SPECIFICATION

FOR

LAKEHEAD UNIVERSITY

BORA LASKIN BUILDING

HVAC UPGRADES

APRIL 2018

Project #BL17-046
(TBTE 18-038)

Prepared by:

TBT ENGINEERING
CONSULTING GROUP

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END OF SECTION

Part 1 General

1.1 INVITATION

.1 Bid Call

.1 Offers signed under seal, executed, and dated will be received by the Owner at the Lakehead University Purchasing Department located at Lakehead University Braun Building, Room BB-1002A, 955 Oliver Road, Thunder Bay ON P7B 5E1 before 15:00:00 (3:00 PM) Local Time on Tuesday, the 22nd day of May 2018. Address tenders to: CONFIDENTIAL BID FOR: Mr. Geoffrey Matte, Manager

.2 Offers submitted after above time shall be returned to bidder unopened.

.3 Offers will be privately opened at 3:30 PM local time on the 22nd day of May, 2018.

.4 Amendments to submitted offer will be permitted if received in writing prior to bid closing and if endorsed by same party or parties who signed and sealed offer.

1.2 INTENT

.1 Intent of this Bid call is to obtain an offer to perform work to complete HVAC Upgrades at the Bora Laskin Building located on the Lakehead University Campus at 955 Oliver Road, Thunder Bay, for a Stipulated Price contract, in accordance with Contract Documents.

.2 Perform Work in within time stated in Section 01 11 00 - Summary of Work.

.3 Initiate work within time stated in Section 01 11 00 - Summary of Work.

1.3 CONTRACT DOCUMENTS IDENTIFICATION

.1 Contract Documents are identified as TBT Engineering Project No. 18-038 – Lakehead University Bora Laskin Building HVAC Upgrades as prepared by the Consultant, located at 1918 Yonge Street, Thunder Bay and listed in Table of Contents.

1.4 CONTRACT/BID DOCUMENTS

.1 Agreement Form.

.2 Definitions

.1 Contract Documents: Defined in CCDC 2 - 2008 Edition, Definitions.

.2 Bid Documents: Contract Documents supplemented with Instructions to Bidders, Bid Form and Bid Supplementary Forms identified herein.

.3 Bid, Offer, or Bidding: Act of submitting an offer under seal.

.4 Bid Price: Monetary sum identified in Bid Form as an offer to perform work.

.3 Availability

.1 Bid Documents are available online at Lakehead University's website, MERX, and the Thunder Bay Construction Association website or may be obtained upon request at office of the Consultant located at 1918 Yonge Street, Thunder Bay, Ontario for a non-refundable deposit by cash or certified cheque in amount of $35.00 per set.

.2 Bidders may print, at their own expense, reproductions from such Drawings and Specifications for bidding purposes.

.3 Bid Documents are made available only for purpose of obtaining offers for this project. Their use does not confer license or grant for other purposes.

.4 Drawings, specifications, and support documentation are the property of the Owner.

.4 Examination

.1 Upon receipt of Bid Documents verify that documents are complete. Notify the Owner should Bid Documents be incomplete.

.2 Immediately notify Consultant upon finding discrepancies or omissions in Bid Documents.

.5 Queries/Addenda

.1 Bidders finding discrepancies or ambiguities in, or omissions from Drawings, Specifications, or other Bidding or Contract Requirements, or having doubt as to the meaning or intent of any part thereof shall contact: Mr. Geoffrey Matte, at Lakehead University for clarification.

.2 Direct questions in writing only to Geoffrey Matte, Manager, Procurement & Contract Services, e-mail gmatte@lakeheadu.ca

.3 Questions will be accepted only from the Contactor. Subcontractors of Suppliers shall obtain any clarifications from Contactors to whom they are bidding.

.4 Any interpretation of, or change in Bid Documents prior to Bid closing date will be made only by written addendum issued by the Consultant.

.5 Information contained in Addenda supersedes and amends the Bidding and Contract Documents. Bidders shall include and allow for Addenda accordingly. Bidders shall state in the space provided on the Bid Form, the numbers of all Addenda received and included for them in the preparation of the Bid. If no Addenda have been received, insert the word, "None".

.6 Addenda may be issued during bidding period. All addenda become part of Contract Documents. Include costs in Bid Price.

.7 Verbal answers are only binding when confirmed by written addenda.

.8 Neither the Owner, nor the Consultant, shall be responsible for instructions, clarifications, or amendments communicated orally. Instructions, clarifications, or amendments which affect the Bid Documents may only be made by Addendum.

.9 Clarifications requested by bidders must be in writing not less than seven (7) working days before date set for receipt of Bids. Reply will be in form of an addendum, a copy of which will be forwarded to known bidders no later than five (5) working days before receipt of Bids. **Last day for**

questions will be 12:00 noon Friday, May 11, 2018. Last Addendum will be issued by 3:00pm Tuesday, May 15, 2018.

.6 Product/System Options

.1 Where Bid Documents stipulate a particular product, specified product shall form the basis of the bid and shall be supplied for the Work without substitution in any detail, subject to allowable substitutions as approved. Where several products are specified, any one of the specified items is acceptable.

.2 A request to substitute a product can be made during the tender period at which time the Consultant may approve it as an equal if the proposed item exceeds the specified product or provides a cost savings to the owner. Final determination of the acceptability of substitution shall be at the discretion of the owner and consultant whose decision shall be final and without recourse.

.3 In submission of substitutions to products specified, Bidders shall include any changes required in work to accommodate such substitutions. A later claim by Bidder for an addition to contract price because of changes in work necessitated by use of substitutions shall not be considered.

.4 Submission shall provide sufficient information to enable Consultant to determine acceptability of such products.

.5 Provide complete information on required revisions to other work to accommodate each substitution, including revisions to other work.

.6 Unless substitutions are submitted in this manner and subsequently accepted, provide products as specified.

.7 Approval to submit substitutions prior to submission of Bids is not required.

1.5 SITE ASSESSMENT

.1 Site Examination and Meeting

.1 Visit project site and surrounding area before submitting Bid.

.2 A one-time Mandatory Site Examination and Meeting for bidders to the project site has been arranged as follows:

Lakehead University, 955 Oliver Road, Thunder Bay, ON, on Friday, May 4, 2018 at 10:30 AM. Meet in Main Entrance Lobby of the Bora Laskin Building.

.3 General contractors and major sub-trades are invited.

.4 Representatives of Owner and Consultant will be in attendance.

.5 Information relevant to Bid Documents will be recorded in Addendum and issued to Bidders who register on the Bidders List.

.6 Bidders must sign-in with the Consultant representative conducting the site meeting. Failure to register (sign in) with the Consultant representative conducting the site meeting will result in your bid being disqualified.

.7 Each Bidder must visit the site of the work before submitting a tender and must satisfy himself by personal examination at to the local conditions to be encountered during the design, delivery, installation and

commissioning of the work. Each Bidder shall make his own estimate of the difficulties to be encountered. Bidders shall not claim at any time after submission of their tender that there was any misunderstanding of the terms and conditions relating to site conditions.

1.6 QUALIFICATIONS

.1 No bid shall be accepted from any contractor, its principals, directors or any officer of that firm, or another related person, as determined by the Owner in his or her sole and unreviewable discretion, with whom the Owner is engaged with in unresolved litigation.

.2 Bidders must demonstrate that they have the necessary staffing, facilities, experience, abilities and financial resources to perform the work in a satisfactory manner. Contractor is to provide list of three representative projects which demonstrate a proven track record complete with references. Use the form Appendix A included in the Bid Form. **Failure to provide references and details of experience may result in submission not being considered.**

.3 Owner reserves right to reject a proposed subcontractor for reasonable cause.

.4 Refer to CCDC 2 Article GC 3.8 of General Conditions.

1.7 BID SUBMISSION

.1 Bid Ineligibility

.1 Bids that are unsigned, improperly signed or sealed, conditional, illegible, obscure, contain arithmetical errors, erasures, alterations, or irregularities of any kind may not be considered, at the discretion of Owner.

.2 Bids shall be for a Stipulated Lump Sum without escalation clauses. Bids containing escalation clauses shall be considered non-compliant.

.3 Bids that contain prices which appear to be so unbalanced as to likely affect adversely the interests of the Owner may be rejected.

.4 Bids with Bid Forms and enclosures which are improperly prepared shall, at discretion of Owner, be declared non-compliant

.5 Bids that fail to include security deposit, bonding or insurance requirements shall, at discretion of Owner, be declared non-compliant.

.6 The Owner will notify bidders who have submitted bids that have been declared non-compliant and have been rejected within a reasonable time after bid closing.

.2 Submissions

.1 Bidders shall be solely responsible for delivery of their Bids in manner and time prescribed.

.2 **Submit three (3) hard copies** of executed offer on Bid Forms provided, signed and with corporate seal together with required security in a sealed opaque envelope, clearly identified with Bidders name, Project name and Owner's name on outside.

.3 Improperly completed information, irregularities in security deposit or bid bond, shall be cause not to declare Bid informal.

1.8 BID ENCLOSURES / REQUIREMENTS

.1 Security Deposit

.1 Bids shall be accompanied by security deposit as follows: Bid Bond or Certified Cheque of Irrevocable Unconditional Bank Letter of Credit in amount of ten percent (10%) of Bid price.

.2 Endorse Bid Bond or certified cheque in name of Owner as obligee, signed and sealed by principal (Contractor) and surety.

.3 Use latest edition CCDC approved bond forms.

.4 Security deposit will be returned after delivery to Owner of required Performance and Labour and Materials Payment Bond(s) by accepted bidder.

.5 Security deposits shall be returned to unsuccessful bidders within a reasonable time after consideration and award of the contract.

.6 If no contract is awarded, all security deposits will be returned.

.7 Bid Bonds and Agreements to Bond shall be valid for ninety (90) days after the time and date set for bid closing.

.2 Agreement to Bond.

.1 Submit with Bid Form and Bid Bond, a Consent of Surety, stating that surety is willing to supply a Performance and Labour and Materials Payment Bond in the amount of 50% of the contract.

.2 Include cost of bonds in Bid Price.

.3 A certified cheque in the amount of 50% of the contract amount is an acceptable alternative to the bonding requirements.

.3 Performance Assurance

.1 Accepted Bidder must provide Performance and Labour and Materials Payment Bond as described when selected bidder is asked to enter into a contract. The bond shall continue in force for the length of the project, including any maintenance periods.

.2 Include cost of bonds in Bid Price.

.4 Insurance

.1 Provide signed "Undertaking of Insurance" on standard form provided by insurance company stating intention to provide insurance to Bidder in accordance with insurance requirements of Contract Documents.

.2 Failure of the successful Bidder to provide the Owner with the specified insurance policies and Bonds within seven (7) days of the award date will cause the Bid to be declared invalid at the Owner’s sole discretion.

.3 Except where specified otherwise, all premiums shall be paid by the Bidder.

.4 Refer to the Bid Form and to the Canadian Standard Construction Document CCDC2-2008, as-amended.

.5 Should the successful Bidder fail to enter into a Contract with the Owner or fail to produce the required Performance Bonds within seven (7) days of the date of acceptance of the Bid, or to start work as-directed, the Bid Bond will be forfeited to the Owner.

.6 Provide Certificate of Insurance for Five Million Dollars ($5,000,000.00) Commercial Liability or proof of ability to provide required insurances and specified limits and deductibles. See Appendix A at the end of this Section.

.5 Bid Form Requirements.

.1 State in Bid Form, time required to complete work. **New Building Heating System to be operational by September 30, 2018. Substantial Completion date for the work must be no later than October 31, 2018.**

.2 Bidder, in submitting an offer, agrees to complete work by date indicated in Contract Documents.

.3 Refer to Bid Form for inclusion of taxes

.6 Bid Signing

.1 Bid form shall be signed under seal by Bidder.

.2 Sole Proprietorship: Signature of sole proprietor in presence of witness who will also sign. Insert words "Sole Proprietor" under signature. Affix seal.

.3 Partnership: Signature of all partners in presence of witness who will also sign. Insert word “Partner” under each signature. Affix seal to each signature.

.4 Limited Company: Signature of duly authorized signing officer(s) in normal signatures. Insert officer's capacity in which signing officer acts, under each signature. Affix corporate seal. If Bid is signed by officials other than President and Secretary of company, or President-Secretary-Treasurer of company, copy of by-law resolution of Board of Directors authorizing them to do so must also be submitted with in Bid envelope.

.5 Joint Venture: Each party of joint venture must execute Bid under respective seals in manner appropriate to such party as described above, similar to requirements of Partnership.

.6 Contractor shall fill in Appendix B List of Sub-Contractors in the Bid Form with all sub-trade information and pricing used in the preparation of their Bid Price.

.7 Appendices to Bid Form

.1 Appendix A - Contractors Example Projects & References

.2 Appendix B - List of Sub-Contractors

1.9 OFFER ACCEPTANCE/ REJECTION

.1 Duration of Offer

.1 Bids shall remain open to acceptance and irrevocable for a period of ninety (90) days after the Bid closing date.

.2 Acceptance of Offer

.1 Owner reserves the right to accept or reject any or all offers.

.2 After acceptance, Owner will issue to successful Bidder, written Bid acceptance.

.3 After a Bid has been accepted, unsuccessful Bidders security deposits will be returned and other requested enclosures.

1.10 HOURS OF WORK

.1 Building access is available to the contractor 24 hours per day, 7 days per week. Schedule work hours appropriately to meet project deliverables, based on the following constraints:

.1 All work within normally occupied areas, such as offices and classrooms, must occur outside of building occupied hours (Monday to Friday – 8:00 a.m. to 4:30 p.m). The contractor shall maintain the work site in a clean and orderly manner throughout the duration of the contract to the building owner's satisfaction. Waste materials shall be removed from site on a daily basis. Ensure normally occupied areas are clean and suitable for use during building occupied hours. Do not perform work that will disrupt building occupancy during building occupied hours, with the following exception:

.1 Bora Laskin Building will be unoccupied during the month of August 2018.

Any required electrical, gas or domestic water shutdown(s) for service upgrades to be coordinated with both the Owner and the consultant.

1.11 CERTIFICATES REQUIRED

.1 Prior to the commencement of any work under this contract the contractor will file with the Owner, "Certificate of Insurance", and a current WSIB Clearance Certificate.

END OF SECTION

SECTION 003000 - TENDER FORM

1. TENDER FOR THE CONSTRUCTION OF

PROJECT NO. BL17-046 (TBTE PROJECT #18-038)
LAKEHEAD UNIVERSITY BORA LASKIN BUILDING HVAC UPGRADES

1.1 SUBMISSION

The following Tender is hereby submitted to:

Lakehead University
Purchasing Department
Braun Building – Room BB-1002A
955 Oliver Road
Thunder Bay ON P7B 5E1
Attention: Geoffrey Matte,
Manager, Purchasing and Contracts

Hereinafter called the “Owner”

This proposal is submitted by:

Name of Company
Street Address
City or Town
Postal Code
Telephone
e-mail
Facsimile

Signatures and Corporate Seal

Print Name of Signing Officer	Signature of Officer
Print Name of Witness	Signature of Witness
(Place Corporate Seal over signatures)	Date (dd/mm/yyyy)

hereinafter called the “Tenderer”

1.1.1 I/We, the undersigned, having fully examined the locality and Place of the Work, having fully investigated the conditions of the Work, having read and understood the Contract Documents (comprised of the tendering information, supplementary general conditions, general conditions, specifications and drawings, including all supplements, addenda and revisions to same to the date of this tender) and having secured all of the information necessary to enable the submission of this tender, hereby agree and offer to perform the totality of the Work described in the Contract Documents, in accordance with the Contract Documents, for the **Total Lump Sum Price for the Bora Laskin HVAC Upgrades (including H.S.T)** of:

_____**Dollars**
(Insert Bid Price in Words, Bid Price indicated above takes precedence over sum of Individual Amounts Below)

$_____**Canadian**
(Insert Bid Price in Numbers)

Bid Price Breakdown

Description	Amount
1. General Conditions	$_____
2. Demolition	$_____
3. Architectural (ceiling, bulkheads, fire separation, etc.)	$_____
4. Mechanical (excluding Plan 'D' Rooftop Units RTU-1 &2)*	$_____
5. Electrical (excluding Classroom and Plan 'D' Lighting)**	$_____
6. Controls	$_____
7. Replacement of Plan 'D' Rooftop Units (RTU-1 &2)	$_____
8. Replacement of Classroom Lighting	$_____
9. Replacement of Plan 'D' Lighting	$_____
10. SUBTOTAL	**$**_____
11. HST	$_____
12. TOTAL BID PRICE	**$**_____

* Do not include the cost of replacing Plan 'D' Rooftop Units RTU-1 &2 in Mechanical Line Item 4. The cost of replacing Plan 'D' Rooftop Units RTU-1 &2 to be shown in Line Item 7. Refer to Drawing M29 for Scope of Work pertaining to replacement of Plan 'D' Rooftop Units RTU-1 &2.

** Do not include the cost of replacing Classroom and Plan 'D' Lighting in Electrical Line Item 5. The cost of replacing Classroom and Plan 'D' Lighting to be shown in Line Items 8 and 9 respectively.

12.1 OWNERS RIGHT TO EVALUATE TENDERS

I/We understand that the Owner reserves the right to evaluate the tender in such a manner that if there are additions or deletions to the base bids, these additions or deletions may be used to determine a total bid price and may have a bearing on award of this contract.

12.2 OWNERS RIGHT TO REJECT TENDERS

I/We understand that the Owner reserves the right to reject the lowest or any tender without cause.

12.3 ADDITIONS AND DEDUCTIONS

12.3.1 The Tenderer agrees that, if this tender is accepted by the Owner:

(i) it will carry out any additional or extra work (including the supplying of any additional Products pertaining thereto) or will delete any work as may be required by the Contract Administrator in accordance with the Contract; and,

(ii) the carrying out of any work referred to in paragraph (i) above or the issuance by the Contract Administrator of a Contract Change Order relating to such work or the acceptance by the Tenderer of such Contract Change Order shall not, except as expressly stated in such Contract Change Order, waive, affect or vary any of the terms of the Contract or of a Contract Change Order previously issued by the Contract Administrator or any of the rights of the Owner or of the Contract Administrator under the Contract.

12.3.2 The Tenderer agrees that, if this tender is accepted by the Owner the prices applicable to work referred to in paragraph 1.4.1 above shall be determined as follows:

(i) The Schedule of Tender Prices shall apply where applicable;

(ii) If the above Schedule is inapplicable the prices shall be determined in accordance with the General Conditions or as amended by the Supplementary General Conditions.

12.4 ADDENDA

We agree that we have received Addenda _____ to _____ inclusive, and the tender price includes for the provisions set out in such Addenda.

12.5 CONTRACT TIME

I/we agree to commence the Work as specified, to proceed continuously to completion, and to be **Substantially Complete by October 31, 2018.**

12.6DECLARATIONS OF TENDERER

(i) The Tenderer declares that no person, firm or corporation other than the Tenderer has any interest in this tender or in the proposed Contract for which this tender is made.

(ii) The Tenderer declares that this tender is made without any connection, comparison of figures or arrangement with, or knowledge of, any other corporation, firm or person making a tender for the same Work and is in all respects fair and without collusion or fraud.

12.7 CONDITIONS OF TENDER

This tender is irrevocable from the official closing time and is unconditionally open for acceptance for 90 days after the official closing time, whether any other tender has been previously accepted or not. In cases where the expiry date of the acceptance period falls on a Saturday, Sunday or holiday, the time for acceptance shall be extended to the first following business day.

12.8 DISCLAIMER

The Tenderer agrees and acknowledges there is no representation, warranty, collateral agreement or condition, whether direct or collateral, or expressed or implied, which induced the Tenderer to submit this tender, or on which reliance is placed by the Tenderer, or which affects this tender.

APPENDIX A

CONTRACTORS EXAMPLE PROJECTS & REFERENCES

I/We also submit three sample projects that is representative of our experience. I/We authorize Lakehead University or its representatives to contact the persons listed as references.

Project #1

Client:

Reference Contact:

Phone No.:

Project Address:

Project Description:

APPENDIX A

CONTRACTORS EXAMPLE PROJECTS & REFERENCES

I/We also submit three sample projects that is representative of our experience. I/We authorize Lakehead University or its representatives to contact the persons listed as references.

