperate with other trades whose work affects or is affected by work of Mechanical Division to ensure satisfactory installation and to avoid delays.
- .2 Provide structural supports for equipment to be mounted on or in walls, supported above floors and/or suspended from the structure.

3.2 INSTALLATION REQUIREMENTS

- .1 The Consultant's drawings and instructions govern the location of all items. Prepare fully coordinated installation drawings before installation.
- .2 Install equipment neatly to the satisfaction of the Consultant. Unless noted otherwise install products and services to follow building planes. Ensure installation permits free use of space and maximum headroom.
- .3 Confirm the exact location of outlets, fixtures and connections. Confirm location of outlets for equipment supplied under other Divisions.
- .4 Install equipment and apparatus to allow free access for maintenance, adjustment and eventual replacement. Verify equipment access and coordinate with equipment supplier to ensure equipment can be physically transported to installation location. Under no circumstances will any claim be allowed for extra cost to disassemble and/or assemble equipment at the final location which will be considered as part of the equipment installation.
- .5 Install metering and/or sensing devices to provide proper and reliable sampling of quantities being measured. Install instruments to permit easy observation.
- .6 Provide suitable shielding and physical protection for devices.
- .7 Install products and services in accordance with the manufacturer's requirements and/or recommendations.
- .8 Provide bases, supports, hangers and fasteners. Secure products and services so as not to impose undue stresses on the structure and systems.

- .9 Do not use power activated tools without written permission of the Consultant. Use them in accordance with the Owner's health and safety policies.
- .10 Ensure that the load onto structures does not exceed the maximum loading per square metre indicated on the structural drawings or as directed by the Consultant.

3.3 CONTRACT DRAWINGS

- .1 The drawings of Mechanical Divisions 20, 21, 22, 23, 25 are performance drawings and indicate general arrangement of the work. They are diagrammatic except where specific details are given. No allowance will be made for additional costs arising from the failure to obtain proper clarification of conflicting information before Bid.
- .2 Obtain accurate dimensions from the architectural and structural drawings, or by measurement. Location and elevation of services are approximate. Verify them before construction is undertaken.
- .3 Make changes where required to accommodate structural conditions, (beams, columns, etc.). Obtain Consultant's approval before proceeding.
- .4 Adjust the location of materials and/or equipment as directed without adjustment to contract price, provided that the changes are requested before installation and do not affect material quantity. Note that outlets and/or equipment may be relocated up to 10 feet (3 Metre) in any direction without a change to the contract price. The Consultant reserves the right to revise the locations of equipment and outlets within any given room without altering the Contract Price provided Notice of Change is given before rough-in.
- .5 The drawings of Mechanical Divisions 20, 21, 22, 23, 25 are intended for tender pricing. The quantities and quality to be included in the bid price shall be based on the layout and specifications as shown on the mechanical documents.

3.4 RECORD DRAWINGS

- .1 Maintain project "as-built" record drawings. Identify each set as "Project Record Copy".
- .2 Record deviations from contract documents caused by site conditions or by changes ordered by the Consultant. Record deviations in red ink clearly and accurately, using industry standard drafting procedures consistent with quality and standards of Consultants documents.
- .3 Record deviations as work progresses throughout the execution of this contract. Maintain record drawings on site in clean, dry, legible condition, making them available for periodic review by the Consultant.
- .4 Record location of concealed services, particularly underground services. Before commencing any backfilling, obtain accurate measurements and information concerning correct location and depth of services.
- .5 Transfer records from the "Project Record Copy" to a Memory/USB stick in Autocad format matching the Consultant's documents. Arrange computer file in layers to exactly match the layering system of the Consultant.
- .6 Submit the "Project Record Copy" on one or more Memory/USB stick with PDF prints of each drawing to the Consultant at the time of Substantial Performance.

3.5 USE OF EQUIPMENT

- .1 For the duration of this contract, do not use any piece of equipment provided under this contract for the purposes of heating, ventilation or air conditioning without the specific authorization of the Owner and Consultant. Ensure the building is "broom clean" and painting is finished before asking permission for testing to begin.
- .2 Where specific written authorization is given for the use of equipment while work is still in progress, seal off ductwork, grilles, diffusers, and registers or other openings to the air distribution systems or air handling equipment that is not in use. Provide filters over openings in ductwork, over grilles, diffusers and registers and in or at any air handling equipment that is in use. Ensure that the edges are sealed so that the filters are not bypassed. Change the filters frequently, to the satisfaction of the Consultant, until the building is turned over the Owner.

3.6 EXTRAS AND CREDITS

- .1 Accompany all price submissions requested by Consultant for extra work, or work to be deleted, with a complete cost breakdown as follows:
 - .1 Materials, quantities and unit costs including any applicable contractors' trade discount clearly identified.
 - .2 Labour hours and unit costs.
 - .3 Total materials and labour costs.
 - .4 Overhead and profit mark-ups in accordance with the General Conditions of the Contract.

3.7 INSTRUCTION

- .1 Instruct and familiarize Owner's operating personnel with the various mechanical systems. Arrange instruction for each system separately.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

- .1 Section 20 01 05 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 WORK INCLUDED

- .1 Installation, protection and maintenance of temporary services as required to support continuing operation of the facility.
- .2 Disconnection and removal of various mechanical equipment in areas to be turned over to the Owner.
- .3 Disconnection and making safe of various mechanical systems and equipment in areas to be demolished and/or renovated.
- .4 Disposal of waste materials in accordance with waste management requirements.
- .5 Re-certification and inspection of changes made to any equipment, machine or apparatus by authorities having jurisdiction including requirements for marking of equipment.

1.4 REGULATORY REQUIREMENTS

- .1 Notify all authorities of intent to demolish and schedule for the work. Obtain required permits from authorities.
- .2 Meet requirements of all codes for demolition work, dust control, products requiring disconnection and re-connection.
- .3 Do not close or obstruct egress width to any building or site exit.
- .4 Do not disable or disrupt building fire or life safety systems without 7 days prior written notice to Owner.
- .5 Meet requirements of procedures applicable when hazardous or contaminated materials are discovered.
- .6 Arrange for re-certification and inspection of changes made to any equipment, machine or apparatus by authorities having jurisdiction. This includes requirements for marking of equipment under rules 2-100 and 2-102 of the Ontario Electrical Safety Code.

1.5 JOB CONDITIONS

- .1 Visit site and examine existing conditions which may affect work of Mechanical Divisions.
- .2 Examine all Contract Documents to ensure that work of Mechanical Divisions may be satisfactorily completed.
- .3 Notify Consultant upon discovery of conditions which adversely affect work of Mechanical Divisions. No allowance will be made after letting of contract for any expenses incurred through failure to do so.
- .4 Submission of a bid confirms that the Contract Documents and site conditions are accepted without qualifications, unless exceptions are specifically noted in the Bid.

1.6 INTERRUPTIONS

- .1 Arrange execution of work to maintain present building operations, and to minimize the effect of work under this Division on existing operations.
- .2 Before interrupting any existing service notify the Owner and Consultant, in writing, at least 7 days in advance, and obtain written authorization. Do not interrupt any existing service without Consultant's specific authorization. Refer to Division 01 for requirements.
- .3 Arrange time and duration of interruption through the Owner's Physical Plant Department. Include in Bid Price for all overtime or premium time hours necessary to minimize duration of service interruption. Where new valves are installed to replace existing valves and it is impractical to shut-down and drain the entire system, valves shall be replaced using pipe freezing techniques.
- .4 Test and verify the proper operation of existing equipment and systems that are shut down due to

- work of this project, before returning to service.
- .5 Assume responsibility for consequential costs on failure to obtain permission to shut-down and/or start-up any item of equipment, system or service.

2 PRODUCTS

Not Applicable

3 EXECUTION

3.1 PREPARATION

- .1 Before start of work under this Section, ensure that the General Trades;
- .1 Provide, erect, and maintain temporary barriers at locations indicated.
 - .2 Erect and maintain weatherproof closures for exterior openings.
 - .3 Erect and maintain temporary partitions to prevent spread of dust, odours, and noise to permit continued Owner occupancy.
- .2 Protect services and equipment which are not to be demolished.
- .3 Coordinate all service shut downs with Owner's project coordinator. Provide notice as required by Owner and submit schedule for the work.
- .4 Provide appropriate temporary signage including signage for exit or building egress.

3.2 RELATIONSHIP WITH OTHER TRADES

- .1 Cooperate with other trades whose work affects or is affected by work of Mechanical Divisions to ensure satisfactory installation and to avoid delays.
- .2 Remove and dispose of bases, supports and anchors for piping, equipment and ductwork mounted on or in walls, supported above floors and/or suspended from the structure.

3.3 PROTECTION

- .1 Protect existing and new work to remain free from damage due to execution of work under this Division with tarpaulins and other protective coverings as necessary.
- .2 Repair any and all damage to the building and components resulting from failure to provide sufficient protection, to the satisfaction of the Consultant.
- .3 All existing air intake and exhaust openings that may be affected by dust and/or debris from the construction work shall be fitted with appropriate filter media to protect against entry of dust and/or debris into the building and its air distribution systems. Filters shall be closely monitored and replaced when necessary. The Contractor shall replace existing filters that become contaminated with dust and/or debris from construction work with new filters.
- .4 In the event that dust and debris from construction work does penetrate the building and/or its air distribution systems, the Contractor shall be responsible for cleaning the affected areas and/or systems.
- .5 Temporary filters shall be removed on completion of the construction works.

3.4 DEMOLITION

- .1 Notify all authorities of intent to demolish and schedule for the work.
- .2 All demolition work shall meet requirements of all codes, regulations, standards and by-laws applicable to the work.
- .3 Isolate and drain systems as required to effect demolition. Disconnect, cap and make safe all mechanical services to the building.
- .4 Protect existing equipment and services to remain from debris and unwanted materials. Clean as necessary to maintain service during demolition period and on completion of the work.
- .5 Coordinate all service shut downs with Owner's project coordinator. Provide notice as required by Owner and submit schedule for the work.
- .6 Remove and dispose of all redundant mechanical services and equipment within the limits of the demolition site and where demolished systems extend beyond these limits.
- .7 Turn over items identified for recovery by the Owner.

- .8 All demolition work shall meet requirements of Occupational Health & Safety and Environmental regulations.
- .9 If during alteration work existing asbestos material, other than known asbestos, is discovered (e.g. fireproofing, acoustic or thermal insulation, tank covering), stop work in the affected area and immediately notify consultant. Follow the Ontario Ministry of Labour's Latest Requirements.
- .10 Ensure that all parties are familiar with requirements and experienced in the work to be undertaken.
- .11 Waste disposal shall meet requirements of the requirements of Division 01, municipal By-Laws and Ministry of the Environment regulations and standards.
- .12 All existing air intake and exhaust openings that may be affected by dust and/or debris from the demolition work shall be fitted with appropriate filter media to protect against entry of dust and/or debris into the building and its air distribution systems. Filters shall be closely monitored and replaced when necessary. The Contractor shall replace existing filters that become contaminated with dust and/or debris from demolition work with new filters.
- .13 In the event that dust and debris from demolition work does penetrate the building and/or its air distribution systems, this Section shall be responsible for cleaning the affected areas and/or systems.
- .14 Demolish in an orderly and careful manner. Protect existing supporting structural members.
- .15 Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.
- .16 Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.
- .17 Remove temporary Work.

3.5 RENOVATIONS

- .1 Isolate and drain systems as required to effect renovations, modifications and/or repairs. When shut-down and drainage of the existing systems is not possible due to facilities operational requirements, the tie-ins shall be completed using pipe freezing. On completion of renovations, modifications and/or repairs, test entire system as if new. Report repairs or replacements required of existing equipment, piping, fittings or devices that are not included in contract to Consultant and Owner for instruction. Flush, clean and refill renovated systems as specified for new. Provide chemical treatment as required and ensure compatibility with the existing systems.
- .2 Relocate or remove existing items so designated unless specifically indicated to be relocated or removed under other Sections.
- .3 Existing items to be relocated shall be cleaned and repaired or altered as required to suit new location. All damaged or ineffective parts shall be replaced and the item made "as new".
- .4 Existing items to be removed remain the property of the owner and shall be delivered to a location on site designated by the owner. If the owner declares no interest in the removed items, assume ownership and remove the items from the site.
- .5 Make good all surfaces and finishes in areas from which items have been removed and in which items are relocated. Cap all existing services required to be severed to effect alterations and do all other work necessary to make good such areas to satisfaction of consultant.
- .6 Openings in existing floor assemblies and vertical fire separations necessitated by installation of equipment and systems or construction in general must be temporarily sealed with fire barrier materials such as mineral wool or other noncombustible insulation.
- .7 If during alteration work existing asbestos material, other than known asbestos, is discovered (e.g. fireproofing, acoustic or thermal insulation, tank covering), stop work in the affected area and immediately notify consultant. Follow the Ontario Ministry of Labour's Latest Requirements.
- .8 Existing refrigerant indicated to be removed shall not be discharged to the atmosphere, but shall be salvaged and reclaimed or disposed of following the guidelines of the authority having jurisdiction.
- .9 All existing air intake and exhaust openings that may be affected by dust and/or debris from the renovation work shall be fitted with appropriate filter media to protect against entry of dust and/or debris into the building and its air distribution systems. Filters shall be closely monitored and replaced when necessary. The Contractor shall replace existing filters that become contaminated with dust and/or debris from renovation work with new filters.
- .10 In the event that dust and debris from renovation work does penetrate the building and/or its air distribution systems, the Contractor shall be responsible for cleaning the affected areas and/or systems.
- .11 Temporary filters shall be removed on completion of the renovation work.

3.6 INSPECTION AND RE-CERTIFICATION

- .1 Where any equipment, machine or apparatus is modified, rebuilt or rewound with any change resulting in its performance or capacity rating and characteristics it shall be inspected and re-certified as required by authorities having jurisdiction.
- .2 A nameplate giving the name of the person or firm making the change and the resulting changes in performance or capacity shall be provided and affixed to the equipment, machine or apparatus adjacent to the original nameplate. Where the original nameplate is removed, the original manufacturer's name and original identifying data, such as serial numbers, shall be added to the nameplate.
- .3 Refer to rules 2-100 and 2-102 of the Ontario Electrical Safety Code.

3.7 REFRIGERANT RECOVERY / RECYCLING

- .1 Removal, relocation and/or refilling of refrigeration piping and/or equipment that contains ozone depleting substances and other halocarbons including the following items shall meet requirements of regulations under the Environmental Protection Act, including O. Reg. 463/10.
 - .1 solvents and sterilants
 - .2 fire extinguishing equipment
 - .3 refrigerants
- .2 Ozone depleting substances (ODS) and other halocarbons shall be recovered using equipment and processes that are designed and approved specifically for the task.
- .3 Disposal of ODS and other halocarbons and associated equipment and containers shall comply with requirements under the Environmental Protection Act, including O. Reg. 463/10.
- .4 Persons servicing, testing and/or performing tasks associated with the removal, relocation and/or refilling of refrigeration piping and/or equipment that contains ozone depleting substances and other halocarbons shall be certified under Section 34 of O. Reg. 463/10.
- .5 Prepare and submit all records and notices required by authorities having jurisdiction.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

- .1 Section 20 05 00 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 REFERENCE STANDARDS

- .1 Provide all work in accordance with requirements of Regulatory Agencies and meet requirements of:
 - .1 Local and district by-laws, regulations and published engineering standards.
 - .2 Ontario Building Code as amended,
 - .3 Ontario Gas Utilization Code as amended
 - .4 Regulations for Construction Projects under The Occupational Health and Safety Act.
 - .5 Fire Code made under the Fire Marshal's Act.
- .2 Meet requirements of the following CSA Standards:
 - .1 CSA W48 series Electrodes.
 - .2 CSA B51, Boiler, Pressure Vessel and Pressure Piping Code.
 - .3 CAN/CSA-W117.2, Safety in Welding, Cutting and Allied Processes
- .3 Meet the requirements of the following National Research Council Canada publications:
 - .1 National Building Code of Canada and Supplements to National Building Code of Canada
 - .2 Canadian Plumbing Code.
 - .3 Model National Energy Code for Buildings
- .4 Meet the requirements of the following American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME) Standards:
 - .1 ANSI/ASME B31.1 Power Piping.
 - .2 ANSI/ASME B31.3, Process 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 ASME A13.1 - Scheme for the Identification of Piping Systems.
- .5 Meet the requirements of the following American Welding Society (AWS) Standards:
 - .1 AWS C1.1, Recommended Practices for Resistance Welding.
 - .2 AWS Z49.1, Safety Welding, Cutting and Allied Process.
 - .3 AWS W1, Welding Inspection.
- .6 Meet the requirements of the following American Society for Testing and Materials (ASTM) Standards:
 - .1 ASTM E1 - Specification for ASTM Thermometers.
 - .2 ASTM E77 - Inspection and Verification of Thermometers.
- .7 Meet the requirements of AFBMA 9 – Load Ratings and Fatigue Life for Ball Bearings.
- .8 Meet the requirements of AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- .9 The above documents or portions thereof are referenced within the work of Mechanical Divisions 21, 22 and 23 and shall be considered part of the requirements of this document as though fully repeated herein.

1.4 QUALIFICATIONS

- .1 Motor manufacturer: Company specializing in manufacture of electric motors for HVAC use, and their accessories, with minimum three years documented product development, testing, and manufacturing experience.
- .2 Firestop Sealant Manufacturer: Company specializing in manufacture of sealants with minimum three years documented product development, testing, and manufacturing experience.
- .3 Firestop components and assemblies shall be ULC listed and tested in accordance with ULC S115 Standard Method of Fire Test for Firestop Systems.

1.5 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 20 01 01.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Transport, handle, store, and protect products. Refer to Division 01 requirements as well.
- .2 Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.7 WASTE MANAGEMENT & DISPOSAL

- .1 Separate and recycle waste materials in accordance with Division 01 Waste Management and Disposal, and with the Contractor's Waste Reduction Workplan.
- .2 Place materials defined as hazardous or toxic waste in designated containers.
- .3 Ensure emptied containers are sealed and stored safely for disposal away from children.

2 PRODUCTS

2.1 PIPING SPECIALTIES

- .1 Cast brass, pressure, copper to copper unions shall be used with seamless copper tubing smaller than 3" (75 mm).
- .2 Dart type, 125 lb. (860 kPa) black malleable iron unions shall be used with all steel pipe for piping 2-1/2" (65 mm) and smaller.
- .3 Gaskets for joining flanged steel pipe shall be 1/16" (4 mm) Cranite ring type gaskets.
- .4 Piping specialties including backflow preventers, strainers, valves etc. shall be line size unless indicated otherwise on drawings.
- .5 Strainers
 - .1 Manufacturers:
 - .1 Sarco SB
 - .2 Armstrong
 - .3 Crane
 - .4 Conbraco
 - .5 Colton
 - .6 Victaulic
 - .2 In copper tubing: Class 250, wye type, bronze, screwed connection, with blind caps, and 1/32" (0.8 mm) perforated stainless steel screen.
 - .3 In Steel Piping: 2" (50mm) and smaller
 - .1 Body and cover: screwed, line size Y type strainer, semi-steel conforming to ASTM A278-85, Class 30, complete with screwed blind cap. Primary service rating of 175 psi @ 350 F (1207 kPa @ 178 C). Body shall have side drain connection.
 - .2 Screen: perforated type 304 stainless steel service:
 - .1 Steam 1/16" (0.4 mm)
 - .2 Water 1/32" (0.8 mm)
 - .3 Glycol 1/32" (0.8 mm)
 - .4 Water @ Pump Suction 1/8" (3.2 mm)
 - .5 Light Oil 1/16" (1.6 mm)
 - .6 Compressed Air 1/64" (0.4 mm)

2.2 ADHESIVES, SEALANTS, PAINTS AND COATINGS

- .1 Adhesives, Sealants, Paints and Coatings: Use only low VOC emitting materials meeting following criteria;
 - .1 Paint for Mechanical Identification: maximum VOC emission of 250g/L
 - .2 Touch-Up Paint: maximum VOC emission of 250g/L
 - .3 Zinc-Rich Primer: maximum VOC emission of 250g/L

- .4 Adhesives for Mechanical Identification: maximum VOC emission of 70g/L
- .5 Sealants for service penetrations: maximum VOC emission of 650g/L clear and 350 g/L pigmented
- .6 Sealants for Firestopping: max. VOC emission of 650g/L clear and 350 g/L pigmented
- .7 Acrylic Sealant for supports and anchors: maximum VOC emission of 250g/L
- .8 Insulation Vapour Barrier Lap Adhesive: maximum VOC emission of 80g/L
- .9 Insulation Joint Sealer: maximum VOC emission of 250g/L
- .10 Insulation Vapour Barrier Mastic: maximum VOC emission of 400g/L
- .11 Flame Retardant Adhesive: maximum VOC emission of 650g/L clear and 350 g/L pigmented

2.3 WELDING ELECTRODES

- .1 Electrodes: in accordance with CSA W48 Series.

2.4 FIRESTOPPING COMPOUND

- .1 Manufacturers:
 - .1 3M products indicated.
 - .2 Dow Corning
 - .3 John Manville
 - .4 Hilti Firestop Systems
- .2 Fire Rated Sealants: Intumescent material, synthetic elastomers, capable of expanding up to 8 to 10 times when exposed to temperatures of 250°F (121°C) or higher. ULC listed and labeled.

2.5 NAMEPLATES

- .1 Provide laminated plastic plates with black face and white centre of minimum size 3-1/2" x 1-1/2" x 3/32" (90 x 40 x 2 mm) nominal thickness, engraved with 1/4" (6 mm) high lettering. Use 1" (25 mm) lettering for major equipment.
- .2 Fasten nameplates securely in conspicuous place. Where nameplates cannot be mounted on cool surface, provide standoffs.
- .3 Identify equipment type and number and service of areas or zone of building served.
- .4 For each item of equipment which may be started automatically or remotely, add a red lamacoid plate, 2-1/2" x 9" (65 x 230 mm), reading: **"WARNING. THIS EQUIPMENT IS AUTOMATICALLY CONTROLLED AND MAY START AT ANY TIME."**

2.6 TAGS

- .1 Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background colour. Tag size minimum 1-1/2" (40 mm) diameter. **OR**
- .2 Metal Tags: Brass, aluminum or stainless steel with stamped letters; tag size minimum 1-1/2" (40 mm) diameter with smooth edges.
- .3 Chart: Typewritten letter size list in anodized aluminum frame.

2.7 STENCILS

- .1 Stencils: With clean cut symbols and letters of following size:
 - .1 3/4"-1-1/4" (20-30 mm) Outside Diameter of Insulation or Pipe: 8" (200 mm) long colour field, 1/2" (15 mm) high letters.
 - .2 1-1/2"-2" (40-50 mm) Outside Diameter of Insulation or Pipe: 8" (200 mm) long colour field, 3/4" (20 mm) high letters.
 - .3 2-1/2"-6" (65-150 mm) Outside Diameter of Insulation or Pipe: 12" (300 mm) long colour field, 1-1/4" (30 mm) high letters.
 - .4 8" - 10" (200-250 mm) Outside Diameter of Insulation or Pipe: 24" (600 mm) long colour field, 2-1/2" (65 mm) high letters.
 - .5 Over 10" (250 mm) Outside Diameter of Insulation or Pipe: 32" (800 mm) long colour field, 3-1/2" (90 mm) high letters.
 - .6 Ductwork and Equipment: 2-1/2" (65 mm) high letters.

2.8 PRESSURE GAUGES

- .1 Manufacturers:
 - .1 Trerice Model 600BC.
 - .2 Weiss
 - .3 Winter
 - .4 Morrison
 - .5 Taylor
- .2 Gauge: 4-1/2" (115mm) diameter black cast aluminum, phosphor bronze bourdon tube, rotary brass movement, brass socket, with front recalibration adjustment, black scale on white background, mid-scale accuracy: 1%, scale: psi and kPa.
- .3 Gauge Cock: Tee or lever handle, brass for maximum 150 psi (1034 kPa).
- .4 Needle Valve: Brass, 1/4" (6 mm) NPT for minimum 150 psi (1034 kPa).
- .5 Pulsation Damper: Pressure snubber, brass with 1/4" (6 mm) connections.
- .6 Syphon: Steel, Schedule 40, 1/4" (6 mm) angle or straight pattern.

2.9 STEM TYPE THERMOMETERS

- .1 Manufacturers:
 - .1 Trerice Model BX9 2 403.
 - .2 Weiss Model 9VS3-1/2.
 - .3 Winter
 - .4 Morrison
 - .5 Taylor
- .2 Thermometer: 9" (230mm) scale, red appearing thermal fluid with black figures on white scale, calibrated in both degrees F and degrees C, accuracy to ASTM E77 of 2%, clear glass lens front tube, cast aluminum case with enamel finish, cast aluminum adjustable joint with positive locking device, 3/4" (20mm) NPT brass stem.
- .3 All thermometers to include a separable well.
- .4 Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- .5 Flange: 3" (75 mm) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.10 DIAL THERMOMETERS

- .1 Manufacturers:
 - .1 Trerice
 - .2 Weiss.
 - .3 Winter.
 - .4 Morrison.
 - .5 Taylor
- .2 Thermometer: ASTM E1, stainless steel case, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.
 - .1 Size: 2" (50 mm) diameter dial.
 - .2 Lens: Clear glass.
 - .3 Accuracy: 1 percent.
 - .4 Calibration: Degrees C Both degrees F and degrees C.

OR
- .3 Thermometer: ASTM E1, stainless steel case, adjustable angle with front recalibration, bimetallic helix actuated with silicone fluid damping, white with black markings and black pointer hermetically sealed lens, stainless steel stem.
 - .1 Size: 3" (75 mm) diameters dial.
 - .2 Lens: Clear glass.
 - .3 Accuracy: 1 percent.
 - .4 Calibration: Degrees F.

OR
- .4 Thermometer: ASTM E1, stainless steel case, vapour or liquid actuated with brass or copper bulb,

copper or bronze braided capillary, white with black markings and black pointer glass lens.

- .1 Size: 2-3/8" (60 mm) diameters dial.
- .2 Lens: Clear glass.
- .3 Length of Capillary: Minimum 60" (1500 mm).
- .4 Accuracy: 2 percent.
- .5 Calibration: Degrees C Both degrees F and degrees C.
- .5 Socket: Brass separable sockets for thermometer stems with or without extensions as required, and with cap and chain.
- .6 Flange: 3" (75 mm) outside diameter reversible flange, designed to fasten to sheet metal air ducts, with brass perforated stem.

2.11 TEST PLUGS

- .1 Manufacturers:
 - .1 Pete's Plug.
 - .2 Watts TP.
- .2 Test Plug: 1/4" or 1/2" (6 mm or 15 mm) brass fitting and cap for receiving 1/8" (3 mm) outside diameter pressure or temperature probe with neoprene core for temperatures up to 93°C (200°F).
- .3 Test Kit: Carrying case, internally padded and fitted containing one diameter pressure gauges, one gauge adapters with 1/8" (3 mm) probes, two 1" (25 mm) dial thermometers.

2.12 STATIC PRESSURE GAUGES

- .1 Manufacturers:
 - .1 Trerice
 - .2 Weiss.
 - .3 Winter.
 - .4 Taylor.
- .2 3-1/2" (90 mm) diameter dial in metal case, diaphragm actuated, black figures on white background, front recalibration adjustment, 2 percent of full scale accuracy.
- .3 Inclined manometer, red liquid on white background with black figures, front recalibration adjustment, 3 percent of full scale accuracy.
- .4 Accessories: Static pressure tips with compression fittings for bulkhead mounting, 1/4" (6 mm) diameter tubing.

2.13 PENETRATION SEALS

- .1 Manufacturer: Link-Seal
- .2 Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill the annular space between the pipe and wall opening. Links shall be loosely assembled with bolts to form a continuous rubber belt around the pipe with a pressure plate under each bolt head and nut.

3 EXECUTION

3.1 INSPECTION

- .1 Inspect installed work of other trades and verify that such work is complete to point where work under Mechanical Divisions 20, 21, 22, 23, 25 may properly begin.
- .2 Verify that work of Mechanical Divisions 20, 21, 22, 23, 25 may be executed in accordance with pertinent codes and regulations, specifications, drawings, and referenced standards.
- .3 Review drawings and verify dimensions at the site. Report discrepancies immediately to Consultant before proceeding with any construction work or shop drawings.

3.2 PREPARATION

- .1 Existing services and equipment shall be relocated or removed to suit new construction and renovation work.
- .2 Services that are no longer required shall be removed or cut back and capped to the satisfaction of

- Consultant.
- .3 Obtain written authorization from Consultant for renovation work that is not specifically indicated.
 - .4 Where modifications or connections to existing systems require shutdown of the system the Contractor shall submit a request for system shutdown describing the system or part to be shutdown, the duration of the shutdown, the work planned and steps to be taken to reinstate the system to full operation. The request shall be submitted in the format stipulated by the Owner.
 - .5 All work required to prepare systems for shutdown and/or re-instatement, such as draining, chemical treatments, and re-filling shall be included in this Bid Price.

3.3 PIPING INSTALLATION - ABOVE GROUND

- .1 Cooperate with other trades whose work affects or is affected by work of Mechanical Sections, to ensure satisfactory installation and to avoid delays. Provide all materials to be built-in such as sleeves, anchors, etc., together with accurate dimensions or templates, promptly.
- .2 Layout all work accurately, installing piping parallel to lines of building.
- .3 Install piping, wherever possible, in partitions and above ceiling. Do not install piping in outside walls unless so shown on drawings. Wrap uninsulated piping in masonry walls with building paper.
- .4 Install concealed piping close to building structure to minimize furring dimensions.
- .5 Provide adequate space around piping to facilitate application of insulation.
- .6 Use dielectric couplings where piping of dissimilar metals connect.
- .7 Where piping passes through concrete floors, or walls, sleeves shall be sized to permit the pipe to expand freely without binding or crushing pipe insulation.
- .8 Where branch pipes are welded into main without the use of "T" connections, torch cut openings must be cut true, beveled and filed smooth. Branch pipes must not be allowed to project inside of main pipe. Openings must not be cut large enough to permit entry of welding metal and slag within the pipe.
- .9 Arrange all take-offs from mains to allow for expansion and contraction of pipes. Hot water branches serving downfeed risers must be taken from lower sides or bottom of mains and grade down slightly to risers. Branches which serve units above the mains shall be taken from the top or sides of mains.
- .10 Install automatic control valves and wells supplied under other Sections of Mechanical Divisions.

3.4 PIPING JOINTS

- .1 Make joints in piping installed under Mechanical Divisions using persons familiar with the particular materials being used and in accordance with CSA B51 and CSA B52, manufacturer's instructions, and as specified herein.
- .2 Use only welder and/or brazer operators, with a valid identification card, as issued under The Boiler and Pressure Vessels Act, to make joints in Registered Piping Systems, as indicated under Section 20 01 01, and 20 05 00.
- .3 Use 95/5 Sb.Sn (tin-antimony) solder for joining copper drainage tubing smaller than 4" (100 mm), and for joining copper water tubing installed above grade, and smaller than 4" (100 mm).
- .4 Use silver solder or Silfos for joining copper tubing 4" (100 mm) and larger in size.
- .5 Carefully ream joints in threaded pipe and paint with approved graphite type joint sealer on male connections only. Make connections with proper wrench to suit pipe size. Where leaks occur, the joint shall be disassembled and corrected if possible, or replaced. Over-tightening, caulking or peening will not be acceptable.
- .6 Make joints in cast iron pipe with standard M-J joints in accordance with manufacturer's recommendations and CSA B70.
- .7 Install unions or welding flanges at connections to valves, etc. to facilitate removal.

3.5 WELDING

- .1 Welder's 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 and Owner.
 - .4 Each welder to possess identification symbol issued by authority having jurisdiction.

3.6 FLUSHING AND CLEANING

- .1 Thoroughly flush all piping installed by Mechanical Divisions.
- .2 Remove, clean and replace all strainers in systems after flushing.
- .3 Thoroughly clean all equipment and fixtures, and lubricate HVAC equipment, and leave all items in perfect order ready for operation.

3.7 PIPING SYSTEMS TESTING AND INSPECTION

- .1 Before tests, isolate all equipment or other parts which are not designed to withstand test pressures.
- .2 Test all piping at the completion of roughing-in, before connecting to existing systems, and before concealment, insulation or covering of piping.
- .3 Repair all leaks exposed during testing and retest. If defects in pipe or fittings are discovered in the system, they shall be removed and replaced.
- .4 Certify tests not required by authorities having jurisdiction.

3.8 EQUIPMENT TESTING AND INSPECTION

- .1 Test operation of equipment installed under Mechanical Divisions according to instructions in appropriate articles of Mechanical Specifications. Make any required adjustments or replacements to ensure equipment is operating as intended. Retest equipment requiring adjustment or replacement.

3.9 TESTING AND BALANCING

- .1 Allow sufficient time for testing and verification before substantial completion. Notify Testing and Balancing Agency on completion of adjusting and balancing of systems.
- .2 Adjust systems and components (drives, sheaves, belts, etc.) as required by Testing and Balancing Agency.
- .3 Maintain systems in full operation during testing and verification.
- .4 Make adjustments to control systems as required to facilitate verification. Maintain all safety controls in operation.
- .5 Provide pitot tube test fittings at all main branches of sheet metal work and at intake and discharge locations of air handling systems as required by Testing and Balancing Agency.

3.10 ELECTRICAL COMPONENTS AND WIRING

- .1 Meet the requirements of Electrical Division 26 for all wiring included in Mechanical Divisions 20, 21, 22 and 23. Includes pre-wired equipment provided within appropriate Sections under Mechanical Divisions 20, 21, 22 and 23.
- .2 Ensure that all pre-wired electrical equipment is CSA approved. Arrange and pay for special approval where this is not possible.

3.11 PROTECTION

- .1 Protect finished and unfinished work by tarpaulins, or other covering, from damage due to execution of work under Mechanical Divisions.
- .2 Repair to satisfaction of Consultant, damage to building resulting from failure to provide such protection.
- .3 All existing air intake and exhaust openings that may be affected by dust and/or debris from the construction work shall be fitted with appropriate filter media to protect against entry of dust and/or debris into the building and its air distribution systems. Filters shall be closely monitored and replaced when necessary. The Contractor shall replace existing filters that become contaminated with dust and/or debris from construction work with new filters.
- .4 In the event that dust and debris from construction work does penetrate the building and/or its air distribution systems, the Contractor shall be responsible for cleaning the affected areas and/or systems.
- .5 Temporary filters shall be removed on completion of the construction works.

3.12 CUTTING AND PATCHING

- .1 Include cutting and patching as required in execution of work under respective Sections of this Mechanical Divisions.
- .2 Holes through the structure will not be permitted without written approval of the Consultant. Any and all openings required through the completed structure must be clearly and accurately shown on a copy of the relevant structural drawing(s). Exact locations, elevations and size of the proposed opening must be identified well in advance of the need for the work.
- .3 All sleeved or formed openings through the structure must be shown on sleeving drawings and must be approved by the Structural Consultant before construction.
- .4 The Contractor shall conduct exploratory work including x-ray of the existing structure, shall mark the location of embedded reinforcements, anchors, conduits and piping on exposed surfaces of adjacent floors and/or walls and shall pay all associated costs.
- .5 Reinforcing shall not be cut or modified without prior approval of the Structural Consultant. Should reinforcement be cut without such prior approval, the cost of any additional reinforcement deemed necessary by the Structural Consultant shall be the responsibility of this Contractor.
- .6 Maintain the integrity of fire rated assemblies where they are pierced by ducts and pipes.
- .7 Make good surfaces affected by this work and repair finish to satisfaction of Consultant. Stop work immediately upon discovery of any hazardous material and report discovery to the Owner and Consultant. Obtain instruction before proceeding with the work.

3.13 SEALANTS & CAULKING

- .1 Fill voids around pipes:
 - .1 Where sleeves pass through non-fire rated walls or floors, caulk space between pipe and sleeve with fibreglass. Seal space at each end with waterproof, fire retardant, non-hardening mastic.
 - .2 Ensure no contact between copper tube or pipe and ferrous sleeve.
 - .3 Fill future-use sleeves with easily removable filler.
 - .4 Coat exposed exterior surfaces or ferrous sleeves with heavy application of zinc rich paint (VOC content not to exceed 250 g/L).
- .2 Temporarily plug all openings during construction.

3.14 FIRESTOPPING

- .1 All openings in fire separations and fire rated assemblies for service penetrations shall be protected with ULC listed service penetration firestop systems (SP).
- .2 The service penetration firestop system shall have F and FT ratings equal to or greater than ratings specified by the Architect for the fire separation (F) and firewall (FT) joint firestop systems (JF).
- .3 All components employed in the service penetration firestop system shall meet the requirements of the ULC listing.
- .4 Contractor shall prepare and submit a schedule of service penetration firestop systems to be employed indicating the ULC listing designation, services involved, location of opening through fire separation and the components of the fire separation assembly.
- .5 Refer to architectural drawings for ratings of fire separations and assemblies.

3.15 SLEEVES

- .1 Provide pipe sleeves at points where pipes pass through masonry or concrete.
- .2 Provide sleeves of minimum schedule 20 galvanized steel or cast iron.
- .3 Use cast iron or steel pipe sleeves with annular fin continuously welded at midpoint:
 - .1 through foundation walls, with penetration seals.
 - .2 through floors of mechanical rooms and equipment rooms.
- .4 Provide 1/4" (6 mm) clearance all around, between sleeve and pipes or between sleeve and insulation.

3.16 SUPPORT AND ATTACHMENT

- .1 Support and attach piping, ductwork fixtures and equipment from load bearing structures such as beams, joists, reinforced concrete slabs and concrete block walls, and do not support from or attach to

steel roof deck and/or wall or ceiling finishes. Roof mounted mechanical equipment and services shall be anchored to the roof structure to resist both lateral and uplift wind forces in accordance with requirements of the Ontario Building Code.

3.17 PAINTING

- .1 Repair minor damage to finish of equipment with standard factory applied baked enamel finish under the appropriate Sections of this division. Replace entirely, items suffering major damage to finish if too extensive to be repaired in the opinion of the Consultant.
- .2 Apply at least one coat of corrosion resistant primer paint to supports, and equipment fabricated from ferrous metals.
- .3 Ensure manufacturer's identification labels are not painted over. Apply masking tape or paper cover to ensure identification labels do not receive field paint finish.

3.18 DISSIMILAR METALS

- .1 Separate dissimilar metals in order to prevent galvanic corrosion.
- .2 Provide gaskets or shims of approved materials to avoid electrolytic action.
- .3 Use dielectric unions and/or flanges where piping of dissimilar metals are connected.

3.19 ADJUST AND CLEAN

- .1 Clean equipment and fixtures, lubricate mechanical equipment installed under Mechanical Divisions and leave items in perfect order ready for operation.
- .2 Test and adjust control devices, instrumentation, relief valves, dampers, etc., installed in Mechanical Divisions after cleaning of systems and leave in perfect order ready for operation.
- .3 Remove from the premises upon completion of work of this division, debris, surplus, and waste materials resulting from operations.

3.20 MECHANICAL IDENTIFICATION INSTALLATION

- .1 Degrease and clean surfaces to receive adhesive for identification materials.
- .2 Prepare surfaces for stencil painting.
- .3 Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer (VOC content not to exceed 680 g/L).
- .4 Install tags with corrosion resistant chain.
- .5 Comply with standard detail drawing plate, "Detail of Piping Identification".
- .6 Apply stencil markings on all covered piping.
- .7 Install plastic tape pipe markers complete around bare pipe to manufacturer's instructions.
- .8 Label piping that is heat traced or equipped with heating cable "HEAT TRACED" in addition to other identification. Locate such labels adjacent to other identifications.
- .9 Clearly identify abandoned services left in place as "ABANDONED".
- .10 Identify pumps, water heating equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.
- .11 Identify control panels and major control components outside panels with plastic nameplates.
- .12 Identify valves in main and branch piping with tags. Consecutively number valves in each system.
- .13 Identify piping, concealed or exposed, with stenciled painting **OR** plastic tape pipe markers. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 20'-0" (6 m) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.
- .14 For each item of equipment which may be started automatically or remotely, add a red lamacoid plate, 2-3/8" x 9" (60 x 230 mm), reading: **"WARNING. THIS EQUIPMENT IS AUTOMATICALLY CONTROLLED. IT MAY START AT ANY TIME."**
- .15 Provide colour coded self-adhesive dots to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.21 MECHANICAL IDENTIFICATION SCHEDULES

- .1 Consult the Owner and identify piping, ductwork and equipment as directed;
 - .1 Conforming to the Owner's existing identification practices, or
 - .2 Conforming to the following Pipe and Valve Identification Table based on ANSI/ASME 13.1:

SERVICE	COLOURS		MATERIAL PROPERTIES
	BACKGROUND	LETTERS	
Flammable or Oxidizing	Yellow	Black	Fluids which are a vapour or produce vapors that can ignite and continue to burn in air
Combustible	Brown	White	Fluids that may burn but are not flammable
Other Water	Green	White	Any other water, except for water used in fire-fighting systems
Compressed Air	Blue	White	Any vapour or gas under pressure that does not fit in a category above
Ductwork	Label all ductwork showing system type Supply, Return, and Exhaust system numbers		

3.22 MANUFACTURER'S NAMEPLATES

- .1 Provide metal nameplates on each piece of equipment, mechanically fastened with raised or recessed letters.
- .2 Include registration plates, Underwriters' Laboratories and CSA approval, as required by respective agency and as specified. Indicate size, equipment model, manufacturer's name, serial number, voltage, cycle, phase and power of motors, all factory supplied.
- .3 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

- .1 Section 20 05 30 applies to and govern all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

- .1 Pipe and equipment hangers and supports.
- .2 Equipment bases and supports.
- .3 Sleeves and seals.

1.4 REFERENCES

- .1 ASME B31.1 - Power Piping.
- .2 ASME B31.5 - Refrigeration Piping and Heat Transfer Components.
- .3 ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- .4 MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- .5 MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- .6 MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.5 SUBMITTALS

- .1 Section 20 01 01: Procedures for submittals.
- .2 Shop Drawings: Indicate system layout with location and detail of trapeze hangers.
- .3 Product Data: Provide manufacturers catalogue data including load capacity.
- .4 Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
- .5 Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.6 REGULATORY REQUIREMENTS

- .1 Meet the requirements of CSA B-51 for support of piping.

2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

- .1 Manufacturers:
 - .1 Anvil
 - .2 Myat
 - .3 Copper B-Line
 - .4 Unistrut
 - .5 Erico
- .2 Hydronic Piping:
 - .1 Meet the requirements of CSA B-51 and ASME B31.9.
 - .2 Hangers for Pipe Sizes 1/2" to 1-1/2" (13 to 38 mm): Carbon steel, adjustable swivel, split ring.
 - .3 Hangers for Cold Pipe Sizes 2" (50 mm) and Over: Carbon steel, adjustable, clevis.
 - .4 Hangers for Hot Pipe Sizes 2" to 4" (50 to 100 mm): Carbon steel, adjustable, clevis.
 - .5 Hangers for Hot Pipe Sizes 6" (150 mm) and Over: Adjustable steel yoke, cast iron roll, double hanger.
 - .6 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - .7 Multiple or Trapeze Hangers for Hot Pipe Sizes 6" (150 mm) and Over: Steel channels with welded spacers and hanger rods, cast iron roll.
 - .8 Wall Support for Pipe Sizes to 3" (76 mm): Cast iron hook.
 - .9 Wall Support for Pipe Sizes 4" (100 mm) and Over: Welded steel bracket and wrought steel

- clamp.
- .10 Wall Support for Hot Pipe Sizes 6" (150 mm) and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
- .11 Vertical Support: Steel riser clamp.
- .12 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- .13 Floor Support for Hot Pipe Sizes to 4" (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
- .14 Floor Support for Hot Pipe Sizes 6" (150 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- .15 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- .3 Refrigerant Piping:
 - .1 Meet the requirements of ASME B31.5.
 - .2 Hangers for Pipe Sizes 1/2" to 1-1/2" (13 to 38 mm): Carbon steel, adjustable swivel, split ring.
 - .3 Hangers for Pipe Sizes 2" (50 mm) and Over: Carbon steel, adjustable, clevis.
 - .4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - .5 Wall Support for Pipe Sizes to 3" (75 mm): Cast iron hook.
 - .6 Wall Support for Pipe Sizes 4" (100 mm) and Over: Welded steel bracket and wrought steel clamp.
 - .7 Vertical Support: Steel riser clamp.
 - .8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - .9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.2 ACCESSORIES

- .1 Hanger Rods: galvanized, carbon steel continuous threaded.
- .2 Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

3 EXECUTION

3.1 INSTALLATION

- .1 Install to manufacturer's instructions.
- .2 Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut above slab.

3.2 PIPE HANGERS AND SUPPORTS

- .1 Support horizontal piping as scheduled.
- .2 Install hangers to provide minimum 1/2" (13 mm) space between finished covering and adjacent work.
- .3 Place hangers within 12" (300 mm) of each horizontal elbow.
- .4 Use hangers with 1-1/2" (38 mm) minimum vertical adjustment.
- .5 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
- .6 Provide copper plated hangers and supports for copper piping.
- .7 Design hangers for pipe movement without disengagement of supported pipe.
- .8 Prime coat exposed steel hangers and supports.

3.4 FLASHING

- .9 Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

3.3 SCHEDULES

.1 Imperial Measure (IP)

Pipe Size (in)	Rod Diameter (in)	Support Spacing (Ft)	
		Steel Pipe	Copper Tube
1/2	3/8	7	6
3/4	3/8	7	6
1	3/8	7	6
1-1/4	3/8	7	6
1-1/2	3/8	9	8
2	3/8	10	9

.2 Metric Measure (SI)

Pipe Size (mm)	Rod Diameter (mm)	Support Spacing (m)	
		Steel Pipe	Copper Tube
13	10	2.1	1.8
20	10	2.1	1.8
25	10	2.1	1.8
32	10	2.1	1.8
38	10	2.7	2.4
50	10	3	2.7

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 20 01 01

1.2 COMMON WORK RESULTS

- .1 Section 20 05 93 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTIONS INCLUDES

- .1 Testing, adjustment, and balancing of air systems.
- .2 Testing, adjustment, and balancing of piping systems.
- .3 Testing, adjustment, and balancing of equipment.

1.4 REFERENCES

- .1 Ontario Building Code.
- .2 AABC - National Standards for Total System Balance.
- .3 ACG - AABC Commissioning Guideline.
- .4 ADC - Test Code for Grilles, Registers, and Diffusers.
- .5 ASHRAE 111 - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.
- .6 ASHRAE Guideline 0 The Commissioning Process,
- .7 ASHRAE Guideline 1 The HVAC Commissioning Process,
- .8 ASHRAE Guideline 1.1 HVAC&R Technical Requirements for the Commissioning Process,
- .9 NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
- .10 SMACNA - HVAC Systems Testing, Adjusting, and Balancing.
- .11 SMACNA HVAC Systems Commissioning Manual.

1.5 SUBMITTALS

- .1 Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.
- .2 Test Reports: Indicate data on AABC National Standards for Total System Balance forms. Submit data based on Project designation IP imperial/SI Metric Units.
- .3 All reports shall be prepared in electronic format using MS Word software and all tabulations shall be prepared in electronic format using MS Excel spreadsheet software. Submittals shall include three (3) copies each of hard copy printout and two (2) copies with text in ".pdf" and tabulations in ".xls" or ".xlsx" formats on DVD or Memory/USB flash drive.

1.6 QUALIFICATIONS

- .1 Agency: Company specializing in the testing, adjusting, and balancing of systems under this Section with minimum five years documented experience certified by AABC or prequalified as listed below.
- .2 Work shall be performed under the supervision of an AABC certified Test and Balance Engineer, an NEBB Certified Testing, Adjusting and Balancing Supervisor or a registered Professional Engineer experienced in the performance of this work and licensed at the place where the Project is located.

1.7 CO-OPERATION

- .1 Co-operate with installing Contractor(s) in advising them of specific scheduling requirements for systems verification.
- .2 Provide advice to installing Contractors regarding the location and installation of devices required to permit system balancing and measurements, prior to start of the installation work.

2 PRODUCTS

2.1 REFERENCE STANDARDS

- .1 All equipment required for the verification of equipment and systems shall be furnished by the agency employed to conduct the Mechanical Systems Verification.
- .2 Testing and measuring equipment used in the verification of the mechanical systems shall be calibrated to give true readings within the accuracy specifications of the equipment used. A certificate of calibration from an independent testing laboratory may be required by the Consultant if there is any reason to suspect that the equipment used is giving erroneous readings. In such an event the verification agency shall reconduct its verifications.
- .3 All equipment used by the agency in its verification of mechanical systems remains the property/responsibility of the agency and is not included in the supply to the project.

3 EXECUTION

3.1 EXAMINATION

- .1 Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 - .1 Systems are started and operating in a safe and normal condition.
 - .2 Temperature control systems are installed complete and operable.
 - .3 Proper thermal overload protection is in place for electrical equipment.
 - .4 Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - .5 Duct systems are clean of debris.
 - .6 Duct system leakage is minimized.
 - .7 Hydronic systems are flushed, filled, and vented.
 - .8 Service and balance valves are open.

3.2 INSTALLATION TOLERANCES

- .1 Air Handling Systems: Adjust to within plus or minus 5 percent of design for supply systems and plus or minus 5 percent of design for return and exhaust systems.
- .2 Air Outlets and Inlets: Adjust total to within plus 5 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 5 percent of design.
- .3 Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.3 ADJUSTING

- .1 Ensure recorded data represents actual measured or observed conditions.
- .2 Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- .3 After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- .4 Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.4 AIR SYSTEM PROCEDURE

- .1 Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- .2 Measure air quantities at air inlets and outlets.
- .3 Use branch volume control dampers and splitters to regulate air quantities. Devices at air outlets may be used only to the extent that adjustments do not create objectionable air motion or sound levels.

3.5 WATER SYSTEM PROCEDURE

- .1 Adjust water systems to provide required or design quantities.

- .2 Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow metering devices are not installed, base flow balance on temperature difference across various heat transfer elements in the system.
- .3 Adjust systems to provide specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.
- .4 Effect system balance with automatic control valves fully open to heat transfer elements.

3.6 MODIFICATIONS TO EXISTING SYSTEMS

- .1 Where an existing air/water system is shown to be modified in any way, no work shall be done on it until the air/water flows in that system are measured and a report submitted to the Engineer. On completion of the modifications, the balancing report shall show the unaffected air/water flows in that system have been rebalanced to the original quantities. "Water" systems include glycol-water systems.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 20 01 01.

1.1 COMMON WORK RESULTS

- .1 Section 20 07 19 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.2 SECTIONS INCLUDES

- .1 Piping insulation.
- .2 Jackets and accessories.

1.3 REFERENCES

- .1 ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.
- .2 ASTM C177 - Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
- .3 ASTM C195 - Mineral Fibre Thermal Insulating Cement.
- .4 ASTM C335 - Steady-State Heat Transfer Properties of Horizontal Pipe Insulation.
- .5 ASTM C449/C449M - Mineral Fibre Hydraulic-setting Thermal Insulating and Finishing Cement.
- .6 ASTM C518 - Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.
- .7 ASTM C533 - Calcium Silicate Block and Pipe Thermal Insulation.
- .8 ASTM C534 - Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
- .9 ASTM C547 - Mineral Fibre Pipe Insulation.
- .10 ASTM C552 - Cellular Glass Thermal Insulation.
- .11 ASTM C578 - Rigid, Cellular Polystyrene Thermal Insulation.
- .12 ASTM C585 - Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe and Tubing (NPS System).
- .13 ASTM C591 - Unfaced Preformed Cellular Polyisocyanurate Thermal Insulation.
- .14 ASTM C610 - Moulded Expanded Perlite Block and Pipe Thermal Insulation.
- .15 ASTM C921 - Properties of Jacketing Materials for Thermal Insulation.
- .16 ASTM D1056 - Flexible Cellular Materials - Sponge or Expanded Rubber.
- .17 ASTM D1667 - Flexible Cellular Materials - Vinyl Chloride Polymers and Copolymers (Closed Cell Foam).
- .18 ASTM D2842 - Water Absorption of Rigid Cellular Plastics.
- .19 ASTM E84 - Surface Burning Characteristics of Building Materials.
- .20 ASTM E96 - Water Vapour Transmission of Materials.
- .21 NFPA 255 - Surface Burning Characteristics of Building Materials.
- .22 UL 723 - Surface Burning Characteristics of Building Materials.
- .23 ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings

1.4 SUBMITTALS

- .1 Product Data: Provide product description, list of materials and thickness for each service, and locations.
- .2 Manufacturer's Installation Instructions: Indicate procedures which ensure acceptable workmanship and installation standards will be achieved.

1.5 QUALITY ASSURANCE

- .1 Materials: Flame spread/smoke developed rating of 25/50 or less to ULC S102 and ASTM E84.

1.6 QUALIFICATIONS

- .1 Applicator: Company specializing in performing the work of this section with minimum three years

experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Transport, handle, store, and protect products.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.
- .3 Store insulation in original wrapping and protect from weather and construction traffic.
- .4 Protect insulation against dirt, water, chemical, and mechanical damage.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.
- .2 Maintain temperature during and after installation for minimum period of 24 hours.

2 PRODUCTS

2.1 GLASS FIBRE

- .1 Manufacturers:
 - .1 Owens Corning Fiberglas
 - .2 Manson
 - .3 Knauf Fiber Glass
 - .4 Johns Manville
- .2 Insulation: ASTM C547; rigid moulded, noncombustible.
 - .1 'ksi' value : ASTM C335, 0.035 at 75°F (24°C).
 - .2 Minimum Service Temperature: -20°F (-28.9°C).
 - .3 Maximum Service Temperature: 302°F (150°C).
 - .4 Maximum Moisture Absorption: 0.2 percent by volume.
- .3 Vapour Barrier Jacket
 - .1 ASTM C921, White kraft paper reinforced with glass fibre yarn and bonded to aluminized film.
 - .2 Moisture Vapour Transmission: ASTM E96; 0.02 perm.
 - .3 Secure with self sealing longitudinal laps and butt strips.
 - .4 Secure with outward clinch expanding staples and vapour barrier mastic.
- .4 Tie Wire: 1.3 mm stainless steel with twisted ends on maximum 12" (300 mm) centres.
- .5 Vapour Barrier Lap Adhesive
 - .1 Compatible with insulation.
- .6 Insulating Cement/Mastic
 - .1 ASTM C195; hydraulic setting on mineral wool, VOC content not to exceed 80 g/L.
- .7 Fibrous Glass Fabric
 - .1 Cloth: Untreated; 9 oz/sq yd (305 g/sq m) weight.
 - .2 Blanket: 1.0 lb/cu ft (16 kg/cu m) density.
- .8 Indoor Vapour Barrier Finish
 - .1 Vinyl emulsion type acrylic, compatible with insulation, white colour, VOC content not to exceed 250 g/L.
- .9 Outdoor Vapour Barrier Mastic
 - .1 Vinyl emulsion type acrylic, compatible with insulation, white colour.
- .10 Insulating Cement
 - .1 ASTM C449, VOC content not to exceed 80 g/L.

2.2 PHENOLIC INSULATION

- .1 Manufacturers:

Resolco International by "Insul-Phen"
- .2 Insulation: ASTM C-1126 Phenolic Foam Thermal Insulation, CFC and HCFC free, rigid moulded, noncombustible insulation fabricated in required shapes by Resolco International approved fabricators to ASTM C-450 and C-585.

- .1 Density: 2.5-lb/ft³ (40-kg/m³)
- .2 Temperature range: -290°F to +250°F (-129°C to +107°C)
- .3 Closed cell content: 92%
- .4 Compressive strength: 29 psi (2 bar)
- .5 Thermal conductivity: 0.13 BTU-in/hr-ft²-°F (18.72 W-mm/m²-°C)
- .6 Fire resistance rating: 25/50 to ASTM E84 on plain and faced product up to 3" (75mm) thick
- .3 Joint Sealer:
 - .1 vapour barrier type, moisture and water resistant, 97% solids by weight, non-hardening, flexible in temperature range from -5°F to +200°F (-20.5°C to +93.3°C), Daxcel 161D, Fosters 30-45, Childers CP-76.

2.3 ELASTOMERIC INSULATION

- .1 Manufacturers:
 - .1 Armacell APArmaflex
 - .2 APArmaflex W
 - .3 APArmaflex SS
 - .4 APArmaflex SA.
- .2 Insulation material shall be a flexible, closed-cell elastomeric insulation in tubular or sheet form to ASTM C 534, "Specification for preformed elastomeric cellular thermal insulation in sheet and tubular form."
- .3 Insulation materials shall have a closed-cell structure to prevent moisture from wicking.
- .4 Insulation material shall be manufactured without the use of CFC's, HFC's or HCFC's, formaldehyde free, low VOC's, fiber free, dust free and shall resist mold and mildew.
- .5 Materials shall have a flame spread index of less than 25 and a smoke-developed index of less than 50 when tested in accordance with ULC S102, ASTM E 84, latest revision. In addition, the product, when tested, shall not melt or drip flaming particles, the flame shall not be progressive and all materials shall pass simulated end-use fire tests.
- .6 Materials shall have a maximum thermal conductivity of 0.27 Btu-in./h-ft²- °F at a 75°F mean temperature when tested in accordance with ASTM C 177 or ASTM C 518, latest revisions.
- .7 Materials shall have a maximum water vapor transmission of 0.08 perm-inches when tested in accordance with ASTM E 96, Procedure A, latest revision.
- .8 The material shall be manufactured under an independent third party supervision testing program covering the properties of fire performance, thermal conductivity and water vapor transmission.
- .9 Adhesives and finishes shall be as recommended by the insulation manufacturer and shall comply with Section 20 05 00. Accessories such as adhesives, mastics and cements shall have the same properties as listed above and shall not detract from any of the system ratings specified.

2.4 HYDROUS CALCIUM SILICATE

- .1 Manufacturers:
 - .1 Industrial Insulation Group Model Thermo-12
- .2 Insulation: ASTM C533, Type 1; rigid, moulded, white, asbestos free, corrosion inhibiting.
 - .1 Thermal conductivity (k) value: ASTM C177, C335 and C518;

Mean Temperature	°F	200	300	400	500	600	700
BTU-in/(Hr-Ft ² -F°)		0.41	0.45	0.5	0.55	0.6	0.65
Mean Temperature	°C	93	149	204	260	316	371
W/(m-C°)		0.059	0.065	0.072	0.079	0.086	0.094

- .2 Maximum Service Temperature: 1200°F (649°C).
- .3 Density: 14.5 lb/ft³ (232 kg/m³) to ASTM C302
- .4 Flexural strength: 65 psi (448 kPa)
- .5 Compressive strength: >100 psi (690 kPa), 5% compression, to ASTM C165
- .6 Mould Growth: Does not support (ASTM C1338)

- .7 Surface burning characteristics: Flame spread: 0, Smoke developed: 0. (ULC S102)
- .3 Tie Wire: stainless steel with twisted ends on 12" (300mm) centres maximum.
- .4 Insulating Cement: to ASTM C449.