Project #2

Client:

Reference Contact:

Phone No.:

Project Address:

Project Description:

APPENDIX A

CONTRACTORS EXAMPLE PROJECTS & REFERENCES

I/We also submit three sample projects that is representative of our experience. I/We authorize Lakehead University or its representatives to contact the persons listed as references.

Project #3

Client:

Reference Contact:

Phone No.:

Project Address:

Project Description:

APPENDIX B

LIST OF SUB-CONTRACTORS

I/We also submit the names of our proposed Sub-Contractors who will be utilized in the Work should we be successful, from whom sub-bids were received, and upon which my/our Bid is based:

Trade	Company	Sub-Bid Price

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Title and description of Work.

.2 Contract Method.

.3 Work sequence.

.4 Contractor use of premises.

.5 Owner occupancy.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract is comprised of renovations to the Bora Laskin Building, located at Lakehead University, 955 Oliver Road, Thunder Bay. The renovations include, but are not limited to, replacement of Heating, Ventilation and Air Conditioning (HVAC) equipment, lighting and building control system, as well as repairs to existing fire separation. All work includes supply of all materials, labour, equipment, freight and associated services for the construction and commissioning.

.2 The Work includes, but is not limited to the following items:

.1 All required pre-contract and pre-construction submittals.

.2 Submission of all required Shop Drawings complete with record of items submitted, submittal dates, returns and re-submittals. Maintain a complete set of approved shop drawings at the Site.

.3 Co-ordination, supply and delivery, storage and security of all equipment and material required to complete the work.

.4 Construction of the upgrades as specified in the contract documents.

.5 All required permits, regulatory inspections, testing, certification and acceptance.

.6 All required submittals and demonstrations for operation and maintenance of the project.

.7 Supply of one (1) set of As-Built Drawings, two (2) sets of Operation and Maintenance Manuals (one hard copy and one electronic copy on CD)

.8 Start-up of specified components complete with start-up supervision and instruction to the Owner’s personnel to effectively operate the building systems to the satisfaction of the Consultant.

.9 Attendance at all project meetings including Pre-Construction, Interim Construction, Substantial Performance, Total Performance and Warranty Inspections.

.10 Timely submittal of all required project paperwork including project schedule and revisions to schedule, price breakdown, payment requests, statutory declaration, inspection testing results, permits, bonding and insurance.

.11 Timely co-ordination and attendance to required maintenance and warranty work.

1.4 SUMMARY OF IMPORTANT DATES/DEADLINES

.1	Tender Start	April 28, 2018
.2	Contractor Mandatory Site Visit	May 4, 2018 at 10:30 AM
.3	Last Day for Questions	May 11, 2018 at 12:00 PM
.4	Last Day for Addenda	May 15, 2018 at 3:00 PM
.5	Tender Close	May 22, 2018 at 3:00 PM
.6	Anticipated Project Award	May 28, 2018
.7	Building Heating System Operational	September 30, 2018
.8	Substantial Completion	October 31, 2018
.9	Total Completion	February 15, 2019

1.5 CONTRACT METHOD

.1 Construct Work under stipulated price contract (CCDC 2 - 2008).

1.6 WORK SEQUENCE

.1 Construct Work to facilitate Owner's expedient return to use of equipment.

.2 Coordinate Progress Schedule and coordinate with Owner during construction.

.3 Maintain fire access/control.

1.7 CONTRACTOR USE OF PREMISES

.1 Contractor shall coordinate use of premises for Work with Owner to allow;

.1 Owner’s regular day to day building operations and maintenance activities.

.2 Coordinate use of premises under direction of Owner and Consultant.

.3 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.

1.8 OWNER OCCUPANCY

.1 Owner will occupy premises during construction period for execution of normal day to day operations and maintenance activities, with the following exception:

.1 The Bora Laskin Building will be unoccupied during the month of August 2018.

.2 Cooperate with Owner in scheduling operations to minimize conflict and to facilitate Owner usage.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Applications for payments.

.2 Substantial performance procedures.

.3 Release of holdback procedures.

.4 Schedule of values.

1.2 REFERENCES

.1 Owner/Contractor Agreement.

.2 Canadian Construction Documents Committee (CCDC).

.1 CCDC 2 - 2008, Stipulated Price Contract.

1.3 APPLICATIONS FOR PROGRESS PAYMENT

.1 Refer to CCDC 2.

.2 Make applications for payment on account monthly as Work progresses.

.3 Date applications for payment last day of agreed monthly payment period and ensure amount claimed is for value, proportionate to amount of Contract, of Work performed and Products delivered to Place of Work at that date.

.4 Submit to Consultant, at least 14 days before first application for payment. Schedule of values for parts of Work, aggregating total amount of Contract Price, so as to facilitate evaluation of applications for payment.

1.4 SCHEDULE OF VALUES

.1 Refer to CCDC 2.

.2 Make schedule of values out in such form and supported by such evidence as Consultant may reasonably direct and when accepted by Consultant, be used as basis for applications for payment.

.3 Include statement based on schedule of values with each application for payment.

.4 Support claims for products delivered to Place of Work but not yet incorporated into Work by such evidence as Consultant may reasonably require to establish value and delivery of products.

1.5 PROGRESS PAYMENT

.1 Refer to CCDC 2.

.2 Consultant will issue to Owner, no later than 10 days after receipt of an application for payment, certificate for payment in amount applied for or in such other amount as Consultant determines to be properly due. If Consultant amends application, Consultant will give notification in writing giving reasons for amendment.

1.6 SUBSTANTIAL PERFORMANCE OF WORK

.1 Refer to CCDC 2.

.2 Prepare and submit to Consultant comprehensive list of items to be completed or corrected and apply for a review by Consultant to establish Substantial Performance of Work when Work is substantially performed.

.3 No later than 10 days after receipt of list and application, Consultant will review Work to verify validity of application, and no later than 7 days after completing review, will notify Contractor if Work or designated portion of Work is substantially performed.

.4 Consultant shall state date of Substantial Performance of Work in certificate.

.5 Immediately following issuance of certificate of Substantial Performance of Work, in consultation with Consultant, establish a reasonable date for finishing Work.

1.7 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF WORK

.1 Refer to CCDC 2.

.2 After issuance of certificate of Substantial Performance of Work:

.1 Submit an application for payment of holdback amount.

.2 Submit sworn statement that all accounts for labour, subcontracts, products, construction machinery and equipment, and other indebtedness which may have been incurred in Substantial Performance of Work and for which Owner might in any way be held responsible have been paid in full, except for amounts properly retained as holdback or as identified amount in dispute.

.3 After receipt of application for payment and sworn statement, Consultant will issue certificate for payment of holdback amount.

.4 Amount authorized by certificate for payment of holdback amount is due and payable on day following expiration of holdback period stipulated in lien legislation applicable to Place of Work. Where lien legislation does not exist or apply, holdback amount is due and payable in accordance with other legislation, industry practice, or provisions which may be agreed to between parties. Owner may retain out of holdback amount any sums required by law to satisfy any liens against Work or, if permitted by lien legislation applicable to Place of Work, other third party monetary claims against Contractor which are enforceable against Owner.

1.8 FINAL PAYMENT

.1 Refer to CCDC 2, GC 5.7.

.2 Submit an application for final payment when Work is completed.

.3 Consultant will, no later than 10 days after receipt of an application for final payment, review Work to verify validity of application. Consultant will give notification that application is valid or give reasons why it is not valid, no later than 7 days after reviewing Work.

.4 Consultant will issue final certificate for payment when application for final payment is found valid.

END OF SECTION

Part 1 General

1.1 DEFINITIONS

.1 Activity: An element of Work performed during course of Project. An activity normally has an expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.

.2 Bar Chart (GANTT Chart). A graphic display of schedule related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date placed horizontal bars. Generally Bar Chart should be derived from commercially available computerized project management system.

.3 Baseline: Original approved plan (for Project Work Break-down package, or activity), plus or minus approved scope changes.

.4 Construction Work Week: Monday to Friday, inclusive, will provide five day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.

.5 Duration: Number of work periods (not including holidays or other nonworking periods) required to complete an activity or other Project element. Usually expressed as workdays or work weeks.

.6 Master Plan: A summary level schedule that identifies major activities and key milestones.

.7 Milestone: A significant event in Project, usually completion of major deliverable.

.8 Project Schedule: The planned dates for performing activities and the planned dates for meeting milestones. A dynamic detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.

.9 Project Planning, Monitoring and Control System: Overall system operated by Consultant to enable monitoring of project work in relation to established milestones.

1.2 REQUIREMENTS

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

.2 Plan to complete Work in accordance with prescribed milestones and time frame.

.3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.

.4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Interim Certificate and Final Certificate as defined times of completion are of essence of this contract.

1.3 SUBMITTALS

.1 Submit to Consultant within 10 working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.

.2 Submit Project Schedule to Consultant within 5 working days of receipt of acceptance of Master Plan.

1.4 PROJECT MILESTONES

.1 Project milestones form interim targets for Project Schedule.

1.5 MASTER PLAN

.1 Structure schedule to allow orderly planning, organizing and execution of Work.

.2 Consultant will review and return revised schedules within 5 working days.

.3 Revise impractical schedule and resubmit within 5 working days.

.4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.6 PROJECT SCHEDULE

.1 Develop detailed Project Schedule derived from Master Plan.

.2 Ensure detailed Project Schedule includes as a minimum milestone and activity types as follows:

.1 Award
.2 Shop Drawings
.3 Permits
.4 Mobilization
.5 Demolition
.6 Mechanical
.7 Electrical
.8 Controls
.9 Finishings/Fire Separation Repairs
.10 Equipment Start-up/Commissioning
.11 Building Heating System Operational
.12 Substantial Completion
.13 Total Completion

1.7 PROJECT SCHEDULE REPORTING

.1 Update Project Schedule on a bi-weekly basis reflecting activity changes and completions, as well as activities in progress.

.2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

1.8 PROJECT MEETINGS

.1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.

.2 Weather related delays with their remedial measures will be discussed and negotiated.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Shop drawings and product data.

.2 Samples.

.3 Certificates and transcripts.

1.2 PRECEDENCE

.1 Division 1 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

1.3 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 01 45 00 - Quality Control.

.3 Section 01 79 00 - Demonstration and Training.

.4 Section 01 78 00 - Closeout Submittals.

.5 Section 23 05 54 - Mechanical Identification.

1.4 REFERENCES

.1 Canadian Construction Documents Committee (CCDC)

.1 CCDC 2-2008, Stipulated Price Contract.

1.5 ADMINISTRATIVE

.1 Submit to Consultant submittals listed for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Work affected by submittal shall not proceed until review is complete.

.3 Present shop drawings and product data in Imperial and SI units.

.4 Where items or information is not produced in SI Metric units converted values are acceptable.

.5 Review submittals prior to submission to Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified

as to specific project will be returned without being examined and shall be considered rejected.

.6 Notify Consultant, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and ensure affected adjacent Work is coordinated.

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

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant review.

.10 Keep one reviewed copy of each submission on site.

1.6 SHOP DRAWINGS AND PRODUCT DATA

.1 Refer to CCDC 2 GC 3.11.

.2 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.4 Allow 7 days for Consultant's review of each submission.

.5 Adjustments made on shop drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.

.6 Make changes in shop drawings as Consultant may require, consistent with Contract Documents. When resubmitting, notify Consultant in writing of any revisions other than those requested.

.7 Accompany submissions with transmittal letter electronically, containing:

- .1 Date.
- .2 Project title and number.
- .3 Contractor's name and address.
- .4 Identification and quantity of each shop drawing, product data and sample.
- .5 Other pertinent data.

.8 Submissions shall include:

- .1 Date and revision dates.

.2 Project title and number.

.3 Name and address of:

.1 Subcontractor.

.2 Supplier.

.3 Manufacturer.

.4 Contractor's stamp, signed by Contractors authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

.5 Details of appropriate portions of Work as applicable:

.1 Fabrication.

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

.3 Setting or erection details.

.4 Capacities.

.5 Performance characteristics.

.6 Standards.

.7 Operating weight.

.8 Wiring diagrams.

.9 Single line and schematic diagrams.

.10 Relationship to adjacent work.

.9 After Consultant's review, distribute copies.

.10 Submit one electronic copy of shop drawings for each requirement requested in specification Sections and as consultant may reasonably request.

.11 Submit one electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by Consultant where shop drawings will not be prepared due to standardized manufacture of product.

.12 Delete information not applicable to project.

.13 Supplement standard information to provide details applicable to project.

.14 If upon review by Consultant, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

1.7 CERTIFICATES AND TRANSCRIPTS

.1 Immediately after award of Contract, submit Workers' Compensation Board status.

.2 Submit transcription of insurance immediately after award of Contract.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Health and safety considerations required to ensure that Contractors show due diligence towards health and safety on construction sites and meet the requirements laid out in the Occupational Health and Safety Act.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures

.2 Section 01 41 00 - Regulatory Requirements

1.3 REFERENCES

.1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.

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

.1 Material Safety Data Sheets (MSDS).

.3 Province of Ontario

.1 Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. 1990 June 2002.

1.4 SUBMITTALS

.1 Make submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit site-specific Health and Safety Plan: Within 10 days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:

.1 Results of site specific safety hazard assessment.

.2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.

.3 Submit 1 copy of Contractor's authorized representative's work site health and safety inspection report to Consultant weekly.

.4 Submit copies of reports or directions issued by Provincial health and safety inspectors.

.5 Submit copies of incident and accident reports.

.6 Submit WHMIS MSDS - Material Safety Data Sheets in accordance City Health and Safety Policies.

.7 Consultant will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 5 days after receipt of plan. Revise plan

as appropriate and resubmit plan to Consultant within 5 days after receipt of comments from Consultant.

.8 Consultant's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

.9 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Consultant.

.10 On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.5 FILING OF NOTICE

.1 File Notice of Project with Provincial authorities prior to beginning of Work.

1.6 SAFETY ASSESSMENT

.1 Perform site specific safety hazard assessment related to project.

1.7 MEETINGS

.1 Schedule and administer Health and Safety meeting with Owners Representative and Consultant prior to commencement of Work.

1.8 REGULATORY REQUIREMENTS

.1 Do Work in accordance with Section 01 41 00 - Regulatory Requirements.

1.9 PROJECT/SITE CONDITIONS

.1 Work at site will not involve contact with:

.1 Asbestos Containing Materials (ACM)

1.10 GENERAL REQUIREMENTS

.1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.

.2 Owners Representative and/or Consultant may respond in writing, where deficiencies or concerns are noted and may request resubmission with correction of deficiencies or concerns.

1.11 RESPONSIBILITY

.1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

.2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.12 COMPLIANCE REQUIREMENTS

.1 Comply with Ontario Health and Safety Act and Regulations for Construction Projects, R.S.O..

1.13 UNFORSEEN HAZARDS

.1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction and advise Consultant verbally and in writing.

1.14 HEALTH AND SAFETY CO-ORDINATOR

.1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:

.1 Have minimum 2 years' site related working experience specific to activities associated with construction projects.

.2 Have working knowledge of occupational safety and health regulations.

.3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.

.4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.

.5 Be on site during execution of Work and report directly to and be under direction of or be site supervisor.

1.15 POSTING OF DOCUMENTS

.1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with Owners Representative.

1.16 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Owners Representative or Consultant.

.2 Provide Owners Representative and Consultant with written report of action taken to correct non-compliance of health and safety issues identified.

.3 Owners Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.17 POWDER ACTUATED DEVICES

.1 Use powder actuated devices only after receipt of written permission from Consultant.

1.18 WORK STOPPAGE

.1 Give precedence to safety and health of public and site personnel and protection of environment over cost and schedule considerations for Work.

END OF SECTION

Part 1 General

1.1 DISPOSAL OF WASTES

.1 Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.

1.2 POLLUTION CONTROL

.1 Control emissions from equipment to local authorities emission requirements.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 References and Codes.

.2 Discovery of Asbestos.

1.2 REFERENCES AND CODES

.1 Perform Work in accordance with Ontario Building Code including all amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.

.2 Meet or exceed requirements of:

.1 Contract documents

.2 Specified standards, codes and referenced documents

1.3 HAZARDOUS MATERIALS

.1 A project specific Designated Substance Survey (DSS), located in Appendix 1, identifies hazardous materials that may be encountered during construction and/or demolition.

.2 Should hazardous materials be encountered in areas not identified in Designated Substance Survey, immediately stop work and notify Consultant.

1.4 BUILDING SMOKING ENVIRONMENT

.1 Comply with smoking restrictions.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Inspection and testing, administrative and enforcement requirements.

.2 Equipment and system adjust and balance.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures

.2 Section 01 78 00 - Closeout Submittals

1.3 REFERENCES

.1 Canadian Construction Documents Committee (CCDC)

.1 CCDC 2-2008, Stipulated Price Contract.

1.4 INSPECTION

.1 Refer to CCDC 2, GC 2.3.

.2 Allow Consultant access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

.3 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Consultant, instructions, or law of Place of Work.

.4 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

.5 Consultant may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Owner shall pay cost of examination and replacement.

1.5 INDEPENDENT INSPECTION AGENCIES

.1 Independent Inspection/Testing Agencies may be engaged by Consultant for purpose of inspecting and/or testing portions of Work.

.2 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Consultant at no cost to the Owner. Pay costs for initial testing and additional testing required.

1.6 ACCESS TO WORK

.1 Allow inspection/testing agencies access to Work.

.2 Co-operate to provide reasonable facilities for such access.

1.7 PROCEDURES

.1 Notify appropriate agency and Consultant in advance of requirement for tests, in order that attendance arrangements can be made.

1.8 REJECTED WORK

.1 Refer to CCDC, GC 2.4.

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

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

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

1.9 EQUIPMENT AND SYSTEMS

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

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 This Section includes specific environmental and sustainable development requirements for building materials, products and systems needed to ensure that this project complies with green design processes and clients' sustainable development plan.

1.2 RELATED SECTIONS

.1 Section 01 33 00 - Submittal Procedures.

.2 American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE)

.1 ASHRAE 62-2010, Ventilation for Acceptable Indoor Air Quality.

.2 ASHRAE 52.2-1999, Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size.

.3 ASHRAE 129-1997, Measuring-Air Change Effectiveness.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-92.1-1989, Sound Absorptive Prefabricated Acoustical Units.

.4 Canadian Standards Association (CSA International)

.1 CSA-A440.1-2000, Windows - User Selection Guide.

.5 Environmental Choice Program

.1 CCD-016-97, Thermal Insulation.

.2 CCD-045-95, Sealant and Caulking Compounds.

.3 CCD-046-95, Adhesives.

.4 CCD-047-98, Surface Coatings.

.5 CCD-048-95, Surface Coatings - Recycled Water-Bourne.

.6 National Air Duct Cleaners Association (NADCA)

.1 NADCA ACR-2002, Assessment Cleaning and Restoration.

.2 NADCA 05-1997, Requirements for the Installation of Service Openings in HVAC Systems.

.7 Sheet Metal and Air Conditioning National Contractors Association (SMACNA)

.1 SMACNA IAQ Guideline for Occupied Buildings Under Construction, 1995.

1.3 SUBMITTALS

.1 Provide submittals for work in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submittals required:

.1 Compliance Report indicating requirement to purchase energy efficient and environmentally benign products.

.2 Energy Report: to indicate EnerGuide ratings of new equipment and appliances.

.3 Material Safety Data Sheets (MSDS)

.1 Submit Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures for the following products. Indicate VOC emissions, prior to installation or use:

.1 Adhesives.

.2 Caulking compounds.

.3 Sealants.

.4 Insulating materials.

.5 Fireproofing or fire stopping materials.

.6 Paints.

.7 Floor and wall patching or levelling materials.

.8 Lubricants.

.2 MSDS sheets to comply with Occupational Health and Safety requirements.

1.4 HAZARDOUS MATERIALS

.1 Follow methods and procedures specified in Section 02 for handling and removal of Hazardous Materials.

.2 Take measures to ensure chemical spills do not enter drains.

.3 Environmental Tobacco Smoke (ETS) Control

.1 Smoking will not be permitted in building.

1.5 SEALANTS, ADHESIVES AND COMPOUNDS

.1 Use adhesives that meet or exceed VOC limits established by Environmental Choice Programs guideline for adhesives CCD-046.

.2 Use sealant products that meet or exceed VOC limits established by Environmental Choice Programs guideline for sealants, CCD-045.

Part 2 Products

2.1 NOT USED

.1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Temporary utilities.

1.2 RELATED SECTIONS

.1 Section 01 52 00 - Construction Facilities

.2 Section 01 56 00 - Temporary Barriers and Enclosures

1.3 INSTALLATION AND REMOVAL

.1 Provide temporary utilities controls in order to execute work expeditiously.

.2 Remove from site all such work after use.

1.4 WATER SUPPLY

.1 Owner will provide continuous supply of potable water for construction use.

.2 Owner will pay for utility charges at prevailing rates.

1.5 TEMPORARY HEATING AND VENTILATION

.1 Ventilating:

.1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.

.2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.

.3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.

.4 Ventilate storage spaces containing hazardous or volatile materials.

.5 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.

1.6 TEMPORARY POWER AND LIGHT

.1 Owner will pay for power during construction for temporary lighting and operating of power tools.

.2 Pay all costs for installation, maintenance and removal.

1.7 TEMPORARY COMMUNICATION FACILITIES

.1 Provide and pay for temporary telephone, fax and data hook ups and equipment necessary for own use.

1.8 FIRE PROTECTION

.1 Provide and maintain temporary fire protection equipment during performance of Work required by insurance companies and governing codes, regulations and bylaws.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Construction aids.

.2 Parking.

.3 Project identification.

1.2 RELATED SECTIONS

.1 Section 01 51 00 - Temporary Utilities

.2 Section 01 56 00 - Temporary Barriers and Enclosures

1.3 REFERENCES

.1 Canadian Construction Documents Committee (CCDC)

.1 CCDC 2- 2008, Stipulated Price Contract.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 1-GP-189M-84, Primer, Alkyd, Wood, Exterior.

.2 CGSB 1.59-97, Alkyd Exterior Gloss Enamel.

.3 Canadian Standards Association (CSA International)

.1 CAN3-A23.1-/A23.2-94, Concrete Materials and Methods for Concrete Construction/Method of Test for Concrete.

.2 CSA-0121-M1978, Douglas Fir Plywood.

.3 CAN/CSA-Z321-96, Signs and Symbols for the Occupational Environment.

1.4 INSTALLATION AND REMOVAL

.1 Provide construction facilities in order to execute work expeditiously.

.2 Remove from site all such work after use.

1.5 SCAFFOLDING

.1 Provide and maintain scaffolding, ramps and ladders as required for completion of work.

1.6 HOISTING

.1 Provide, operate and maintain cranes required for moving of materials and equipment. Make financial arrangements with Subcontractors for use thereof.

.2 Cranes shall be operated by qualified operator.

1.7 SITE STORAGE/LOADING

.1 Refer to CCDC 2, GC 3.12.

.2 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.

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

1.8 CONSTRUCTION PARKING

.1 Parking will be permitted on site as directed by owner.

.2 Maintain adequate access to project site.

1.9 SECURITY

.1 Provide and pay for responsible security personnel to guard site and contents of site after working hours and during holidays if required.

1.10 EQUIPMENT, TOOL AND MATERIALS STORAGE

.1 Provide and maintain, in a clean and orderly condition, lockable weatherproof facilities for storage of tools, equipment and materials.

.2 Locate materials not required to be stored in weatherproof shelters on site in a manner to cause least interference with work activities.

1.11 SANITARY FACILITIES

.1 Permanent washroom facilities may be used. Maintain facilities in a clean and orderly manner.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Barriers.

.2 Environmental Controls.

.3 Fire Routes.

1.2 RELATED SECTIONS

.1 Section 01 51 00 - Temporary Utilities

.2 Section 01 52 00 - Construction Facilities

1.3 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CGSB 1.189M-[84], Primer, Alkyd, Wood, Exterior.
.2 CGSB 1.59-[97], Alkyd Exterior Gloss Enamel.

.2 Canadian Standards Association (CSA International)

.1 CSA-O121-[M1978], Douglas Fir Plywood.

1.4 INSTALLATION AND REMOVAL

.1 Provide temporary controls in order to execute Work expeditiously.

.2 Remove from site all such work after use.

1.5 ACCESS TO SITE

.1 Maintain clear passage of existing roads for access to Work.

1.6 FIRE ROUTES

.1 Maintain access to property for use by emergency response vehicles.

1.7 PROTECTION OF BUILDING FINISHES

.1 Provide protection for finished building finishes and equipment during performance of Work.

.2 Provide necessary covers, and hoardings.

.3 Be responsible for damage incurred due to lack of or improper protection.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Product quality, availability, storage, handling, protection, and transportation.

.2 Manufacturer's instructions.

.3 Quality of Work, coordination and fastenings.

.4 Existing facilities.

1.2 RELATED SECTIONS

.1 Section 01 73 03 - Execution.

1.3 REFERENCE STANDARDS

.1 Canadian Construction Documents Committee (CCDC)

.1 CCDC 2- 2008, Stipulated Price Contract.

1.4 QUALITY

.1 Refer to CCDC 2

.2 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

.3 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

.4 Should any dispute arise as to quality or fitness of products, decision rests strictly with Consultant based upon requirements of Contract Documents.

.5 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.

.6 Permanent labels, trademarks and nameplates on products are acceptable in prominent locations and when located in mechanical or electrical rooms.

1.5 AVAILABILITY

.1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of products are foreseeable, notify Consultant of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

.2 In event of failure to notify Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Consultant reserves the right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.6 STORAGE, HANDLING AND PROTECTION

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

.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.

.3 Store products subject to damage from weather in weatherproof enclosures.

.4 Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

.5 Remove and replace damaged products at own expense and to satisfaction of Consultant.

.6 Touch-up damaged factory finished surfaces to Consultant's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.7 TRANSPORTATION

.1 Pay costs of transportation of products required in performance of Work.

.2 Unload, handle and store such products.

1.8 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.

.2 Notify Consultant in writing, of conflicts between specifications and manufacturer's instructions, so that Consultant may establish course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Consultant to require removal and reinstallation at no increase in Contract Price or Contract Time.

1.9 QUALITY OF WORK

.1 Ensure Quality of Work is of highest standard, executed by qualified workers experienced and skilled in respective duties for which they are employed. Immediately notify Consultant if required Work is such as to make it impractical to produce required results.

.2 Do not employ anyone unskilled in their required duties. Consultant reserves the right to require dismissal from site, workers deemed incompetent or careless.

.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Consultant whose decision is final.

1.10 CO-ORDINATION

.1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.11 CONCEALMENT

.1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.

.2 Before installation, inform Consultant if there is interference. Install as directed by Consultant.

1.12 REMEDIAL WORK

.1 Refer to CCDC 2 and Section 01 73 03 - Execution Requirements.

.2 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.

.3 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.13 LOCATION OF FIXTURES

.1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate unless indicated otherwise.

.2 Inform Consultant of conflicting installation. Install as directed.

1.14 FASTENINGS

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

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.

.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.

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

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.15 FASTENINGS - EQUIPMENT

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

.2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.

.3 Bolts may not project more than one diameter beyond nuts.

.4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.16 PROTECTION OF WORK IN PROGRESS

.1 Prevent overloading of any part of building. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of Consultant.

1.17 EXISTING UTILITIES

.1 When breaking into or connecting to existing services or utilities, execute Work at times directed Owner and/or Consultant, with minimum of disturbance to Work, and/or building occupants.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Requirements and limitations for cutting and patching the Work.

1.2 RELATED SECTIONS

.1 Section 01 11 00 - Summary of Work

.2 Individual product Sections: cutting and patching incidental to work of section. Advance notification to other sections required.

1.3 SUBMITTALS

.1 Submit written request in advance of cutting or alteration which affects:

- .1 Structural integrity of any element of Project.
- .2 Integrity of weather-exposed or moisture-resistant elements.
- .3 Efficiency, maintenance, or safety of any operational element.
- .4 Visual qualities of sight-exposed elements.
- .5 Work of Owner or separate contractor.

.2 Include in request:

- .1 Identification of Project.
- .2 Location and description of affected Work.
- .3 Statement on necessity for cutting or alteration.
- .4 Description of proposed Work, and products to be used.
- .5 Alternatives to cutting and patching.
- .6 Effect on Work of Owner or separate contractor.
- .7 Written permission of affected separate contractor.
- .8 Date and time work will be executed.

1.4 MATERIALS

.1 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 - Submittal Procedures.

1.5 PREPARATION

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

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

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

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

.5 Provide protection from elements for areas which may be exposed by work.

1.6 EXECUTION

.1 Execute cutting, fitting, and patching to complete Work.

.2 Uncover Work to install ill-timed Work.

.3 Remove and replace defective and non-conforming Work.

.4 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.

.5 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.

.6 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.

.7 Restore work with new products in accordance with requirements of Contract Documents.

.8 Fit Work weather or airtight as required to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.

.9 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with ULC rated fire stopping material as per manufacturer's recommendations.

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

.11 Conceal pipes, ducts and wiring in floor, wall and ceiling construction of finished areas except where indicated otherwise.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Progressive cleaning.

.2 Final cleaning.

1.2 RELATED SECTION

.1 Section 01 77 00 - Closeout Procedures

1.3 REFERENCE STANDARDS

.1 Canadian Construction Documents Committee (CCDC)

.1 CCDC 2- 2008, Stipulated Price Contract.

1.4 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Owner or other Contractors.

.2 Remove waste materials from site at regularly scheduled times or dispose of as directed by Consultant.

.3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.4 Provide on-site containers for collection of waste materials and debris.

.5 Provide and use clearly marked separate bins for recycling.

.6 Remove waste material and debris from site at end of each working day.

.7 Dispose of waste materials and debris at designated dumping areas off site.

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

.9 Store volatile waste in covered metal containers, and remove from premises at end of each working day.

.10 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.

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

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

1.5 FINAL CLEANING

.1 Refer to CCDC 2, GC 3.14.

.2 When Work is Substantially Performed, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.3 Remove waste products and debris other than that caused by others and leave Work clean and suitable for occupancy.

.4 Prior to final review, remove surplus products, tools, construction machinery and equipment.

.5 Remove waste products and debris other than that caused by Owner or other Contractors.

.6 Remove waste materials from site at regularly scheduled times or dispose of as directed by Consultant.

.7 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.8 Clean and polish mechanical and electrical fixtures. Replace broken, scratched or disfigured lenses.

.9 Remove stains, spots, marks and dirt from mechanical and electrical fixtures, walls and floors.

.10 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

.11 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Administrative procedures preceding preliminary and final inspections of Work.

1.2 RELATED SECTIONS

.1 Section 01 78 00 - Closeout Submittals.

.2 Section 01 91 00 - Commissioning.

1.3 REFERENCES

.1 Canadian Construction Documents Committee (CCDC)

.1 CCDC 2- 2008, Stipulated Price Contract.

1.4 INSPECTION AND DECLARATION

.1 Contractor's Inspection: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.

.1 Notify Consultant in writing of satisfactory completion of Contractor's inspection and that corrections have been made.

.2 Request Consultant's Inspection.

.2 Consultant's Inspection: Consultant and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.

.3 Completion: submit written certificate that the following have been performed:

.1 Work has been completed and inspected for compliance with Contract Documents.

.2 Defects have been corrected and deficiencies have been completed.

.3 Equipment and systems have been tested, adjusted and balanced and are fully operational.

.4 Certificates required by applicable inspection agencies have been submitted.

.5 Operation of systems has been demonstrated to Owner's personnel.

.6 Work is complete and ready for Final Inspection.

.4 Final Inspection: when items noted above are completed, request final inspection of Work by Owner and Consultant. If Work is deemed incomplete by Owner and Consultant, complete outstanding items and request re-inspection.

.5 Declaration of Substantial Performance: when Owner and Consultant consider deficiencies and defects have been corrected and it appears requirements of Contract have been substantially performed, make application for certificate of Substantial Performance. Refer to CCDC 2, General Conditions Article for specifics to application.

.6 The client shall withhold $5,000.00 until O&M manuals have been received and accepted as complete.

.7 Commencement of Lien and Warranty Periods: date of Owner's acceptance of submitted declaration of Substantial Performance shall be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work.

.8 Final Payment: When Owner and Consultant consider final deficiencies and defects have been corrected and it appears requirements of Contract have been totally performed, make application for final payment. Refer to CCDC 2. If Work is deemed incomplete by Owner and Consultant, complete outstanding items and request re-inspection.

.9 Payment of Holdback: After issuance of certificate of Substantial Performance of Work, submit an application for payment of holdback amount in accordance with CCDC 2.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Equipment and systems.

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

.3 Operation and maintenance data.

.4 Spare parts, special tools and maintenance materials.

.5 Warranties and bonds.

.6 Final site survey.

1.2 RELATED SECTIONS

.1 Section 01 45 00 - Quality Control

.2 Section 01 77 00 - Closeout Procedures.

.3 Section 01 91 00 - Commissioning.

.4 Section 01 79 00 - Demonstration and Training

1.3 SUBMISSION

.1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.

.2 Copy will be returned after final inspection with Consultant's comments.

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

.4 Two weeks prior to Substantial Performance of the Work, submit to the Consultant, final copies of operating and maintenance manuals in English.

.5 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.

.6 If requested, furnish evidence as to type, source and quality of products provided.

.7 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

.8 Pay costs of transportation.

1.4 FORMAT

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

.2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf [219 x 279] mm with spine and face pockets.

.3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.

.4 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.5 Arrange content by systems under Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.7 Text: Manufacturer's printed data or typewritten data.

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

.9 Provide electronic copy of operations and maintenance manual on CD. Format as per hard copy.

1.5 CONTENTS - EACH VOLUME

.1 Table of Contents: provide title of project;

.1 Date of submission; names,

.2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties;

.3 Schedule of products and systems, indexed to content of volume.

.2 For each product or system:

.1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

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

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

.5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

.6 Training: Refer to Section 01 79 00 - Demonstration and Training.

1.6 RECORDING ACTUAL SITE CONDITIONS

.1 Record information on drawings provided by the Consultant.

.2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.

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

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

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

.2 Field changes of dimension and detail.

.3 Changes made by change orders.

.4 Details not on original Contract Drawings.

.5 References to related shop drawings and modifications.

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

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

.2 Changes made by Addenda and change orders.

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

1.7 EQUIPMENT AND SYSTEMS

.1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and any special operating instructions.

.5 Maintenance Requirements: include routine procedures and guide for troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.6 Provide servicing and lubrication schedule, and list of lubricants required.

.7 Include manufacturer's printed operation and maintenance instructions.

.8 Include sequence of operation by controls manufacturer.

.9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.

.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.14 Include test and balancing reports as specified in Section 01450 - Quality Control and 01810 - Commissioning.

.15 Additional requirements: As specified in individual specification sections.

1.8 SPARE PARTS

.1 Provide spare parts, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to site; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.9 MAINTENANCE MATERIALS

.1 Provide maintenance and extra materials, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to site; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.10 SPECIAL TOOLS

.1 Provide special tools, in quantities specified in individual specification section.

.2 Provide items with tags identifying their associated function and equipment.

.3 Deliver to site; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual.

1.11 STORAGE, HANDLING AND PROTECTION

.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.

.2 Store in original and undamaged condition with manufacturer's seal and labels intact.

.3 Store components subject to damage from weather in weatherproof enclosures.

.4 Store paints and freezable materials in a heated and ventilated room.

.5 Remove and replace damaged products at own expense and to satisfaction of Consultant.

1.12 WARRANTIES AND BONDS

.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.

.4 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.

.5 Verify that documents are in proper form, contain full information, and are notarized.

.6 Co-execute submittals when required.

.7 Retain warranties and bonds until time specified for submittal.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Procedures for demonstration and instruction of equipment and systems to Owner's personnel.

1.2 RELATED SECTIONS

.1 Section 01 78 00 - Closeout Submittals.

.2 Section 01 91 00 - Commissioning.

1.3 DESCRIPTION

.1 Demonstrate operation and maintenance of equipment and systems to Owner's personnel prior to date of final inspection.

.2 Owner will provide list of personnel to receive instructions and will coordinate their attendance at agreed upon times.

1.4 QUALITY CONTROL

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

1.5 SUBMITTALS

.1 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Consultant's approval.

.2 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.

.3 Give time and date of each demonstration, with list of persons present.

1.6 CONDITIONS FOR DEMONSTRATIONS

.1 Equipment has been inspected and put into operation in accordance with manufacturer’s recommendations.

.2 Testing, adjusting and balancing has been performed in accordance with Section 01 91 00 - Commissioning and equipment and systems are fully operational.

.3 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.7 PREPARATION

.1 Verify that conditions for demonstration and instructions comply with requirements.

.2 Verify that designated personnel are present.

1.8 DEMONSTRATION AND INSTRUCTIONS

.1 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing and maintenance of each item of equipment at agreed upon times at the equipment location.

.2 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.

.3 Review contents of manual in detail to explain all aspects of operation and maintenance.

.4 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

1.9 TIME ALLOCATED FOR INSTRUCTIONS

.1 Ensure amount of time required for instruction of each item of equipment or system as follows:

.1 New HVAC Equipment: 4 hours of instruction.

.2 New DDC System: 4 hours of instruction.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Includes general requirements for commissioning facilities and facility systems.

1.2 RELATED SECTIONS

.1 Section 01 45 00 - Quality Control

1.3 QUALITY ASSURANCE

.1 Co-operate with and provide testing services under provisions specified in Section 01 45 00 - Quality Control.

1.4 SUBMITTALS

.1 Prior to start of Work, submit name of persons proposed to perform commissioning services for each equipment component. Designate who has managerial responsibilities for coordination of entire testing and adjusting.

.2 Submit preliminary specimen copies of each of equipment start up report forms proposed for use.

.3 Prior to Substantial Performance, submit electronic copies of final reports on applicable forms.

1.5 PROCEDURES - GENERAL

.1 Notify Consultant three (3) days prior to beginning of operations.

.2 Accurately record data for each step.

.3 Report to Consultant any deficiencies or defects noted during performance of services.

1.6 FINAL REPORTS

.1 Persons having managerial responsibility shall make reports.

.2 Ensure each form bears signature of commissioning personnel.

1.7 CONTRACTOR RESPONSIBILITIES

.1 Prepare each system for testing.

.2 Cooperate with commissioning technician and provide access to equipment and systems.

.3 Provide personnel and operate systems at designated times, and under conditions required for proper testing and adjusting.

1.8 PREPARATION

.1 Provide instruments required for testing and adjusting operations.

.2 Make instruments available to Consultant to facilitate spot checks during testing.

.3 Retain possession of instruments and remove at completion of services.

.4 Verify systems installation is complete and in continuous operation.

1.9 EXECUTION

.1 Test equipment and adjust devices for all new HVAC and building control systems.

1.10 SCHEDULE OF SYSTEMS REQUIRING TESTING AND ADJUSTING SERVICES

.1 HVAC Equipment

.2 Direct Digital Control System

END OF SECTION

1 General

1.1 SUMMARY

.1 Section Includes.

.1 Methods and procedures for demolishing, salvaging, recycling and removing items designated to be removed in whole or in part, restoration and repair.

1.2 RELATED SECTIONS

.1 Section 09 21 16 – Gypsum Board Assemblies and Firestopping

1.3 QUALITY ASSURANCE

.1 Regulatory Requirements: ensure Work is performed in compliance with applicable Provincial regulations.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Storage and Protection.

.1 Protect existing items designated to remain and items designated for salvage. In event of damage to such items, immediately replace or make repairs to approval of Consultant and at no cost to Owner.

1.5 SITE CONDITIONS

.1 Existing Conditions.

Review existing conditions and report any visible signs of suspected hazardous materials prior to commencement of related work.

2 Products

.1 Fire-rated and Non-Rated Ceiling and Wall Access Panels.

.1 Supply and install by Section 09 21 16 Gypsum Board Assemblies.

3 Execution

3.1 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

A. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

B. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

C. Dust Hoarding: provide dust hoarding around areas of cutting or patching where operations will affect other finished areas or occupied spaces.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting or patching to minimize interruption to occupied areas.

3.2 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.

3. Concrete or Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill. Use “toothing” of masonry coarses where new exposed masonry openings are being installed into existing masonry walls. Maintain mortar joints.

4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

5. Where cutting affects rooms or spaces on opposite side, prepare, protect and restore other affected rooms or spaces.

6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing-up, and similar operations following performance of other Work to “make good”. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

   a. Clean piping, conduit, and similar features before applying paint or other finishing materials.

   b. Restore damaged pipe covering to its original condition.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.

b. Patch concrete floors with concrete fill, insert 10M dowels embedded minimum 4" (100mm) into existing and new concrete surfaces. Provide shoring or affix metal pan or plywood to underside of suspended slabs for infilling. Where slab-on-grade, restore insulation and / or vapor barrier where in existence.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

6. Fire-Rated Elements: Install firestopping systems to comply with applicable Individual Specification Sections and firestopping manufacturer's written installation instructions and published drawings for products and applications.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove dust, debris, paint, mortar, oils, putty, and similar materials.