2.5 JACKETS

- .1 PVC Plastic
 - .1 Jacket: ASTM C921, One piece moulded type fitting covers and sheet material.
 - .1 Minimum Service Temperature: -31°F (-35°C).
 - .2 Maximum Service Temperature: 151°F (66°C).
 - .3 Moisture Vapour Transmission: ASTM E96; 0.03 perm inches.
 - .4 Maximum Flame Spread: ASTM E84; 25 or less.
 - .5 Maximum Smoke Developed: ASTM E84; 50 or less.
 - .6 Thickness: 20 mil (0.4 mm) minimum.
 - .2 Colour: standard off-white OR coloured to suit pipe identification.
 - .3 Covering Adhesive Mastic
 - .1 Compatible with insulation, maximum VOC content of 50 g/L.
 - .4 Manufacturer;
 - .1 Ceel-Co 300 series
 - .2 Speedline Smoke Safe

2.6 ACCESSORIES

- .1 Adhesives and finishes shall be as recommended by the insulation manufacturer and shall comply with Section 20 05 00 Accessories such as adhesives, mastics and cements shall have the same properties as listed above and shall not detract from any of the system ratings specified.
- .2 Vapor retarder lap adhesive shall be water based, fire retardant
- .3 Tapes shall be of cloth reinforced aluminum, soft adhesive with minimum 2" (50 mm) width.
- .4 Tie wire shall be of 1/16" (1.5 mm) \emptyset stainless steel.
- .5 Fasteners shall be of 1/8" (4 mm) \emptyset pins, with 35 mm square clips. Clip length to suit insulation thickness.
- .6 Bands shall be 1/2" (12 mm) wide 1/4" (6mm) thick galvanized steel.
- .7 Facing shall be of 1" (25 mm) galvanized steel hexagonal wire mesh attached on both faces of insulation

3 EXECUTION

3.1 EXAMINATION

- .1 Verify that piping has been tested before applying insulation materials.
- .2 Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

- .1 Install piping insulations to TIAC National Installation Standards.
- .2 Apply insulation materials, accessories, jackets and finishes in accordance with manufacturer' written instructions and as specified.
- .3 On exposed piping locate insulation and cover seams in least visible locations.
- .4 For insulated pipes conveying fluids above ambient temperature:
 - .1 Provide standard jackets, with or without vapour barrier, factory applied or field applied.
 - .2 Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.
 - .3 Finish with glass cloth and adhesive.
 - .4 PVC fitting covers may be used.
 - .5 For hot piping conveying fluids 140°F (60°C) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.
 - .6 For hot piping conveying fluids over 140°F (60°C), insulate flanges and unions at equipment.
- .5 Inserts and Shields:

- .1 Application: Piping 1-1/2" (40 mm) diameter or larger.
- .2 Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
- .3 Insert Location: Between support shield and piping and under the finish jacket.
- .4 Insert Configuration: Minimum 6" (150 mm) long, of same thickness and contour as adjoining insulation; may be factory fabricated.
- .5 Insert Material: hydrous calcium silicate insulation.
- .6 Finish insulation at supports, protrusions, and interruptions.

3.3 PIPE INSULATION

- .1 Insulate new or altered piping with rigid pipe insulation and re-insulate existing piping where insulation has been removed or damaged as follows:

RIGID PIPE INSULATION (I-P)			
Service	Operating Temperature Range °F	Pipe Diameter in.	Insulation Thickness in.
Hydronic heating (hot water & glycol/water)	105 to 140	4 and smaller	1
		5 and larger	1-1/2
	141 to 200	All sizes	1-1/2

RIGID PIPE INSULATION (SI)			
Service	Operating Temperature Range °C	Pipe Diameter (mm)	Insulation Thickness (mm)
Hydronic heating (hot water & glycol/water)	41 to 60	100 and smaller	25
		125 and larger	40
	61 to 93	All sizes	40

- .2 Phenolic insulation may be used in place of rigid fiberglass pipe insulation, thickness to provide equivalent thermal resistance.
- .3 Where the pipe hanger is around the insulation, provide an insulation protection shield within the pipe saddle. Coordinate with installation of hangers.
- .4 Insulate all fittings, flanges and valves on pipes to provide equivalent insulation to that on adjoining pipe.
- .5 Extend pipe insulation and covering through walls, floors, ceilings, and concrete beams, unless indicated otherwise on drawings. Protect exposed insulation extending through floors with 4" (100 mm) wide strip of 18 gauge (1.3 mm) galvanized iron.
- .6 Pack annular space between pipe sleeves and piping or pipe covering with glass fibre insulation or rockwool insulation. In fire rated assemblies use Dow Silicon RTV or other ULC listed materials. Seal exposed insulation with mastic.

3.4 REFRIGERATION PIPE INSULATION

- .1 Insulate all refrigerant suction and hot gas piping and fittings with flexible foamed plastic pipe insulation. Insulation shall fit pipe. Thickness shall be as follows: 1/2" (13 mm) thick for pipe 1" (25 mm) O.D. and smaller; 3/4" (20 mm) thick for pipe 1-1/8" (28 mm) to 2" (50 mm) O.D.; 1" (25 mm) thick for pipes 2-1/8" (54 mm) O.D. and larger.

- .2 Slip insulation on to tubing before tubing sections and fittings are assembled. Keep slitting of insulation to a very minimum. Seal all joints in the insulation with Armaflex 520 BLV. Insulate flexible pipe connectors.
- .3 On insulation exposed outside the building, place "slit" joint seams on bottom of pipe and cover with UV-resistant PVC jacket. Extend insulation through pipe support clamps. Provide a 6" (150 mm) long, 20 gauge (1.1 mm) galvanized steel sleeve around pipe insulation at each support.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

- .1 Section 20 90 50 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 MECHANICAL-ELECTRICAL EQUIPMENT SCHEDULE

- .1 The following Mechanical-Electrical Equipment Schedule is provided to assist the Contractor in coordinating the efforts of sub-trades. The assignment of work among subcontractors is the Contractor's responsibility and the Contractor is free to amend the schedule as he sees fit.
- .2 The Mechanical-Electrical Equipment Schedule also describes work that is required and may or may not be described elsewhere. All work indicated in the Mechanical-Electrical Equipment Schedule shall be included in the Bid Price.
- .3 The Mechanical-Electrical Equipment Schedule shall not limit the extent of the Contract in any way. Work indicated elsewhere or otherwise needed for a complete and functioning installation shall be provided whether or not shown in the Mechanical-Electrical Equipment Schedule.

1.4 RESPONSIBILITY CODES

- .1 Responsibility Codes in the Mechanical Equipment Schedule shall be interpreted as follows:
 - .1 "Supplied by Div." means that the equipment is to be supplied to the site under the division described by number.
 - .2 "Installed by Div." means that the equipment is to be received from the supplier, handled, set in place and installed at the site under the Division described by number.
 - .3 "Wired and connected by Div." means that the equipment and its associated devices are to be wired and connected to the various electrical systems in accordance with the equipment manufacturer's installation instructions and wiring diagrams under the Division described by number.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

- .1 Section 23 21 13 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25

1.3 SECTION INCLUDES

- .1 Pipe and pipe fittings for:
 - .1 Heating water piping system.
 - .2 Equipment drains and overflows.
- .2 Valves:
 - .1 Gate valves.
 - .2 Globe or angle valves.
 - .3 Ball valves.
 - .4 Circuit balancing valves
 - .5 Drain valves.

1.4 REFERENCES

- .1 ASME - Welding and Brazing Qualifications.
- .2 ASME B16.3 - Malleable Iron Threaded Fittings Class 50 and 300.
- .3 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
- .4 ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .5 ASME B31.5 - Refrigeration Piping and Heat Transfer Components.
- .6 ASME B31.1 - Code for Power Piping.
- .7 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .8 A183 Carbon Steel Track Bolts and Nuts.
- .9 ASTM A234/A234M - Piping Fittings of Wrought-Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- .10 ASTM B32 - Solder Metal.
- .11 ASTM B88 - Seamless Copper Water Tube.
- .12 AWS A5.8 - Filler Metals for Brazing and Braze Welding.
- .13 AWS D1.1 - Structural Welding Code - Steel.
- .14 MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacture.
- .15 MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- .16 MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.5 SUBMITTALS

- .1 Product Data: Include data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.
- .2 Manufacturer's Installation Instructions: Indicate hanging and support methods, joining procedures.
- .3 Maintenance Data: Include installation instructions, spare parts lists, exploded assembly views.

1.6 REGULATORY REQUIREMENTS

- .1 Conform to ASME B31.1 code for installation of piping system.
- .2 Welding Materials and Procedures: Conform to ASME SEC 9 and applicable provincial labour regulations.
- .3 Provide certificate of compliance from authority having jurisdiction indicating approval of welders.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Accept valves on site in shipping containers with labeling in place. Inspect for damage.

- .2 Provide temporary protective coating on cast iron and steel valves.
- .3 Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- .4 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

2 PRODUCTS

2.1 VALVES - GENERAL

- .1 Manufacturers:
 - .1 Kitz.
 - .2 Crane
 - .3 Conbraco.
 - .4 Nibco
 - .5 Jenkins
 - .6 Bray
 - .7 Victaulic
- .2 Conform to requirements of ANSI, ASTM, ASME, and applicable MSS standards.
- .3 Provide valves of the same manufacturer where possible.
- .4 Manufacturer's name and pressure rating clearly marked on body to MSS-SP-25.
- .5 Valid CRN (Canadian Registration Number) required for each valve.
- .6 Materials:
 - .1 Bronze: ASTM B62 or B61 as applicable
 - .2 Brass: ASTM B283 C3770
 - .3 Ductile Iron: ASTM A536 Grade 65-45-12
 - .4 Cast Iron: ASTM A126 Class B
- .7 End Connections:
 - .1 Threaded ends: ANSI B1.20.1
 - .2 Grooved ends: CSA B242/AWWA C606
 - .3 Flanged ends: ANSI B16.1 (Class 125), ANSI B16.5
 - .4 Face-to-face dimensions: ANSI B16.10
- .8 Design and Testing:
 - .1 Bronze Gate & Check valves: MSS-SP-80
 - .2 Ball Valves: MSS-SP-110
 - .3 Cast Iron Gate Valves: MSS-SP-70
 - .4 Cast Iron Globe Valves: MSS-SP-85
 - .5 Cast Iron Check: MSS-SP-71
 - .6 Butterfly Valves: MSS-SP-67

2.2 HYDRONIC SYSTEMS TO 150 PSIG, ABOVE GROUND

- .1 Nominal Operating Pressure 125 psig
- .2 Design Pressure 150 psig
- .3 Test Pressure 225 psig
- .4 Design Temperature 350°F
- .5 Corrosion Allowance 0.0625 in.
- .6 Steel Pipe ASTM A53 Gr.B ERW or ASTM A106 Gr.B SMLS, sch 40,
- .7 Joints, 2" and smaller screwed
- .8 Screwed Fittings 150 Lb. malleable iron
- .9 Unions CI.150, ASTM A-47 malleable iron, ASTM A-153 galvanized, ANSI B2.1 threads.
- .10 Copper Tubing, 2" and Smaller ASTM B88, Type L, hard drawn.
- .11 Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 220°C to 280°C.
- .12 Fittings: ASME B16.18, cast brass, or ASME B16.22, solder wrought copper
- .13 Dielectric Unions Union with galvanized or plated steel threaded end, copper

- .14 Dielectric Waterway Fittings solder end, water impervious isolation barrier. Copper silicon casting conforming to UNS C87850 with grooved and/or threaded ends. Victaulic Series 647.
- .15 Valves, 2" and smaller
Gate Valves (Isolating) ASTM A105
300 psig non-shock WOG, ASTM B62 bronze body, solid wedge disc, rising stem, bronze trim, threaded ends, Kitz #25
Globe Valves (Throttling) 300 psig non-shock WOG, ASTM B62 bronze body, composition (Teflon) disc, rising stem, bronze trim, threaded ends, Kitz #09
Check Valves (Backflow) 300 psig non-shock WOG, ASTM B62 bronze body, Y-pattern horizontal, swing type disc, threaded ends, Kitz #29
Ball Valves (Drain) 600 psig non-shock WOG, forged brass, 2-piece, chrome ball and stem, full port, blow-out proof PTFE seats & stem, lever handle, threaded ends, Kitz #68AC.
- .16 Provide stem extensions for insulated piping.
- .17 Strainers, 2" and smaller Class 250, 400 psig WOG, cast iron body, Y-pattern, screwed cap and ends, A167 304 stainless steel screen with 1/32" perforations. Mueller Steam 11M.

2.3 EQUIPMENT DRAINS AND OVERFLOWS

- .1 Copper Tubing: ASTM B88, Type M and DWV, hard drawn.
 - .1 Fittings: ASME B16.18, cast brass, or ASME B16.22 solder wrought copper.
 - .2 Joints: Solder, lead free, ASTM B32, 95-5 tin-antimony, or tin and silver, with melting range 4428°F to 536°F (220°C to 280°C).

2.4 CIRCUIT BALANCING VALVES

- .1 Circuit Balancing Valves; 2" (50 mm) and smaller
 - .1 Screwed connection, globe style design, nonferrous, pressure die-cast, nonporous DZR brass. A metal Copper Alloy. Valves shall be sized to flow and selected for 2 ft pressure drop across the valve in fully open position in accordance with manufacturer's recommendations.
 - .2 Valves shall provide the following functions:
 - .1 Precise flow measurement.
 - .2 Precision flow balancing.
 - .3 Positive shut off with no drip seat and teflon disc.
 - .4 Drain connection with protective cap.
 - .3 Valves shall have four 360° adjustment turns of handwheel for maximum vernier-type setting with "Hidden Memory" feature to program the valve with precision tamper-proof balancing setting.
 - .4 Valves shall be shipped in a 4.5 R factor polyurethane container that shall be used as insulation after valve is installed.
 - .5 Provide valves suitable for maximum working pressure of 250 psi (1720 kPa) and maximum operating temperature of 250°F (121°C).
 - .6 Acceptable Products:
 - .1 S.A. Armstrong CRV I
 - .2 Tour & Anderson STA-D
 - .3 Newman Hattersley.

3 EXECUTION

3.1 PREPARATION

- .1 Ream pipe and tube ends, remove burrs and bevel plain end ferrous pipe.
- .2 Remove scale and dirt on inside and outside before assembly.
- .3 Prepare piping connections to equipment with flanges or unions.
- .4 Keep open ends of pipe free from scale and dirt. Protect open ends with temporary plugs or caps.
- .5 After completion, fill, clean, and treat systems.

3.2 APPLICATIONS

- .1 Where more than one piping system material is specified, ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.
- .2 Install unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.
- .3 Provide non-conducting dielectric connections whenever jointing dissimilar metals in open systems.
- .4 Provide pipe hangers and supports to CSA B51 unless indicated otherwise.
- .5 Use ball valves for shut-off and to isolate equipment.
- .6 Use 3/4 inch (20 mm) gate or ball valves with cap and chain for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain.
- .7 Small runouts, size 3/4" (20 mm) and less for extension of domestic make-up piping may be constructed using hand drawn copper tube type 'K' or "L" and comply to ASTM B88.

3.3 INSTALLATION

- .1 Install to manufacturer's instructions.
- .2 Install heating water piping to CSA B51.
- .3 Route piping in orderly manner, parallel to building structure, and maintain gradient.
- .4 Install piping to conserve building space, and not interfere with use of space.
- .5 Slope piping and arrange to drain at low points.
- .6 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- .7 Pipe Hangers and Supports:
 - .1 Install to CSA B51.
 - .2 Support horizontal piping as scheduled.
 - .3 Install hangers to provide minimum 1/2" (13 mm) space between finished covering and adjacent work.
 - .4 Place hangers within 12" (300 mm) of each horizontal elbow.
 - .5 Use hangers with 1-1/2" (38 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
 - .6 Provide copper plated hangers and supports for copper piping.
 - .7 Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- .8 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.
- .9 Provide access where valves and fittings are not exposed.
- .10 Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.
- .11 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer (VOC content not to exceed 250 g/L) to welds.
- .12 Install valves with stems upright or horizontal, not inverted.
- .13 All strainers 1-1/2" (38mm) & larger shall be fitted with chain valves.
- .14 Unless specified otherwise, drain piping shall be sloped down in the direction of flow not less than 1" in 40 feet.
- .15 Eccentric reducers shall be provided to keep the bottom of sloped piping aligned in order to minimize risk of water hammer and to facilitate drainage.
- .16 Valves shall be installed with stems upright or angled 45 deg. above horizontal unless instructed otherwise.

3.4 EQUIPMENT CONNECTIONS

- .1 Install unions or flanges at connections to all equipment and specialty components.
- .2 Arrange piping connections to allow ease of access and removal of equipment.
- .3 Align and independently support piping adjacent to equipment connections in order to prevent piping stresses from being transferred to equipment.

- .4 Piping reducers shall be used where equipment connections differ from pipe sizes indicated. The use of bushings will not be permitted.

3.5 VALVES, COCKS AND FAUCETS

- .1 Use valves of line size unless noted otherwise.
- .2 Provide isolating valves in each branch from the main line and where indicated.
- .3 Provide isolating valves at all equipment connections.
- .4 Where new valves are installed to replace existing valves and it is impractical to shut-down and drain the entire system, valves shall be replaced using pipe freezing techniques. Refer to Cash Allowance.

3.6 HYDRONIC SPECIALTIES

- .1 Circuit Balancing Valve (CBV): provide a CBV in each branch serving a heating and/or cooling terminal unit and where indicated on drawings. Installation shall be in accordance with manufacturer's installation instructions. Ensure that manufacturer's recommended clearances are maintained to minimize turbulence and to promote accuracy.

3.7 CONTROLS DEVICES

- .1 Install pipe wells for various remote sensors such as temperature, pressure and flow sensors. Supply of sensors and controls wiring will be under this Division 25.
- .2 Supply of valves, valve actuators and controls wiring will be under this Division unless specifically noted under Division 25.

3.8 TESTING AND INSPECTION

- .1 Test liquid heat transfer piping hydrostatically at not less than 150% of operating pressure or not less than 125 psi (860 kPa) whichever is the greater. Test period shall be not less than six (6) hours duration during which time each joint shall be inspected, given a sharp tap with a hammer and checked for leaks.
- .2 Arrange and pay for inspection by authorities having jurisdiction.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

- .1 Section 23 23 00 applies to and governs all work of Mechanical Divisions 20, 21, 22, 23 and 25.

1.3 SECTION INCLUDES

- .1 Piping.
- .2 Refrigerant.
- .3 Moisture and liquid indicators.
- .4 Valves.
- .5 Strainers.
- .6 Check valves.
- .7 Pressure relief valves.
- .8 Filter-driers.
- .9 Solenoid valves.
- .10 Expansion valves.
- .11 Receivers.
- .12 Flexible connections.

1.4 REFERENCES

- .1 AHRI 495 - Refrigerant Liquid Receivers.
- .2 AHRI 710 - Liquid-Line Driers.
- .3 AHRI 730 - Flow-Capacity Rating and Application of Suction-Line Filters and Filter-Driers
- .4 AHRI 750 - Thermostatic Refrigerant Expansion Valves.
- .5 AHRI 760 - Solenoid Valves for Use With Volatile Refrigerants.
- .6 ASHRAE 15 - Safety Standard for Refrigeration Systems.
- .7 ASHRAE 34 - Designation and Safety Classification of Refrigerants.
- .8 ASME - SEC 9 - Welding and Brazing Qualifications.
- .9 ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
- .10 ASME B16.26 - Cast Copper Alloy Fittings For Flared Copper Tubes.
- .11 ASME B31.5 - Refrigeration Piping and Heat Transfer Components.
- .12 ASME B31.9 - Building Services Piping.
- .13 ASME SEC 8D - Boilers and Pressure Vessels Code - Rules for Construction of Pressure Vessels.
- .14 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
- .15 ASTM A234/A234M - Piping Fittings of Wrought-Carbon Steel and Alloy Steel for Moderate and High Temperature Service.
- .16 ASTM B88 - Seamless Copper Water Tube.
- .17 ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
- .18 ASTM F708 - Design and Installation of Rigid Pipe Hangers.
- .19 AWS A5.8 - Filler Metals for Brazing and Braze Welding.
- .20 AWS D1.1 - Structural Welding Code - Steel.
- .21 MSS SP58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
- .22 MSS SP69 - Pipe Hangers and Supports - Selection and Application.
- .23 MSS SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- .24 UL 429 - Electrically Operated Valves.

1.5 SUBMITTALS

- .1 Shop Drawings: Indicate schematic layout of system, including equipment, critical dimensions, and sizes.
- .2 Product Data: Provide general assembly of specialties, including manufacturer's catalogue

- information. Provide manufacturers catalogue data including load capacity.
- .3 Design Data: Submit design data indicating pipe sizing. Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.
 - .4 Test Reports: Indicate results of leak test, acid test.
 - .5 Manufacturer's Installation Instructions: Indicate support, connection requirements, and isolation for servicing.
 - .6 Submit welder's certification of compliance with ASME SEC 9.
 - .7 Prepare and submit all records and notices required by authorities having jurisdiction.
 - .8 Record exact locations of equipment and refrigeration accessories on record drawings.

1.6 QUALIFICATIONS

- .1 Installer: Company specializing in performing the work of this section with minimum 5 years documented experience.
- .2 Persons servicing, testing and/or performing tasks associated with the removal, relocation and/or refilling of refrigeration piping and/or equipment that contains ozone depleting substances and other halocarbons shall be certified under Section 34 of O. Reg. 463/10.

1.7 REGULATORY REQUIREMENTS

- .1 Conform to CSA B52 Mechanical Refrigeration Code as adopted.
- .2 Welding Materials and Procedures: Conform to ASME SEC 9 and applicable provincial labour regulations.
- .3 Welders Certification: To ASME SEC 9.
- .4 Products Requiring Electrical Connection: Listed and classified by CSA, ULC, cUL or Special Inspection as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Transport, handle, store, and protect products.
- .2 Deliver and store piping and specialties in shipping containers with labeling in place.
- .3 Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.
- .4 Dehydrate and charge components such as piping and receivers, seal prior to shipment, until connected into system.

2 PRODUCTS

2.1 PIPING

- .1 Copper Tubing: ASTM B280, Type ACR hard drawn or annealed.
 - .1 Fittings: ASME B16.22 wrought copper.
 - .2 Joints: Braze, AWS A5.8 BCuP silver/phosphorus/copper alloy with melting range 1185 to 1480°F (640 to 805° C.)
- .2 Copper Tubing to 22 mm OD: ASTM B88, Type K, annealed.
 - .1 Fittings: ASME B16.26 cast copper.
 - .2 Joints: Flared.
- .3 Pipe Supports and Anchors:
 - .1 Conform to ASME B31.5.
 - .2 Hangers for Pipe Sizes ½" to 1-1/2" (13 to 38 mm): Malleable iron adjustable swivel, split ring.
 - .3 Hangers for Pipe Sizes 2" (50 mm) and Over: Carbon steel, adjustable, clevis.
 - .4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - .5 Wall Support for Pipe Sizes to 3" (75 mm): Cast iron hook.
 - .6 Wall Support for Pipe Sizes 4" (100 mm) and Over: Welded steel bracket and wrought steel clamp.
 - .7 Vertical Support: Steel riser clamp.
 - .8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

- .9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.
- .10 Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.
- .11 Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.2 MOISTURE AND LIQUID INDICATORS

- .1 Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, colour coded paper moisture indicator with removable element cartridge and plastic cap; for maximum working pressure of 500psi (3450 kPa), and maximum temperature of 200°F (93°C).

2.3 VALVES

- .1 Ball Valves:
 - .1 Two piece bolted forged brass body with teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi (3450 kPa) and maximum temperature of 300°F (149°C).
- .2 Service Valves:
 - .1 Forged brass body with copper stubs, brass caps, removable valve core, integral ball check valve, flared or solder ends, for maximum pressure of 500 psi (3450 kPa).

2.4 STRAINERS

- .1 Straight Line or Angle Line Type:
 - .1 Brass or steel shell, steel cap and flange, and replaceable cartridge, with screen of stainless steel wire or monel reinforced with brass; for maximum working pressure of 430 psi (2960 kPa.)
- .2 Straight Line, Non-Cleanable Type:
 - .1 Steel shell, copper plated fittings, stainless steel wire screen, for maximum working pressure to suit application.

2.5 CHECK VALVES

- .1 Globe Type:
 - .1 Cast bronze or forged brass body, forged brass cap with neoprene seal, brass guide and disc holder, phosphor-bronze or stainless steel spring, teflon seat disc; for maximum working pressure of 430 psi (2930 kPa) and maximum temperature of 300°F (149°C).
- .2 Straight Through Type:
 - .1 Brass body and disc, phosphor-bronze or stainless steel spring, neoprene seat; for maximum working pressure of 430 psi (3450 kPa) and maximum temperature of 200°F (93°C).

2.6 PRESSURE RELIEF VALVES

- .1 Straight Through or Angle Type: Brass body and disc, neoprene seat, factory sealed and stamped with ASME UV and National Board Certification NB; for standard 235 psi (1620 kPa) setting; selected to ASHRAE 15.

2.7 FILTER-DRIERS

- .1 Replaceable Cartridge Angle Type:
 - .1 Shell: AHRI 710, UL listed, brass, removable cap, for maximum working pressure of 350 psi (2410 kPa).
 - .2 Filter Cartridge: Pleated media with integral end rings, stainless steel support.
 - .3 Filter/Dryer Cartridge: Pleated media with solid core sieve with activated alumina.
 - .4 Wax Removal Cartridge: Molded bonded core of activated charcoal with integral gaskets.

2.8 SOLENOID VALVES

- .1 Valve: AHRI 760, pilot operated, copper or brass or steel body and internal parts, synthetic seat, stainless steel stem and plunger assembly, integral strainer, with flared, solder, or threaded ends; for maximum working pressure of 500 psi (3450 kPa). Stem to permit manual operation in case of coil failure.
- .2 Coil Assembly: UL 429, UL listed, replaceable with moulded electromagnetic coil, moisture and fungus proof, with surge protector and colour coded lead wires, integral junction box with pilot light.
- .3 Electrical Characteristics: 120 volts, single phase, 60 Hz.

2.9 EXPANSION VALVES

- .1 Angle or Straight Through Type: AHRI 750; design suitable for refrigerant, brass body, internal or external equalizer, bleed hole, superheat setting, replaceable inlet strainer, with non-replaceable capillary tube and remote sensing bulb and remote bulb well.
- .2 Selection: Evaluate refrigerant pressure drop through system to determine available pressure drop across valve. Select valve for maximum load at design operating pressure and minimum 6 degrees C superheat. Select to avoid being undersized at full load and excessively oversized at part load.

2.10 FLEXIBLE CONNECTORS

- .1 Corrugated stainless steel hose with single layer of stainless steel exterior braiding, minimum 9" (230 mm) long with copper tube ends; for maximum working pressure 500 psi (3450 kPa).

3 EXECUTION

3.1 SYSTEM DESCRIPTION

- .1 Where more than one piping system material is specified ensure system components are compatible and joined to ensure the integrity of the system is not jeopardized. Provide necessary joining fittings. Ensure flanges, union, and couplings for servicing is consistently provided.
- .2 Provide pipe hangers and supports to ASTM B31.5 unless indicated otherwise.
- .3 Liquid Indicators:
 - .1 Use line size liquid indicators in main liquid line leaving condenser.
 - .2 If receiver is provided, install in liquid line leaving receiver.
 - .3 Use line size on leaving side of liquid solenoid valves.
- .4 Valves
 - .1 Use service valves on suction and discharge of compressors.
 - .2 Use gauge taps at compressor inlet and outlet.
 - .3 Use gauge taps at hot gas bypass regulators, inlet and outlet.
 - .4 Use check valves on compressor discharge.
 - .5 Use check valves on condenser liquid lines on multiple condenser systems.
- .5 Refrigerant Charging (Packed Angle) Valve: Use in liquid line between receiver shut-off valve and expansion valve.
- .6 Strainers:
 - .1 Use line size strainer upstream of each automatic valve.
 - .2 Where multiple expansion valves with integral strainers are used, use single main liquid line strainer.
 - .3 Use shut-off valve on each side of strainer.
- .7 Pressure Relief Valves: Use on ASME receivers and pipe to outdoors.
- .8 Replaceable Cartridge Filter-Driers:
 - .1 Use vertically in liquid line adjacent to receivers.
 - .2 Use filter-driers for each solenoid valve.
- .9 Solenoid Valves:
 - .1 Use in liquid line of systems operating with single pump-out or pump-down compressor control.
 - .2 Use in liquid line of single or multiple evaporator systems.
 - .3 Use in oil bleeder lines from flooded evaporators to stop flow of oil and refrigerant into the suction line when system shuts down.
- .10 Flexible Connectors: Utilize at or near compressors where piping configuration does not absorb

vibration.

3.2 PREPARATION

- .1 Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.
- .2 Remove scale and dirt on inside and outside before assembly.
- .3 Prepare piping connections to equipment with flanges or unions.

3.3 REFRIGERANT RECOVERY / RECYCLING

- .1 Removal, relocation and/or refilling of refrigeration piping and/or equipment that contains ozone depleting substances and other halocarbons including;
 - .1 Solvents and sterilants
 - .2 Fire extinguishing equipment
 - .3 Refrigerants shall conform to regulations under the Environmental Protection Act, including O. Reg. 463 /10.
- .2 Ozone depleting substances (ODS) and other halocarbons shall be recovered using equipment and processes that are designed and approved specifically for the task.
- .3 Disposal of ODS and other halocarbons and associated equipment and containers shall comply with requirements under the Environmental Protection Act, including O. Reg. 463 /10.