3.1 RESTORATION – OPENINGS AND FINISHES

.1 Restore surfaces and fill any voids, holes or openings caused by the demolition or removal of services to accommodate the demolition; including but not limited to patching of concrete, gypsum board and fire-stopping where penetration or opening is through a fire separation, not otherwise covered by the drawings or other sections of the specifications.

. 2 Restore areas and existing works outside areas of demolition to conditions that existed prior to beginning of Work and match condition of adjacent, undisturbed areas. Make work good.

3.2 SCHEDULE OF DEMOLITION + REPAIR WORK

.1 The following Schedule does not alleviate performing the Work related to scope of work indicated elsewhere in the drawings or specifications;

.1 **EXISTING DOORS AND FRAMES**

.1 Remove existing barn-style doors, frames and hardware at Boiler Room #0001B and Electrical Room #0001BC and prepare for new hollow metal doors and frames.

.2 Cut and remove existing strap hinges from perimeter steel frames, leave steel frames in place for installation of new door frames.

.3 Anchor frames through jambs into existing concrete opening, fill and sand for painting. Spray foam insulate perimeter of rough opening, foam rod and caulk for finished seal around door opening.

.4 Finish around inside and outside perimeter of rough openings with bent 1/8" anodized aluminum trims, set into sealant and mechanically fastened.

.2 **EXISTING CEILING ACCESS PANELS**

.1 Remove existing ceiling access panels and sufficient surrounding 12x12 ceiling tile from plaster substrate where noted. Replace with fire-rated ceiling access panels to suit existing opening, making adjustments to opening size as needed to accommodate new fire-rated access panels.

.3 **EXISTING 12x12 TILE CEILINGS WITHIN FIRE-RATED PLASTER CEILINGS**

.1 Remove existing infill 12x12 acoustic tiles where noted within existing fire-rated plaster ceiling areas and prepare for installation of new suspended fire-rated gypsum board ceiling patch.

.2 Remove additional adjacent 12x12 tile to facilitate fire-taping of the new drywall and existing plaster ceiling joints.

.4 **EXISTING MENS DRESSING ROOM #1010 BENCH**

.1 Remove and modify existing dressing room bench seats and wall shelf to accommodate new wall chase framing. Cut bench back to existing wall supports, reinstall once furring wall is completed.

.2 Cut wall shelfs back to suit, reinstall and relocate wall bracket supports as needed.

.5 **EXISTING MECHANICAL ROOM #2028 ROOF OPENINGS**

.1 Repair roof openings left from removal of mechanical items, install new metal deck with steel angle supports between existing structure.

.2 Patch roofing to provide a weatherproof seal at existing roof, including vapor barrier, insulation and roofing materials.

3.3 CLEANING

.1 Remove debris and leave work site clean, upon completion of Work

.2 Use cleaning solutions and procedures which are not harmful to health.

END OF SECTION 02 41 13 – SELECTIVE DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

1. **General Requirements**: Conform with requirements of all Sections of Division 1, General Requirements, as it applies to the work of this Section.
   .1 This section is related to the supply and installation of interior hollow metal doors, frames, glazing and door hardware.

2. **Related Sections**:
   .1 Section 02 41 13 – Selective Demolition + Repair
   .7 Section 09 91 23 - Interior Painting

1.2 QUALITY ASSURANCE

.1 Perform Work to requirements of CSDMA (Canadian Steel Door Manufacturers Association) standards.

1.3 DELIVERY, STORAGE, AND HANDLING

1. Brace frame units with two temporary steel jamb spreaders welded to the base of jambs or mullions to prevent distortion in shipment, and protect finished surfaces by sturdy protective wrappings.

2. Store frames in a secure dry location. Protect from damage from any cause. Store frames vertically, on planks, with blocking between to allow air to circulate.

3. Repair damage to finishes immediately it occurs to prevent rusting. Use zinc rich primer for painted surfaces.

1.4 SUBMITTALS

.1 Product Data:
   .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Submittal Procedures.
.2 Hollow Metal Doors an Frames:
   .1 Submit shop drawing identifying door and frame size, type and swing.
.3 Hardware:
   .1 Submit cut-sheets of recommended hardware to match existing hardware manufacturer and door function.
   .2 Indicate specified hardware by set and include make, model, material, function, size, finish, and other pertinent information.

PART 2 PRODUCTS

2.1 MATERIALS

1. **Galvanized Sheet**: Tension levelled and galvanized to meet specified requirements of ASTM A653M-97, Commercial Quality (CQ), coating designation ZF75 (A25), known commercially as paintable Galvanneal.

2. **Heavy Duty Galvanized Sheet**: Tension levelled and galvanized to meet specified requirements of ASTM A653M-94, Commercial Quality (CQ), coating designation Z275 (G90).

3. **Accessories**: Hot dipped galvanized to requirements of CAN/CSA-G164-M92.

4. **Insulating Glass:** to CAN/CGSB-12.8-M90. Dual glazed ¼" (6mm) clear float glass, ½" (13mm) air space, argon filled. For use in exterior doors.

5. Low expanding spray foam, foam rod and sealant.

6. Bent 1/8" clear anodized aluminum closure flashings, minimum 1-1/2" legs, to suit door rough openings.

7. **Door Hardware:**

.1 CORES

1. Hardware cores are to be "authentic" to the manufacturers lockset specified.
2. Supply all doors with construction cores for use during construction.
3. Supply a second set of cores to be turned over to Lakehead University for their use in keying the cores and for their own installation at the end of construction.
4. Cores to be "1247" Type keyway, "zero-pinned".

.2 KEYING

1. Provide locksets with construction cores as indicated and provide 3 construction master keys to General Contractor. Additional cores to be handed over to Lakehead University as indicated.
2. Doors, Lakehead University will develop their own keying schedule, cut keys and pin the second set of cores / locks in-house.
3. Remove all temporary construction cores and coordinate installation of final cores with Lakehead University at the end of construction.

2.2 FABRICATION

1. **General**:

1. Fit and assemble work in shop where possible. Make trial assembly in shop when not possible.

2. Fabricate and reinforce component parts and assemblies to support loads imposed without deflection detrimental to function, appearance, or safety.

3. Provide structural steel vertical support for frames and screens as required to provide stability unless indicated otherwise on Drawings. Secure structural support to slab and structure above.

4. Prepare frames for finish hardware with mortises and reinforcement, as follows:
   - 16 ga. for locks, strikes and flush bolts,
   - 10 ga. for hinges, push-pulls, and panic devices,

- 12 ga. for surface mounted hardware, for door closer brackets and arms.

5. Drill and tap frames for hardware at reinforcement locations to template information.

2. **Frames and Framing Members**:

1. Fabricate frames with wiped coated galvanized steel ZF075 for interior frames and Z275 heavy duty galvanized steel for exterior frames, to details shown on Drawings.

2. Fabricate steel frames in minimum thickness of 18 ga. unless otherwise specified or indicated.

3. Fabricate steel frames of 16 ga. for exterior frames, and for interior frames with doors over 1.07 m wide, or 2.18 m high, or both.

4. Minimum frame material thickness applies only to frames not otherwise requiring heavier gauges to meet specified fire rated construction.

5. Where members join at corners, cut mitres and weld continuously along inside of section. Do not weld removable stop corners.

6. Where tubular mullions meet frame members, join by continuous butt welding.

7. Attach two 18 ga. steel channel spreaders at bottom of door frames to maintain square alignment. Provide removable attachment for spreaders on frames and remove them after frames are built in.

9. Prepare frames, for single stud rubber door bumpers supplied as specified in Section 08 71 00. Provide for three bumpers at single openings and two at double openings.

11. Anchor frames to floor by 16 ga. angle clips, welded to frame and provided with two holes for floor anchorage.

13. For frames occurring in steel stud walls provide steel anchors of suitable design, for installation inside each jamb as follows: 4 anchors for frames up to 2.28 m height, 5 anchors for frames 2.28 m to 2.44 m, for frames over 2.44 m provide 5 anchors, plus one additional anchor for each 610 mm or fraction thereof.

15. Frames for double doors, or single doors wider than 910 mm, shall have anchors installed in the door header similar to those in door jambs; and located 150 mm from jambs and 610 mm oc maximum.

18. For frames exceeding 3 m in length and installed in stud partitions, provide 12 ga. steel channel extension members, for lateral support. Weld extension members to top of frames and extend to underside of structure above, locate at 3 m oc maximum. Securely bolt extension members to structure above.

3. **Doors**:
    1. Sheet steel faces 1.2mm thick, flush design
    2. Laminated core construction, longitudinal edges mechanically interlocked with visible edge seams, honeycomb core.
    3. Top and Bottom Channels: Inverted, recessed, welded steel channels.
    4. Fabricate doors with hardware reinforcement plates welded in place.

4. **Accessories**:
    1. Door Silencers: Single stud rubber / neoprene.

PART 3 EXECUTION

3.1 EXAMINATION

1. Before fabrication of frames, take site measurements of construction to which work of this Section must conform, to ensure that alteration of product is not required. Alterations to frames in the field will not be allowed.

3.2 INSTALLATION

1. **Pressed Metal Frames**:

.1 Set frame plumb, square, aligned, without twist at correct elevation.

.2 In steel stud walls, anchor hollow metal door frames to adjacent jamb studs at top, at 300 mm from the top and spaced no more than 600 mm for remainder of door height. Fix each frame clip to floor with two anchors.

.3 Brace frame rigidly in position prior to building-in. Remove temporary steel shipping jamb spreaders. Install wood spreaders at third points of frame rebate height to maintain frame width. Provide vertical support at centre of head for openings exceeding 1200 mm in width. Remove wood spreaders after frame has been built-in.

.4 Install doors and frames to CSDMA standards in accordance with NFPA 80 and Ontario Building Code.

.5 Coordinate with gypsum board wall construction.

.6 Install door silencers.

.7 Finish paint in accordance with Section 09 91 23 – Interior Painting.

3.3 HARDWARE INSTALLATION

.1 Installation to be included under this Section.
Unless otherwise directed by the Consultant, install finish hardware at the following heights above finish floor:
Locksets/Latchsets 1025 to centre of strike

Deadlocks	1200 to centre of strike
Exit Devices	1025 to centre of strike
Push Plates	1050 to centre of plate
Guard Bars	1070 to centre of bar
Door Pulls	1050 to centre of pull

.2 Where door stop contacts door pulls, mount stop to strike bottom of pull. Install key control cabinet.

3.4 SCHEDULE OF DOOR HARDWARE

.1 Following is the list of door hardware for supply and install.

2– 1200mm x 2150mm x 45mm, insulated hollow metal door, PSF
(include insulated door filler panels as indicated on door elevation)

D001B	Boiler Room #0001B from exterior	
3 pr	Ives 5BB1HW/NRP/A5111/5 x 4 ½ hinges	US32D
1	Von Duprin 98/996L x rim cyl x 626/exit device	626
1	Schlage B660P deadbolt	626
2	Ives SB1600 surface bolts	626
2	LCN 4040XP/H/CUSH/Rw/PA/EDA closer	AL
2	Hagar 8400 B-CS x 1.14mm ga protection plate 915mm x 914mm	US32D
2	Hagar 181K x 1.14mm ga x 914mm overlap door edging	US32D
2	K.N.C. w13s sweep 965mm	627
1	K.N.C. w-16S x 6230mm silicone/black w/seal	627
1	K.N.C. CT-75 t/bkn threshold	627
1	K.N.C. W-9S alum astragal c/w silicone seal	627

2 - 965mmx 2150mm x 45mm, insulated hollow metal door, PSF

D0001BC	Electrical Room #0001BC from exterior	
3 pr	Ives 5BB1HW/NRP/A5111/5 x 4 ½ hinges	US32D
1	Von Duprin 98/996L x rim cyl x 626/exit device	626
1	Schlage B660P deadbolt	626
2	Ives SB1600 surface bolts	626
2	LCN 4040XP/H/CUSH/Rw/PA/EDA closer	AL
2	Hagar 8400 B-CS x 1.14mm ga protection plate 915mm x 914mm	US32D
2	Hagar 181K x 1.14mm ga x 914mm overlap door edging	US32D
2	K.N.C. w13s sweep 965mm	627
1	K.N.C. w-16S x 6230mm silicone/black w/seal	627
1	K.N.C. CT-75 t/bkn threshold	627
1	K.N.C. W-9S alum astragal c/w silicone seal	627

3.5 GLAZING INSTALLATION

.1 Install sealed glass units within door frames.

.1 Combination method - tape/sealant:

.1 Cut glazing tape to proper length and set against permanent stops, 5

mm below sightline. Install horizontal strips first, extend over entire width of opening before applying vertical strips. Weld corners together by butting tape and dabbing with sealant.

3.6 DOOR FRAME INSTALLATION

.1 Install hollow metal door frames into existing concrete openings, field verify opening dimensions. Refer to Section 02 41 13 – Selective Demolition + Repair

3.7 ADJUSTING

.1 Adjust doors and hardware to move freely, without excessive play and to fit accurately.

3.8 CLEANING

.1 Clean work for specified finishing at completion of installation.

END OF SECTION 08 11 00 – HOLLOW METAL DOORS, FRAMES GLAZNG + HARDWARE

1 General

1.1 SUMMARY

1. **Section Includes**: Gypsum wall and ceiling board installation, patching, repair and finishing, firestopping, fire-rated and non-rated access panel supply and install, and shaft wall bulkheads.

2. **Related Sections**:
    1. Section 02 41 13 – Selective Demolition + Repair
    2. Section 09 22 16 - Metal Stud Framing
    3. Section 09 91 23 – Interior Painting

1.2 REFERENCES

.1 Aluminum Association
- .1 Designation for Aluminum Finishes-1997.

.2 American Society for Testing and Materials International, (ASTM)
- .1 ASTM C1396 / C1396M, Standard Specification for Gypsum Board.
- .2 ASTM C475-01, Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- .3 ASTM C514-01, Specification for Nails for the Application of Gypsum Board.
- .4 ASTM C557-99, Specification for Adhesives for Fastening Gypsum Wallboard to Wood Framing.
- .5 ASTM C840-01, Specification for Application and Finishing of Gypsum Board.
- .6 ASTM C954-00, Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs From 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
- .7 ASTM C1002-01, Specification for Steel Self-Piercing Tapping Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs.
- .8 ASTM C1047-99, Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- .9 ASTM C1280-99, Specification for Application of Gypsum Sheathing Board.

.3 Association of the Wall and Ceilings Industries International (AWEI)

.4 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-51.34-M86(R1988), Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .2 CAN/CGSB-71.25-M88, Adhesive, for Bonding Drywall to Wood Framing and Metal Studs.

.5 Underwriters' Laboratories of Canada (ULC)
- .1 CAN/ULC-S102-1988(R2000), Surface Burning Characteristics of Building Materials and Assemblies.

1.3 SUBMITTALS

.1 Submit manufacturers product data for fire-rated ceiling access panels.

.2 Submit manufacturers written instruction and ULC design criteria for selected fire-stopping products and details.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials in original packages, containers or bundles bearing manufacturers brand name and identification.

.2 Store materials inside, level, under cover. Keep dry. Protect from weather, other elements and damage from construction operations and other causes.

.3 Handle gypsum boards to prevent damage to edges, ends or surfaces. Protect metal accessories and trim from being bent or damaged.

1.5 SITE ENVIRONMENTAL REQUIREMENTS

.1 Maintain temperature minimum 10 degrees C, maximum 21 degrees C for 48 hours prior to and during application of gypsum boards and joint treatment, and for at least 48 hours after completion of joint treatment.

.2 Apply board and joint treatment to dry, frost free surfaces.

.3 Ventilation: Ventilate building spaces as required to remove excess moisture that would prevent drying of joint treatment material immediately after its application.

2 <u>Products</u>

2.1 MATERIALS

.1 Standard Gypsum board: to ASTM C1396 / C1396M Regular, 15.9mm Thick, Type-X, 15.9 mm thick, 1200 mm wide x maximum practical length, ends square cut, edges bevelled.

.1 Acceptable Materials:

.1 CGC Sheetrock Brand Gypsum Wall Board or equal.

.2 Joint compound: asbestos-free and dust free.

.1 Acceptable Material:

.1 CGC Dust Control Joint Compound.

.2 Certainteed ProRoc Dust Away Joint Compound.

.3 Joint tape: paper tape.

.4 For use in all areas except Washrooms, Kitchens, Janitor and Service Rooms.

.2 CGC Shaft Liner panels, 1” thickness.

.3 Metal furring runners, hangers, tie wires, inserts, anchors to suit suspended ceiling repair and openings.

.4 Drywall furring channels: 0.5 mm core thickness galvanized steel channels for screw attachment of gypsum board.

.5 Resilient clips and drywall furring : 0.5 mm base steel thickness galvanized steel for resilient attachment of gypsum board.

.6 Steel drill screws: to ASTM C1002.

.7 Stud adhesive: to CAN/CGSB-71.25 ASTM C557.

.8 Laminating compound: as recommended by manufacturer, asbestos-free.

.9 Casing beads, paper-faced metal corner beads, control joints and edge trim: to ASTM C1047, zinc-coated by hot-dip process, 0.5 mm base thickness, perforated flanges, one piece length per location.

.10 Fire-stopping: ULC listed fire-stopping systems to suit conditions at head-of-wall, base of wall, penetrations and joints.

.11 Polyethylene: to CAN/CGSB-51.34, Type 2.

.12 Insulating strip: rubberized, moisture resistant, 3 mm thick closed cell neoprene strip, 12 mm wide, with self sticking permanent adhesive on one face, lengths as required.

.13 Joint compound: to ASTM C475, asbestos-free, low dust formula.
- .1 Acceptable Material:
  - .1 CGC Dust Control Joint Compound.
  - .2 Certainteed ProRoc Dust Away Joint Compound.

.14 **Fire Stopping:** Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- .1 Acceptable Material: Hilti firestop products, or equal.

.15 **Access Panels:** Refer to drawings for locations within walls and ceilings.
- .1 Fire-rated access panels (ceilings): Acudor, model FWC-5015, primed for painting in field. Size based on 16” x 16” (406mm x 406mm) and 24” x24” (610mm x 610mm) to suit replacement of existing non-rated panels where noted.
- .2 Non-rated Access Panels (vertical surfaces): Acudor, model UF 5000, primed for painting in field. Size to be 16” x 16” (406mm x 406mm).

3 Execution

3.1 ERECTION

.1 Do application and finishing of gypsum board in accordance with ASTM C840 except where specified otherwise.

.2 Do application of gypsum sheathing in accordance with ASTM C1280.

.3 Erect hangers and runner channels for suspended gypsum board ceilings in accordance with ASTM C840 except where specified otherwise.

.4 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 600 mm around perimeter of fixture.

.5 Install work level to tolerance of 1:1200.

.6 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles and as indicated.

.7 Install 19 x 64 mm furring channels parallel to, and at exact locations of steel stud partition header track.

.8 Furr for gypsum board faced vertical bulkheads within and at termination of ceilings.

.9 Install wall furring for gypsum board wall finishes in accordance with ASTM C840, except where specified otherwise.

.10 Furr openings and around built-in equipment, cabinets, access panels and as indicated on four sides. Extend furring into reveals. Check clearances with equipment suppliers.

.11 Furr duct shafts, beams, columns, pipes and exposed services where indicated.

.12 Erect drywall resilient furring transversely across studs spaced maximum 400 mm on centre and not more than 150 mm from ceiling/wall juncture. Secure to each support with25 mm drywall screw.

3.2 APPLICATION

.1 Do not apply gypsum board until bucks, anchors, blocking, sound attenuation, electrical and mechanical work are approved.

.2 Apply gypsum board to wood or metal furring or framing using screw fasteners. Maximum spacing of screws 300 mm on centre.

.1 Single-Layer Application:

.1 Apply gypsum board on ceilings prior to application of walls in accordance with ASTM C840.

.2 Apply gypsum board vertically or horizontally, providing sheet lengths that will minimize end joints.

.2 Double-Layer Application:

.1 Install gypsum board for base layer and exposed gypsum board for face layer.

.2 Apply base layer to ceilings prior to base layer application on walls; apply face layers in same sequence. Offset joints between layers at least 250 mm.

.3 Apply base layers at right angles to supports unless otherwise indicated.

.4 Apply base layer on walls and face layers vertically with joints of base layer over supports and face layer joints offset at least 250 mm with base layer joints.

.3 Apply water-resistant gypsum board adjacent to slop sinks janitor's closets and other wet areas with painted drywall surfaces. Apply water-resistant sealant to edges, ends, cut-outs which expose gypsum core and to fastener heads.

.4 Apply 12 mm diameter bead of acoustic sealant continuously around periphery of each face of partitioning to seal gypsum board/structure junction where partitions abut fixed building components. Seal full perimeter of cut-outs around electrical boxes, ducts, in partitions where perimeter sealed with acoustic sealant.

.5 Install ceiling boards in direction that will minimize number of end-butt joints. Stagger end joints at least 250 mm.

.6 Install gypsum board on walls vertically to avoid end-butt joints. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs, except where local codes or fire-rated assemblies require vertical application.

.7 Install gypsum board with face side out.

.8 Do not install damaged or damp boards.

.9 Locate edge or end joints over supports. Stagger vertical joints over different studs on opposite sides of wall.

3.3 INSTALLATION

.1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges. Secure at 150 mm on centre using contact adhesive for full length.

.2 Install casing beads around perimeter of suspended ceilings.

.3 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated. Seal joints with sealant.

.4 Install insulating strips continuously at edges of gypsum board and casing beads abutting metal window and exterior door frames, to provide thermal break.

.5 Install shadow mould at gypsum board/ceiling juncture as indicated. Minimize joints; use corner pieces and splicers.

.6 Construct control joints of preformed units set in gypsum board facing and supported independently on both sides of joint.

.7 Provide continuous polyethylene dust barrier behind and across control joints.

.8 Locate control joints at approximate 10m spacing on long corridor runs at approximate 15 m spacing on ceilings. Install at locations susceptible to developing cracking due to movement. Use back-to-back L-Moldings and caulk joint following painting.

.9 Install control joints straight and true.

.10 Construct expansion joints at building expansion and construction joints. Install using back-to-back L-Moldings or premanufactured control joint if condition requires.

.11 Install expansion joints straight and true.

.12 Splice corners and intersections together and secure to each member with 3 screws.

.13 Install access doors to electrical and mechanical fixtures specified in this section.
- .1 Rigidly secure frames to furring or framing systems.
- .2 Coordinate cutting and patching to suit opening size in existing gypsum / plaster ceilings.

.14 Finish face panel joints and internal angles with joint system consisting of joint compound, joint tape and taping compound installed according to manufacturer's directions and feathered out onto panel faces.

.15 Gypsum Board Finish: finish gypsum board walls and ceilings to following levels in accordance with Association of the Wall and Ceiling Industries (AWCI) International Recommended Specification on Levels of Gypsum Board Finish:

.16 Finish corner beads, control joints and trim as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.

.17 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after surface finish is completed.

.18 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.

.19 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for surface finish.

.20 Apply one coat of white primer sealer over surface to be textured. When dry apply textured finish in accordance with manufacturer's instructions.

.21 Mix joint compound slightly thinner than for joint taping.

.22 Apply thin coat to entire surface using trowel or drywall broadknife to fill surface texture differences, variations or tool marks.

.23 Allow skim coat to dry completely.

.24 Remove ridges by light sanding or wiping with damp cloth.

.25 Provide protection that ensures gypsum drywall work will remain without damage or deterioration at time of substantial completion.

3.4 REPAIR AND PREPARATION OF EXISTING SURFACES

.1 Prepare surface and install new gypsum board where indicated and where rough-in or installation has disrupted existing gypsum finishes on walls or ceilings.

.2 Install new fire-rated gypsum board to existing ceilings and wall surfaces where indicated.

.3 Install gypsum board Bulkheads and gypsum board over existing wall paneling in Lower floor Hall as part of Separate Price No.1.

.4 **SCHEDULE OF REPAIRS**

.1 The following conditions, and any condition resulting from the Work indicated on the drawings and other parts of the specifications, will require repair as a result of the Work;

.1 Wall and ceiling finishes due to demolition, including removal of existing partitions, doors and frames.

.2 Cutting and patching for removal and / or installation of plumbing or ventilation

.3 Cutting, repair and patching for plumbing rough-in affecting other spaces on floors below.

.4 Patching and repair prior to re-painting of existing wall surfaces.

3.5 SHAFTWALL BULKHEADS

.1 For extension of fire-rated concrete masonry unit (CMU) partitions interrupted by open web steel joists (OWSJ). Install framing for shaftwall bulkheads in front of existing fire-rated CMU partitions and fit gypsum board liner panels and face sheets around existing OWSJ cross-bracing, pipes and conduit. Fire seal all penetrations on both surfaces as work proceeds.

.2 Provide head of wall fire stopping at underside of existing metal deck and fire seal perimeter edges of face sheet at sides and bottom.

3.6 FIRESTOPPING

.1 Prepare surface and install new gypsum board where indicated and where rough-in or installation material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in, or construction joints between fire rated wall and floor assemblies.

.2 Install firestop and components in accordance with manufacturers published details and instruction.

.3 Firestop rated partitions at head of wall, floor and at vertical joints that are not taped and filled to adjacent surfaces.

.4 Use white firestop caulking on joints that are to be left exposed to finished view.

END OF SECTION 09 21 16 – GYPSUM BOARD ASSEMBLIES

1 General

1.1 SUMMARY

1. **General Requirements**: Section includes metal stud framing, furring and framing of openings, installation of partitions, suspended gypsum ceilings, enclosures, bulkheads, shaft wall bulkheads and infilling of openings.

2. **Related Sections**:
   Section 02 41 13 – Selective Demolition + Repair.
   Section 09 21 16 - Gypsum Board Assemblies + Firestopping.

1.2 REFERENCES

1. Perform work of this Section to meet specified requirements of ASTM C754-97. Requirements specified in this Section are intended to modify, supplement or clarify specifications contained in ASTM C754-97 and will take precedence.

1.3 DELIVERY, STORAGE AND HANDLING

1. Handle and store materials to prevent damage and rusting.

1.4 PROJECT CONDITIONS

1. Design and install gypsum ceiling systems to be suspended from concrete deck or structural steel framing systems but not structural steel deck. Do not suspend any items from structural steel deck.

2 Products

2.1 MATERIALS

1. Materials for work that is specified in ASTM C754-97 shall meet requirements of the Standard, and are not repeated here.

2. **Accessories**: Provide types of accessories to suit finish system thickness.

3. **Furring and Studs**:
   1. **Metal Studs**:
      .1 With knurled flanges 32 mm wide with edges doubled back at least 5 mm, 25 ga. steel, galvanized, and with service access holes. Depth of studs shall be 92 mm, unless indicated otherwise.
      .2 C-H Studs, tracks and runners for shaftwall bulkhead construction.

   2. **Partition Runners**: Steel; of depth, gauge and material to suit studs in which they are incorporated.

   3. **Stud Bracing**: 19 x 10 mm x 18 ga. furring channels.

   4. **Furring Channels**: 25 ga. steel, galvanized, nominal size of 22 mm deep x 32 mm face, hat type, with knurled face.

5. **Screws**: Self-drilling, self tapping, case-hardened, Phillips head, drywall screws, with corrosion resistant finish.

6. **Carrying Channels**: 1-1/2" x ½" (38 x 13 mm) 16 ga. cold rolled galvanized with hanger wire spaced no greater than 4'-0" (1200mm) on centre.

7. **Deflection Track:** Max-Trak (SLT) slotted deflection track.
.1 Manufactured by ClarkDietrich Building Systems, T. (877) 832-3206, clarkdietrich.com

4. **Hanger Anchoring Devices**: Red Head, self-drilling for use in concrete deck, of appropriate size to take hanger. Or suitable type for use in structural steel framing systems, galvanized after forming, suitable for structure and ceiling conditions and loading. Do not suspend any items from structural steel deck.

5. **Neoprene Tape**: Moisture resistant 3 mm thick foam strip, 12 mm wide, with self-sticking adhesive on one face, lengths as required.

6. **Acoustic Insulation**: Roxul Safe'N'Sound Batt, 3" (76mm) or Owens Corning Thermafiber SAFB, 3" (76mm).

3 Execution

3.1 EXAMINATION

1. All partitions and ceilings must be inspected by Consultant prior to final gypsum board enclosure to ensure all partitions and ceilings are free from debris and waste material.

2. Before lathing commences, ensure that services have been installed, tested and approved by jurisdictional authorities and Architect; that conduits, pipes, cables, outlets are plugged, capped or covered; and that fastenings and supports for work of others are installed.

3. Ensure that work preceding that of this Section is satisfactory, and will permit compliance with the quality and dimensions required for work specified in this Section. Do not permit the work of others to touch back of gypsum board surfaces.

4. Verify that work performed under other Sections as a part of an underwriter specification for a fire rated assembly has been done in accordance with that specification.

3.2 INSTALLATION

1. Work shall include bulkheads at doors, screens and ceiling level changes, and furred beams; and furred pipe, duct, and electrical service spaces in gypsum board areas; all as shown on Drawings or to dimensions approved by Architect.

2. Do not regard framing and furring shown on Drawings as exact or complete. Build in openings with steel stud and gypsum board, unless indicated otherwise. Where gypsum board is applied over concrete masonry units or concrete surfaces, apply boards on metal furring channels, unless indicated as adhesive applied.

3. Construct work with bracing to provide adequate strength to withstand stresses imposed by use without distortion, and to maintain dimensions and contours indicated on Drawings.

4. Erect materials to dimensions indicated on Drawings, plumb, level, and straight and square to adjoining elements.

5. Do not install metal framing, trim, casings, or other accessories which have been bent, dented or otherwise deformed.

6. Provide for movement at intersections with structural members to avoid transference of loads to work.

7. Do not support work of this Section from, nor make attachments to, ducts, pipes, conduit, or the support framing of the work of other Sections.

8. Do not install framing for gypsum bases in close proximity to hot pipes or to heating ducts.

9. Attach to framing adequate steel reinforcing members or an 18 ga. steel flat stock or metal stud mounted horizontally (and notched around furring members if studs are used) to support the load of, and to withstand the withdrawal and shear forces imposed by, items installed upon the work of this Section. Such items include, but are not restricted to, coat hooks, washroom accessories, handrail anchors, rub rails, grab bars, guards, wall-hung cabinets and fitments, shelving, curtain and drape tracks; Owner supplied equipment; and minor mechanical and electrical work. Supply and install all backing required. Heavy mechanical and electrical equipment shall be self-supporting in Divisions 15 and 16.

10. Provide wood stud bucks around all door and window frame openings.

11. Make allowance for thermal movements in gypsum board systems. Use deflection track at underside of all structure, beams and OWSJ's.

12. Incorporate expansion joints to coincide with building expansion joints, and where otherwise indicated.

13. Provide control joints in interior gypsum board walls and ceilings at no greater spacing than 9 m in each direction, or as otherwise indicated. Line up control joints with joints in other construction, or with centre lines of mullions, columns, piers, or similar building elements.

14. Install thermal breaks at junctions of gypsum board with exterior door, window, or screen frames.

15. Do not use through-the-roof hangers without approval of Architect.

16. Install suspended ceiling framing independent of walls, columns, facings, ducts, and pipes.

17. Provide for support and incorporation of flush-mounted and recessed mechanical and electrical equipment and fixtures only after consultation and verification of methods with those performing the work of Divisions 15 and 16.

18. Provide for support of flush mounted curtain track and curtains, IV track and IV pole, specified in Section 10990.

19. Install plaster rings in gypsum board ceilings for electrical fixtures.

20. **Metal Stud Partition Framing**:
    1. Install stud partition framing suitable for specified finish, including accessories required to make installation complete in accordance with manufacturer's erection specification requirements.

    2. Secure floor channels with concrete nails, or equivalent, spaced at 600 mm oc; and ceiling channels with screws, wire ties, or otherwise, as suitable for construction, spaced at 600 mm oc.

    3. Install runner channels at heads and sills of openings screwed or tied to studs as suitable.

    4. Space studs at 406.4 mm (1'-4") oc, unless indicated otherwise, as specified for wall supports in ASTM C754-99a, or for wall furring as specified in this Section, whichever is applicable for finish supported. Do not erect at a distance greater than 50 mm from abutting walls, partitions and corners. Extend studs to underside of structural slab above, unless indicated otherwise.

    5. Space studs at 300 mm centres for curved applications or at closer centres as required to suit wall curvature.

    6. Provide studs with wood bucks at all openings, sill, head and jambs and at door jambs. At each jamb of door openings exceeding 1200 mm in width, in addition to wood bucks, install double 20 ga. studs each side of opening extending to structure above, and adequately anchored at each end. Provide steel studs above and below openings spaced at 406.4 mm oc maximum. All metal stud partitions above doors and screens over 1.22 m wide shall be secured to structure over and reinforced with sway bracing to stabilize walls to prevent lateral movement.

    7. Erect three studs at corner and intermediate intersections of partitions. Space 50 mm apart and brace together with wired 19 mm channels.

    8. Stiffen partitions over 2.44 m high or 3 m long, or both, with horizontal bracing extended for full length of partitions. Provide one line of bracing in partitions. Space lines to provide equal unbraced panels. Provide bracing for portions of partitions over door openings in partitions over 3 m high, and bracing both above and below openings in partitions located no greater than 150 mm from top and bottom of opening, and extending two stud spaces beyond each edge of opening for both doors and windows. Wire tie or weld bracing to studs.

    9. Coordinate work with others installing horizontal runs of service lines. Where standard holes are too small in roll formed studs, notch them and splice notched flanges with splice pieces 300 mm longer than notches, and fasten each with two screws. Install

double service walls as indicated on Drawings. Brace between studs at maximum spacing of 1.22 m oc.

10. Ensure that electrical boxes are not installed back to back, or occur within same stud space.

11. For all partitions, provide a large bead of acoustical sealant around periphery of metal stud partitions, applied at junction between partition component and surrounding construction on both sides of partition. Acoustical sealant bead shall be large enough so that gypsum board is embedded into the sealant on all edges.

12. Additionally, for partitions indicated as acoustically insulated or providing low sound transmission apply a dual strip of closed cell neoprene tape between runner and concrete floor as well as acoustical sealant along each side of the bottom track at the floor line. Fill all voids between metal studs with acoustic insulation.

13. Insulate duct-chase partitions with acoustic insulation, as specified.

21. **Bulkheads**:
    1. Provide metal furring to frame bulkheads for gypsum board finish and transitions in ceilings where indicated.
    2. For extension of fire-rated concrete masonry unit (CMU) partitions interrupted by open web steel joists (OWSJ). Install framing for shaftwall bulkheads in front of existing fire-rated CMU partitions and fit gypsum board liner panels and face sheets around existing OWSJ cross-bracing, pipes and conduit. Fire seal all penetrations on both surfaces as work proceeds.
        .1 Provide head of wall fire stopping at underside of existing metal deck and fire seal perimeter edges of face sheet at sides and bottom.

22. **Suspended Gypsum Ceilings**:
    1. Provide carrier channel and hangers for the infill of plaster and gypsum ceilings where indicated.
    2. Space carrying channels no more than 2’-0” O/C and hangers no more than 4’-0” O/C.

END OF SECTION 09 22 16 – METAL STUD FRAMING

Part 1 GENERAL

1.1 SUMMARY

.1 **General Requirements**: Section includes new suspended acoustic ceilings, adjustment and modification of existing suspended acoustic tile ceilings and cutting and fitting for new ceiling diffusers and grilles where indicated.

1.2 REGULATORY REQUIREMENTS

.1 Provide written confirmation that the suspended ceiling provides adequate support for the electrical fixtures, as required by the current bulletin of the Electrical Inspection Department of Ontario Hydro.

1.3 DELIVERY, STORAGE, AND HANDLING

.1 Package finish materials. Store materials in protected dry area.

.2 Ensure that finish metal members are not bent, dented, or otherwise deformed.

1.4 PROJECT CONDITIONS

.1 Install Work only in areas closed and protected against weather, and maintained at no less than 10°C.

.2 Do not install Work in any area unless satisfied that Work in place has dried out, and that no further installation of damp materials is contemplated.

1.5 MAINTENANCE

.1 **Extra Materials**: Provide extra stock of acoustical panels equal to 5% or minimum one-full carton (whichever is greater) in unopened carton lots of each type of acoustical panel used. Deliver to Owner's place of storage.

Part 2 PRODUCTS

2.1 MATERIALS

.1 **Ceiling Panels**:

.1 **ACT:**

.1 Acoustic Ceiling Tile Type 1**:** CGC “Frost” basic acoustic ceiling panels.

.1 24” x 48”, Color: White, fine fissured, Square Edge, NRC 0.70, cast mineral fiber ceiling panels.

.2 CGC Donn Acoustical Suspension System.

.1 15/16” double web aluminum, Color: Flat white.

.2 **General**:

.1 As is applicable: cut grid as required to suit room shape and to accommodate columns and other room irregularities.

.2 As is applicable: Wall Moulding: Standard angle except where shadow wall mould is indicated. Shadow wall mould shall be fabricated from 20 ga. steel. Provide curved angles at bulkhead where may be indicated.

.3 Provide any additional required trims and finishing accessories to obtain a 100% complete and finished product.

.3 **Hangers**: As is applicable:

.1 Galvanized annealed steel wire; #12 ga. to support a maximum weight of 68 kg/hanger, #9 ga. to support a maximum weight of 140 kg/hanger.

.2 Galvanized annealed steel rod: 4.8 mm diameter to support a maximum weight of 227 kg/hanger.

.3 Hangers shall be hot dipped galvanized.

.4 Inserts and Hanger Connections: Red Head; self-drilling for use in concrete deck; or other type as required to suit installation and structural steel framing.

.4 **Accessories**:

.1 Miscellaneous clips, splicers, connectors, screws, and other standard accessories shall be steel, zinc coated or cadmium plated, of strength and design compatible with suspension methods and system specified. Work shall include special accessories required to provide a complete assembly.

2.2 FABRICATION

.1 Suspension systems shall be manufactured to minimum requirements of ASTM C 635-95, modified as required to suit grid designs. Concealed and exposed members shall be heavy duty with support runners and stabilizer bars for Type 5 System.

Part 3 EXECUTION

3.1 EXAMINATION

.1 Ensure that environmental conditions and preceding work are satisfactory, and work above ceilings has been installed, tested and is complete.

3.2 INSTALLATION

.1 Refer to drawings, elevations, and room finish schedules for layouts and installation details. Pay close attention to manufacturer's installation, storage, and handling instructions. Confirm that job site is ready for installation prior to beginning work. Notify Architect immediately of any concerns or issues before beginning installation.

.2 Coordinate Work of this Section with that of other Sections. Ensure that adequate preparation is made for attachment of hangers and fasteners. Do not use through-the-roof hangers. Provide for carrying and integration of flush-mounted and recessed service components only after consultation and

verification of methods and locations with those performing the Work of Divisions 15 and 16.

.3 As is applicable, space hangers for supporting grid generally at 1200 mm centres each way, to suit structure and ceiling system. Secure hangers to structure with hanger anchoring devices. Secure wire hangers to framing by bending sharply upward and wrapping securely with three turns. Install hangers free of kinks and at no more than 5 degrees off vertical. Provide extra hangers at each corner of lighting fixtures, and reinforce other ceiling equipment with hangers.

.4 Install the entire hanger and suspension grid to adequately support the ceiling assembly.

.5 Lay out Work to provide even spacing in each area, with grid lines symmetrical about room axis, columns, and service elements, and with maximum border widths of equal dimensions on opposite sides of areas, or as indicated on reflected ceiling plans. Work shall include angle mouldings to match exposed grid where ceilings abut walls or other vertical surfaces.

.6 Frame around recessed fixtures, diffusers, grilles, and openings. Make cuts in acoustic tile to suit speakers specified in Division 16.

.7 Maintain true surface planes, and component and joint lines throughout each area.

.8 Do not install panel units with exposed edges either broken or marred.

.9 Install grid system ceilings as specified by the manufacturer of the system. Ensure that methods of installation used are acceptable to the manufacturer of each system component and to Architect.

.10 Brace system to maintain alignment of grid.