3.4 INSTALLATION

- .1 Install refrigeration specialties to manufacturer's instructions.
- .2 Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.
- .3 Install piping to conserve building space and not interfere with use of space.
- .4 Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return.
- .5 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- .6 Pipe Hangers and Supports:
 - .1 Install to ASTM B31.5.
 - .2 Support horizontal piping as scheduled.
 - .3 Install hangers to provide minimum 1/2" (13 mm) space between finished covering and adjacent work.
 - .4 Place hangers within 12" (300 mm) of each horizontal elbow.
 - .5 Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
 - .6 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
 - .7 Provide copper plated hangers and supports for copper piping.
- .7 Arrange piping to return oil to compressor. Provide traps and loops in piping, and provide double risers as required. Slope horizontal piping 0.40 percent in direction of flow.
- .8 Provide clearance for installation of insulation and access to valves and fittings.
- .9 Provide access to concealed valves and fittings.
- .10 Flood piping system with nitrogen when brazing.
- .11 Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer (VOC content not to exceed 250 g/L) to welding.
- .12 Insulate piping and equipment; refer to Section 20 07 16.
- .13 Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.
- .14 Provide replaceable cartridge filter-driers, with isolation valves and valved bypass.
- .15 Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.
- .16 Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.
- .17 Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.
- .18 Fully charge completed system with refrigerant after testing.
- .19 Provide electrical connection to solenoid valves.

3.5 FIELD QUALITY CONTROL

- .1 Test refrigeration system to ASME B31.5.
- .2 Pressure test system with dry nitrogen to 210 psi (1470 kPa.) Perform final tests at 13 psi (92 kPa) vacuum and 210 psi (1470 kPa) using halide torch. Test to no leakage.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 20 01 01 applies to and governs all work of Division 21, 22 and 23.

1.2 SECTION INCLUDES

- .1 Condensing unit package.
- .2 Charge of refrigerant and oil.
- .3 Controls and control connections.
- .4 Refrigerant piping connections.
- .5 Motor starters.
- .6 Electrical power connections.

1.3 REFERENCES

- .1 AHRI 210/240 - Unitary Air-Conditioning and Air-Source Heat Pump Equipment.
- .2 AHRI 270 - Sound Rating of Outdoor Unitary Equipment.
- .3 AHRI 365 - Commercial and Industrial Unitary Air-Conditioning Condensing Units.
- .4 ASHRAE 14 - Methods of Testing for Rating Positive Displacement Condensing Units
- .5 ASHRAE 15 - Safety Standard for Refrigeration Systems.
- .6 ASHRAE 90.1 - Energy Standard for Buildings
- .7 CSA B52 – Mechanical Refrigeration Code.
- .8 NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- .9 UL 207 - Refrigerant-Containing Components and Accessories, Non-electrical.
- .10 UL 303 - Refrigeration and Air-Conditioning Condensing, and Air-Source Heat Pump Equipment.

1.4 SUBMITTALS FOR REVIEW

- .1 Section 20 01 01: Procedures for submittals.
- .2 Shop Drawings: Indicate components, assembly, dimensions, weights and loadings, required clearances, and location and size of field connections. Include schematic layouts showing condensing units, cooling coils, refrigerant piping, and accessories required for complete system.
- .3 Product Data: Provide rated capacities, weights specialties and accessories, electrical nameplate data, and wiring diagrams. Make submission with coils.

1.5 SUBMITTALS FOR INFORMATION

- .1 Section 20 01 01: Submittals for information.
- .2 Design Data: Indicate pipe and equipment sizing.
- .3 Submit manufacturer's installation instructions.

1.6 SUBMITTALS AT PROJECT CLOSEOUT

- .1 Section 20 01 01: Submittals for project closeout.
- .2 Operation and Maintenance Data: Include start-up instructions, maintenance instructions, parts lists, controls, and accessories.

1.7 REGULATORY REQUIREMENTS

- .1 Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

- .1 Section 20 01 01: Transport, handle, store, and protect products.
- .2 Comply with manufacturer's installation instructions for rigging, unloading, and transporting units.

- .3 Protect units on site from physical damage. Protect coils.

1.9 WARRANTY

- .1 Section 20 01 01: Submittals for project closeout.
- .2 Provide a five year warranty to include coverage for refrigerant compressors.

2 PRODUCTS

2.1 MANUFACTURERS

- .1 Daikin
- .2 Trane
- .3 Carrier
- .4 Engineered Air
- .5 York

2.2 MANUFACTURED UNITS

- .1 Units: Self-contained, packaged, factory assembled and pre-wired units suitable for outdoor use consisting of cabinet, compressors, condensing coil and fans, integral sub-cooling coil, controls, liquid receiver, wind deflector, and screens.
- .2 Construction and Ratings: To AHRI 210/240. Testing to ASHRAE 14.
- .3 Performance Ratings: Energy Efficiency Rating (EER) and Coefficient of Performance (COP) not less than prescribed by ASHRAE 90.1A. Seasonal Energy Efficiency Ratio (SEER) as per Mechanical Schedules.

2.3 CASING

- .1 House components in welded steel frame with steel panels with weather resistant, baked enamel finish.
- .2 Mount starters, disconnects, and controls in weatherproof panel provided with full opening access doors. Provide mechanical interlock to disconnect power when door is opened.
- .3 Provide removable access doors or panels with quick fasteners and piano hinges.

2.4 CONDENSER COILS

- .1 Coils: Aluminum fins mechanically bonded to seamless copper tubing. Provide sub-cooling circuits. Air test under water to 2900 kPa (420 psi), and vacuum dehydrate. Seal with holding charge of nitrogen.
- .2 Coil Guard: Expanded metal.

2.5 FANS AND MOTORS

- .1 Vertical discharge direct driven propeller type condenser fans with fan guard on discharge. Equip with roller or ball bearings with grease fittings extended to outside of casing.
- .2 Weatherproof motors suitable for outdoor use, single phase ECM or 3 phase, with permanent lubricated ball bearings and built in current and thermal overload protection.
- .3 Horizontal discharge, double width, double inlet forward curved centrifugal type condenser fans, equipped with roller or ball bearings with grease fittings extended to outside of casing, V-belt drive with belt guard.

2.5 COMPRESSORS

- .1 Compressor: Semi-hermetic reciprocating type, 2-stage.
- .2 Mounting: Statically and dynamically balance rotating parts and mount on spring vibration isolators. Internally isolate hermetic units on springs.
- .3 Lubrication System: Reversible, positive displacement oil pump with oil charging valve, oil level sight glass, and magnetic plug or strainer.

- .4 Motor: Constant speed 1800 rpm suction gas cooled with electronic sensor and winding over temperature protection, designed for across-the-line starting. Provide with starter.
- .5 Capacity Reduction Equipment: Suction valve unloaders, with lifting mechanism operated by electrically actuated solenoid valve, with unloaded compressor start; controlled from suction pressure.
- .6 Sump Oil Heater: Evaporates refrigerant returning to sump during shut down. Energize heater continuously.
- .7 High-density foam compressor sound blanket.

2.7 REFRIGERANT CIRCUIT

- .1 Provide each unit with one refrigerant circuit, factory supplied and piped. Refer to Section 23 23 00.
- .2 For each refrigerant circuit, provide:
 - .1 Filter dryer replaceable core type.
 - .2 Liquid line sight glass and moisture indicator.
 - .3 Thermal expansion valve for maximum operating pressure.
 - .4 Insulated suction line.
 - .5 Suction and liquid line service valves and gauge ports.
 - .6 Liquid line solenoid valve.
 - .7 Charging valve.
 - .8 Discharge line check valve.
 - .9 Compressor discharge service valve.
 - .10 Condenser pressure relief valve.

2.8 CONTROLS

- .1 On unit, mount weatherproof steel control panel, NEMA 3R, containing power and control wiring, moulded case disconnect switch, factory wired with single point power connection. Factory mount disconnect switch on unit.
- .2 For each compressor, provide across-the-line starter, non-recycling compressor overload, starter relay, and control power transformer or terminal for controls power. Provide manual reset current overload protection. For each condenser fan, provide across-the-line starter with starter relay.
- .3 Provide safety controls arranged so any one will shut down machine:
 - .1 High discharge pressure switch (manual reset) for each compressor.
 - .2 Low suction pressure switch (automatic reset) for each compressor.
 - .3 Oil Pressure switch (manual reset).
- .4 Provide the following operating controls:
 - .1 One minute off timer prevents compressor from short cycling.
 - .2 Periodic pump-out timer to pump down on high evaporator refrigerant pressure.
 - .3 Low ambient temperature controls.
 - .4 Hot gas bypass sized for minimum compressor loading on one compressor only, bypasses hot refrigerant gas to evaporator.
 - .5 Lead-lag switch to alternate compressor operation.
 - .6 Low ambient thermostat to lock out compressor at low ambient temperatures.
- .5 Gauges: Pre-piped for suction and discharge refrigerant pressures and oil pressure for each compressor.
- .6 Provide electric solid state microcomputer based room thermostat, located as indicated on the drawings with remote sensor located as indicated. Coordinate provision of thermostat with Unit Ventilator manufacturer (Section 23 82 23)
 - .1 Incorporate:
 - .2 Automatic switching from heating to cooling.
 - .3 Preferential rate control to minimize overshoot and deviation from set point.
 - .4 Set-up for four separate temperatures per day.
 - .5 Instant override of setpoint for continuous or timed period from one hour to 31 days.
 - .6 Short cycle protection.
 - .7 Programming based on weekdays, Saturday and Sunday.
 - .8 Switch selection features including imperial or metric display, 12 or 24 hour clock, keyboard disable, remote sensor, fan on-auto.

2.9 PERFORMANCE

- .1 As schedule on drawings.

3 EXECUTION

3.1 INSTALLATION

- .1 Install to manufacturer's installation instructions.
- .2 Complete mechanical, and electrical connections to manufacturer's installation instructions.
- .3 Provide for connection to electrical service.
- .4 Provide connection to refrigeration piping system and evaporators. Comply with ASHRAE 15 and CSA B52 Mechanical Refrigeration Code.
- .5 Provide charge of refrigerant and oil.

3.2 DEMONSTRATION AND INSTRUCTIONS

- .1 Section 20 01 01: Demonstrating installed work.
- .2 Supply initial charge of refrigerant and oil for each refrigeration system. Replace losses of oil or refrigerant prior to end of correction period.
- .3 Charge system with refrigerant and test entire system for leaks after completion of installation. Repair leaks, put system into operation, and test equipment performance.
- .4 Shut-down system if initial start-up and testing takes place in winter and machines are to remain inoperative. Repeat start-up and testing operation at beginning of first cooling season.
- .5 Provide cooling season start-up, and winter season shut-down for first year of operation.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 20 01 01.

1.2 COMMON WORK RESULTS

- .1 Section 23 82 23 applies to and governs all work of Divisions 20, 21, 22, 23 and 25.

1.3 REFERENCES

- .1 AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
- .2 AFBMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- .3 AMCA 99 - Standards Handbook.
- .4 AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.
- .5 AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
- .6 AMCA 301 - Method of Publishing Sound Ratings for Air Moving Devices.
- .7 AMCA 500 - Method of Testing Louvres for Ratings.
- .8 AMCA 5000 - Method of Testing Dampers for Ratings.
- .9 AHRI 410 - Forced-Circulation Air-Cooling and Air-Heating Coils.
- .10 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
- .11 UL 900 - Air Filter Units.

1.4 SUBMITTALS

- .1 Section 20 01 01: Procedures for submittals.
- .2 Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.
- .3 Product Data:
 - .1 Provide literature which indicates dimensions, operating weights, capacities, ratings, fan performance, gauges and finishes of materials, and electrical characteristics and connection requirements.
 - .2 Provide data of filter media, filter performance data, filter assembly, and filter frames.
 - .3 Provide fan curves with specified operating point clearly plotted.
 - .4 Submit sound power level data for both fan outlet and casing radiation at rated capacity.
 - .5 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.
- .4 Manufacturer's Installation Instructions.

1.5 OPERATION AND MAINTENANCE DATA

- .1 Section 20 01 01: Submittals for project closeout.
- .2 Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.6 QUALIFICATIONS

- .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience, who issues complete catalogue data on total product.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Section 20 01 01: Transport, handle, store, and protect products.
- .2 Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.
- .3 Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

1.9 EXTRA MATERIALS

- .1 Section 20 01 01: Submittals for project closeout.
- .2 Provide one spare set for each unit of the following;
 - .1 filters

2 PRODUCTS

2.1 MANUFACTURERS – HORIZONTAL

- .1 Daiken
- .2 Trane

2.2 UNIT VENTILATOR – HORIZONTAL

- .1 Cabinet
 - .1 Unit frames shall be of unitized, welded construction, with structural elements aligned in an assembly jig prior to welding, to insure proper dimensions and rigidity, and squareness. Frames assembled with mechanical fasteners shall not be acceptable. Internal sheet metal parts shall be constructed of galvanized steel to inhibit corrosion.
 - .2 Exterior cabinet panels shall be fabricated from furniture grade steel of not less than 18 gauge steel with no sharp edges and shall receive an electrostatically applied powder paint, and be oven baked with environmentally friendly thermosetting urethane powder finish to provide a high quality appearance. Finish color shall be off- white
 - .3 The interior areas of the unit ventilator shall be insulated for sound attenuation and to provide protection against condensation of moisture on or within the unit. The unit shall be provided with an ultra-quiet sound package consisting of acoustically matched low speed fans to fan housing, sound barrier insulation material (non-fiberglass) adhered to the bottom underside of the unit top panel, sides of the fan section and sound absorbing insulation (non-fiberglass) material applied to the unit front panel.
 - .5 Units shall be constructed so that testing and troubleshooting can be accomplished in the end pockets of operating units, without affecting the normal air flow patterns through the unit.
 - .6 Each unit shall be provided with a non-fused power interrupt switch that disconnects the main power to the unit for servicing or when the unit is to be shut down for an extended period of time. The fan motor and controls shall have the hot line(s) protected by factory installed cartridge type fuse(s).
 - .7 The manufacturer shall have published cataloged sound data available for the engineer's review. Sound test data shall be based on standard cfm in accordance with AHRI 350 procedures based upon ARI 350. The engineer shall have the right to reject equipment not conforming to the specified manufacturer's sound data, as a minimum. Sound levels shall not exceed those shown below:

Octave Band and Center Frequency (Hz)								
UNIT CFM	Speed	2 125	3 250	4 500	5 1000	6 2000	7 4000	8 8000
750	High	57.4	51.8	52.5	52.6	51.2	46.9	35.2
	Med.	50.1	44.9	45.6	44.8	42.8	34.2	19.9
	Low	45.6	40.4	40.8	39.1	35.7	24.4	12.0
1000	High	57.0	52.8	53.9	53.7	51.5	46.8	35.9
	Med.	52.9	48.6	50.2	49.6	46.5	40.1	27.9
	Low	49.4	45.4	47.0	45.5	42.0	33.6	20.7
1250	High	62.4	55.2	55.7	55.3	54.4	49.7	38.5
	Med.	59.3	52.1	52.5	51.7	50.4	44.0	31.8
	Low	55.6	48.6	49.1	47.2	45.6	37.1	24.0
1500	High	63.8	56.6	58.0	58.2	56.4	52.4	41.9
	Med.	58.4	51.3	52.7	52.4	49.5	43.5	30.5
	Low	54.8	47.6	49.4	47.5	44.2	36.2	21.5
Sound Power Levels - dB re 10 ⁻¹² watt								

• Test data based on a valve control unit having 3 rows of coil and no outdoor air. Sound Power data may vary based on the type of unit, number of coil rows and other external factors.

.2 Floor Units

- .1 Floor mounted units shall have an integral pipe tunnel for convenient crossover of piping and a built-in metal wire raceway from right end compartment to left end compartment to contain any line voltage electrical wiring separate from the air stream. Line voltage wiring shall not be touchable in the air stream of the unit during normal maintenance procedures of oiling bearings or motors. Unit shall come standard with a factory installed and wired disconnect switch.
- .2 Unit top surface shall be supplied with a charcoal bronze textured finish, to resist scuffing, reduce glare and help hide fingerprints. Unit top shall have two access doors, one at each end (for access to motor and bearings for easy servicing).
- .3 Unit discharge grille shall be constructed of continuous rounded edge steel bars to provide 10 degree vertical deflection. A 1/4" painted, galvanized mesh screen shall be provided beneath the discharge grille to protect against objects being dropped through the discharge grille.
- .4 The unit top and grille shall be of a modular construction so that it is removable for service and maintenance.
- .5 The unit front surface shall be comprised of three separate removable panels. The controls and piping shall be accessible without removing the entire front panel. Panels shall be secured to the unit with recessed, tamper resistant, Allen head fasteners. Slots for flat head screwdrivers shall not be acceptable as tamper resistant.
- .6 An extended cabinet depth unit, 21 7/8" deep, shall incorporate a full adapter back with full rear panel and closed pipe tunnel with the same features of the standard cabinet depth units with the additional capability of bringing in fresh air from 1" to 28" from the floor. A full rear panel shall be screwed and sealed to the unit rear with insulation attached to the rear panel in the outdoor section. The unit top, back and vertical adapter back partitions shall be insulated to form a thermal barrier. A compressible gasket shall be provided to form an airtight seal between the wall and the contractor cut fresh air opening in the unit full rear panel.

.3 Ceiling Units (Ceiling Units shall be similar in construction to floor units, with the following additional features):

- .1 The unit shall be of modular construction so that the fan, coil and damper sections are removable for service and maintenance.
- .2 Three bottom panels, two of which are hinged, shall be provided for ease of service access and handling. Retainer chains shall be provided to prevent sudden release of the hinged bottom panels. End panels shall be secured to the unit with recessed, tamper resistant, Allen head fasteners. Slots for flat head screwdrivers shall not be acceptable as tamper resistant.

- .3 Ceiling mounted units shall have a built-in metal wire raceway from right end compartment to left end compartment to contain any line voltage electrical wiring separate from the air stream. Line voltage wiring shall not be touchable in the air stream of the unit during normal maintenance procedures of oiling bearings or motors.
- .4 The discharge opening of the unit shall be fitted with a duct collar.
- .4 Coils
 - .1 Coil assembly shall be of a modular construction so that it is removable from the front of the unit.
 - .2 Coil assembly shall be of a modular construction so that it is removable from the bottom of the unit.
 - .3 All coils shall be installed in a draw through position to assure uniform air distribution over the full-face area of the coil, and an even unit discharge temperature.
 - .4 All heating and cooling coils shall be constructed with copper tubes and mechanically bonded aluminum corrugated plate type fins. All coils shall have aluminum individual unshared fin surfaces. An air break shall exist between coils.
 - .5 Water heating coils shall be furnished with a threaded drain plug at the lowest point and a manual air vent at the high point of the coil. A factory installed low temperature freezestat shall be provided on the leaving edge of the water heating coil in a wave-like configuration to sense multiple locations and shall react to possible freezing conditions. The unit-mounted controls shall incorporate this device.
- .5 Drain Pans
 - .1 All units shall come furnished with an insulated drain pan constructed of galvanized steel. A drain outlet shall be provided on both ends of the drain pan with one outlet capped. The drain hand of connection shall be easily field-reversed by relocating the cap to the opposite end without disassembly of the unit or movement of the unit drain pan.
 - .2 The drain pan shall be able to be sloped in either direction for proper condensate removal.
 - .3 Drain shall be provided with a secondary, overflow drain connection on both ends of the pan.
- .6 Fans and Motor:
 - .1 The fan and motor assembly shall be of a low speed design to assure maximum quietness and efficiency.
 - .2 Fans shall be double-inlet, forward-curved, centrifugal type with offset aerodynamic blades. Fans and shaft shall be statically and dynamically balanced as an assembly in the unit before shipment.
 - .3 Fan housings shall be constructed of galvanized steel incorporating logarithmic expansion for quiet operation. Fan and motor assembly shall be of the direct drive type.
 - .4 Motors shall be 208 volt, single phase, 60 Hz, Electrically Commuted Motor (ECM), plug-in type with auto reset internal thermal overload device designed specifically for unit ventilator operation. Motors shall be located out of the conditioned air stream.
 - .5 Motors shall be 115 volt, single phase, 60 Hz, Electrically Commuted Motor (ECM), plug-in type with auto reset internal thermal overload device designed specifically for unit ventilator operation. Motors shall be located out of the conditioned air stream.
 - .6 All components of the fan/motor assembly shall be removable from the top of floor-mounted units.
 - .7 All components of the fan/motor assembly shall be removable from the bottom of ceiling mounted units.
 - .8 Units shall have sleeve type motor and fan shaft bearings. All bearings shall be located out of the airstream. Bearings in the air stream are not acceptable.

- .10 ECM Motor speed shall be factory programmed for three (3) speeds, HIGH-MEDIUM-LOW-OFF
Fan motor shall have hot leg protected by a factory installed cartridge fuse.

- .7 Outdoor and Room Dampers
 - .1 Each unit shall be provided with separate room air and outdoor air dampers.
 - .2 The room air damper shall be two-piece, double-wall construction fabricated from aluminum, and be counterbalanced against backpressure to close by gusts of wind pressure, thereby preventing outdoor air from blowing directly into the room.
 - .3 The outdoor air damper shall be two piece, double wall construction fabricated from galvanized steel, with ½" thick, 1½ lb. density glassfiber insulation encapsulated between the welded blade halves for rigidity and to inhibit corrosion. The outdoor air damper shall have additional foam insulation on the exterior surface damper blade and on the ends of the outdoor air chamber. A single blade damper, which can be twisted and will leak air, will not be considered.
 - .4 Dampers shall be fitted with blended mohair seals along all sealing edges. Pressure adhesive sponge neoprene or plastic clip-on brush type sealers for damper seals are not acceptable. Rubber type gasket using pressure adhesive for fastening to metal and exposed to the outside air is not acceptable.
 - .5 Dampers shall use the turned-metal principle on long closing ends with no metal-to-metal contact for proper sealing.
 - .6 The damper shaft shall be mechanically fastened to the blade, and shall operate in bearings made of nylon or other material which does not require lubrication.
 - .7 Provide and wire outdoor and return air damper actuators as required for stand-alone operation unless provided by Division 25 BAS under separate price.

- .8 Filter
 - .1 Each vertical unit ventilator shall be equipped with a one-piece filter located to provide filtration of the return air/outdoor air mixture, in lieu of separate filters for each air stream. The entire filter surface must be useable for filtration of 100% room air or 100% of outdoor air. The filter shall be easily accessible from the front, and removable in one piece without removal of the unit return air damper stop. The unit shall ship with a factory installed 1" thick fiberglass, single- use type.

- .9 Control Components:
 - .1 The hot water or steam heating coil shall use a factory selectable, field installed, modulating control valve to modulate the heating medium during the heating cycle. Upon a power failure, the modulating heating valve shall spring return to the normally open position for flow of water. Modulating valves without spring return to the normal position upon a power failure shall not be acceptable. The modulating valves shall be of 3-way configuration.
 - .2 Each unit ventilator shall be furnished capable of accepting direct coupled damper actuators and, if a hot water coil is furnished, with a factory installed low temperature freeze-stat provided on the leaving edge of the water heating coil in a wave-like configuration to sense multiple locations and shall react to possible freezing conditions. The mechanical contractor shall be responsible for the proper operation of controls to prevent damage of any unit ventilator components while ensuring comfort.
 - .3 Wire controls for outdoor unit.

- .10 Control Functions

- .1 The Unit Ventilator Digital Controller (here after referred to as UVC) shall support ASHRAE Cycle II operation. The control cycle shall be used to maintain the required minimum amount of ventilation whenever possible, which can be increased during normal operation for economizer cooling, but can also be reduced to prevent excessively cold discharge air temperatures OR Division 25 (Durrell) to supply controller capable of all unit ventilator functions as described here for stand-alone operation as described herein as well as integration with existing BAS system as described in BAS section. Provide thermostat in accordance with school standards to match existing.

.11 Unit Ventilator Options/Accessories

- .1 Outdoor Air Intake Louver: Outdoor air intake louver shall be provided by unit ventilator manufacturer except as otherwise noted on the drawings. Louvre size to match existing opening.
 - .1 Where indicated, each intake louver assembly shall be furnished with a matching four sided flange around the perimeter of the opening of same material and finish as louver.

3 EXECUTION

3.1 INSTALLATION

- .1 Install to manufacturer's instructions.
- .2 Install to AHRI 435.
- .3 The Installing contractor shall be responsible for the integration of all factory provided unit mounted controls and unit communications as required/specified for stand-alone unit operation.
- .4 Contractor shall clean each unit and accessory section of construction dust and debris, prior to turning systems over to the owner.
- .5 Contractor shall install clean filters in each unit at time of system commissioning.
- .6 The manufacturer's factory trained service technician shall provide check, test, and start-up of each unit ventilator system.
- .7 Contractor shall submit a completed "Check Test and Start Sheet" for each Unit Ventilator installed for verification of proper installation and start up.

3.2 UNIT VENTILATOR SCHEDULE

- .1 Unit Ventilator Schedule: As scheduled on drawings.

END OF SECTION

1 GENERAL

1.1 GENERAL

- .1 Read and conform to:
 - .1 The Contract CCDC 2-2008, Stipulated Price Contract as amended.
 - .2 Division 1 General Requirements.
 - .3 Section 20 01 01 General Requirements.

1.2 SECTION INCLUDES

- .1 Building Automation System (Separate Price)

1.3 SYSTEM DESCRIPTION

- .1 This Section defines the manner and method by which controls function.
- .2 Requirements for each type of control system operation are specified.
- .3 Equipment, devices, and system components required for control systems are to be provided by Durrell (Delta Controls)
- .4 All BAS work to be submitted as a separate price in lieu of stand-alone unit ventilator controls as described in separate section.

1.4 SUBMITTALS FOR REVIEW

- .1 Section 20 01 01: Procedures for submittals.
- .2 Shop Drawings: Indicate mechanical system controlled and control system components.
 - .1 Label with settings, adjustable range of control and limits. Include written description of control sequence.
 - .2 Include flow diagrams for each control system, graphically depicting control logic.
 - .3 Include draft copies of graphic displays indicating mechanical system components, control system components, and controlled function status and value.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- .1 Section 20 01 01: Submittals for project closeout.
- .2 Project Record Documents: Record actual locations of components and set points of controls, including changes to sequences made after submission of shop drawings.

1.6 QUALITY ASSURANCE

- .1 Design system under direct supervision of a Professional Engineer experienced in design of this Work and licensed in the Province of Ontario.

2 PRODUCTS

- .1 Equipment, devices, and system components required for control systems are to be provided by Durrell (Delta Controls) to match school board BAS standards.

3 EXECUTION

3.1 UNIT VENTILATORS CONTROLS (SEPARATE PRICE)

- .1 Provide controller and devices to manufacturer for factory mounting, coordinate with unit manufacturer as part of the base price. Base price shall include stand-alone controls (Unit Ventilator controller and temperature sensor) as identified in contract documents and Specification Section 23 82 23 - Unit Ventilators.
- .2 The unit(s) will be commanded on as per occupancy schedule. Fan status will be monitored by a current sensor. In the event of fan failure, an alarm will be generated to operator's workstation.

- .3 Heating coil control valve & freeze stat are supplied by manufacturer, monitor freeze stat status, send an alarm upon tripping and close outside air damper. Monitor mixed air temperature.
- .4 Occupied mode: The space temperature set point will change from night setback to day temperature set point. The unit ventilator controller stages DX cooling coil and modulates heating valve in sequence to maintain space temperature sensor set point. Monitor discharge air temperature.
- .5 Unoccupied mode: The outside air damper will shut down in unoccupied mode. The return air damper will open fully. The supply fan will be cycled on/off to maintain unoccupied set points.
- .6 Schedule: The BAS shall provide a weekly schedule for occupied (daytime) and unoccupied (nighttime). The occupants shall be able to override this schedule for a limited time (adjustable) through an occupancy button built in room temperature sensor.
 - .1 Occupied (Heating) Set Point: 70°F (21.1°C) adj.
 - .2 Unoccupied (Heating) Set Point: 60°F (15.5°C) adj.
 - .3 Occupied (Cooling) Set Point: 75°F (23.0°C) adj.
 - .4 Unoccupied (Cooling) Set Point: 80°F (26.7°C) adj.
- .7 Alarms:
 - .1 Fan Failure: Commanded on, but the status is off.
 - .2 Room Temperature: High/Low Room Temperature
 - .2 Mixed Air Temperature: Mixed Air Temperature greater than 90°F (32.2°F) adj, and lower than 45°F (7.2°C) adj.
 - .3 Damper Failure: Commanded open, but the status is off.
 - .4 Freezestat

GRAPHICAL USER INTERFACE

- .1 All systems described in sequence of operation shall be shown on the existing graphical user interface with the temperature values and alarms as described in the individual sequences.

3.2 POINTS LIST

I/O TYPE	NAME	DESCRIPTION	SIGNAL	AI	BI	AO	BO
		Room Temperature		3			
		Enable/Disable				3	
		Fan Status			3		
		O/A Damper Position				2	
		R/A Damper Position				2	
		Heating Water Coil				3	
		Cooling Enable Stage 1					2
		Cooling Enable Stage 2					2
		Freeze stat			2		
		Mixed Temperature		2			
		Discharge Air Temperature		3			

END OF SECTION

1 GENERAL

1.1 REFERENCES

- .1 The General Conditions of the Contract and the Supplementary Conditions, and all Sections of Division 01 apply to and are a part of this Section of the Specification.

1.2 APPLICATION

- .1 This Section specifies requirements that are common to electrical work Sections of the Specification, and it is a supplement to each Section and is to be read accordingly.