3.3 EXISTING CEILINGS TO RECEIVE NEW GRILLES AND DIFFUSERS

.1 Cut and replace existing ceiling tile to accommodate new ceiling grilles and diffusers. Install cross-tees as needed for support of new diffusers, grilles and ceiling tile. Refer to drawings for locations.

3.4 EXISTING CEILINGS TO BE ALTERED, MODIFIED OR REPAIRED

.1 Remove existing ceiling tile and grid as required to facilitate the work of other trades. Reinstall grid, hangers and tile, replacing tile where damaged.

3.5 SITE TOLERANCES

.1 Install ceilings within 3 mm of dimensioned height above floor unless approved otherwise by Architect, and level within a maximum tolerance of 3 mm in 3 m.

3.6 CLEANING

.1 Clean soiled or discoloured surfaces of exposed Work on completion of Work.

END OF SECTION 09 51 13 – ACOUSTIC PANEL CEILING

Part 1. General

1.1 SECTION INCLUDES

.1 Section Includes: All labor, materials, tools and other equipment, services and supervision required to complete all interior repainting work as indicated on the drawings and in specifications.

.2 Refer to drawings for type, location and extent of interior painting required, scheduled, or specified. Paint interior and exterior of new hollow metal doors and frames.

1.2 RELATED SECTIONS

.1 Section 08 11 00 – Hollow Metal Doors, Frames and Hardware
.2 Section 09 21 16 - Gypsum Board Assemblies and Firestopping

1.3 SUBMITTALS

.1 Section 01 33 10: Submission procedures.

.2 Samples: Submit two (2) sample draw-downs, minimum 100 mm (4”) in size, illustrating colour, finish, and textures for paint colours to match existing adjacent surfaces requiring painting, repainting.

1.4 QUALITY ASSURANCE

.1 This Contractor shall have a minimum of five (5) years proven satisfactory experience and shall show proof if requested. When requested, Contractor shall provide a list of the last three comparable interior repainting jobs including, name, location, specifying authority / project manager, start / completion dates and value of the work.

.2 All surfaces requiring repainting shall be inspected by the Painting Subcontractor who shall notify the General Contractor in writing of any defects or problems, prior to commencing repainting or after preparation work.

1.5 ENVIRONMENTAL REQUIREMENTS

.1 Provide continuous ventilation and heating facilities to maintain surface and ambient temperatures above 7 degrees C for twenty-four (24) hours before, during and forty-eight (48) hours after application of finishes.

.2 Provide minimum 270 lx of lighting surfaces to be finished.

1.6 Product Delivery, Storage and Handling:

.1 Deliver all painting materials in sealed, original labeled containers bearing manufacturer's name, brand name, type of paint or coating and color designation, standard compliance, materials content as well as mixing and/or reducing and application requirements.

.2 Store all paint materials in original labeled containers in a secure (lockable), dry, heated and

well ventilated single designated area meeting the minimum requirements of both paint manufacturer and authorities having jurisdiction and at a minimum ambient temperature of 45 F (+7C). Only material used on this project to be stored on site.

.3 Take all necessary precautionary and safety measures to prevent fire hazards and spontaneous combustion and to protect the environment from hazard spills. Materials that constitute a fire hazard (paints, solvents, drop clothes, etc.) shall be stored in suitable closed and rated containers and removed from the site on a daily basis.

1.7 Project / Site Requirements:

.1 UNLESS specifically pre-approved by the specifying body and the applied product manufacturer, perform no interior repainting work when interior ambient air and substrate temperatures and humidity level exceeds manufacturer's stated limits.

.2 Perform no interior painting or repainting work unless adequate continuous ventilation and sufficient heating facilities are in place to maintain minimum ambient air and substrate temperatures for 24 hours before, during and after paint application. Provide supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.

.3 Perform no repainting work unless a minimum lighting level of 323 Lux (30 foot candles) is provided on surfaces to be repainted. Adequate lighting facilities shall be provided by the General Contractor.

.4 Apply paint only to dry, clean, and adequately prepared surfaces in areas where dust is no longer generated by construction activities such that airborne particles will not affect the quality of finished surfaces.

1.8 Scheduling:

.1 Schedule interior painting and repainting operations to prevent disruption of and by other trades when applicable.

.2 Schedule interior painting and repainting operations to prevent disruption of occupants in and about the building where work is occurring in a working building. Obtain written authorization from Consultant / Owner for changes in work schedule.

1.9 Maintenance Materials:

.1 At project completion provide a minimum of 4 liters (1 gallon) of each type and color of paint from same production run (batch mix) used in unopened cans, properly labeled and identified for Owner's later use in maintenance. Store where directed.

Part 2. Products

2.1 MATERIALS

.1 Materials of the following manufacturers are acceptable:

.1 **PT** *Paint Finishes*:

1. Benjamin Moore: Eco Spec WB Interior Latex: Sheen as indicated.
2. Sherwin-Williams "Harmony" Interior Latex, Sheen as indicated.
3. Dulux, "Lifemaster" Acrylic Latex, Zero VOC, sheen as indicated.
4. Cloverdale Paints Canada
5. Pittsburgh Paints
6. Colours:
    a. Allow up to five (5) different colours to match existing wall surfaces, using a G3 (Eggshell) and / or G4 (satin) finish.
    b. Metal Doors and Frames to be painted as a separate color from walls using a G5 (semi-gloss) finish, allow for one (1) color.
    c. All ceilings and bulkheads to be G1 (flat) finish. Allow for one (1) color.

.2 Primers: of type recommended by paint manufacturer for use and paint being used on project.

.1 Use appropriately bonding primer for painting of latex paint over oil-based or other non-compatible existing surfaces.

.3 "Top line" materials produced by their manufacturers only are acceptable. CGSB Standard numbers are listed in the Finish Formula Schedule to establish generic finish material types. Use only materials of manufacturers whose best quality lines meet or exceed CGSB Standards, except where otherwise specified by reference to another material or by a specific manufacturer.

.4 Other finishing materials, such as oils, shellacs, putties, thinners, and other materials required for specified finishes shall be of the best quality produced or recommended by the manufacturer approved for supply of applicable finish materials.

.5 Materials where indicated in formula shall be certified by CSA as conforming to the EcoLogo Environmental Choice Program by Environment Canada.

2.2 Gloss / Sheen:

.1 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following MPI gloss / sheen standard values:

4 **Gloss** **5** **Level**	**2.1 Description**	**8** **Units** **9** **@ 60 degrees**	**11** **Units** **12** **@ 85 degrees**
13 G1	2.1 Matte or Flat finish	2.2 0 to 5	2.3 10 maximum
15 G2	2.1 Velvet finish	2.1 10 maximum	2.1 10 to 35
20 G3	2.1 Eggshell finish	2.1 10 to 25	2.1 10 to 35

25 G4	2.1 Satin finish	2.1 20 to 35	2.1 35 minimum
30 G5	2.1 Semi-Gloss finish	2.1 35 to 70	
35 G6	2.1 Gloss finish	2.1 70 to 85	
40 G7	2.1 High-Gloss finish	2.1 > 85	

2.3 Preparation of Surfaces

.1 Prior to commencement of repainting work, thoroughly examine (and test if required) all interior conditions and surfaces scheduled to be repainted and report in writing to the General Contractor any conditions or surfaces that will adversely affect work of this section.

.2 The degree of surface deterioration (DSD) shall be assessed using the assessment criteria as follows:

45 Condition	**.1 Description**
47 DSD-0	.1 Sound Surface (may include visual (aesthetic) defects that do not affect film's protective properties).
49 DSD-1	.1 Slightly Deteriorated Surface (may show fading; gloss reduction, slight surface contamination, minor pin holes scratches, etc.) / Minor cosmetic defects (runs, sags, etc.).
52 DSD-2	.1 Moderately Deteriorated Surface (small areas of peeling, flaking, slight cracking, staining, etc.).
55 DSD-3	.1 Severely Deteriorated Surface (heavy peeling, flaking, cracking, checking, scratches, scuffs, abrasion, small holes and gouges).
58 DSD-4	.1 Substrate Damage (repair or replacement of surface required by others).

.3 Other than the repair of DSD-1 to DSD-3 defects included under this scope of work, structural and DSD-4 substrate defects discovered prior to and after surface preparation or after first coat of paint shall be made good and sanded by others ready for painting, unless otherwise agreed to by the Owner and painter to be included in this Work.

.4 No repainting work shall commence until all such DSD-4 adverse conditions and defects have been corrected and surfaces and conditions are acceptable to the Painting Subcontractor. The Painting Subcontractor shall not be responsible for the condition of the substrate or for correcting defects and deficiencies in the substrate, which may adversely affect the painting work except for minimal work normally performed by the Painting Subcontractor and as, indicated herein. It shall always, however, be the responsibility of the Painting Subcontractor to see that surfaces are properly prepared before any paint or coating is applied. It shall also be the Painting Subcontractor's responsibility to paint the surface as specified providing that the owner accepts responsibility for uncorrected DSD-4 substrate conditions.

Part 3 Execution

3.1 EXAMINATION

.1 Verify that specified environmental conditions are ensured before commencing work.

.2 Ensure that surfaces to receive finishing materials are satisfactory for specified materials; have been provided as specified in the work of other Sections; will not adversely affect execution, permanence, or quality of work; and can be put into an acceptable condition by means of preparation specified in this Section.

.3 Test all surfaces for moisture content with an electronic moisture meter, and concrete, masonry, and gypsum surfaces for acid-alkali balance.

.4 Maintain at site at all times until work is completed a moisture meter, hygrometer, and thermometer to verify surface and environmental conditions.

3.2 PREPARATION

.1 Verify that surfaces and substrate conditions are ready to receive work as instructed by the product manufacturer.

.2 Verify whether existing finishes or substrates are suspect of containing hazardous or designated materials and complete work in accordance with regulatory, health and safety requirements.

.3 Measure moisture content of surfaces using an electronic moisture meter where necessary. Do not apply finishes unless moisture content of surfaces is below recommended maximum.

.4 Sand, clean, dry, etch, neutralize and/or test all surfaces under adequate illumination, ventilation and temperature requirements.

.5 Remove and securely store all miscellaneous hardware and surface fittings / fastenings (e.g. electrical plates, mechanical louvers, door and window hardware (e.g. hinges, knobs, locks, trim, frame stops), removable rating / hazard / instruction labels, washroom accessories, light fixture trim, etc. from wall and ceiling surfaces, doors and frames, prior to repainting and replace upon completion. Carefully clean and replace all such items upon completion of repainting work in each area. Do not use solvent or reactive cleaning agents on items that will mar or remove finishes (e.g. lacquer finishes). Doors shall be removed before repainting to paint bottom and top edges and then re-hung.

.6 Protect all adjacent interior surfaces and areas, including rating and instruction labels on doors, frames, equipment, piping, etc., from repainting operations and damage by drop cloths, shields, masking, templates, or other suitable protective means and make good any damage caused by failure to provide such protection.

3.3 **APPLICATION**

.1 Do not commence repainting unless substrates are acceptable and until all environmental conditions (heating, ventilation, lighting and completion of other subtrade work, if applicable) are acceptable for applications of products.

.2 Apply products to manufacturer's written instructions.

.3 Paint all exposed to view surfaces.

.4 Sand lightly between coats, including prime coat, to achieve required finish.

.5 Do not apply finishes to surfaces that are not dry.

3.4 **MECHANICAL AND ELECTRICAL EQUIPMENT**

.1 Remove finished louvres, grilles, covers, and access panels on mechanical and electrical components from location and paint separately. Finish paint primed equipment to colour to match adjacent work.

.2 Paint interior surfaces of air ducts, convector and baseboard heating cabinets that are visible through grilles and louvres with one (1) coat of flat black paint, to limit of sight line. Paint dampers exposed behind louvres, grilles, convector and baseboard cabinets to match face panels.

.3 Paint exposed conduit and electrical equipment occurring in finished areas. Colour and texture to match adjacent surfaces.

.4 Paint both sides and edges of plywood backboards for electrical equipment before installing equipment.

.5 Paint access panels that are primed to receive paint finish, color to match adjacent wall or ceiling color.

3.5 **PREPARATION OF MATERIALS / SURFACES**

Metal Surfaces:

.1 Unprimed Steel: Remove weld flux, scale and rust with scrapers, wire brushes, wire power wheels, sandblasting, chipping, or grinding as may be required. Finish surfaces smooth, and remove weld flux alkali contamination with phosphoric acid solution. Wash with solvent.

.2 Primed steel: Before touch-up of prime paint, smooth out surface irregularities; clean weld joints, bolts, nuts, and damaged areas with phosphoric acid solution; and wash with solvent.

.3 Galvanized Steel: Lightly abrade surface with bronze wool. Wash thoroughly with mineral spirits, and wipe dry with completely clean cloths. Phosphatize surfaces in

accordance with CAN/CGSB-31.116-M90, or apply one coat of etch type primer unless otherwise specified.

Concrete and Masonry: Remove residue of form oil from concrete with xylol.

.1 Fill minor holes and cracks in concrete and concrete masonry with Portland cement grout. Match patches to texture of adjacent surfaces.

.2 Remove dirt, scale, loose mortar, and similar foreign matter by brushing.

.3 Remove oil and grease with a washing with trisodium phosphate solution followed by a thorough rinsing with water.

.4 Remove efflorescence by dry brushing; or, if required, by washing with dilute muriatic solution of one part commercial muriatic acid to 20 parts water, followed by a complete rinse with a drenching by clear water.

.5 Wire brush concrete generally. Etch very smooth concrete, such as floors, with application of a solution of one part commercial muriatic acid (31.45%) to three parts of water by volume. Apply at rate of one litre solution for each 1 to 2 m5 of surface. When foaming action is finished, flush surfaces clean of cement laitance with high pressure water.

Wood:

.1 Sand finish surfaces smooth with No. 00 sandpaper.

.2 Clean soiled surfaces with an alcohol wash.

.3 Wipe off dust and other loose dirt, or vacuum clean before application of coatings.

.4 Seal knots, pitch, and sapwood with two coats of orange shellac, or an application of special sealer, for painted surfaces and two coats white shellac for stained surfaces. Use only sealer that is compatible with transparent finish.

.5 After prime coat is dry and sanded, fill nail and screw holes, and cracks with wood filler, or with putty for interior work and caulking compound for exterior work. Colour fillers to match wood or stain if surfaces are given clear final coatings. Smooth, sand, and prime fillers when set.

Gypsum Board:

.1 Fill holes, screw holes, and other similar defects after the first coat of paint has been applied. Colour match filler.

3.6 APPLICATION

.1 **General**:

.1 Perform work of this Section under supervision of experienced foremen, with clean equipment designed for purpose used, and in accordance with printed directions and instructions of the material manufacturer.

.2 Finish glazing rebates before glazing commences.

.3 Do not paint caulked joints, coloured or prefinished metal, unless indicated otherwise, finish hardware, aluminum, stainless steel and brass.

.4 Remove spatters of finish materials from adjacent surfaces, including glass, before they set up, and by methods not harmful to the surfaces.

.2 **Finishing Methods**:

.1 Apply finishing materials at proper consistency, free from brush marks, sags, crawls, streaks, runs, laps, skips, voids, pinholes, missed areas, and other perceptible defects, and with even colour, sheen, and texture. Vary each coat slightly in tone to permit supervision identity.

.2 Apply finishing materials to provide full coverage, and at a rate not to exceed that recommended by the manufacturer for the applicable surface.

.3 Make clean true junctions with no overlap between adjoining applications of finish coatings.

.4 Leave all parts of mouldings and trim clean and true to details with no undue amount of coating in corners and depressions.

.5 Use materials of a single manufacturer in each coating system.

.6 Apply each coat only after preceding coat is dry and hard, or as otherwise directed by material manufacturer.

.7 Sand surfaces lightly with No. 00 sandpaper between coats on wood and metal.

.3 **Priming and Backpriming**:

.1 Verify, by review of other Sections of this Specification, the extent of surfaces primed under work of other Sections. Priming of unprimed surfaces shall be included in work of this Section.

.2 Backprime exterior and interior woodwork, frames, fitments, and similar work as soon as it is delivered and before installed. Use exterior primer compatible to finish coat for exterior work, and enamel undercoater for interior work to receive paint or enamel finishes. Prevent primer from running over faces.

.3 Backprime exterior and interior woodwork receiving clear finishes with gloss varnish reduced 25% by mineral spirits.

.4 Prime tops and bottoms of painted wood doors with enamel undercoater, and tops and bottoms of clear finished doors with gloss varnish. When doors are stained apply varnish after staining. Prime tops and bottoms of plastic faced doors with gloss varnish. Remove doors to prime finish edges.

.5 Prime ferrous metal surfaces including mechanical and electrical equipment, piping, ducts and conduit that have not received a shop coat of paint, with a coat of approved primer. Touch up metal work which has received a shop primer and which is to be finish painted after removing loose paint and scale.

.6 Prime gypsum board surfaces using proprietary primer recommended by paint manufacturer which will preclude ghosting or telegraphing of material density.

.7 Prime alkaline surfaces with alkali resistant primer.

.8 Brush out and force primers into grain of wood, and into crevices, cracks, and joints in all materials.

.4 **Painting**:

.1 Apply paint by brush or rollers. Spray paint ceilings and exposed areas above ceiling only when requested or approved by Architect, and in areas restricted and approved

by him. Discontinue spraying if prohibited by Architect because of inadequate coverage, overspray, paint fog drift, or disturbance to other work on building.

.2 Use only brushes for enamels and varnishes, and for painting wood.

.3 Specified formulae are intended to completely cover surfaces. Apply as many coats as necessary to provide complete coverage with no less than the number of coats indicated.

.4 Use only unadulterated paint. Thin as specified by manufacturer.

.5 Touch up visible suction spots on dried primer, and ensure that they are sealed before application of second coat. Repeat on second coat if still visible.

.6 Do not paint metal access and electrical panels when they are closed. Paint when open and leave open until dry.

.7 Paint glazing compound only after it is set and skimmed over. Remove dirt and grease from compound before painting, and without breaking skin.

.5 **Staining**:

.1 Pad filler well into pores of open-grained wood with a circular rubbing motion. Before filler dries, clean surplus off by rubbing across the grain.

.2 Apply three coats of clear varathane to hardwood nosing's and edges where detailed on drawings.

.6 **Doors and Frames**:

.1 HOLLOW METAL DOORS AND FRAMES: Touch-up primer and prepare doors and frames to receive paint finish both sides of doors and frames.

.2 WOOD DOORS: Finish wood edges of doors exposed to view with the same number of coats of material and colour as adjoining surface finishes. Where not exposed to view, finish with two coats of varnish.

.1 Where exposed to view, fill open end grain of painted doors, and holes and open grain of exposed plywood edges, with wood filler following prime coats. Sand smooth before applying next coat.

.3 Paint existing and new doors identified for paint finish. Remove and reinstall existing door hardware to facilitate painting.

.7 RE-INSTALLATION

.1 Touch up and refinish minor defective work. Refinish entire wall, ceiling or similar surfaces where finish is damaged or not acceptable.

.8 Field Quality Control / Standard of Acceptance:

.1 All surfaces, preparation and paint applications shall be inspected.

.2 Repainted interior surfaces shall be considered to lack uniformity and soundness if any of the following defects are apparent to the Painting Inspection Agency inspector:

a. brush / roller marks, streaks, laps, runs, sags, drips, heavy stippling, hiding or shadowing by inefficient application methods, skipped or missed areas, and foreign materials in paint

coatings.

b. evidence of poor coverage at rivet heads, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
c. damage due to touching before paint is sufficiently dry or any other contributory cause.
d. damage due to application on moist surfaces or caused by inadequate protection from the weather.
e. damage and/or contamination of paint due to blown contaminants (dust, spray paint, etc.).

.3 Repainted interior surfaces shall be considered unacceptable if any of the following are evident under final lighting source conditions:

a. visible defects are evident on vertical surfaces when viewed at 90 degrees to the surface from a distance of 1000 mm (39”).
b. visible defects are evident on horizontal surfaces when viewed at 45 degrees to the surface from a distance of 1000 mm (39”).
c. visible defects are evident on ceiling surfaces when viewed at 45 degrees to the surface.
d. when the final coat on any surface exhibits a lack of uniformity of sheen across full surface area.

.4 Repainted surfaces rejected by the inspector shall be made good at the expense of the Contractor. Small affected areas may be touched up; large affected areas or areas without sufficient dry film thickness of paint shall be repainted. Runs, sags of damaged paint shall be removed by scraper or by sanding prior to application of paint.

.9 Protection:

.1 Protect all newly painted exterior surfaces from rain and snow, condensation, contamination, dust, salt spray and freezing temperatures until paint coatings are completely dry. Curing periods shall exceed the manufacturer's recommended minimum time requirements.

.2 Erect barriers or screens and post signs to warn, limit or direct traffic away or around work area as required.

.10 Clean-up:

.1 Remove all paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.

.2 Keep work area free from an unnecessary accumulation of tools, equipment, surplus materials and debris.

.3 Remove combustible rubbish materials and empty paint cans each day and safely dispose of same in accordance with requirements of authorities having jurisdiction.

.4 Clean equipment and dispose of wash water / solvents as well as all other cleaning and protective materials (e.g. rags, drop cloths, masking papers, etc.), paints, thinners, paint removers/strippers in accordance with the safety requirements of authorities having jurisdiction.

3.7 PAINTING AND FINISHING SCHEDULE

.1 **General**:

.1 Painting and finishing shall include finishing all surfaces to the interior of areas within the renovation areas, indicated on the drawings and surfaces indicated herein, unless indicated otherwise.

.2 Finish interior work, including objects within each area unless otherwise excluded.

.3 Where painting exposed structure is indicated, this shall include, structural steel sections, steel joists, miscellaneous framing, underside of deck, exposed electrical conduit, electrical boxes, junction boxes, sprinkler piping, other exposed piping that can be painted and ductwork.

.4 Unless otherwise specified or indicated on Drawings or Schedules, finish equipment, panels, fitments, services, ducts, pipes, conduit, structure, attachments, accessories, prime coated hardware, or similar appurtenances on or near finished surfaces shall match finish of the surface.

.5 Finish edges and tops of trim, projecting ledges, fitments, door edges and similar work to match adjacent surfaces, whether or not they are above or beyond sight lines.

.6 Finish interiors of alcoves, recesses, closets, fitments, and similar spaces to match adjacent surfaces unless otherwise indicated.

.7 Finish surfaces visible through grilles, convector covers, louvres, and openings, including inside of ductwork, with two coats of matte black paint, for a minimum distance of 1 m.

.2 **Surfaces left unfinished**:

.1 Finishing of the following surfaces is not included in the work: Plastics; metals with porcelain enamel, baked enamel or plated finishes; stainless steel, acoustical panels; ceramic or plastic facing; control panels, circuit breakers, switches, receptacles or similar electrical components; or name and specification plates on equipment; ducts, pipes and conduit concealed from view.

.3 **Existing Wall Surfaces and Hollow Metal Doors and Frames:**

.1 Prime any patching or skim coat added to existing wall surfaces and paint existing wall surfaces identified on the drawings to receive paint. Paint existing walls in their entirety, remove wall plates, accessories and any other items affecting the paint finish. Re-install after painting.

.2 Prime existing surfaces to receive new paint with primer suited for the existing painted surfaces for proper bonding of new paint.

.3 Prepare, prime and paint new hollow metal doors and hollow metal frames indicated. Refer to drawings and schedules for locations. Paint all sides of doors and frames.

3.8 FINISH FORMULA SCHEDULE

.1 **Interior Painted Wood**:

.1 Alkyd Paint or Enamel Finish:

.1 One coat: Enamel Undercoat, tinted, CAN/CGSB-1.38-M91.

.2 Two coats: Alkyd Enamel, semi-gloss, CAN/CGSB-1.57-M90.

.2 **Interior Natural or Stained Wood**:

.1 Polyurethane Finish:

.1 One coat: Wood stain, CAN/CGSB-1.145-M90, Type II,

.2 One coat: Filler, tinted to match wood stain, for open grain wood.

.3 One coat: Sealer of oil modified polyurethane coating, reduced by thinner as recommended by manufacturer.

.4 One coat: Oil Modified Polyurethane Coating, CAN/CGSB-1.175-M89, applied within 24 hours of 1st coat, matte finish.

.3 **Interior Galvanized Metals Including Ductwork**:

.1 One coat: Galvanized Iron Primer, CAN/CGSB-1.198-92.

.2 One coat: Alkyd Undercoat, CAN/CGSB-1.38-M91,

.3 One coat: Interior Alkyd Enamel, CAN/CGSB-1.57-M90, semi-gloss.

.4 Equivalent to INT 5.3C, G5 (semi-gloss)

.4 **Interior Ferrous Metals**:

.1 Enamel Finish:

.2 One coat: Alkyd Metal Primer, CGSB 1-GP-48M.

.3 Omit first coat if previously primed under the work of other Sections, but touch up primer as required.

.4 One coat: Interior Alkyd, gloss, CAN/CGSB-1.60-M89.

.5 One coat: Interior Alkyd, semi-gloss, CAN/CGSB-1.57-M90.

.6 Equivalent to INT 5.3C, G5 (semi-gloss)

.5 **Interior Gypsum Board**:

.1 Paint Finish (**PT**):

.2 One coat: Latex sealer, CAN/CGSB-1.119-M89.

.3 Two coats: Interior Acrylic Latex, CAN/CGSB-1.195-M90, eggshell, exhibiting EcoLogo.

.4 Equivalent to INT 9.2M, G3 (Eggshell)

.6 **Interior Concrete Masonry Units**:

.1 Paint Finish (**PT**):
.2 One coat: Latex block sealer
.3 Two coats: Interior Acrylic Latex, eggshell, exhibiting EcoLogo.
.4 Equivalent to INT 4.2E, G3 (Eggshell)

.7 **Interior Pipe Fabric Insulation Covering**:
.1 One coat: Latex Sealer, CAN/CGSB-1.119-M89.
.2 Two coats: Alkyd Enamel, eggshell, CAN/CGSB-1.57-M90.

.8 **Interior Piping and Conduit**:
.1 One coat: Alkyd Metal Primer, CGSB 1-GP-48M.
.2 One coat: Alkyd Enamel gloss, CAN/CGSB-1.60-M89.
.3 One coat: Interior Alkyd Enamel, CAN/CGSB-1.57-M90, semi-gloss.

END OF SECTION 09 91 23 – INTERIOR PAINTING

PART 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for plumbing pumps.

.2 Sustainable requirements for construction and verification.

.2 Conform to Sections of Division 01, as applicable.

1.2 REFERENCES

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

.1 Material Safety Data Sheets (MSDS).

PART 2 Products

2.1 DOMESTIC HOT WATER CIRCULATING PUMPS

.1 P2: Provide three (3) speed wet rotor circulator supplied complete with stainless steel pump housing, 32mm (1 1/4”) diameter flanged connections, polyether imide impeller, ceramic shaft and bearings, EPDM gasket material.

.2 Capacity: 0.32 L/s (5 GPM) at 4.57 meters (15 feet) head pressure.

.3 Note: Field remove factory installed pump outlet check valve as per manufacturer's instructions and recommendation.

.4 Supports: Provide as recommended by manufacturer.

.5 115/1/60 power.

.6 Provide Armstrong Astro 2 Series Model 250SS or approved equivalent.

PART 3 Execution

3.1 INSTALLATION

.1 Make piping and electrical connections to pump and motor assembly and controls as indicated.

.2 Ensure pump and motor assembly do not support piping.

3.2 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

- .1 Check power supply.
- .2 Check protective devices.

.2 Start-up, check for proper and safe operation.

.3 Check settings and operation of hand-off-auto selector switch, operating, safety and limit controls, audible and visual alarms, over-temperature and other protective devices.

3.3 START-UP

.1 Procedures:

- .1 Check power supply.
- .2 Start pumps, check impeller rotation.
- .3 Check for safe and proper operation.
- .4 Check settings, operation of safety controls, audible/visual alarms, other protective devices.
- .5 Adjust alignment of piping and conduit to ensure full flexibility.
- .6 Eliminate causes of cavitation, flashing, air entrainment.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for copper domestic water service used in the following:

.1 Hard drawn copper domestic hot and cold water services inside building

1.2 RELATED SECTIONS

.1 Section 23 05 05 - Installation of Pipework.

.2 Section 23 08 01 – Performance Verification for Mechanical Piping Systems.

.3 Section 23 08 02 – Cleaning and Start-up of Mechanical Piping Systems.

.4 Conform to Sections in Division 01, as applicable.

1.3 REFERENCES

.1 American National Standards Institute (ANSI)/American Society of Mechanical Engineers International (ASME).

.1 ANSI/ASME B16.15-02, Cast Bronze Threaded Fittings, Classes 125 and 250.

.2 ANSI/ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ANSI/ASME B16.22-01, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

.4 ANSI/ASME B16.24-01, Cast Copper Alloy Pipe Flanges and Flanged Fittings, Class 150, 300, 400, 600, 900, 1500 and 2500.

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM A307-03, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.2 ASTM B88M-03, Standard Specification for Seamless Copper Water Tube (Metric).

.3 ASTM F492-95, Standard Specification for Propylene and Polypropylene (PP) Plastic-Lined Ferrous Metal Pipe and Fittings.

.3 American Water Works Association (AWWA).

.1 AWWA C111-00, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International).

.1 CSA B242-M1980 (R1998), Groove and Shoulder Type Mechanical Pipe Couplings.

.5 Department of Justice Canada (Jus).

.1 Canadian Environmental Protection Act, 1999, c. 33 (CEPA).

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

.1 Material Safety Data Sheets (MSDS).

.7 Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS).

.1 MSS-SP-67-02, Butterfly Valves.

.2 MSS-SP-70-98, Cast Iron Gate Valves, Flanged and Threaded Ends.

.3 MSS-SP-71-97, Cast Iron Swing Check Valves, Flanged and Threaded Ends.

.4 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.

.8 National Research Council (NRC)/Institute for Research in Construction.

.1 NRCC 38728, National Plumbing Code of Canada (NPC) - 1995.

.9 Transport Canada (TC).

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

PART 2 Products

2.1 PIPING

.1 Domestic hot, cold and recirculation systems within building.

.1 Above ground: copper tube, hard drawn, Type M to ASTM B88M.

2.2 FITTINGS

.1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI/ASME B16.24.

.2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.

.3 Cast copper, solder type: to ANSI/ASME B16.18.

.4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.

2.3 JOINTS

.1 Rubber gaskets, latex-free 1.6 mm (0.06”) thick: to AWWA C111.

.2 Bolts, nuts, hex head and washers: to ASTM A307, heavy series.

.3 Solder: Lead-free, Canfield Watersafe or equal.

.4 Teflon tape: for threaded joints.

.5 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F492, complete with thermoplastic liner.

2.4 BALL VALVES

.1 NPS 50mm (2”) and under, screwed:

.1 Class 150.

.2 Bronze body, chrome plated brass stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle. Lead-free construction.

.2 NPS 50mm (2”) and under, soldered:

.1 To ANSI/ASME B16.18, Class 150.

.2 Bronze body, chrome plated brass stainless steel ball, PTFE adjustable packing, brass gland and PTFE seat, steel lever handle, with NPT to copper adaptors. Lead-free construction.

PART 3 Execution

3.1 INSTALLATION

.1 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.

.2 Install pipework in accordance with Section 23 05 05 - Installation of Pipework and supplemented as specified herein.

.3 Assemble piping using fittings manufactured to ANSI standards.

.4 Install CW and HW piping as indicated on drawings to maintain maximum working clearance.

.5 Connect to fixtures and equipment in accordance with manufacturer's written instructions unless otherwise indicated.

3.2 VALVES

.1 Isolate equipment, fixtures and branches with ball valves.

3.3 PRESSURE TESTS

.1 Test pressure: greater of 1-1/2 times maximum system operating pressure or 860 kPa (125 PSI).

3.4 FLUSHING AND CLEANING

.1 Flush, disinfect, rinse and test entire system as a minimum and as per requirements of local authorities. Provide third-party water quality testing report prior to project completion.

3.5 PRE-START-UP INSPECTIONS

.1 Systems to be complete, prior to flushing, testing and start-up.

.2 Verify that system can be completely drained.

.3 Ensure that air cushion chambers, expansion compensators are installed properly.

3.6 DISINFECTION

.1 Flush, disinfect, rinse and test entire system as a minimum and as per requirements of local authorities.

3.7 START-UP

.1 To applicable requirements of Section 23 08 02 – Cleaning and Start-up of Mechanical Piping Systems. Note: Steps unique to glycol heating systems shall not apply.

3.8 PERFORMANCE VERIFICATION

.1 To requirements of Section 23 08 01 – Performance Verification for Mechanical Piping Systems.

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section Includes:

.1 The installation of drainage, waste and vent piping.

.2 Related Sections:

.1 Section 23 05 05 - Installation of Pipework.

.2 Conform to Sections in Division 01, as applicable.

1.2 REFERENCES

.1 American Society for Testing and Materials International, (ASTM).

.1 ASTM D2235, Specification for Solvent Cement for Acrylonitrille-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.

.2 ASTM D2564, Specification for Solvent Cements for Poly(Vinyl-Chloride) (PVC) Plastic Piping Systems.

.2 Canadian Standards Association (CSA International).

.1 CSA-Series B1800, Plastic Nonpressure Pipe Compendium.

.2 CSA-B181.2, PVC Drain, Waste and Vent Pipe and Pipe Fittings.

.3 CSA-B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.

PART 2 Products

2.1 MATERIAL

.1 For drainage, waste and vent piping concealed in a wall or below grade: Schedule 40 PVC to CSA B181.2

.2 For drainage, waste and vent piping above grade that is not concealed: Schedule 40 PVC to CSA B181.2 and CAN/ULC S102.2, IPEX System 15 or equal

.3 For drainage, waste and vent piping above grade that is not concealed and installed in a return air plenum space: Schedule 40 PVC to CSA B181.2 and CAN/ULC S102.2, IPEX System XFR 15-50 or equal.

2.2 JOINTS

.1 Solvent weld to ASTM D2564.

PART 3 Execution

3.1 INSTALLATION

.1 In accordance with Section 23 05 05 - Installation of Pipework.

.2 Install in accordance with Ontario Building Code and local authority having jurisdiction.

.3 PVC vent piping used in methane and soil gas exhaust system will not require cleanouts, however positive sloping to promote drainage back to sump pits is required.

3.2 TESTING

.1 Test to verify grades and freedom from obstructions.

3.3 PERFORMANCE VERIFICATION

.1 Cleanouts:

.1 Ensure accessibility and that access doors are correctly located.
.2 Open, cover and re-seal.
.3 Verify cleanout rods can probe as far as the next cleanout, at least.

.2 Test to ensure traps are fully and permanently primed.

.3 Storm water drainage:

.1 Verify domes are secure.
.2 Ensure weirs are correctly sized and installed correctly.
.3 Verify provisions for movement of roof system.

.4 Ensure fixtures are properly anchored, connected to system and effectively vented.

.5 Ensure venting used in methane and soil gas exhaust system is properly sealed at joints and terminal connections.

.6 Affix applicable label (storm, sanitary, vent, pump discharge, etc.) c/w directional arrows every floor or 4.5 m (15 ft) (whichever is less).

END OF SECTION

PART 1 General

1.1 Conform to Sections of Division 01, as applicable.

1.2 REFERENCES

.1 Canadian Gas Association (CGA)

- .1 ANSI Z21.10.3-2001/CSA 4.3-2001, Gas Water Heaters - Volume III - Storage Water Heaters, with Input Ratings Above 22 kW (75,000 Btu Per Hour).
- .2 CSA-B149.1-00, Natural Gas and Propane Installation Code.

PART 2 Products

2.1 DOMESTIC HOT WATER HEATER

.1 HWT-1-4: Tankless natural gas-fired condensing wall mounted water heater.

- .1 Construction: steel case, dual stainless steel heat exchangers, eco premixed burner, negative pressure gas valve, condensate collector, internal circulation pump and buffer tank.
- .2 Piping: Lead-free plumbing, pressure relief valve.
- .3 Venting: 50mm (2”) CPVC vent termination with debris screen, interior/exterior wall opening plates.
- .4 Controls: ready line communication cable, internal circuit board, flame sensor system, air proving switch, ignition operation detector, water temperature high limit switch, exhaust temperature high limit sensor, overheat prevention device, freeze protection mode, and fan motor rotation detector.
- .5 Capacity: 4.5 L (1.2 Gal) water holding capacity, 1,158 Lph (5.1 GPM) water flow rate @ 25 degrees C (77 degrees F) temperature rise, rated input capacity of 58.6 kW (199.9 MBTU/h).
- .6 Electrical power: 120/1/60.
- .7 Provide Navien Model NPE-240A or approved equivalent.

2.2 ANCHOR BOLTS AND TEMPLATES

.1 Supply for installation by other Divisions.

PART 3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturer's recommendations and authority having jurisdiction.

.2 Provide structural supports for instantaneous heaters.

.3 Install gas fired domestic water heaters in accordance with CSA-B149.1 and CSA-B149.2.

3.2 FIELD QUALITY CONTROL

.1 Manufacturer's certified representative to start up and commission DHW heaters.

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for plumbing specialties and accessories.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM).

.1 ASTM A126-95(2001), Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.

.2 ASTM B62-02, Specification for Composition Bronze or Ounce Metal Castings.

.2 American Water Works Association (AWWA).

.1 AWWA C700-02, Cold Water Meters-Displacement Type, Bronze Main Case.

.2 AWWA C701-02, Cold Water Meters-Turbine Type for Customer Service.

.3 AWWA C702-1-01, Cold Water Meters-Compound Type.

.3 Canadian Standards Association (CSA International).

.1 CSA-B64 Series-01, Backflow Preventers and Vacuum Breakers.

.2 CSA-B356-00, Water Pressure Reducing Valves for Domestic Water Supply Systems.

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

.1 Material Safety Data Sheets (MSDS).

.5 Plumbing and Drainage Institute (PDI).

.1 PDI-WH201-92, Water Hammer Arresters Standard.

PART 2 Products

2.1 MATERIALS

.1 Materials and resources in accordance with applicable sustainability requirements.

2.2 TRAP SEAL PRIMERS

.1 **TSPM-1**

.1 Trap-seal primer supplied complete with surface mounted cabinet, model D-814 access door, recycle timer box, 12mm (1/2") NPT inlet and outlet connections, one (1) 12mm (1/2") FNPT connection to suit connection to primed item denoted on design drawings, timer solenoid valve and 115/1/60 power.

.2 Provide Precision Plumbing Model MPB-500 mini prime electronic trap priming manifold or approved equal.

2.3 BALL VALVES AND SEDIMENT FAUCETS

.1 Solder/brazing to be lead free. Acceptable material: Canfield Watersafe.

.2 Ball valves: full port, bronze construction, chrome plated ball.

.3 Provide Conbraco 70 Series or approved equivalent.

2.4 THERMOSTATIC MIXING VALVES

.1 MV-1: Domestic Hot Water Mixing Valve

.1 Provide electronic thermostatic mixing system with stainless steel 3-way mixing valve with stainless steel trim and 25mm (1") diameter connections.

.2 Controls: 24 VAC actuator, microprocessor electronic tempering valve control module with PID logic, and built-in 120/24V transformer, digital display, LED indicator. System to be BACnet compatible.

.3 Sensors: tempered water thermistor-type temperature sensor/probe with optional hot and cold water temperature sensors/probes.

.4 Provide Heat-Timer Corporation Model 915672-BAC ETV Platinum Plus or approved equivalent.

.5 Size and location shown on drawings.

2.5 DOMESTIC HOT WATER EXPANSION TANKS

.1 EXP-3: Diaphragm-style expansion tank.

.1 Supplied complete with deep drawn steel construction, heavy duty butyl rubber diaphragm, polypropylene liner material, factory 276 kPa (40 PSIG) precharge, 19mm (3/4") NPTM stainless steel connection.

.2 Capacity: 7.6 L (2 Gal) tank volume, 3.4 L (0.9 Gal) acceptance volume.

.3 Provide Amtrol Therm-X-Trol Model ST-5 or approved equivalent.

2.6 FLOOR DRAINS

.1 FD1: Provide funnel floor drain supplied complete with epoxy coated cast iron material, anchor flanges, weepholes, 6mm (1/4") thick adjustable nickel bronze strainer, 100mm (4") diameter nickel bronze funnel, no hub, 12mm (1/2") diameter trap seal primer connection and 75mm (3") diameter outlet.

.2 Provide Watts Model FD-200-C or approved equivalent.

PART 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

.1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheet.

3.2 INSTALLATION

.1 Install in accordance with National Plumbing Code of Canada and local authority having jurisdiction.