1.3 DEFINITIONS

- .1 The following are definitions of words found in electrical work Sections of the Specification and on associated drawings:
 - .1 "concealed" – means work hidden from normal sight in furred spaces, shafts, tunnels, ceiling spaces, underground, walls and partitions
 - .2 "exposed" – means work normally visible, including work in equipment rooms and similar spaces
 - .3 "provide" (and tenses of provide) – means supply and install complete
 - .4 "install" (and tenses of install) – means install and connect complete
 - .5 "supply" – means supply only
 - .6 "finished area" - means any area or part of an area which receives a finish such as paint, or is factory finished
 - .7 "governing authority" and/or "regulatory authority" and/or "Municipal authority" – means all government departments, agencies, standards, rules and regulations that apply to and govern the electrical work and to which the work must adhere
 - .8 "Consultant" – means the Architect or Consulting Engineer who has prepared the Contract Documents on behalf of the Owner
 - .9 "O&M" – means Operating and Maintenance
- .2 Wherever the words "indicated", "shown", "noted", "listed", or similar words or phrases are used in the specification they are understood, unless otherwise defined, to mean that the product referred to is "indicated", "shown", "listed", or "noted" on the drawings.
- .3 Wherever the words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected" or similar words or phrases are used in the specification or on the drawings they are understood, unless otherwise defined, to mean that work or product referred to is "approved by", "inspected by", etc., the Consultant.
- .4 In the electrical specification, singular may be read as plural, and vice-versa.
- .5 "Owner": means Building Owner as defined in the Contract or the Owner's designated representative.
- .6 "Wet": means wet areas requiring special materials. Where indicated on drawings and/or specified herein. Includes but not limited to pools, whirlpools, showers, etc.

1.4 METRIC AND IMPERIAL MEASUREMENTS

- .1 Both Metric and Imperial units of measurement are indicated in the electrical Specification.

1.5 EXAMINATION OF SITE AND DOCUMENTS

- .1 When estimating the cost of the work and prior to submitting a bid for the work, carefully examine all of the bid documents and visit the site to determine and review all existing site conditions that will or may affect the work, and include for all such conditions in the bid price.
- .2 Report to the Consultant, prior to bid submittal, any existing site condition that will or may affect performance of the work as per the drawings and specifications. Failure to do so will not be grounds for additional costs.

1.6 DRAWINGS AND SPECIFICATION

- .1 Read the electrical work drawings in conjunction with mechanical drawings.
- .2 The electrical drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of the building are to be taken at the site. Do not scale the drawings, and do not use the drawings for prefabrication work.
- .3 The drawings are intended to convey the scope of work and do not show architectural and structural details. Provide, at no extra cost to this Contract, all offsets, fittings, transformations, and similar products required as a result of obstructions and other architectural and structural details but not shown on the drawings.
- .4 Adjust the location of materials and/or equipment as directed without adjustment to contract price, provided that the changes are requested before installation and do not affect material quantity. Note that equipment may be relocated up to 3 meters (10 feet) in any direction without a change to the contract.
- .5 Sections of the electrical specification are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work, and the Sections are to be read as a whole.
- .6 The electrical specification does not generally indicate the specific number of items or extent of material required. The specification is intended to provide product data and installation requirements. It is necessary to refer to drawing plans to determine correct quantities.
- .7 The electrical drawings and specification are intended to be cooperative. Perform all work that is shown, specified, or reasonably implied on the drawings but not mentioned in the specification, or vice-versa, as though fully covered by both.
- .8 When the scale and date of the drawings are the same, or when the discrepancy exists within the specification, the most costly arrangement will take precedence.
- .9 In the case of discrepancies between the drawings and specifications, the documents will govern in the order specified in the General Conditions, however, when the scale and date of the drawings are the same, or where the discrepancy exists within the specification, the most costly arrangement will take precedence.
- .10 Provide all products and methods mentioned or shown in the Contract documents complete with incidentals necessary for a complete operating installation. Provide all tools, equipment and services required to do the work.
- .11 The electrical drawings and specifications have been prepared solely for the use by the party with whom the Consultant has entered into a contract and there are no representations of any kind made by the Consultant to any other party.

1.7 PLANNING AND LAYOUT OF THE WORK, AND ASSOCIATED DRAWINGS

- .1 Properly plan, coordinate, and establish the locations and routing of services with all subcontractors affected prior to installation such that the services will clear each other as well as any obstructions. Unless otherwise specified, the order of right-of-way for services is to be as follows:
 - .1 piping requiring uniform pitch
 - .2 piping 100 mm (4") dia. and larger
 - .3 large air ducts (main runs)
 - .4 piping less than 100 mm (4") dia.
 - .5 smaller branch ductwork
 - .6 conduit less than 100 mm (4") dia.
- .2 Unless otherwise shown or specified, conceal all work in finished areas, and conceal work in partially finished or unfinished areas to the extent made possible by the area construction. Install conduit and similar services as high as possible to conserve headroom and/or ceiling space. Notify the Consultant where headroom or ceiling space appears to be inadequate prior to installation of the work.
- .3 Revise or alter the arrangement of work that has been installed without proper coordination, study and review, even if it was completed in accordance with the Contract Documents, in order to conceal the work behind finishes, or to allow the installation of other work, at no additional cost. In addition, pay for the cost of alterations in other work required by the alterations to the electrical work.
- .4 All junction boxes, pullboxes and similar products, particularly such products located above

- suspended ceilings, must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.
- .5 Layout Drawings: Do not use the Contract Drawing measurements for prefabrication and layout of work. Locations and routing are to generally be in accordance with the Contract Drawings, however, layout drawings are to be prepared for all such work. Use established bench marks for both horizontal and vertical measurements. Coordinate with and make allowances for the work of other trades, accurately layout the work, and be entirely responsible for all work installed in accordance with layout drawings.
- .6 Interference Drawings: Prepare dimensioned working interference drawings, supplementary to the Contract Drawings for all areas where multiple services and/or equipment occur, or where the work due to architectural and structural considerations requires special study and treatment. Review interference drawings with the Consultant before the work is installed. Where this Contractor's work has been installed in such areas without preparation of interference drawings and conflicts occur, revise this work to suit at no additional cost.

1.8 COORDINATION OF THE WORK

- .1 Review all the Contract Documents and coordinate the work with the work of all subcontractors.

1.9 PHASING OF THE WORK

- .1 Coordinate phasing and sequencing of the work with the Owner and Consultant. Include all costs for phasing the work including all required "off hours" premium time labour costs.

1.10 QUALITY ASSURANCE

- .1 All electrical work is to be done by journeyman tradesmen who perform only the work that their certificates permit, or by apprentice tradesmen under direct on site supervision of an experienced journeyman tradesman. The use of apprentice tradesmen is to be limited and the journeyman/apprentice ratio is subject to the Consultant's approval.
- .2 All journeyman tradesmen are to have valid trade certificates available at the site for review by the Consultant at any time.
- .3 An experienced and qualified superintendent is to be on-site at all times when electrical work is being performed.

1.11 EQUIPMENT AND MATERIALS

- .1 Unless otherwise specified, all equipment and materials are to be new.
- .2 All equipment is to be installed in accordance with the manufacturer's published instructions, unless specified otherwise in the specification or on the drawings.
- .3 Where price, quality, and local service facilities are equivalent, preference will be given to products produced in the locality of the work or by producers located in the locality of the work. The decision as to the equality of products rests solely with the Owner.

1.12 EQUIPMENT AND MATERIAL MANUFACTURERS

- .1 Equipment and materials selected, scheduled or specified on the drawings or in the specification have been selected to establish a performance and quality standard, and, in some cases, a dimensional standard for the Project. In most cases acceptable manufacturers are listed for any product specified by manufacturer's name and model number. Bid Prices shall include only products specified or approved equivalents. Contractors may propose unsolicited alternatives to the products specified. Alternative proposals shall be submitted in sealed envelope at time of General Contract Bid submission and shall include full description and technical data, and a statement of the related increase or decrease in Bid Price should alternatives be accepted. All additional costs associated with unsolicited alternative proposals such as space revisions to associated equipment, controls, etc. shall be included in the alternative proposals. Prior approval by consultant is not required for unsolicited alternative proposals.
- .2 Where Contractor uses equipment other than that first named, on which the design is based, he shall

be responsible for all details of installation including size, arrangement, fit, and maintenance of all required clearances. Contractor shall prepare and submit revised layouts to indicate arrangement of all affected piping, ductwork, conduit, lighting, equipment, etc. Failure by Contractor to provide such drawings will be considered indication that original arrangements and space allocations are adequate. All additional costs associated with equivalent product such as space revisions to associated equipment, controls, etc. shall be included in Bid Price.

- .3 If products supplied by a manufacturer named as acceptable are used in lieu of the products specified by first named manufacturer's name and model number, ensure that the product is equivalent in performance and operating characteristics to the specified product. Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a manufacturer other than the first named specified manufacturer. In addition, in equipment spaces where products named as acceptable are used in lieu of the specified products and the dimensions of such products differ from the specified products, prepare and submit for review, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.
- .4 Do not supply products of different types that have been "bulked" by a supplier who has quoted a lump sum price for the "bulked" products.
- .5 The Consultant will review and evaluate unsolicited alternatives and substitutions proposed by the Contractor. Such review and evaluation work will be undertaken by the Consultant on an additional fee basis. The Contractor shall reimburse the Owner for all costs associated with such reviews and evaluations. The Contractor shall also reimburse the Owner for any and all costs incurred in updating Contract Documents to reflect such changes.

1.13 SUBSTITUTED OR ALTERNATIVE PRODUCTS

- .1 Products supplied by a manufacturer/supplier other than a manufacturer listed as acceptable may be considered for acceptance by the Consultant if requested in writing a minimum of ten (10) full working days prior to the bid closing date. Requests may be made by letter, by fax, or by email. Telephone requests will not be considered.
- .2 Each request for acceptance of a proposed substitution or alternative product must be accompanied by detailed catalogue and engineering data, fabrication information, and performance characteristics to permit the Consultant to make an informed decision.
- .3 Pay for any additional costs and changes to associated or adjacent work resulting from the use of products supplied by a substituted or alternative or other than first named manufacturer. In addition, in equipment spaces where substituted or alternative or other than first named products are used in lieu of the specified first named products and the dimensions of such products differ from the specified first named products, prepare and submit for review, accurately dimensioned layouts of the rooms affected to prove that all the equipment in the room will fit properly.
- .4 The Consultant's decision regarding any proposed substitution or alternative product is final.

1.14 CODES, REGULATIONS, AND STANDARDS

- .1 All Codes, Regulations, and Standards referred to in this Section are the latest edition of the Codes, Regulations, and Standards in effect at the time of tendering this Project.
- .2 All work is to be in accordance with requirements with Codes, Regulations, and Standards applied by governing authorities.
- .3 Where any governing Code, Regulation, or Standard requires preparation and submission of special details or drawings for review they are to be prepared and submitted. Pay all associated costs associated with these submittals.
- .4 All electrical items associated with mechanical equipment are to be certified and bear the stamp or seal of a recognized testing agency such as CSA, UL, ULC, ETL, etc., or bear a stamp to indicate special electrical utility approval.
- .5 Requirements of the Contract Documents are to take precedence when they are more stringent than codes, ordinances, standards, and statutes.

1.15 PERMITS, FEES, AND CERTIFICATES

- .1 Submit to the Consultant, all approval/inspection certificates issued by governing authorities to confirm that the work as installed is in accordance with the rules and regulations of the governing authorities. Pay any costs associated with issue of the certificates.
- .2 Include a copy of all approval/inspection certificates in each operating and maintenance manual.

1.16 WORKPLACE SAFETY

- .1 Comply with requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding the use, handling, storage and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for all products where required, and maintain one copy at the site in a visible and accessible location available to all personnel.
- .2 Comply with all requirements of Occupational Health and Safety Regulations and all other regulations pertaining to health and safety, including worker's compensation/ insurance board and fall protection regulations.

1.17 SHOP DRAWINGS AND PRODUCT DATA SHEETS

- .1 Prior to supplying any products to the site, submit for review, shop drawings and/or product data sheets indicating in detail the design, construction, and performance of products as requested in Sections of this Specification. The number of copies of shop drawings and/or product data sheets will be as later directed.
- .2 Wherever possible, shop drawings and/or product data sheets are to be 216 mm x 280 mm (8½" x 11"), 216 mm x 356 mm (8½" x 14"), or 356 mm x 432 mm (11" x 17") single side white bond paper with sufficient clear space for review stamps and comments.
- .3 Each shop drawing or product data sheet is to be properly identified with the project name and the product drawing or specification reference and all shop drawing or product data sheet dimensions are to be either SI or Imperial to match dimensions on the drawings.
- .4 Where any item of equipment is required by Code or Standard or By-Law to meet a specific requirement, ensure that this requirement is clearly indicated on the submission.
- .5 Carefully review each shop drawing and product data sheet prior to submittal to ensure that the proposed product is correct, as per the Electrical Supplementary Bid Form as applicable, and meets with all requirements of the Project. Endorse each copy of each shop drawing or product data sheet "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS" and include the company name, the submittal date, and the signature of an officer of the company to indicate your review and approval as above.
- .6 The Consultant will review shop drawings and product data sheets and will indicate the review status by stamping the shop drawings and product data sheets as follows:
 - .1 "Reviewed" or "Reviewed As Modified" to indicate that his review is final and no re-submittal is required
 - .2 "Revise and Resubmit" to indicate that the submission is rejected and is to be revised in accordance with comments marked on the shop drawings and product data sheets by the Consultant and re-submitted
- .7 The Consultant will retain one or two copies of each shop drawing or product data sheet submission.
- .8 The following is to be read in conjunction with the wording on the Consultant's review stamp applied to each and every electrical work shop drawing or product data sheet submitted:
 - .1 "This review is for the sole purpose of ascertaining conformance with the general design concept. This review does not approve the detail design inherent in the shop drawings, responsibility for which remains with the Contractor, and such review does not relieve the Contractor of the responsibility for errors or omissions in the shop drawings or of his responsibility for meeting all requirements of the Contract Documents. Be responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the work of all sub-trades."
- .9 Provide final commissioning report with record drawings.
- .10 Provide draft copy of all manuals 100 days prior to expected date of completion of work for review by Owner.

1.18 CHANGES OR REVISIONS TO THE WORK

- .1 Whenever the Consultant proposes in writing to make a change or revision to the design, arrangement, quantity or type of any work from that required by the Contract Documents, prepare and submit to the Consultant for approval, a quotation being your proposed cost for executing the change or revision.
- .2 The Contractor's quotation is to be a detailed and itemized estimate of all product, labour, and equipment costs associated with the change or revision, plus overhead and profit percentages and all applicable taxes and duties.
- .3 The following requirements apply to all quotations submitted:
 - .1 when the change or revision involves deleted work as well as additional work, the cost of the deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from the cost of the additional work before overhead and profit percentages are applied to the additional work
 - .2 material costs are not to exceed those published in local estimating price guides
 - .3 costs for journeyman and apprentice labour must not exceed prevailing rates at the time of execution of the Contract and listed in the Supplementary Bid Form and must reflect the actual personnel performing the work
 - .4 the cost for the site superintendent must not exceed 10% of the total hours of labour estimated for the change or revision, and the change or revision must be such that the site superintendent's involvement is necessary
 - .5 costs for rental tools and/or equipment are not to exceed local rental costs
 - .6 Refer to the General Conditions of the Contract and the Supplementary Conditions for allowable percentages for overhead and profit.
 - .7 the overhead percentage will be deemed to cover all quotation costs other than actual site labour and materials, and rentals
 - .8 all quotations, including those for deleted work, must include a figure for any required change to the Contract time
- .4 Quotations submitted that are not in accordance with requirements specified above will be rejected and returned for re-submittal. Failure to submit a proper quotation to enable the Consultant to expeditiously process the quotation and issue a Change Order will not be grounds for any additional change to Contract time.
- .5 If, in the Contractor's opinion, changes or revisions to the work should be made, inform the Consultant in writing and, if the Consultant agrees a Notice of Change will be issued.
- .6 Do not execute any change or revision until written authorization for the change or revision has been obtained.

1.19 NOTICE FOR REQUIRED FIELD REVIEWS

- .1 Whenever there is a requirement for the Consultant to perform a field review prior to concealment of any work, to inspect/re-inspect the work for deficiencies prior to Substantial Performance, for commissioning demonstrations, and any other such field review, give the Consultant adequate notice in writing.
- .2 If the Consultant is unable to attend a field review when requested, arrange an alternative date and time.
- .3 Do not conceal work until the Consultant advises that it may be concealed.
- .4 When the Consultant is requested to perform a field review and the work is not ready to be reviewed, reimburse the Consultant for all time and travel expenses.

1.20 PROJECT CLOSEOUT SUBMITTALS

- .1 Prior to application for Substantial Performance of the Project, submit all required documentation specified, including the following:
 - .1 Operating and Maintenance Manuals
 - .2 as-built record drawings and associated data
 - .3 extended warranties as specified

- .4 other data or products specified

1.21 OPERATING AND MAINTENANCE MANUALS

- .1 Submit, prior to application for Substantial Performance, 3 hard copies of operating and maintenance manuals consolidated in black hardcover 3 "D" ring binders, and identified permanently on binder spine with the Project name, "ELECTRICAL OPERATING AND MAINTENANCE MANUAL" wording, and the date. Manuals are to include the following:
 - .1 an Introduction sheet listing the Consultant's, Contractor's, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses. Include special telephone numbers for service departments on normal and emergency call basis.
 - .2 a Table of Contents sheet, and corresponding index tab sheets. Use plastic tab indices for all sections of the manual with separate sections for each different type of equipment item.
 - .3 a copy of each "Reviewed" or "Reviewed As Modified" shop drawing or product data sheet, with manufacturer's/supplier's name, telephone and fax numbers, email address, and the email address for local source of parts and service
 - .4 operating data, which is to include:
 - .1 Diagram of the electrical system indicating the wiring of all related electrical components such as fuses, interlocks, electrical switches and relays
 - .5 Maintenance data, which is to include:
 - .1 manufacturer's maintenance instructions, servicing maintenance, operation and trouble-shooting instructions for each item; list parts numbers and lists, name of supplier and maintenance and lubrication instructions
 - .2 schedules of tasks, frequency, tools required, and task time
 - .3 complete parts lists with numbers
 - .4 testing reports
 - .5 where fuses with maximum let-through current are indicated, provide manufacturer's fuse curve data in Operating and Maintenance Manuals showing fuse coordination with system interrupting capacity at that location in the system
 - .6 performance data, which is to include:
 - .1 performance verification test results, and commissioning report
- .2 Submit, prior to application for Substantial Performance, four digital versions of the hard copy manual using the latest version of Adobe Acrobat Portable Document Format and enhanced with bookmarks, internet links, and internal document links. The digital copies are to be copied to CDR with custom labels which indicate the project name, date, the Consultant's name, and "Operating & Maintenance Manual for Electrical Systems". Provide one additional digital version copy for Consultant's use.

1.22 RECORD "AS-BUILT" DRAWINGS

- .1 Obtain PDF's from the Consultant for the production of record "AS-BUILT" drawings and pay for costs of reproduction and transmission costs. As work progresses at the site, clearly mark in red in a neat and legible manner on a set of white prints of the drawings, all significant changes and deviations from the routing of services and locations of equipment shown on the Contract Drawings and resulting from the issue of Addenda, Site Instructions, Change Orders, and job conditions. Use notes marked in red as required. Maintain the white print red line as-built set at the site for the exclusive use of recording as-built conditions, keep the set up-to-date at all times, and ensure that the set is always available for periodic review. The as-built set is also to include the following:
 - .1 the location of all work such as junction boxes and pullboxes concealed in inaccessible locations
 - .2 the locations of control devices with identification for each
- .2 When work on site is complete, transfer all the as-built red line information from the site as-built drawings to a recordable and identified CAD disc with CAD work of equal quality to the Contract Drawings. Obtain a CAD disc as described below.
- .3 The electrical drawings have been prepared on a computer aided drafting system. Obtain and pay for an electronic version of the drawings from the Consultant for use in producing final as-built drawings.
- .4 Prior to inspection for Total Performance of the work, submit for review, the red line site as-built white prints, a CAD disc of the as-built drawings, and a bound set of white prints (of equal quality to the

Contract Drawings) made from the disc. The Consultant will review the drawings and, if necessary, return the disc and the marked-up white prints for corrections or further revisions, in which case complete the corrective and/or revision work and resubmit the disc and white prints until they are determined to be acceptable.

1.23 PROGRESS PAYMENT BREAKDOWN

- .1 Within 15 working days of written notification of award of contract submit a breakdown of the cost of the electrical work to assist the Consultant in reviewing and approving monthly progress payment claims.
- .2 The payment breakdown is subject to the Consultant's approval and progress payments will not be processed until an approved breakdown is in place. The breakdown is to include one time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning including testing, and project closeout submittals.

1.24 REQUIREMENTS FOR CONTRACTOR RETAINED ENGINEERS

- .1 All professional engineers retained by this Contractor to perform consulting services with regard to his work are to be members in good standing with the local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of the governing authorities in the locale of the work.
- .2 This Contractor's retained engineer's professional liability insurance is to protect his Consultants and Sub-Consultants, and their respective servants, agents, and employees against any loss of damage resulting from the professional services rendered by his Consultants, Sub-Consultants, and their respective servants, agents, and employees in regards to the work of this Contract.
- .3 Liability insurance requirements are as follows:
 - .1 coverage is to be a minimum of \$1,000,000.00 inclusive of any one occurrence, or as indicated in the Division 0.
 - .2 the insurance policy is not to be cancelled or changed in any way without the insurer giving the Owner a minimum of thirty days written notice
 - .3 liability insurance is to be obtained from an insurer registered and licensed to underwrite such insurance in the location of the work
 - .4 evidence of the required liability insurance in such forms as may be required is to be issued to the Owner, the Owner's Consultant, and Municipal Authorities as required prior to commencement of your Consultant's services

1.25 GENERAL RE: INSTALLATION OF EQUIPMENT

- .1 Unless otherwise specified all equipment is to be installed in accordance with the equipment manufacturer's recommendations and instructions, and requirements of governing Codes, Standards, and Regulations.
- .2 Ensure that proper access and code required service clearances are maintained around equipment.

1.26 EXTENDED WARRANTIES

- .1 All extended warranties specified in electrical work Sections of the Specification are to be full parts and labour warranties, at the site, and in accordance with requirements of the Contract warranty, but direct from the equipment manufacturer/supplier to the Owner. Submit signed and dated copies of extended warranties which clearly state requirements specified above.

1.27 PRODUCT DELIVERY, HANDLING AND STORAGE

- .1 Immediately after letting of contract, review material and equipment requirements for this work, determine supply and delivery dates for all items, and notify Consultant of any potential delays in completion of this project in order that remedial action may be taken.
- .2 Store neatly out of the way and protected from damage and theft, materials and equipment supplied under this Division that are received at the site by this Division.

1.28 WARRANTY

- .1 Refer to General Conditions. Arrange with each manufacturer/supplier to extend warranties as necessary to coincide with warranty period or those periods specified.
- .2 Make submissions necessary to register product warranties to the benefit of the Owner.
- .3 Submit to Consultant, prior to Substantial Performance of the Contract, manufacturer's written warranties covering periods longer than one year or offering greater benefits than required in specifications and in the Owner's name.

1.29 PROTECTION

- .1 Protect finished and unfinished work by tarpaulins, or other covering, from damage due to execution of work under this Division.
- .2 Repair to satisfaction of Consultant, damage to building resulting from failure to provide such protection.

1.30 EQUIPMENT AND SYSTEM COMMISSIONING

- .1 After successful start-up and prior to Substantial Performance, commission the electrical work. Commissioning work is the process of the Contractor demonstrating to the Owner and Consultant, for the purpose of final acceptance by means of successful and documented functional performance testing, that all systems and/or subsystems are capable of being operating and maintained to perform in accordance with requirements of the Contract Document, as further described below.
 - .1 Operational Performance Testing: The Contractor is to test, adjust and operate components, equipment, systems and /or subsystems after start-up but before functional performance testing, to confirm that all components, equipment, systems and/or subsystems operate in accordance with requirements of the Contract Documents, including all modes and sequences of control and monitoring, interlocks ,and responses to emergency conditions. The Contractor is to complete commissioning data sheets to document successful operational performance testing.
 - .2 Functional Performance Testing: The Contractor is to repeat successful operational performance testing with complete commissioning data sheet documentation by the Contractor in the presence of the Consultant and Owner to validate and verify that the equipment, systems and subsystems are complete in all respects, function correctly, and are ready for acceptance.
 - .3 Submittals: The Contractor is to submit final commissioning data sheets, and other required submittals.

1.31 SPECIAL TOOLS AND SPARE PARTS

- .1 Identify spare parts containers as to contents and replacement parts number.
- .2 Provide one set of special tools required to service equipment as recommended by manufacturers.
- .3 Prepare a complete itemized list of special tools and spare parts and submit to consultant for review. List will be used as a checklist and should include provision for sign off by Owner on receipt.

2 PRODUCTS

Not Applicable

3 EXECUTION

Not Applicable

END OF SECTION

1 GENERAL

1.1 APPLICATION

- .1 This Section specifies products, common criteria and characteristics, and methods and execution that are common to one or more electrical work Sections of the Specification, and it is intended as a supplement to each Section and is to be read accordingly.

1.2 SUBMITTALS

- .1 Submit the following for review:
 - .1 Product data sheets: submit for:
 - .1 Firestopping and smoke seal products
 - .2 Waterproofing seal assemblies
 - .3 Electrical work identification products
 - .2 Sleeve and formed opening location drawings: upon notification of award of Contract begin to prepare accurately dimensioned drawings to locate all required electrical work sleeves, formed openings, and recesses in poured concrete work, and submit the drawings prior to concrete work commencing. Provide a copy of approved sleeving drawings to the reinforcement detailer well in advance of planned pours.
 - .3 List of equipment nameplates: submit a list of equipment identification nameplates indicating proposed wording and sizes
 - .4 Waste management and reduction plan: submit a waste management and reduction plan prior to commencing work and as per requirements specified in this Section
 - .5 Additional submittals: submit any other submittals specified in this Section or other electrical work Sections of the Specification

2 PRODUCTS

2.1 SLEEVES

- .1 Galvanized Sheet Steel: Minimum #16 gauge galvanized steel with an integral flange at one end to secure the sleeve to formwork construction.
- .2 Polyethylene: Factory fabricated, flanged, high density polyethylene sleeves with reinforced nail bosses.
- .3 Galvanized Steel Pipe – Waterproof: Schedule 40 mild galvanized steel pipe with a welded-on square steel anchor and water stop plate at the sleeve midpoint.
- .4 Galvanized Steel or Cast Iron Pipe: Schedule 40 mild galvanized steel pipe, or Class 4000 cast iron pipe, cut to length.

2.2 FIRESTOPPING AND SMOKE SEAL MATERIALS

- .1 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with CAN4-S115 and CAN/ULC-S01 for installation in ULC designated firestopping and smoke seal systems to provide a positive fire, water and smoke seal, and a fire-resistance rating (flame, hose stream and temperature) not less than the fire resistance rating of surrounding construction.
- .2 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports and anchoring devices in accordance with the firestopping manufacturer's recommendations and the ULC tested assembly.
- .3 Multi-Cable Transits: UL/ULC listed and labelled multi-cable transits sized to the fire barrier opening and to suit the number of conduits involved, and to provide a minimum two hour water-tight fire and smoke seal. Each assembly is to be complete with a stainless steel frame, cadmium plated compression bolts, proper end packing, compression plates, steel stay plates, and fire rated neoprene insert blocks.

2.3 WATERPROOFING SEAL MATERIALS

- .1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to

continuously fill the annular space between the conduit, etc., and the sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so that when the bolts are tightened the links expand to seal the opening watertight. The seal assemblies are to be selected to suit the conduit, etc., size and the sleeve size or wall opening size. Acceptable products are:

- .1 Thunderline Corp. (Power Plant Supply Co.) "LINK SEAL" Model S
- .2 The Metraflex Co. "MetraSeal" type ES

2.4 ESCUTCHEON PLATES

- .1 One-piece chrome plated brass or #4 finish type 302 stainless steel plates with matching screws for attachment to the building surface, each plate sized to completely cover the sleeve or building surface opening, and to fit tightly around the conduit.

2.5 ELECTRICAL WORK IDENTIFICATION MATERIALS

- .1 Equipment Nameplates: Minimum 3 mm (1/8") thick 2-ply laminated, engraved, coloured plastic plates, minimum 12 mm x 50 mm (1/2" x 2") for items such as disconnect switches. Additional requirements are as follows:
 - .1 Unless otherwise specified or required, nameplates are to be white with black wording.
 - .2 Each nameplate is to be complete with bevelled edges and wording is to be as large as possible and completely identify the equipment and its use with no abbreviations
 - .3 Wording is generally to be as per the drawings, and is to include the building area/zone served, but must be reviewed and approved by the Consultant prior to engraving
 - .4 Supply stainless steel self-tapping screws for securing nameplates in place
- .2 Self-Adhesive Labels: Equal to Brother "P-Touch" or Thomas & Betts Canada Ltd. "EZCODE" Model EZL500 electronic labelling system self-adhesive labels with size and colour as directed, and permanently printed circuit identification nomenclature which is to be approved by the Consultant prior to producing the labels.
- .3 Warning Signs: Equal to Thomas & Betts Canada Ltd. "BP" Series 250 mm x 355 mm (10" x 14") semi-rigid vinyl signs with corner screw holes, the required printed wording (generally red on a white background with black trim) and pressure sensitive adhesive pads on the back.
- .4 Conduit Identification: Equal to Brady Canada minimum 50 mm (2") wide self-adhesive coloured vinyl tape.
- .5 Conductor Terminations: Equal to Electrovert Ltd. slip-on "Z" type.

2.6 FASTENING AND SECURING HARDWARE

- .1 Concrete Inserts: Zinc alloy cast-in-place or "wood-knocker" type formwork anchors for single or double runs of conduit, cable tray, etc., and for equipment, and Unistrut Ltd. or equal multi type inserts for runs of three or more conduits, etc, or where a grid support system is required.
- .2 Concrete Fasteners: Equal to wej-it Fastening Systems anchors or self-drilling anchors, or, for light loads, lead plugs and screws.
- .3 Masonry Fasteners: Equal to wej-it Fastening Systems expansion shields and machine bolts, or, for light loads, lead plugs and screws.
- .4 Gypsum Board Fasteners: Two-wing spring toggles, for light loads only.
- .5 Structural Steel: Equal to Erico International Corp. "CADDY" beam clamps to suit the application.

2.7 ELECTRICAL ENCLOSURES

- .1 Unless otherwise specified herein or on the drawings, NEMA, EEMAC, and CSA enclosures for disconnect switches and similar equipment are to be as follows:
 - .1 Outdoor – type 3R rain-proof
 - .2 Indoor – type 1

3 EXECUTION

3.1 GENERAL

- .1 Manufacturer's Instructions: For all materials and equipment, ensure that the manufacturers' installation instructions are followed unless otherwise specified herein or on the drawings, and unless such instructions contradict governing codes and regulations.
- .2 Cleaning: Clean all conduit and equipment prior to installation. Temporarily cap or plug ends of conduits which are open and exposed during construction.
- .3 Surfaces to Receive Your Work: Inspect surfaces and structure prepared by other trades before performing your work. Verify that surfaces or the structure to receive your work have no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing. Installation of your work will constitute acceptance of such surfaces as being satisfactory.
- .4 Repair of Finished Surfaces: For factory applied finishes, repaint or refinish all surfaces damaged during shipment and installation. The quality of the repair work is to match the original finish. This requirement also applies to galvanized finishes.
- .5 Accessibility: Locate all work to permit easy access for service or maintenance as required and/or applicable. Locate all junction boxes and pull boxes, and any other equipment which will or may need access, maintenance or repairs and which are installed in accessible construction so as to be easily accessible.

3.2 GENERAL CONDUIT & CONDUCTOR SYSTEM INSTALLATION REQUIREMENTS

- .1 Unless otherwise specified, locate and arrange horizontal conduit and conductors above or at the ceiling on floors on which they are shown, arranged so that under consideration of all other work in the area, the maximum ceiling height and/or usable space is maintained.
- .2 Unless otherwise specified, install all conduit concealed in finished spaces, and concealed to the degree possible in partially finished and unfinished spaces. Note that walls which are painted are considered finished.
- .3 Install all exposed conduit parallel to building lines and to each other. Neatly group and arrange all exposed work.
- .4 Do not install conduit within 150 mm (6") of "hot" piping or equipment unless the conduit are associated with the equipment.
- .5 All conduit must be supported from the structure, not from ceiling hangers, piping, ductwork, cable tray, and similar mechanical or electrical products.

3.3 INSTALLATION OF SLEEVES

- .1 Where conduits pass through concrete and/or masonry surfaces provide sleeves as follows:
- .2 In poured concrete slabs, unless otherwise specified - minimum 16 gauge flanged galvanized steel or, where permitted by governing authorities, factory fabricated plastic sleeves
- .3 In concrete or masonry walls - Schedule 40 galvanized steel pipe or Class 4000 cast iron pipe, cut to length
- .4 Waterproof Sleeves: Sleeves in waterproofed slabs or walls are to be lengths of Schedule 40 mild galvanized steel pipe with a water stop. Provide waterproof sleeves in the following locations:
 - .1 In all floors equipped with waterproof membranes
 - .2 In waterproof walls
- .5 Size sleeves, unless otherwise specified, to leave 12 mm (½") clearance around the conduit.
- .6 Pack and seal the void between the sleeves and the conduit for the length of the sleeves as follows:
 - .1 Fire rated construction: pack sleeves in fire rated construction as specified in the article below entitled "INSTALLATION OF FIRESTOPPING AND SMOKE SEAL MATERIALS"
 - .2 Non-fire rated construction: pack sleeves in non-fire rated interior construction with mineral wool and seal both ends of the sleeves with non-hardening silicone base caulking compound
 - .3 Exterior walls above grade: pack sleeves in exterior walls above grade with mineral wool and seal both ends of the sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified

- .4 Exterior walls below grade: seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified below
- .7 Where sleeves are required in masonry work, accurately locate and mark the sleeve location, and hand the sleeves to the mason for installation.
- .8 Terminate piping used for sleeves that will be exposed so that the sleeve is flush at both ends with the building surface concerned so that the sleeve may be completely covered by an escutcheon plate, except for sleeves in waterproof floors which are to terminate 100 mm (4") above the finished floor.
- .9 "Gang" type sleeving will not be permitted.
- .10 Where piping has been removed from existing sleeves, cap and seal both ends of the sleeved opening. Where the sleeve is located in fire rated construction, ensure that the sleeve is sealed with firestopping material.

3.4 INSTALLATION OF WATERPROOF MECHANICAL SEALS

- .1 Provide watertight link type mechanical seals for conduit through exterior wall openings where shown and/or specified.
- .2 Assemble and install each mechanical seal in accordance with the manufacturer's instructions.
- .3 After installation, periodically check each mechanical seal installation for leakage and, if necessary, tighten link seal bolts until the seal is completely watertight.

3.5 INSTALLATION OF FIRESTOPPING AND SMOKE SEAL MATERIALS

- .1 Where electrical work penetrates fire rated construction, provide ULC listed and labelled firestopping and smoke seal materials installed in accordance with requirements of CAN4-S115 and CAN/ULC-S101-M to seal the penetrations.
- .2 Work is to be performed only by a specialist company using tradesmen experienced in firestopping and smoke seal work.
- .3 When firestopping and smoke seal work is complete, obtain from the specialist firm who performed the work a letter certifying that all required firestopping and smoke seal work has been completed in strict accordance with requirements of the Building Code, ULC requirements, any other applicable local Municipal Codes or Regulations, and the instructions of the firestopping and smoke seal manufacturer. Submit the letter to the Consultant.

3.6 INSTALLATION OF CABLE AND CONDUIT TRANSITS

- .1 Provide fire rated UL/ULC listed transits in rectangular openings in fire rated slabs and walls where or multiple conduits penetrate the fire barrier.

3.7 INSTALLATION OF ESCUTCHEON PLATES

- .1 Provide escutcheon plates suitable secured over all exposed conduit passing through finished building surfaces. A finished building surface is any surface with a factory finish or that receives a site applied finish.
- .2 Install the plates so that they are tight against the building surface concerned, and ensure that the plates completely cover sleeves and/or openings, except where waterproof sleeves extend above floors, in which case the plate is to fit tightly around the sleeve.

3.8 INSTALLATION OF FASTENING AND SECURING HARDWARE

- .1 Provide all fastening and securing hardware required for electrical work to maintain installations attached to the structure or to finished floors, walls and ceilings in a secure and rigid manner capable of withstanding the dead loads, live loads, superimposed dead loads, and any vibration of the installed products.
- .2 Use fasteners compatible with structural requirements, finishes and types of products to be connected. Do not use materials subject to electrolytic action or corrosion where conditions are liable to cause such action.
- .3 Where the floor, wall or ceiling construction is not suitable to support the loads, provide additional framing or special fasteners to ensure proper securement to the structure that is to support the

products. Provide reinforcing or connecting supports where required to distribute the loading to the structural components.

- .4 Obtain written consent before using explosive actuated fastening devices. If consent is obtained, comply with requirements of CSA Standards CAN3-Z166.1 and 2.

3.9 ELECTRICAL WORK IDENTIFICATION

- .1 General: The following requirements apply to electrical work identification:
 - .1 The size and wording of identification nameplates must be approved by the Consultant prior to manufacture. Provide shop drawings of all nameplates and labels for review and comment
 - .2 Identification wording for equipment is to follow drawing nomenclature for the equipment, unless otherwise specified
 - .3 Secure nameplate to equipment with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces
 - .4 Locate equipment nameplates in the most conspicuous and readable location
 - .5 For multi-cell or multiple component equipment, provide a main nameplate and a smaller nameplate for each component to identify its name and service
 - .6 Colour code: comply with OESC-4-036.
- .2 Pull Boxes, Junction Boxes, Etc.: Clearly identify main pull and junction boxes by spray painting the outside surface of the covers. Paint colours are to be as specified below for conduit identification.
- .3 Disconnect Switches: Provide a nameplate for each disconnect switch provided as part of the electrical work for motorized equipment provided as part of the mechanical work. Nameplates are to identify the equipment being controlled, and the voltage.
- .4 Conduit & Cable: Colour code conduit by means of 25 mm (1") wide primary colour plastic adhesive backed tape or neatly applied suitable paint with, where scheduled, a 20 mm (3/4") wide auxiliary colour at points where the conduit or cable enters a wall, ceiling or floor, at least once in each room or accessible ceiling space and elsewhere at maximum 15 m (45') intervals. Unless otherwise specified herein or on the drawings, colours are to be as follows:
- .5 Wire and Cable Terminations: Identify both ends of wire and cable terminations with the same unique number. Where numbers are not indicated or specified, assign a number and record them.

3.10 FINISH PAINTING OF ELECTRICAL WORK

- .1 Finish paint exposed electrical work as specified and/or scheduled in accordance with requirements of the painting Section in Division 09.

3.11 GENERAL ELECTRICAL WORK TESTING

- .1 In addition to tests required by Codes and Regulations, or tests specified in other electrical work sections of the specification, perform the following:
 - .1 After all disconnect switches and similar electrical items are installed, whether as part of the electrical work or as part of the work of other sections of the specification, test all work to ensure that there are no grounds or crosses
 - .2 Establish proper motor rotation, measure full load running currents, and check overload elements, and report any discrepancies to the Consultant
 - .3 Demonstrate to the Consultant that branch circuit voltage drop is within specified limits
 - .4 Ensure that all devices are commissioned and operable

3.12 BRANCH CIRCUIT BALANCING

- .1 Connect all branch circuits to panelboards so as to balance the actual loads (wattage) to within 5%. If required, transpose branch circuits to achieve this requirement.
- .2 When requested by the Consultant, and after the building is occupied, perform tests to demonstrate that branch circuit balancing has been achieved.

3.13 ELECTRICAL WIRING WORK FOR MECHANICAL WORK

- .1 Unless otherwise specified or indicated, the following electrical wiring work for mechanical equipment is to be done as part of the electrical work:
 - .1 "Line" side power wiring to motor controllers or disconnects, and "load" side wiring from the controllers or disconnects to the equipment
- .2 Mechanical wiring work not listed above or specified herein or on the drawings to be done as part of the electrical work will be done as part of the mechanical work.

3.14 EQUIPMENT BASES, SUPPORTS AND CURBS

- .1 Structural Steel Supports: Where required, provide welded, cleaned and prime coat painted structural steel supports.

3.15 PACKING AND SEALING CORE DRILLED OPENINGS

- .1 Pack and seal the void between the conduit, etc., opening and the conduit, etc., for the length of the opening as follows:
 - .1 non-fire rated interior construction: pack openings in non-fire rated interior construction with mineral wool and seal both ends of the opening with non-hardening silicone base caulking compound to produce a water-tight seal
 - .2 Fire rated construction: pack and seal openings in fire rated walls and slabs as specified in this Section
 - .3 Exterior walls above grade: pack sleeves in exterior walls above grade with mineral wool and seal both ends of the sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified

3.16 CLEANING ELECTRICAL WORK

- .1 Clean all electrical work prior to application for Substantial Performance of the work.

3.17 USE OF ELECTRICAL SYSTEMS FOR TEMPORARY POWER AND LIGHTING

- .1 Permanent electrical systems in the building may be used for temporary power and lighting during construction subject to the following conditions:
- .2 Each entire system is complete, tested, and commissioned
- .3 Building has been closed in and areas are clean and will not thereafter be subjected to dust-producing processes
- .4 There is no possibility of damage from any cause
- .5 All systems are operated as per the manufacturer's recommendations or instructions, and are monitored on a regular and frequent basis
- .6 Warranties are not affected in any way
- .7 Regular preventive and all other manufacturer's recommended maintenance routines are performed.
- .8 before Substantial Performance, each entire system is to be cleaned internally and externally.
- .9 energy costs are to be paid by the Contractor.

3.18 MAINTAINING EQUIPMENT PRIOR TO ACCEPTANCE

- .1 Maintain all equipment in accordance with the manufacturer's printed instructions prior testing and commissioning.

3.19 CONNECTIONS TO OTHER EQUIPMENT

- .1 Carefully examine the Contract Documents during the bidding period and include for electrical work connections to equipment requiring such connections.

3.20 EQUIPMENT AND SYSTEM COMMISSIONING

- .1 Prior to Substantial Performance, test, adjust, and commission the electrical work. Commissioning

work is the process of the Contractor demonstrating to the Owner and Consultant, for the purpose of final acceptance, by means of successful and documented functional performance testing, that all systems and/or subsystems are capable of being operated and maintained to perform in accordance with requirements of the Contract Documents, as further described below.

- .1 Operational Performance Testing: the contractor is to test, adjust and operate components, equipment, systems and/or subsystems after start-up but before functional performance testing, to confirm that all components, equipment, systems and/or subsystems operate in accordance with requirements of the contract documents, including all modes and sequences of control and monitoring, interlocks, and responses to emergency conditions
- .2 Functional Performance Testing: The Contractor is to repeat successful operational performance testing with documentation by the Contractor in the presence of the Consultant and Owner to validate and verify that the equipment, systems and subsystems are complete in all respects, function correctly, and are ready for acceptance.
- .3 Submittals: The Contractor is to submit final commissioning reports, project closeout documents, and other required submittals.

3.21 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials in accordance with requirements of Canadian Construction Association Standard Document CCA 81, A Best Practices Guide to Solid Waste Reduction.
- .2 Prepare a waste management and reduction plan and submit a copy for review prior to work commencing at the site.
- .3 Ensure emptied containers are sealed and stored safely for disposal.

3.22 REQUIREMENTS FOR BARRIER FREE ACCESS

- .1 Include for all applicable requirements for barrier free access in accordance with requirements of the OBC, whether shown on the drawings or not.

END OF SECTION

1 GENERAL

1.1 APPLICATION

- .1 This Section specifies requirements, criteria, methods and execution for electrical demolition work that are common to one or more electrical work Sections, and it is intended as a supplement to each Section and is to be read accordingly.

2 PRODUCTS

Not Applicable

3 EXECUTION

3.1 DISCONNECTION AND REMOVAL AND/OR RELOCATION OF EXISTING ELECTRICAL WORK

- .1 Where indicated on the drawings, disconnect and remove existing obsolete electrical work. Disconnect at the point of supply, remove obsolete connecting services and conductors, and make the system safe. Cut back obsolete conduit behind finishes and cap water-tight unless otherwise specified.
- .2 The scope and extent of the demolition or revision work is only generally indicated on the drawings. Determine the scope, extent and cost of the work at the site during the bidding period site visit(s). Claims for extra costs for demolition work not shown or specified but clearly visible or ascertainable at the site during bidding period site visits will not be allowed.
- .3 If any re-design is required due to discrepancies between the electrical drawings and site conditions, notify the Consultant who will issue a Site Instruction. If, in the opinion of the Consultant, discrepancies between the electrical drawings and actual site conditions are of a minor nature, the required modifications are to be done at no additional cost.
- .4 Under all conditions and circumstances, existing electrical systems and services serving operating portions of the building must be maintained in service.
- .5 Unless otherwise specified, remove from the site and dispose of all existing materials which have been removed and are not to be relocated or reused. Refer to waste management and disposal requirements specified in the Basic Electrical Materials and Methods Section.
- .6 Where existing panelboard breakers are replaced, or revised, provide new typed panelboard circuit directories.
- .7 Before beginning Work and admittance of any workers on the site, furnish the Consultant with a report in the form of a deficiency list, covering all fittings, fitments, fixtures, surfaces, and any other building component in the existing buildings and exterior building surfaces or site work where Work is being done, whose proximity to alteration Work renders it vulnerable to damage.
- .8 Existing raceways shall not be used for new and/or relocated wiring unless otherwise noted and/or approved in writing by the Consultant.
- .9 Make good all surfaces and finishes in areas from which items have been removed and in which items are relocated. Cap all existing services required to be severed to effect alterations and do all other work necessary to make good such areas to satisfaction of consultant.
- .10 Openings in existing floor assemblies and vertical fire separations necessitated by installation of equipment and systems or construction in general to be temporarily sealed with fire barrier materials such as mineral wool or other noncombustible insulation.
- .11 All existing dead wiring and conduit in areas of work shall be removed in its entirety where accessible. Where not accessible, wiring only shall be removed and conduit shall remain.

3.2 HAZARDOUS MATERIALS AND/OR WASTE

- .1 Asbestos, Mould, Lead Paint, Etc.: If at any time during the course of the work asbestos containing materials, black mould, lead paint, or any other such materials are encountered or suspected, immediately report the discovery to the Consultant and cease all work in the area in question. Do not resume work in affected areas until the situation has been properly corrected and without written approval from the Owner.

3.3 INTERRUPTION TO AND SHUT-DOWN OF ELECTRICAL SERVICES AND SYSTEMS

- .1 Co-ordinate all shut-down and interruption to existing electrical systems with the Owner.
- .2 Upon award of contract, submit a list of anticipated shut-down times and their maximum duration.
- .3 Prior to each shut-down or interruption, inform the Owner in writing 5 working days in advance of the proposed shut-down or interruption and obtain written approval to proceed. Do not shut-down or interrupt any system or service without such written approval.
- .4 Perform work associated with shut-downs and interruptions as continuous operations to minimize the shut-down time and to reinstate the systems as soon as possible, and, prior to any shut-down, ensure that all materials and labour required to complete the work for which the shut-down is required are available at the site.
- .5 Coordinate all start-up of existing electrical systems which have been shut-down with the Owner.
- .6 Include in Bid Price for all overtime or premium time hours necessary to minimize duration of service interruptions.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

- .1 Test Reports: Submit signed test reports for all testing work specified.
- .2 Approval Certificates: Submit Certificates of Approval as issued by governing authorities.

2 PRODUCTS

Not applicable.

3 EXECUTION

3.1 GENERAL ELECTRICAL WORK TESTING REQUIREMENTS

- .1 Satisfactorily perform all testing required by governing authorities, Codes, Regulation, and the Specification, including general testing specified below. Prepare and sign test reports to confirm satisfactory completion of testing and submit as specified in Part 1 of this Section.
- .2 Leaks, Grounds, and Crosses: After disconnect switches, and similar equipment has been installed, whether or not the work has been installed as part of the work of this Division of the Specification or by other Divisions, test the work to ensure that there are no leaks, grounds, or crosses.
- .3 Motor Operation: Test and establish proper motor rotation, measure full load running currents, and check overload elements. Report to the Consultant any discrepancies that are found.
- .4 Branch Circuit Voltage Drop: Demonstrate to the Consultant that branch circuit voltage drop is within specified limits.

3.2 GROUNDING AND BONDING SYSTEM

- .1 Provide visual and mechanical inspection of the grounding and bonding system and verify that the system is in compliance with all requirements.

3.3 DISTRIBUTION SYSTEM TESTING AND COORDINATION STUDY

- .1 The on-site test is to include, as applicable:
 - .1 an insulation resistance test of "load" side feeders with respect to ground
 - .2 a test of cables and disconnect switches

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

- .1 Product Data: Submit product data sheets for all products specified in this Section. Indicate compatibilities and limitations, and application instructions and include data to confirm that the product proposed meets all requirements of the Specification.
- .2 MSDS Sheets: Submit Material Safety Data Sheets for conductor pulling lubricants.

2 PRODUCTS

2.1 DISTRIBUTION AND BRANCH CIRCUIT CONDUCTORS

- .1 Minimum gauge: #12 AWG, unless specifically noted otherwise. Conductors #12 and #10 AWG are to be solid. Conductors #8 AWG and larger are to be stranded. Use #14 AWG for control wiring unless noted otherwise. All conductors are to be constructed from 98% conductive copper and are to be approved for 600 volts. Conductors are to be colour coded, factory identified on the insulation with the manufacturer's name, conductor size and metal, voltage rating, and CSA type and designation. Conductors are to be as follows:
 - .1 "T-90 Nylon" single copper conductor in accordance with CSA C22.2 No. 75, Thermoplastic-Insulated Wires and Cables, 90° C (194° F) rated, PVC insulated and nylon covered for #10 AWG and smaller.
 - .2 "RW-90" single copper conductor in accordance with CAN/CSA C22.2 No 38, Thermoset-Insulated Wires and Cables, 90°C (194° F) rated, X-link polyethylene insulated for #8 AWG and larger.
 - .3 "TWU" single copper conductor in accordance with CSA C22.2 No. 75, 60° C (140° F) rated, PVC insulated

2.2 LOW VOLTAGE (24 VOLT) CONDUCTORS

- .1 "T-90" or "RW90" stranded copper conductors as specified above

2.3 CONNECTORS

- .1 Conductors In Conduit: Except as noted, equal to Ideal Industries Inc. "Wing Nut" CSA certified, 600 volt rated pressure type twist connectors.

3 EXECUTION

3.1 GENERAL RE: CONDUCTOR INSTALLATIONS

- .1 Conform to the following conductor installation requirements:
 - .1 Conductor Routing: Conductor routing indicated on the drawings is schematic and approximate. Determine exact routing and conductor lengths at the site. Route conductors to avoid interference with other work. Unless otherwise specified or shown install conductors parallel to building lines.
 - .2 Conductor Pulling: When pulling conductors into conduit use lubricant and ensure that the conductors are kept straight and are not twisted.
 - .3 Securing/Supporting Conductors: Conform to the following requirements:
 - .1 Neatly secure exposed conductors in equipment enclosures with proper supports and/or ties
 - .4 Conductor Splicing: Generally conductor splicing is not permitted unless otherwise approved by the Consultant, and if approved, splicing is subject to the following conditions:
 - .1 Splicing is permitted to extend existing conductors
 - .2 For thermoplastic insulated conductors, splices are to be made within an approved electrical box with mechanical compression connectors to suit the type and size of conductors, and the box(es) are to be properly identified and locations are to be indicated on "as-built" drawings

3.2 INSTALLATION OF DISTRIBUTION AND BRANCH CIRCUIT CONDUCTORS

- .1 Provide all required conductors.
- .2 Non-Fire Rated Conductors: Unless otherwise specified herein or on the drawings, non-fire rated conductors are to be as follows:
 - .1 For conductors except as specified above or elsewhere in the Specification or on the drawings - T90 Nylon or RW90
- .4 Conductor Sizing: Generally, conductor sizes are indicated on the drawings. Unless otherwise specified, do not use conductors smaller than No. 12 AWG in systems over 30 volts. Conductor sizes indicated on the drawings are minimum sizes and must be increased, where required, to suit length of run and voltage drop in accordance with the voltage drop schedule found at the end of this Section.
- .5 Conductor Colour Coding: Unless otherwise specified, colour code conductors to identify phases, neutral, and ground by means of self-laminating coloured vinyl tape, coloured conductor insulation, or properly secured coloured plastic discs. Colours are to be as follows:
 - .1 phase A – red
 - .2 phase B – black
 - .3 phase C – blue
 - .4 neutral – white
 - .5 control – orange

3.3 MAXIMUM BRANCH WIRING DISTANCE FOR 120 VOLT SYSTEM AT 3% VOLTAGE DROP

Wire Size	Breaker Size (Amperes)	15	20	30	40	50	60	70	80	100
	Max. Load At 80% (Amperes)	12	16	24	32	40	48	56	68	80
No.12	---	22.0	16.0	---	---	---	---	---	---	---
No.10	---	36.0	27.0	18.0	---	---	---	---	---	---
No.8	---	59.0	44.0	30.0	22.0	---	---	---	---	---
No.6	---	91.0	70.0	47.0	35.0	28.0	23.0	---	---	---
No.4	---	---	109.0	73.0	54.0	42.0	35.0	30.0	25.0	---
No.2	---	---	---	114.0	85.0	68.0	57.0	50.0	41.0	35.0
No.1	---	---	---	---	103.0	85.0	73.0	61.0	50.0	43.0
No.1/0	---	---	---	---	128.0	102.0	85.0	73.0	60.0	48.0
No.2/0	---	---	---	---	---	121.0	100.0	86.0	74.0	60.0
No.3/0	---	---	---	---	---	---	118.0	102.0	88.0	70.0
No.4/0	---	---	---	---	---	---	---	120.0	102.0	83.0
250 MCM	---	---	---	---	---	---	---	---	114.0	91.0
300 MCM	---	---	---	---	---	---	---	---	---	103.0

NOTE: DISTANCES INDICATED IN METERS FROM PANEL TO LOAD FOR SINGLE PHASE.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

- .1 Shop Drawings/Product Data: Submit shop drawings and product data sheets for products specified in this Section.
- .2 Test Reports: Submit signed test reports for all testing work specified.

2 PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

- .1 Equipment Grounding Conductors: Unless otherwise specified, insulated (green colour) stranded copper conductors, except that conductors #10 gauge and smaller may be solid copper.
- .2 Bonding Conductors: As for equipment ground conductors but bare copper.

2.2 GROUNDING AND BONDING CONNECTIONS

- .1 Below Grade: Equal to Erico International Corp. "Cadweld" exothermic welded connections.
- .2 Above Grade: Compression type connectors with zinc-plated fasteners and external tooth lock washers, or, if approved by the Consultant, exothermic connections as for below grade connections

3 EXECUTION

3.1 GENERAL ELECTRICAL WORK GROUNDING REQUIREMENTS

- .1 Perform all required electrical work grounding and bonding. Unless otherwise specified, grounding and bonding work is to be in accordance with requirements of CAN/CSA-C22.2 No. 0.4-04. Bonding of Electrical Equipment, and the requirements of all other governing authorities.
- .2 Bond metallic conduits, boxes and non-current carrying metal parts of equipment together to form a continuous ground system..
- .3 Install connectors in accordance with the manufacturer's instructions.

3.2 EQUIPMENT GROUNDING

- .1 Provide grounding connections to mechanical and electrical equipment as shown and/or specified on the drawings and in accordance with CAN/CSA C22.2 No. 0.4 and requirements of governing authorities.
- .2 Ground hinged doors of electrical equipment to the equipment enclosure main frame using flexible jumpers.

3.3 FIELD QUALITY CONTROL

- .1 Prior to energizing the electrical distribution system perform ground continuity and resistance tests using the 62% or "fall of potential" to confirm proper resistance to ground values and submit signed test results.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

- .1 Submit the following for review:
- .2 Product data sheets: submit for special conduit as the Consultant directs
- .3 Additional submittals: submit any other submittals specified in this Section of the Specification

2 PRODUCTS

2.1 EMT

- .1 Galvanized electrical metallic tubing (EMT) to CSA C22.2 No. 83, complete with an interior coating, factory made bends where site bending is not possible, and joints and terminations made with steel couplers and set-screw type connectors with insulated throats, concrete tight where required.

2.2 RIGID GALVANIZED STEEL CONDUIT

- .1 Rigid galvanized steel to CSA C22.2 No. 45, Rigid Metal Conduit, with an interior enamel coating, galvanized threads where factory cut, red lead coated threads where site cut, factory made bends where site bending is not possible, factory made and threaded fittings and connectors, and terminations made with rigid couplings, concrete tight where required.

2.3 FLEXIBLE GALVANIZED STEEL LIQUID-TIGHT CONDUIT

- .1 Flexible galvanized steel liquid-tight conduit to CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal, complete with conduit connectors to suit the application.

2.4 FISH CORD

- .1 Polypropylene rope.

3 EXECUTION

3.1 CONDUIT INSTALLATION REQUIREMENTS

- .1 General: Refer to the article entitled General Conduit and Conductor Installation Requirements in Part 3 of the Section entitled Basic Electrical Materials and Methods.
- .2 Conduit Types: Unless otherwise specified, provide conduit for all conductors. Conduit is to be as follows:
 - .1 For concealed conduit in exterior walls – rigid galvanized steel
 - .2 For conduit exposed outside the building– rigid galvanized steel
 - .3 For short (minimum 450 mm (18”), maximum 600 mm (24”) with a 180° loop wherever possible) runs of conduit to motors- flexible galvanized steel liquid-tight conduit
 - .4 For all conduit except as specified above – EMT
- .3 Conduit Fittings: Unless otherwise specified, conduit fittings are to be constructed of the same material as the conduit and are to be suitable in all respects for the application. Provide proper adaptors for joining conduits of different materials.
- .4 Conduit Sizes: Generally, conduit is sized on the drawings. Conduit not sized on the drawings is to be sized in accordance with the Ontario Electrical Safety Code. The sizes of branch circuit conductors specified are minimum sizes and must be increased to suit length of run and voltage drop as specified, therefore, when conductor sizes are increased to suit length of run and voltage drop, increase the conduit size to suit. Sizes indicated do not include allowance regarding percentage conduit fill for bonding and grounding conductors unless noted otherwise. Increase conduit size as necessary to comply with OESC-12-1014(4). Conductors in conduit. Do not install conduit less than 19 mm (3/4”) dia.
- .5 Conduit Bends: Site made bends for all conduit must be made using proper bending equipment, bends must maintain the full conduit diameter with no kinking, and conduit finishes must not flake or

- crack when the conduit is bent.
- .6 Site Cutting Conduit: Cut square and ream all site made conduit ends. Plug or seal ends of roughed-in conduit which are open and exposed during construction.
 - .7 Threading Conduit: Site cut threaded rigid conduit using proper threading equipment located in an approved area and where protection for adjacent building surfaces is in place. Clean threads and lubricate. Coat rigid conduit threads with red lead or other zinc rich coating. Field threads must be of sufficient length to draw conduits up tight.
 - .8 Support of Conduit: Conduit support requirements are as follows:
 - .1 Support and secure surface mounted and suspended single or double runs of metal conduit at support spacing in accordance with the Ontario Electrical Safety Code by means of galvanized steel pipe straps, conduit clips, ring bolt type hangers with galvanized steel hanger rod, or by other approved manufactured devices
 - .2 Support multiple metal conduits by means of conduit racks and galvanized steel rod with spacing to suit the requirements of the smallest dia. conduit in the group
 - .3 Perforated pipe straps not acceptable

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

- .1 Shop Drawings and Product Data: Submit shop drawings and product data sheets for motor controllers and accessories. Ensure that the shop drawings and product data sheets indicate all features of the controllers to confirm that the equipment is in accordance with requirements of this Section.

2 PRODUCTS

2.1 MOTOR CONTROLLERS AND ACCESSORIES

- .1 General: All motor controllers are to be CSA Certified; EEMAC rated, must be capable of starting the associated motors under the imposed loads, and must be suitable in all respects for the motor. Confirm that controller voltages match the motors prior to ordering. IEC and half size controllers and contactors are not acceptable.
- .2 Three phase controllers and contactors minimum EEMAC size 1.
- .3 Single phase controllers and contactors minimum EEMAC size 0.
- .4 All three phase controllers shall be complete with single phase protection.
- .5 Controllers For Single Phase Motors: Unless otherwise specified, starters for single phase motors are to be 120 V, thermal overload protected manual starting switches, each with a neon pilot light, a surface or recess mounting enclosure to suit the application and mounting location, and, where automatic operation is required, a "hand-off-automatic" switch in an enclosure to match the starter enclosure.
- .6 Controllers For Three Phase Motors: Unless otherwise specified, controllers are to be combination heavy-duty "quick-make" and "quick-break" fused door interlock disconnects and full voltage non-reversing across-the-line starters, each complete with solid- state overload relay per phase, an enclosure to suit the application, and, a "hand-off-automatic" switch, pilot lights, control transformer, auxiliary contacts, and other accessories.
- .7 Motor Controller Enclosures: Unless otherwise specified, motor controller enclosures are to be in accordance with the following NEMA/EEMAC ratings:
 - .1 all enclosures exposed to the elements – Type 3R, constructed of stainless steel
 - .2 all enclosures except as noted above – Type 1
- .8 Acceptable Manufacturers: Acceptable manufacturers are:
 - .1 Rockwell Automation (Allen-Bradley)
 - .2 Schneider Electric Ltd. (Square D)
 - .3 Siemens Canada
 - .4 Eaton Corp. (Cutler-Hammer)

2.2 MOTOR CONTROLLER PANELS

- .1 Minimum #14 gauge sheet steel panels with steel angle reinforcing, framing, rounded corners and no sharp edges, cleaned, primed and painted with ASA Gray equipment enamel, each complete with a suitable length of splitter trough and sized to accommodate the number of starters required with space and splitter trough capacity for two additional starters.

3 EXECUTION

3.1 INSTALLATION OF MOTOR CONTROLLERS AND ACCESSORIES

- .1 Provide motor controllers for mechanical equipment, except for controllers integral with packaged equipment, and controllers factory installed in equipment power and control panels. Refer to Mechanical/Electrical Equipment Schedule.
- .2 Disconnect Switches on Motor Controller Panels: Where package type equipment with integral controllers, or equipment with controllers integral in loose power and control panels supplied with the equipment is fed from a motor controller panel, provide a disconnect switch on the motor controller panel.

- .3 Single Phase Motor Controllers: Unless otherwise specified or shown on the drawings, mount single phase motor controllers adjacent to the equipment they serve and connect complete.
- .4 Electrical Wiring for Mechanical Work: Refer to the Section entitled Electrical Wiring For Mechanical Work.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

- .1 Shop Drawings and Product Data: Submit shop drawings and product data sheets for disconnect switches and accessories. Ensure that the shop drawings and product data sheets indicate all features of the disconnects to confirm that the equipment is in accordance with the requirements of this Section.

2 PRODUCTS

2.1 DISCONNECT SWITCHES

- .1 Heavy-duty, CSA certified, quick-make/quick break action switches complete with a handle suitable for padlocking in the "off" position and arranged so that the door cannot be opened with the handle in the "on" position and an EEMAC enclosure. Fusible units are to be complete with fuse clips to suit fuse types specified below, without adaptors.
- .2 Fuses: Unless otherwise scheduled or specified fuses are to be equal to English Electric Ltd. HRC fuses, Form I Class "J" for constant running equipment and Form II Class "C" for equipment that cycles on and off. Equivalent fuses by Mersen or Cooper-Bussman are acceptable.
- .3 Enclosures: Unless otherwise specified, enclosures are to be in accordance with the following NEMA/EEMAC ratings:
 - .1 All enclosures exposed to the elements – Type 3R, constructed of stainless steel
 - .2 All enclosures except as noted above – Type 1
- .4 Acceptable Manufacturers: Acceptable manufacturers are:
 - .1 Rockwell Automation (Allen-Bradley)
 - .2 Eaton Corp. (Cutler-Hammer)
 - .3 Siemens Canada
 - .4 Schneider Electric Ltd. (Square D)

3 EXECUTION

3.1 INSTALLATION OF DISCONNECT SWITCHES

- .1 Provide all required disconnect switches in accordance with drawing plans, schedules, details, and requirements of the Specification.
- .2 Provide fuses for fusible disconnects.
- .3 Refer to the Section titled, Wiring Requirements For Mechanical Equipment.

END OF SECTION

1 GENERAL

1.1 PRODUCT DATA COORDINATION

- .1 Shop Drawings and Product Data: If required, review shop drawings and product data sheets for mechanical equipment requiring wiring connections as part of the electrical work to ensure that all connection requirements are performed.

2 PRODUCTS

2.1 WIRING PRODUCTS

- .1 Wiring products such as conduit, conductors, boxes, etc., are to be as specified in appropriate Sections of this Division of the Specification.

3 EXECUTION

3.1 WIRING CONNECTIONS FOR MECHANICAL WORK

- .1 Unless otherwise specified or indicated, perform the following electrical wiring work:
 - .1 "Line" side power wiring to motor controllers or disconnect switches and "load" side wiring from the controllers or disconnects to the equipment
- .2 Mechanical wiring work not listed above or specified herein or on the drawings to be done as part of the electrical work will be done as part of the mechanical work.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

- .1 Shop Drawings and Product Data: Submit shop drawings and product data sheets for metal raceway and accessories. Include data to confirm that the raceway proposed meets all requirements of the Specification.
- .2 Layout Coordination Drawings: Submit floor plans and elevations drawn to scale with site measurements to indicate the proposed raceway layout and relationships between components and adjacent structural, architectural, and mechanical elements.
- .3 Colour Chart: If more than one raceway finish colour is available, submit the manufacturer's colour chart.

1.2 QUALITY ASSURANCE

- .1 All metal raceway is to be CSA certified in accordance with CAN/CSA C22.2 No. 62, Surface Raceway Systems, and ULC listed.

2 PRODUCTS

2.1 SURFACE METAL RACEWAY

- .1 Surface mounting, one-piece design metal raceway sized as shown and/or specified, constructed of minimum 1 mm (0.040") thick steel, one-piece design consisting of a base and snap-on cover, and the raceway is to be complete with:
 - .1 All required fittings and accessories including internal and external corners, couplings for joining raceway sections, wire clips, blank end fittings, and device mounting brackets and plates as applicable
 - .2 A factory applied ivory or gray enamel finish, as indicated
- .2 Acceptable manufacturers are:
 - .1 Legrand-Wiremold
 - .2 Canadian Electrical Raceways Inc.
 - .3 Hubbell/Bryant
 - .4 Schneider Electric/Square D
 - .5 Panduit Corp.

3 EXECUTION

3.1 INSTALLATION OF METAL RACEWAY

- .1 Provide surface metal raceway where shown, complete with all required fittings and all required accessories. Site measure for proper lengths.
- .2 Accurately locate the raceway and secure in place in accordance with the manufacturer's instructions, level and plumb.
- .3 Where possible, butt raceway end to adjacent walls, cabinets, millwork, and similar items.
- .4 Do not exceed the raceway manufacturer's wire fill requirements.
- .5 Test raceway to ensure proper operation of devices, and electrical continuity of bonding and grounding connections.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

- .1 Shop Drawings and Product Data: If requested, submit shop drawing and product data sheets for products specified in this Section. Include data to confirm that the product proposed meets all requirements of the Specification.

2 PRODUCTS

2.1 PULL BOXES AND JUNCTION BOXES

- .1 Each box is to be CSA certified, sized to suit the number and size of conduit and conductors, and complete with connecting and securing facilities. Unless otherwise specified, pull boxes and junction boxes are to be as follows:
 - .1 Galvanized or prime coat plated steel, suitable in all respects for the application and complete with screw-on or hinged covers as required and connectors suitable for the connected conduit
 - .2 "Condulet", threaded galvanized cast iron or cast aluminum pull boxes and junction boxes of an exact type to suit the application, each complete with screw-on gasketed cover

3 EXECUTION

3.1 INSTALLATION OF PULL BOXES AND JUNCTION BOXES

- .1 Provide pull boxes in conduit systems wherever shown on the drawings, and/or wherever necessary to facilitate conductor installations. Generally, conduit runs exceeding 30 m (100') in length, or with more than three 90° bends, are to be equipped with a pull box installed at a convenient and suitable intermediate accessible location.
- .2 Provide junction boxes wherever required and/or indicated on the drawings.
- .3 Unless otherwise specified, boxes are to be as follows:
 - .1 In rigid conduit and EMT inside the building – stamped galvanized or prime coated steel
 - .2 In exterior rigid conduit – "Condulet" cast aluminum gasketed boxes unless otherwise noted
- .4 All pull boxes and junction boxes must be accessible after the work is complete.
- .5 Accurately locate and identify all concealed pull boxes and junction boxes on "as built" record drawings.
- .6 Cover boxes in fire walls with aluminum tape and seal with caulking.

END OF SECTION

1 GENERAL

1.1 SUBMITTALS

- .1 Shop Drawings/ Product Data: Submit shop drawings and product data sheets for products specified in this Section. Ensure that the shop drawings and data sheets indicate all features of the equipment to confirm that the equipment is in accordance with requirements of this Section.

1.2 QUALITY ASSURANCE

- .1 Short circuit rating of circuit breakers shall match existing short circuit rating of feeding panelboards. Indicate conformance with this requirement on product data sheets submitted for review.

2 PRODUCTS

2.1 BRANCH CIRCUIT PANELBOARDS - CIRCUIT BREAKERS

- .1 Circuit Breaker type shall match existing breaker type in the existing feeding panelboards. Breakers are to be moulded case, bolt-on breakers in accordance with CSA-C22.2 No. 5, Molded-Case Circuit Breakers, Molded-Case Switches, and circuit Breaker Enclosures, sized in accordance with the drawing and as follows:
 - .1 Current limiting time-limit type quick-make, quick-break for manual and automatic operation for motor protection
 - .2 Branch circuit breaker interrupting capacity is to suit the panelboard voltage in accordance with OESC requirements.
- .2 Proposed circuit breakers shall be manufactured by the existing manufacturer of the panelboards:
 - .1 Federal Pioneer

3 EXECUTION

3.1 INSTALLATION OF CIRCUIT BREAKERS

- .1 Provide all required circuit breakers in accordance with drawing plans, and requirements of the specification.
- .2 Provide an updated printed circuit directory card in panelboard.

END OF SECTION

1 GENERAL

1.1 GENERAL REQUIREMENTS

- .1 Comply with General Requirements of Section 26 03 00.

1.2 MECHANICAL-ELECTRICAL EQUIPMENT SCHEDULE

- .1 The following Mechanical-Electrical Equipment Schedule is provided to assist the Contractor in coordinating the efforts of sub-trades. The assignment of work among subcontractors is the Contractor's responsibility and the Contractor is free to amend the schedule as he sees fit.
- .2 The Mechanical-Electrical Equipment Schedule also describes work that is required and may or may not be described elsewhere. All work indicated in the Mechanical-Electrical Equipment Schedule shall be included in the Bid Price.
- .3 The Mechanical-Electrical Equipment Schedule shall not limit the extent of the Contract in any way. Work indicated elsewhere or otherwise needed for a complete and functioning installation shall be provided whether or not shown in the Mechanical-Electrical Equipment Schedule.

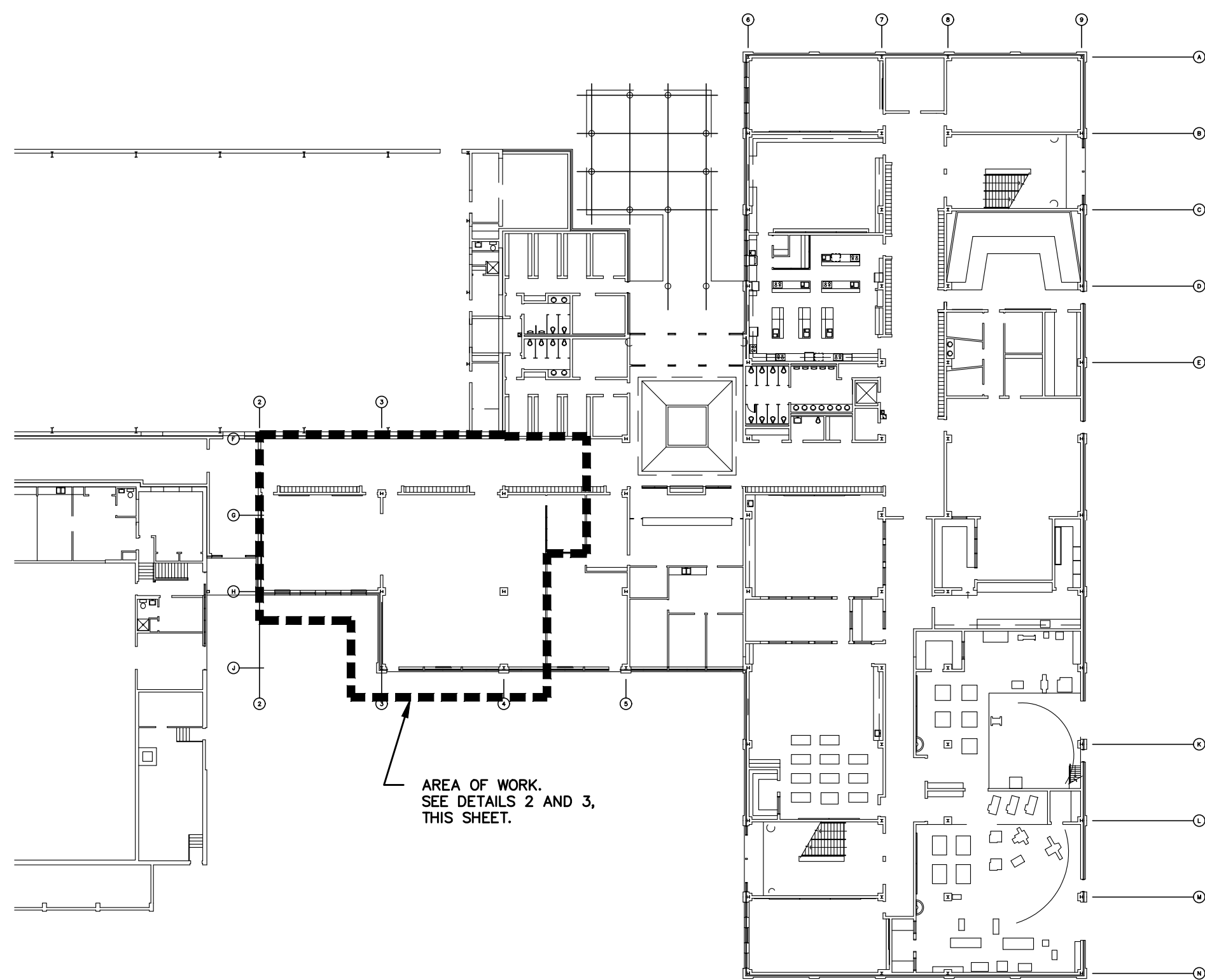
1.3 RESPONSIBILITY CODES

- .1 Responsibility Codes in the Mechanical-Electrical Equipment Schedule shall be interpreted as follows
 - .1 "Supplied by Div." means that the equipment is to be supplied to the site under the Division described by number.
 - .2 "Installed by Div." means that the equipment is to be received from the supplier, handled, set in place and installed at the site under the Division described by number.
 - .3 "Wired and connected by Div." means that the equipment and its associated devices are to be wired and connected to the various electrical systems in accordance with the equipment manufacturer's installation instructions and wiring diagrams under the Division described by number.

END OF SECTION

No.	Equipment			Controls			Responsibility			
	Item	Characteristics	Location	Type	Location	Manufacturer's Reference	Supplied by Div.	Installed By Div.	Wired & Connected by Div.	
1	Indoor Unit Ventilator UV-1A	MCA	3.8A	Library	Disconnect	In Unit	See mech spec.	23	23	26
		Voltage	208V		Starter	In Unit	See mech spec.	23	23	23
		Phase	1		Thermostat	See dwgs.	See mech spec.	23	23	23
		Freq.	60 Hz.		Other Controls	At Unit	See mech spec.	23	23	23
					BAS (separate price)	See mech spec.	See mech spec.	25	25	25
2	Outdoor Condensing Unit CU-1A	MCA	26.7A	Exterior by the Library	Disconnect (WP)	Wall mounted	See elec dwg & spec.	26	26	26
		Voltage	208V		Controls	Indoor unit to outdoor unit	See mech spec.	23	23	23
		Phase	1		Other Controls	See mech spec	See mech spec	23	23	23
		Freq.	60 Hz.		BAS (separate price)	See mech spec.	See mech spec.	25	25	25
		Division 26 to provide 3/4" conduit complete with pull wire between indoor unit and outdoor unit.								
3	Indoor Unit Ventilator UV-1B	MCA	3.8A	Library	Disconnect	In Unit	See mech spec.	23	23	26
		Voltage	208V		Starter	In Unit	See mech spec.	23	23	23
		Phase	1		Thermostat	See dwgs.	See mech spec.	23	23	23
		Freq.	60 Hz.		Other Controls	At Unit	See mech spec.	23	23	23
					BAS (separate price)	See mech spec.	See mech spec.	25	25	25
4	Outdoor Condensing Unit CU-1B	MCA	26.7A	Exterior by the Library	Disconnect (WP)	Wall mounted	See elec dwg & spec.	26	26	26
		Voltage	208V		Controls	Indoor unit to outdoor unit	See mech spec.	23	23	23
		Phase	1		Other Controls	See mech spec	See mech spec	23	23	23
		Freq.	60 Hz.		BAS (separate price)	See mech spec.	See mech spec.	25	25	25
		Division 26 to provide 3/4" conduit complete with pull wire between indoor unit and outdoor unit.								
5	Indoor Unit Ventilator UV-2	MCA	3.8A	Library Office	Disconnect	In Unit	See mech spec.	23	23	26
		Voltage	120V		Starter	In Unit	See mech spec.	23	23	23
		Phase	1		Thermostat	See dwgs.	See mech spec.	23	23	23
		Freq.	60 Hz.		Other Controls	At Unit	See mech spec.	23	23	23
					BAS (separate price)	See mech spec.	See mech spec.	25	25	25

REVIEW ALL DRAWINGS AND VERIFY ALL DIMENSIONS AT THE SITE. DO NOT SCALE THE DRAWINGS. REPORT ALL DISCREPANCIES TO THE ENGINEER BEFORE PROCEEDING WITH ANY CONSTRUCTION OR SHOP FABRICATION. ALL DRAWINGS, SPECIFICATIONS AND RELATED DOCUMENTS ARE THE COPYRIGHT PROPERTY OF VANDERWESTEN & RUTHERFORD ASSOCIATES INC. AND MUST BE RETURNED UPON REQUEST. REPRODUCTION OF DRAWINGS, SPECIFICATIONS AND RELATED DOCUMENTS IN PART OR WHOLE IS FORBIDDEN WITHOUT THE ENGINEER'S WRITTEN PERMISSION.



1 ELECTRICAL GROUND FLOOR REFERENCE PLAN
SCALE: 1/32"=1'-0"

DEMOLITION GENERAL NOTES

- ELECTRICAL SYSTEMS SHOWN ON DEMOLITION PLANS ARE BASED ON INFORMATION OBTAINED FROM ORIGINAL CONSTRUCTION CONTRACT/TENDER DOCUMENTS. THESE DRAWINGS ARE NOT BASED ON "AS-BUILT RECORDS" OR ON EXHAUSTIVE FIELD MEASUREMENT AND ARE PROVIDED TO ASSIST THE CONTRACTOR IN DETERMINING THE EXTENT OF WORK REQUIRED.
- ELECTRICAL EQUIPMENT BEING REMOVED AND NOT BEING REUSED WILL BE STORED ON SITE AND REMAIN THE PROPERTY OF THE OWNER. ANY SUCH EQUIPMENT THE OWNER DOES NOT WISH TO RETAIN WILL BE REMOVED FROM SITE AND DISPOSED OF BY THIS TRADE.
- REFER TO MECHANICAL DRAWINGS FOR ADDITIONAL INFORMATION.

DEMOLITION KEY NOTES

- DISCONNECT AND REPLACE EXISTING 30AMP, 3-POLE NON-FUSED DISCONNECT SWITCH. REMOVE ITS ASSOCIATED CONDUIT AND WIRING BACK TO SOURCE.
- DISCONNECT EXISTING POWER AND CONTROL CONNECTIONS SERVING CONDENSING UNIT BEING REPLACED. REMOVE ITS ASSOCIATED CONDUIT AND WIRING BACK TO SOURCE.
- DISCONNECT EXISTING POWER AND CONTROL CONNECTIONS SERVING FLOOR-MOUNTED VENTILATOR BEING REPLACED. REMOVE ITS ASSOCIATED CONDUIT AND WIRING BACK TO SOURCE.
- DISCONNECT EXISTING POWER AND CONTROL CONNECTIONS SERVING CEILING-MOUNTED VENTILATOR BEING REPLACED. MAINTAIN EXISTING CONDUIT AND WIRING.
- DISCONNECT EXISTING THERMOSTAT BEING REPLACED. REMOVE ITS ASSOCIATED WIRING BACK TO SOURCE. MAINTAIN EXISTING CONDUIT TO THE GREATEST EXTENT POSSIBLE. REFER TO MECHANICAL DRAWINGS FOR ADDITIONAL INFORMATION.
- DISCONNECT AND REMOVE EXISTING THERMOSTAT. REMOVE ITS ASSOCIATED CONDUIT AND WIRING BACK TO SOURCE.
- DISCONNECT AND REMOVE EXISTING POWER AND CONTROL CONNECTIONS SERVING FLOOR-MOUNTED VENTILATOR BEING REMOVED. REMOVE ITS ASSOCIATED CONDUIT AND WIRING BACK TO SOURCE.
- DISCONNECT AND REPLACE EXISTING 30AMP, 3-POLE AND 40AMP, 3-POLE BREAKERS MADE SPARE IN EXISTING PANEL 102 (CIRCUITS #31, 33, 35 AND 37, 39, 41, RESPECTIVELY). REFER TO CONSTRUCTION PLAN FOR ADDITIONAL INFORMATION.

CONSTRUCTION GENERAL NOTES

- DO NOT SCALE DRAWINGS FOR INSTALLATION PURPOSES. OBTAIN ALL DIMENSIONS FROM MANUFACTURER'S SHOP DRAWINGS AND ON SITE INSPECTIONS.
- MECHANICAL AND ELECTRICAL TRADES SHALL WORK IN CONJUNCTION WITH ONE ANOTHER SO AS TO AVOID INTERFERENCES BETWEEN PIPING, DUCTWORK, CONDUIT, LIGHTING FIXTURES, ETC.
- REFER TO MECHANICAL DRAWINGS FOR ADDITIONAL INFORMATION. REVIEW MECHANICAL DRAWINGS AND PROVIDE ON SITE INSPECTIONS TO DETERMINE FULL EXTENT OF PROJECT PRIOR TO SUBMITTING BID.

CONSTRUCTION KEY NOTES

- PROVIDE REPLACEMENT NEMA 3R 60AMP, 2-POLE COMBINATION DISCONNECT SWITCH AND MOTOR CONTROLLER: HUBBELL #HBL16R92D (TO MATCH EXISTING MANUFACTURER), OR APPROVED EQUAL. CONNECT REPLACEMENT CONDENSING UNIT CU-1A AND COMBINATION SWITCH VIA 2#10 + #12 GROUND IN 3/4" (21mm) CONDUIT TO REPLACEMENT 40AMP, 2-POLE BREAKER IN EXISTING PANEL 102. CONNECT REPLACEMENT CONDENSING UNIT CU-1B AND COMBINATION SWITCH VIA 2#10 + #12 GROUND IN 3/4" (21mm) CONDUIT TO EXISTING 40AMP, 2-POLE SPARE BREAKER IN EXISTING PANEL 101 (CIRCUITS #33,35). FOR SURFACE-MOUNTED APPLICATION IN THE LIBRARY, ROUTE WIRING IN SINGLE-CHANNEL, ONE-PIECE STEEL SURFACE RACEWAY: WIREMOLD V700, OR APPROVED EQUAL. PROVIDE ALL REQUIRED FITTINGS AND MOUNTING ACCESSORIES.
- REPLACEMENT FLOOR-MOUNTED VENTILATOR WITH INTEGRAL DISCONNECT SWITCH. CONNECT BOTH VENTILATORS UV-1A AND UV-1B VIA 2#12 + #14 GROUND IN 3/4" (21mm) CONDUIT TO REPLACEMENT 15AMP, 2-POLE BREAKER IN EXISTING PANEL 102. PROVIDE CONDUIT TO CONNECT EACH VENTILATOR AND ITS ASSOCIATED CONDENSING UNIT. REFER TO MECHANICAL-ELECTRICAL EQUIPMENT SPECIFICATION FOR ADDITIONAL INFORMATION. FOR SURFACE-MOUNTED APPLICATION IN THE LIBRARY, ROUTE WIRING IN SINGLE-CHANNEL, ONE-PIECE STEEL SURFACE RACEWAY: WIREMOLD V500, OR APPROVED EQUAL. PROVIDE ALL REQUIRED FITTINGS AND MOUNTING ACCESSORIES.
- REPLACEMENT CEILING-MOUNTED VENTILATOR WITH INTEGRAL DISCONNECT SWITCH. MODIFY AND EXTEND EXISTING CONDUIT AND WIRING TO VENTILATOR AS REQUIRED.
- PROVIDE REPLACEMENT 40AMP, 2-POLE AND 15AMP, 2-POLE BREAKERS IN EXISTING PANEL 102 (CIRCUITS #31, 33 AND 35, 37, RESPECTIVELY). BREAKERS SHALL MATCH EXISTING MANUFACTURER (FEDERAL PIONEER NBLP TYPE) AND SHORT CIRCUIT RATING. PROVIDE SPACE COVER AS REQUIRED. PROVIDE UPDATED TYPED PANEL DIRECTORY IN EXISTING PANEL.
- REPLACEMENT THERMOSTAT. IF EXISTING CONDUIT CANNOT BE REUSED FOR REPLACEMENT THERMOSTAT WIRING (BY DIVISION 25), PROVIDE SINGLE-CHANNEL, ONE-PIECE STEEL SURFACE RACEWAY: WIREMOLD V500, OR APPROVED EQUAL. TO ACCESSIBLE CEILING. PROVIDE ALL REQUIRED FITTINGS AND MOUNTING ACCESSORIES.
- PROVIDE UPDATED TYPED PANEL DIRECTORY IN EXISTING PANEL.

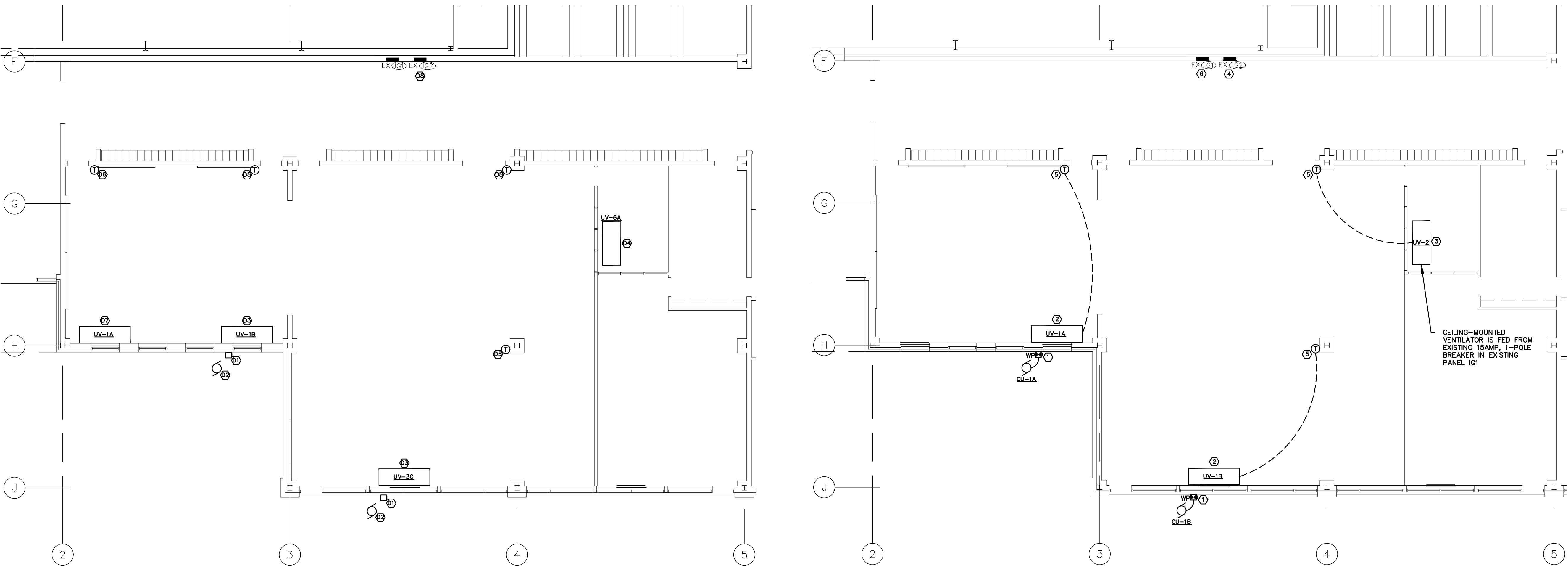
LEGEND

THIS LEGEND OF SYMBOLS REPRESENTS VANDERWESTEN RUTHERFORD ASSOCIATES INC. STANDARD/GENERIC LEGEND. ALL SYMBOLS MAY NOT APPEAR ON THE DRAWINGS.

SYMBOL	DESCRIPTION	MTG HT
EX	EXISTING TO REMAIN	
WP	WEATHER PROOF	
■	ELECTRICAL PANEL	
○	MOTOR CONNECTION	
□	DISCONNECT SWITCH	
⊞	COMBINATION DISCONNECT AND MOTOR CONTROLLER	
Ⓣ	THERMOSTAT WALLBOX	47" (1200)

GENERAL NOTES

- ALLOWANCE PROVIDED FOR CUTTING AND PATCHING. OWNERS FORCES TO PROVIDE FLOOR AND WALL PATCHING AS REQUIRED UPON REMOVAL OF UNIT VENTILATOR AND ASSOCIATED CONNECTIONS.



2 ELECTRICAL GROUND FLOOR DEMOLITION PLAN
SCALE: 1/8"=1'-0"

3 ELECTRICAL GROUND FLOOR CONSTRUCTION PLAN
SCALE: 1/8"=1'-0"

No.	Issued	Date	By
1	ISSUED FOR TENDER	2018-12-14	

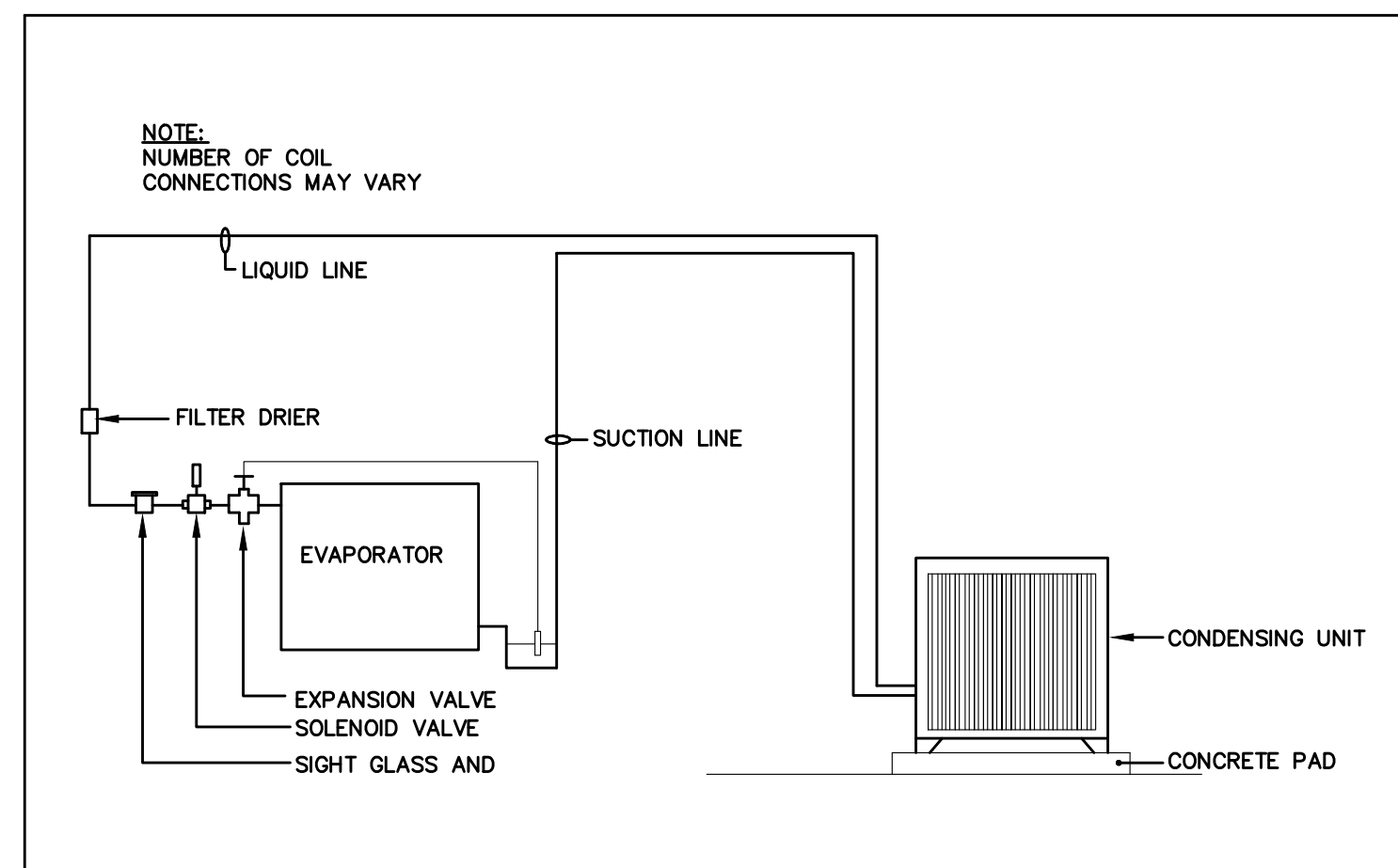
VR Vanderwesten & Rutherford Associates Inc.
Mechanical & Electrical Engineers
London, Windsor, Ottawa
www.vrinc.ca 1-519-652-5047

Project:
URSULINE COLLEGE CHATHAM
UNIT VENTILATOR REPLACEMENT

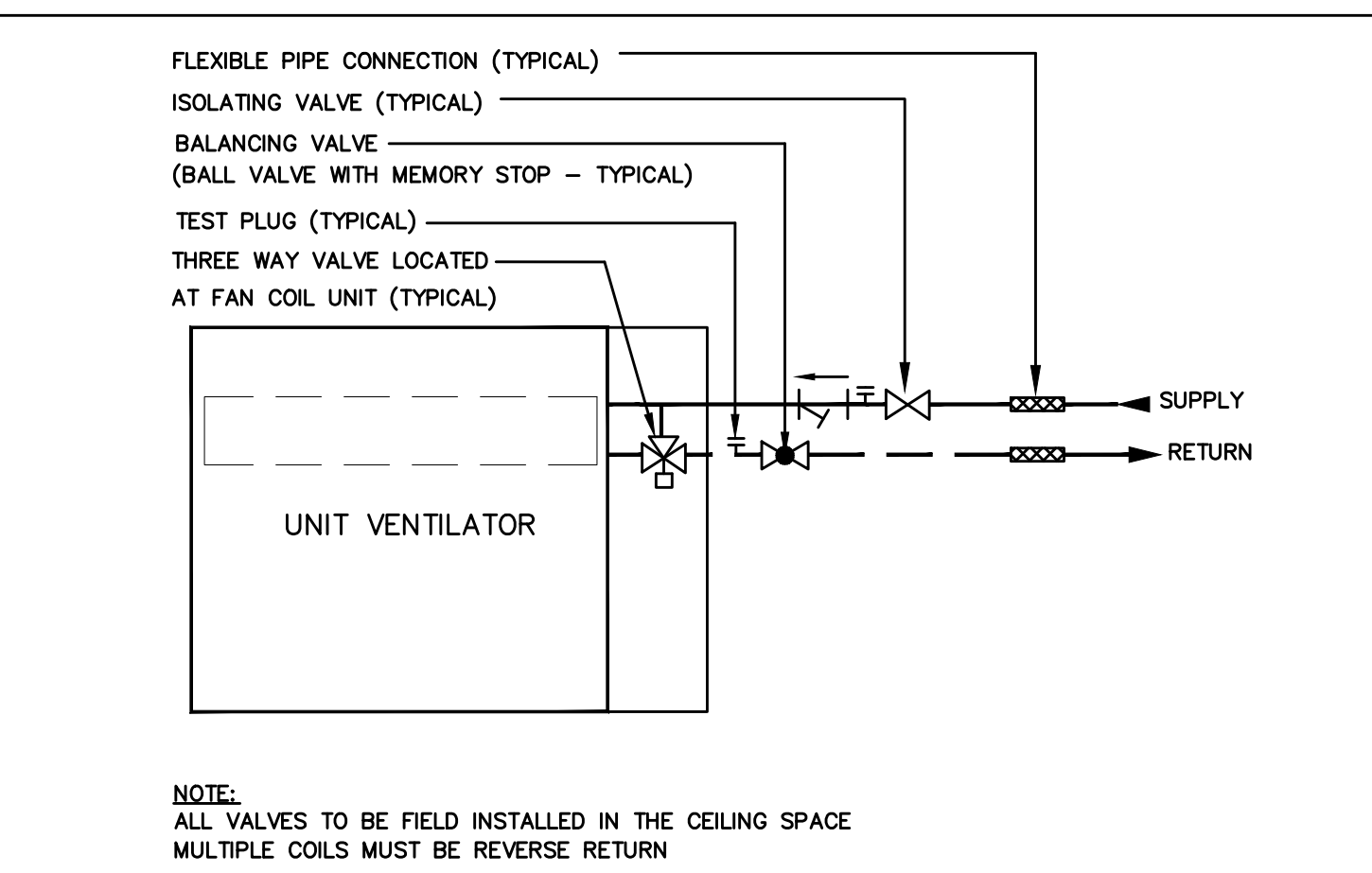
Drawing Title:
ELECTRICAL LEGEND, NOTES, AND GROUND FLOOR REFERENCE, DEMOLITION, CONSTRUCTION PLANS

Drawn By: PR	Checked By: ELC
Date: 2018-12-14	Scale: AS NOTED
Project Number: 18-125	Drawing No.: E-1

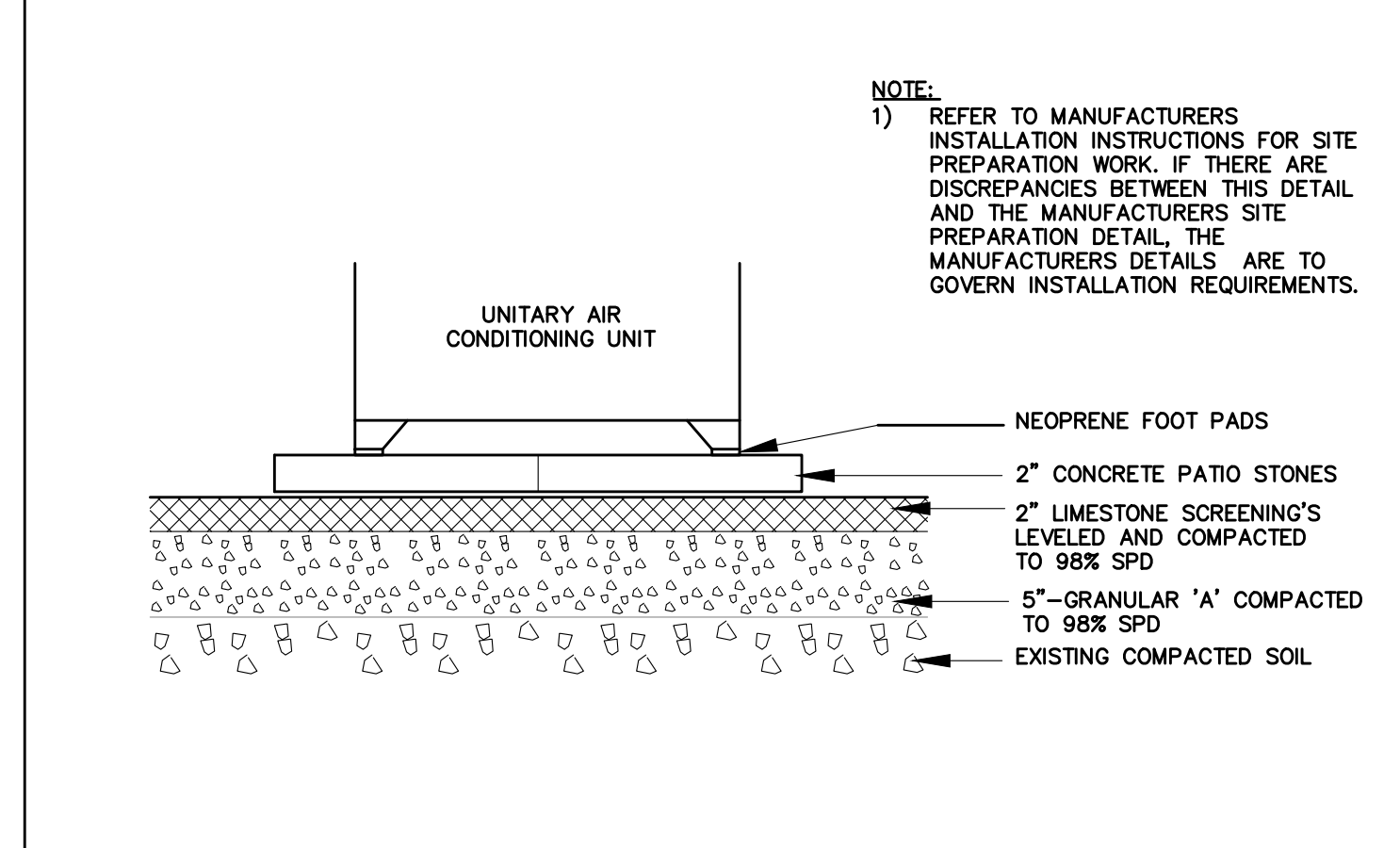




1
M-1
REFRIGERANT PIPING SCHEMATIC



3
M-1
DETAIL OF PIPING TO 2 PIPE HORIZONTAL UNIT VENTILATOR



2
M-1
PATIO STONE INSTALLATION FOR AIR CONDITIONING UNIT

CONDITIONING UNIT SCHEDULE			
	DESCRIPTION	CU-1A	CU-1B
SYSTEM	SYSTEM	UV-1A	UV-1B
	MODEL REFERENCE	DAIKIN - DX16TC0481	DAIKIN - DX16TC0481
PERFORMANCE	TOTAL COOLING CAPACITY, MBH	45.5	45.5
	COOLING POWER INPUT, KW	3.7	3.7
	HEATING CAPACITY, MBH	-	-
	HEATING POWER INPUT, KW	-	-
	COMPRESSOR TYPE	TWO STAGE	TWO STAGE
OTHERS	REFRIGERANT TYPE	R410A	R410A
	EER/SEER	12.5/16.0	12.5/16.0
	SOUND PRESSURE LEVEL (dBA)	74	74
	DIMENSIONS: H X W X D, MM(IN)	940 x 908 x 908 (37 x 35.75 x 35.75)	940 x 908 x 908 (37 x 35.75 x 35.75)
	NET WEIGHT, LBS(KG)	285 (129.2)	285 (129.2)
NOTES	ELECTRICAL: V/PH/Hz	208/1/60	208/1/60
	ELECTRICAL: MCA	26.7	26.7
	ELECTRICAL: MOCP	45	45
	1. COOLING CONDITIONS BASED ON INDOOR: 80F (27C) DBT & 67F (19C) WBT, OUTDOOR: 95F (35C) DBT & 75F (24C) WBT		
	2. COOLING OPERATION RANGE: 65F (18C) - 115F (46C)		
	3. MAXIMUM REFRIGERANT PIPE LENGTH: 200FT		
	4. STAND-ALONE CONTROLS AND THERMOSTAT		

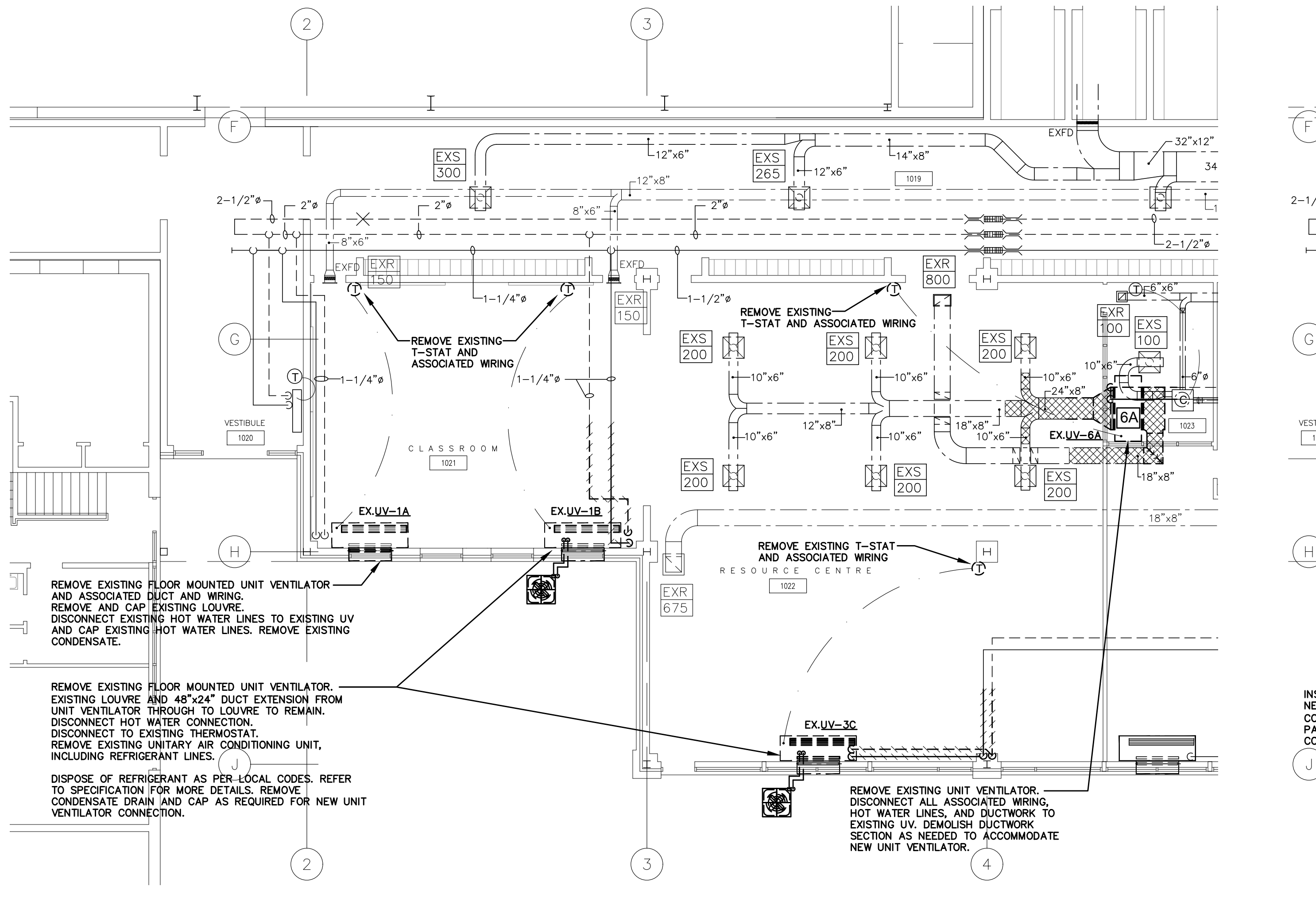
UNIT VENTILATOR SCHEDULE				
	DESCRIPTION	UV-1A	UV-1B	UV-2
SUPPLY FAN	AIRFLOW: CFM (L/S)	1212 (672)	1212 (672)	1,250 (690)
	EXTERNAL STATIC PRESS.: IN.WG. (kPa)	0.25 (0.06)	0.25 (0.06)	0.25 (0.06)
	TOTAL STATIC PRESS.: IN.WG. (kPa)	-	-	-
HEATING COIL	MOTOR SIZE: HP (kW)	1/3 (0.25)	1/3 (0.25)	1/3 (0.25)
	AIRFLOW: CFM (L/S)	1212 (672)	1212 (672)	1,250 (690)
	ROWS: NO.	2	2	2
	ENTERING AIR TEMPERATURE: °F (°C) DB	40 (4.0)	40 (4.0)	40 (4.0)
	LEAVING AIR TEMPERATURE: °F (°C) DB	119.6 (48.7)	119.6 (48.7)	118.7 (48.2)
	ENTERING WATER TEMPERATURE: °F (°C)	180 (82.2)	180 (82.2)	180 (82.2)
	LEAVING WATER TEMPERATURE: °F (°C)	150 (65.6)	150 (65.6)	160 (71.1)
DX COOLING COIL	HEAT OUTPUT: MBH (kW)	104.7 (30.7)	104.7 (30.7)	106.7 (31.2)
	FLUID FLOW RATE: GPM (L/S)	7.0 (0.44)	7.0 (0.44)	7.0 (0.44)
	FLUID PRESSURE DROP: FT.H2O	7.0	7.0	7.0
	HEAT TRANSFER FLUID:	HOT WATER	HOT WATER	HOT WATER
	AIRFLOW: CFM (L/S)	1212 (672)	1212 (672)	1,250 (690)
	ROWS: NO.	2	2	2
	NOMINAL TONNAGE:	3.6	3.6	3.6
ELEC.	SENSIBLE CAPACITY: MBH (TON)	32.6 (2.7)	32.6 (2.7)	32.6 (2.7)
	HEAT TRANSFER FLUID:	R410A	R410A	R410A
	MCA: (A)	3.8	3.8	3.8
	VOLTAGE: (V/PH/Hz)	208/1/60	208/1/60	115/1/60
UNIT DATA	WEIGHT: LBS	525.00	525.00	540.00
	MINIMUM OUTDOOR AIRFLOW: CFM (L/S)	380 (179)	380 (179)	-
NOTES	MODEL REFERENCE	DAIKIN - UAUV9H13	DAIKIN - UAUV9H13	DAIKIN - UAUV9H13
	1. UNIT CW FILTERS, MODULATING VALVE TEMP CONTROL, DISCONNECT SWITCH			
	2. COLOR CODE W - OFF WHITE			
	3. FIELD MEASURE TO VERIFY DIMENSIONS OF UNIT MATCH EXISTING FOOTPRINT.			

- GENERAL NOTES**
- ALLOWANCE PROVIDED FOR CUTTING AND PATCHING. OWNERS FORCES TO PROVIDE FLOOR AND WALL PATCHING AS REQUIRED UPON REMOVAL OF UNIT VENTILATOR AND ASSOCIATED CONNECTIONS.
 - IF ISOLATION AND DRAINAGE OF EXISTING HEATING WATER SYSTEM IS IMPRACTICAL ALLOW FOR HEATING LINE PIPE FREEZING FOR NEW CONNECTIONS AND SHUT-OFF CONTROL VALVE INSTALLATION. REFER TO CASH ALLOWANCE C. (TYPICAL FOR ALL)

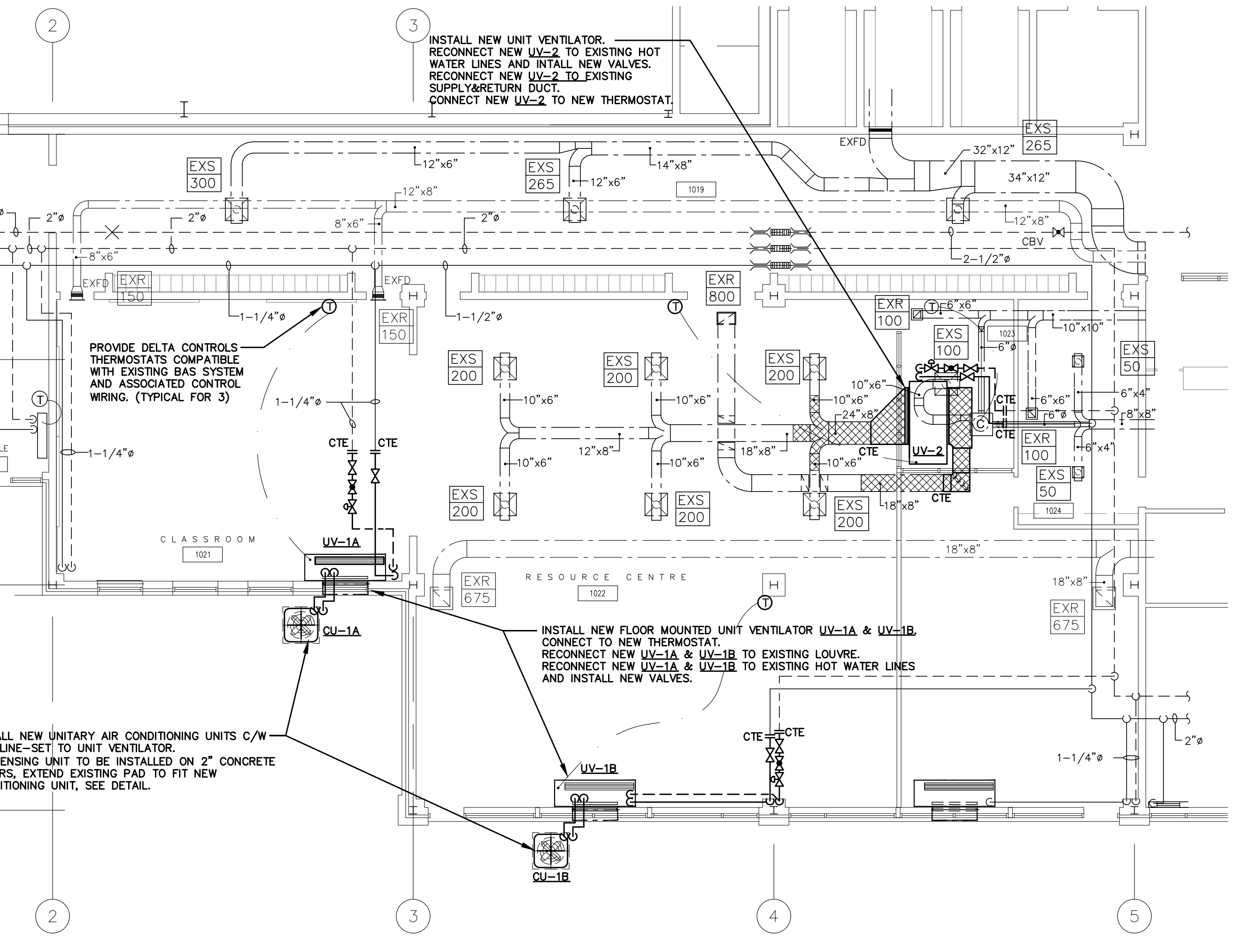
LEGEND OF SYMBOLS - H.V.A.C.

SYMBOL	DESCRIPTION
	INTERNALLY LINED DUCTWORK
	TURNING VANES
	THERMOSTAT
	PIPING RISER DOWN
	2-WAY CONTROL VALVE
	ISOLATING (SHUT-OFF) VALVE
	CIRCUIT BALANCING VALVE
C/W	COMPLETE WITH
CTE	CONNECT TO EXISTING
	DEMO EXISTING PIPING

NOTE: NOT ALL SYMBOLS USED IN THIS PROJECT



1
MECHANICAL GROUND FLOOR DEMOLITION PLAN
SCALE: 1/8"=1'-0"



2
MECHANICAL GROUND FLOOR NEW PLAN
SCALE: 1/8"=1'-0"

REVIEW ALL DRAWINGS AND VERIFY ALL DIMENSIONS AT THE SITE. DO NOT SCALE THE DRAWINGS. REPORT ALL DISCREPANCIES TO THE ENGINEER BEFORE PROCEEDING WITH ANY CONSTRUCTION OR SHOP FABRICATION. ALL DRAWINGS, SPECIFICATIONS AND RELATED DOCUMENTS ARE THE COPYRIGHT PROPERTY OF VANDERWESTEN & RUTHERFORD ASSOCIATES INC. AND MUST BE RETURNED UPON REQUEST. REPRODUCTION OF DRAWINGS, SPECIFICATIONS AND RELATED DOCUMENTS IN PART OR WHOLE IS FORBIDDEN WITHOUT THE ENGINEER'S WRITTEN PERMISSION.

1	ISSUED FOR TENDER	2018-12-14	
No.	Issued	Date	By



Seals

Project:
URSULINE COLLEGE CHATHAM

UNIT VENTILATOR REPLACEMENT

Drawing Title:
MECHANICAL NOTES, SCHEDULES, DETAILS, GROUND FLOOR DEMOLITION AND NEW FLOOR PLAN

Drawn By: YB	Checked By: SVM
Date: 2018-12-14	Scale: 1/8" = 1'-0"
Project Number: 18-125	Drawing No.: M-1