.2 Install in accordance with manufacturer's instructions, per Section 23 05 05 – Installation of Pipework and as specified, even if not specified in Sections below.

3.3 BALL VALVES AND SEDIMENT FAUCETS

.1 Install sediment faucets at bottom of risers, at low points to drain systems, and as indicated.

3.4 TRAP SEAL PRIMERS

.1 Install for floor drains and elsewhere, as indicated.

.2 Install on cold water supply to nearest frequently used plumbing fixture, in concealed space, to approval of Consultant.

3.5 STRAINERS

.1 Install with sufficient room to remove basket.

3.6 START-UP

.1 General:

.2 Timing: start-up only after:

.1 Pressure tests have been completed.

.2 Disinfection procedures have been completed.

.3 Provide continuous supervision during start-up.

3.7 TESTING AND ADJUSTING

.1 Application tolerances:

.1 Pressure at fixtures: +/- 70 kPa (10.1 PSI).

.2 Flow rate at fixtures: +/- 20%.

.2 Adjustments:

.1 Verify that flow rate and pressure meet design criteria.

.2 Make adjustments while flow rate or withdrawal is (1) maximum and (2) 25% of maximum and while pressure is (1) maximum and (2) minimum.

.3 Access doors:

.1 Verify size and location relative to items to be accessed.

.4 Cleanouts:

.1 Verify covers are gas-tight, secure, yet readily removable.

.5 Strainers:

.1 Clean out repeatedly until clear.

.2 Verify accessibility of cleanout plug and basket.

.3 Verify that cleanout plug does not leak.

END OF SECTION

PART 1 General

.1 Conform to Sections of Division 01 as applicable.

.2 This Section applies to and governs the Work of all Sections of Division 23.

.3 Where other Mechanical Trades Sections conflict with requirements specified in this Section the Specifications of that particular section govern.

1.2 RELATED SECTIONS

.1 Conform to Section 26 05 01 – Common Work Results - Electrical

1.3 REFERENCES

ANSI B31.1 to B31.9	Piping.
ASTM	Boiler and Pressure Vessel Code, Section V: Non-destructive Examination.
CAN/CGSB-24.3-92-	Identification of Piping Systems.
CAN/CSA A23.1/A23.2-00	Concrete Materials and Methods of Concrete Construction/Method of Tests for Concrete.
CAN/CSA S16.1-01	Limit States Design of Steel Structures.
CAN/CSA-G40.20/G40.21-98	General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
CSA W117.2-01	Safety in Welding, Cutting and Allied Processes.
CAN/CGSB-1.40-97	Primer, Structural Steel, Oil Alkyd Type.
CSA B51-03	Boiler, Pressure Vessel and Pressure Piping Code.
CSA B52-99	Mechanical Refrigeration Code.
CSA W47.1-92(R2001)	Certification of Companies for Fusion Welding of Steel Structures.
CSA W48.-01	Filler Metals and Allied Materials for Metal Arc Welding
CSA W59-1989(R2001)	Welded Steel Construction (Metal Arc Welding) (Imperial version)
CSA W59-M1989(R2001)	Welded Steel Construction (Metal Arc Welding) (Metric version)
ISO Standard 210816-1 1995	
ISO Standard 2954	
OPSS 1010-93	Material Specifications for Aggregates - Granular A, B, M and Select Subgrade Material
ASHRAE 90.1-2001	Energy standard For Buildings Except Low Rise Residential Buildings

1.4 DESCRIPTION

.1 Provide work in accordance with the full intent and meaning of the Drawings and Specifications as required to result in complete and operating systems.

.2 The Drawings show the arrangement and general design. The work is suitably outlined on the Drawings with regard to sizes, locations, general arrangements and installation details. The mains and connections thereto are shown more or less in diagram except where in certain cases the Drawings may include details giving the exact locations and arrangements required. Installation of specified equipment shall comply with the manufacturers installation recommendations contained in the product specific literature.

1.5 WORK COVERED BY OTHER DIVISIONS OR CONTRACTS

.1 Refer to other Divisions of the specifications and to the Drawings for work related to the mechanical work to avoid interferences with work of other trades (and other Contractors) and to ensure proper completion of the work as a whole.

1.6 APPORTIONMENT OF THE WORK

.1 Classify and apportion all materials and the performance of all labour to the several trades involved in accordance with all local customs, rules, regulations, jurisdictional awards, decisions, etc., insofar as they may apply and as required to efficiently execute the work involved in this contract.

1.7 PERMITS AND FEES

.1 Obtain all permits required for the installation of mechanical trades work, arrange for inspections and tests therewith and pay all fees and costs for the permits, inspections and fees. Obtain permits immediately after notification of award of Contract.

.2 Obtain copies of Drawings from the Owner for submission with application for permits.

1.8 MATERIALS AND EQUIPMENT

.1 Use materials and dimensions as specified herein. Design of mechanical systems has been based on the equipment and sizes stated on the Drawings. If the Owner gives approval of substitution of any item of mechanical equipment, include and pay for all necessary changes (labour, materials, overhead, etc.) due to the substitution of the equipment.

.2 Locations and dimensions of openings, framing etc., where indicated on the Drawings, are based on an arrangement to suit the above. Be responsible to verify

the actual size requirements of the openings and notify the Consultant immediately in case the dimensions supplied are impeded by field conditions.

.3 Bear all costs for modification of openings resulting from failure to notify Consultant prior to the fabrication or construction of openings or framing.

1.9 SUBMITTALS

.1 Shop Drawings

.1 Submit shop drawings in accordance with Submittals for item specified.

.2 Supplement shop drawings with brochures where necessary or as required. The initial submission of shop drawings for any one trade shall include a checklist of all related specified items for that trade to ensure complete submittal and review.

.3 Stamp as follows: SHOP DRAWINGS FOR RECORD PURPOSES ONLY - CHECKED FOR CONSTRUCTION IN ACCORDANCE WITH CONTRACT DOCUMENTS.

.4 Record purpose submissions shall include:

- Air Conditioning Systems & Equipment
- Air Handling Equipment
- Air Terminal Units
- Boilers
- Balancing Dampers
- Chemical Pot Feeder/Filter
- DDC Control Components
- Duct Insulation
- Ductwork Access Doors
- Expansion Tanks
- Heat/Energy Recovery Ventilators
- Fire Dampers
- Grilles, Diffusers, Registers, Louvers
- Glycol Feeders
- Hydronic Control Valves
- Hydronic Balancing Valves
- Hydronic Heaters
- Hydronic Specialties
- Hydronic Pumps
- Natural Gas Piping Specialties
- Piping Specialties
- Piping Insulation
- Plumbing Specialties
- Plumbing Pumps
- Sensors, Gauging
- Variable Frequency Drives

.5 Submit Drawings or Brochures to the Consultant, who will review such Drawings or Brochures. If items are not as specified, re-submit corrected copies.

.6 General Shop Drawings showing more than one size or model will not be considered unless properly marked up.

.7 Clearly indicate the materials and/or equipment being supplied, all details of construction, finish, accurate dimensions, capacities and performance on Shop Drawings and brochures. Have all drawings certified correct for construction by the manufacturer, before submission. Identify equipment Shop Drawings with designations as shown on the Drawings or in the Specifications. If not complied with, Shop Drawings will not be reviewed and will be returned to the Contractor.

.8 Each Shop Drawing and/or brochure must bear the stamp and signature of a responsible official in the Contractor's and the subcontractor's organization for each submission as evidence that the drawing has been checked against the requirements as called for in the specifications and Drawings. Also, in the case where the equipment attaches to and/or where there is external wiring connecting to other equipment, that it has been properly coordinated with this equipment, whether supplied under this or other contracts.

.9 Revisions to shop drawings will not be allowed after they are reviewed unless further review and submission is required.

.2 **Record Drawings**: Maintain an accurate dimensional record of all deviations and changes in ductwork, piping and equipment from the Contract Drawings. Transfer this information to two (2) sets of record drawings filed at the job site and submit to the Owner at job completion.

.3 **Installation and Start-up Instructions**: Furnish copies of installation instructions and copies of start-up instructions for any item of equipment when requested by the Owner.

.4 Operating and Maintenance Instruction Manuals

.1 Provide written copies of complete operating and maintenance instructions for equipment furnished under this Contract. Provide duplicate manual in electronic format on CD. Provide Operating and Maintenance Manuals as per specifications.

.2 Bind instructions in loose-leaf 3-ring binders. When only one volume is required, provide a complete index. When more than one volume is required, include in the first book a complete index of all volumes and an individual index in each succeeding volume. Include the following manuals:

.3 Control Shop Drawings and operating sequence including wiring of components.

.4 Maintenance instructions including preventive maintenance instructions for components of the equipment.

.5 Manufacturers' warranties and guarantees.

1.10 QUALITY ASSURANCE

.1 Regulatory Requirements

.1 Conform to governing Municipal or Provincial Codes, Rules and Regulations and/or Authorities having jurisdiction.

.2 Codes and Standards referred to hereinafter are by inference, in each case, the latest issue of the Specified Code or Standard, including all revisions and amendments thereto as adopted and published at date of tender closing.

.3 Do all work and supply all equipment in accordance with the requirements and recommendations of the latest issue of the applicable standards and codes of the:

- National Standards of Canada (NS Can)
- Canadian General Standards Board (CGSB)
- Canadian Standards Association (CSA)
- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- American Society of Mechanical Engineers (ASME)
- Ontario Building Code O.Reg. 403/97, as amended
- Environmental Protection Act O. Reg. 189/94 as amended to O.Reg. 238/01- Refrigerants and 190/94 - Non-Venting of Refrigerants
- Ontario Regulation 413/94 - Halon Fire Extinguishing Equipment
- Ontario Fire Code
- Ontario Ministry of Labour
- American Society of Heating, Refrigerating and
- Air Conditioning Engineers (ASHRAE)
- Sheetmetal and Air Conditioning Contractors' National Association (SMACNA)
- National Research Council Canada – Model Energy Code of Canada for Buildings 1997
- American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE) Standard 90.1-2001 - Energy Standard For Buildings Except Low-Rise Residential Buildings.

1.11 ELECTRICAL REQUIREMENTS

.1 Comply with the requirements of the Electrical Safety Code.

.2 All equipment specified in Division 23 or shown on the Mechanical drawings to be supplied and installed by Division 23 and wired by Division 26 unless specifically indicated otherwise. Generally, all wiring above 70 volts by Division 26 and all low voltage control wiring below 70 volts by Division 23 unless otherwise indicated.

.3 The nominal electrical service available for mechanical equipment is 208 or 575 volts, 1 or 3 ph, 60 Hz and 120 volts, 1 ph, 60 Hz, unless specifically stated otherwise on the Drawings.

.4 If the Owner gives approval of substitution of any item of mechanical equipment, include and pay for all necessary electrical changes (labour, materials, overhead, etc.) due to the substitution of the equipment.

PART 2 Products – Not Used.

PART 3 Execution

3.1 GENERAL CONSTRUCTION REQUIREMENTS

.1 General

.1 Conform with applicable requirements of the Occupational Health and Safety Act and Regulations for Construction Projects, Ontario Regulation 213/91 Amended to O. Reg 85/04.

.2 Measurements and Deviations

.1 Where any parts of the mechanical work are specifically located by dimensions on the Drawings, check and verify these dimensions on the site prior to installation.

.2 Before installing ductwork and piping, review site conditions and all applicable design drawings. Coordination and cooperation between all construction trades is required to accommodate mechanical system components within the space available in the building. Where interference may occur and departures from arrangements as shown are required, consult with and obtain approval from the Consultant for proposed changes before proceeding with the work.

.3 Should any discrepancies occur during installation of mechanical work which will necessitate major revisions to the mechanical trades work or the work of other trades or contractors, notify the Consultant immediately and obtain written authorization before proceeding with the work.

.3 Scaffolding and Hoisting Equipment

.1 Provide all required scaffolding and hoisting equipment to carry out mechanical work as indicated on the drawings and outlined in specifications.

.4 Overloading

.1 During installation of mechanical work, do not load any part of the building structure with a load greater than it is capable of bearing. Bear full responsibility should any accident occur or damage result through the violation of this requirement.

.5 Cutting and Patching

.1 Cutting of holes up to 200 mm (4”) in diameter and related patching shall be done under Division 23. Holes and other

openings larger than 200 mm (4") in diameter, all chases, bulk-heads, furring and related patching shall be done by others. Read same for detailed information regarding cutting and patching.

3.2 PAINTING

.1 Painting Work to be in accordance with Division 09. Painting requirements identified herein is applicable only to mechanical systems within Division 23.

.2 Painting and Cleaning

.1 Touch up minor damage to finish on equipment with standard factory applied baked enamel finish. If, in the Owner's opinion, the damage is too extensive to be remedied by touch up, replace damaged equipment.

.2 Clean miscellaneous steel by scraping, wire brushing or other effective means to remove base scale, rust, oil, dirt or other foreign matter.

.3 Apply one coat of zinc chromate iron oxide primer, conforming to CAN/CGSB-1.40M to all miscellaneous steel.

.4 In the field, touch up all bolt heads and nuts, previously unpainted connections and surfaces damaged during erection with primer as hereinbefore specified.

.5 Give two coats of primer to all surfaces which will be inaccessible after erection.

.6 Thoroughly remove all foreign matter from steelwork on completion of installation.

3.3 PROTECTION

.1 Protect all building openings before and after erection from weather and other hazards and keep in a clean and orderly manner.

.2 Protect building openings to prevent damage or intrusion. Provide caps for curbs until construction is complete.

3.4 PERFORMANCE TESTING AND BALANCING

.1 Perform Testing, Adjusting and Balancing in accordance with Section 23 05 93 – Testing Adjusting and Balancing for HVAC.

.2 Assume responsibility for testing, balancing and placing all air handling and hydronic systems in operation, prior to final acceptance in presence and under direction of Consultant.

.3 Provide all instruments required to test and balance systems. Balance systems in accordance with design requirements indicated on the Drawings and in Specifications. Report to the Consultant immediately any

deficiencies in the systems or equipment performance resulting in design requirements being unobtainable.

.4 On completion of testing and balancing of all systems, submit to Consultant a final an electronic report of findings, including complete data of pump and fan performance, pressures, air quantities, flow rates and ampere readings of all motors, taken at motor terminals when equipment is operating under full load conditions.

.5 Submit with each copy of the report, complete sets of duct and piping layout prints showing all locations at which test readings were taken, the air volume, velocity and static pressure in each supply and return duct, and the final reading at test points. Submit hydronic flow measurement reports showing flow rates at all heating system components.

3.5 ADJUSTMENT AND OPERATION OF SYSTEMS

.1 When the work is complete, adjust all equipment items of the various systems for proper operation within the framework of design intent, and the operating characteristics as published by the equipment manufacturer.

.2 Note: Additional instructions are specified under the respective Sections of this Division.

.3 The Owner reserves the right to require the services of an authorized representative of the manufacturer in the event that any item of equipment is not adjusted properly. Arrange for such services and bear all incurred costs thereof. After completion of adjustments, place the systems in full operating condition and advise the Owner that the work is ready for acceptance.

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Use of mechanical systems during construction.

1.2 USE OF SYSTEMS

.1 Use of new heating, ventilating and/or air conditioning systems for supplying temporary heat or ventilation is not permitted during construction. In addition, the Contractor will ensure that no debris or contaminants enter new ductwork, piping, or equipment. Protective air-tight films or covers shall be used on open ends of ductwork and piping to prevent entry of aforementioned contaminants and debris. Provide temporary filters on all return air duct openings if equipment is started before construction is completely finished.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

.1 Section 23 08 01 – Performance Verification for Mechanical Piping Systems.

.2 Section 23 08 02 – Cleaning and Start-up of Mechanical Piping Systems.

.3 Conform to Sections of Division 01 and Division 07 as applicable.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

PART 2 **Products** - Not Used.

PART 3 Execution

3.1 CONNECTIONS TO EQUIPMENT

.1 In accordance with manufacturer's instructions unless otherwise indicated.

.2 Use valves and either unions or flanges for isolation and ease of maintenance and assembly.

.3 Use double swing joints when equipment mounted on vibration isolation and when piping subject to movement.

3.2 CLEARANCES

.1 Provide clearance around systems, equipment and components for observation of operation, inspection, servicing, maintenance and as recommended by manufacturer.

.2 Provide space for disassembly, removal of equipment and components as recommended by manufacturer or as indicated (whichever is greater) without interrupting operation of other system, equipment, and components.

3.3 DRAINS

.1 Install piping with grade in direction of flow except as indicated.

.2 Install drain valve at low points in piping systems, at equipment and at section isolating valves.

.3 Drain valves: NPS 19mm (3/4") gate or globe valves unless indicated otherwise, with hose end male thread, cap and chain.

3.4 AIR VENTS

.1 Install air vents at high points in piping systems.

.2 Install ball type isolating valve at each automatic air valve.

.3 Install drain piping to approved location and terminate discharge as indicated.

3.5 DIELECTRIC COUPLINGS

.1 General: Compatible with system, to suit pressure rating of system.

.2 Locations: Where dissimilar metals are joined.

.3 NPS 50mm (2”) and under: isolating unions or bronze valves.

.4 Over NPS 50mm (2”): Isolating flanges.

3.6 PIPEWORK INSTALLATION

.1 Screwed fittings jointed with thread sealing compound or Teflon tape.

.2 Protect openings against entry of foreign material.

.3 Install to isolate equipment and allow removal without interrupting operation of other equipment or systems.

.4 Assemble piping using fittings manufactured to ANSI standards.

.5 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main.

.1 Hole saw (or drill) and ream main to maintain full inside diameter of branch line prior to installing saddle.

.6 Install exposed piping, equipment, rectangular cleanouts and similar items parallel or perpendicular to building lines.

.7 Install concealed pipework to minimize furring space, maximize headroom and conserve space.

.8 Slope piping, except where indicated, in direction of flow for positive drainage and venting.

.9 Install, except where indicated, to permit separate thermal insulation of each pipe.

.10 Group piping wherever possible and where indicated.

.11 Ream pipes, remove scale and other foreign material before assembly.

.12 Use eccentric reducers at pipe size changes to ensure positive drainage and venting.

.13 Valves:

.1 Install in accessible locations.

.2 Remove interior parts before soldering.

.3 Install with stems above horizontal position unless otherwise indicated.

.4 Leave valves accessible for maintenance without removing adjacent piping.

.5 Use ball or butterfly valves at branch take-offs for isolating purposes except where otherwise specified.

.6 Install ball or butterfly valves for glycol service.

.14 Check Valves:

.1 Install swing check valves in horizontal lines on discharge of pumps and elsewhere as indicated.

3.7 SLEEVES

.1 General: Install where pipes pass through masonry, concrete structures, fire rated assemblies, and elsewhere as indicated.

.2 Material: Schedule 40 black steel pipe.

.3 Construction: Foundation walls and where sleeves extend above finished floors to have annular fins continuously welded on at mid-point.

.4 Sizes: 6 mm (1/4”) minimum clearance between sleeve and un-insulated pipe or between sleeve and insulation.

.5 Installation:

.1 Concrete, masonry walls: Terminate flush with finished surface.

.2 Before installation, paint exposed exterior surfaces with heavy application of zinc-rich paint to CAN/CGSB-1.181.

.6 Sealing:

.1 Foundation walls and below grade floors: Fire retardant, waterproof non-hardening mastic.

.2 Elsewhere: Provide space for firestopping. Maintain fire rating integrity.

.3 Sleeves installed for future use: Fill with lime plaster or other easily removable filler.

.4 Ensure no contact between copper pipe or tube and sleeve.

3.8 ESCUTCHEONS

.1 Install on pipes passing through walls, partitions, floors, and ceilings in finished areas.

.2 Construction: One-piece type with set screws. Chrome or nickel plated brass or Type 302 stainless steel.

.3 Sizes: Outside diameter to cover opening or sleeve. Inside diameter to fit around pipe or outside of insulation if so provided.

3.9 PREPARATION FOR FIRESTOPPING

.1 Material and installation within annular space between pipes, ducts, insulation and adjacent fire separation shall conform to Division 07.

.2 Uninsulated unheated pipes not subject to movement: No special preparation.

.3 Uninsulated heated pipes subject to movement: Wrap with non-combustible smooth material to permit pipe movement without damaging firestopping material or installation.

.4 Insulated pipes and ducts: Ensure integrity of insulation and vapour barriers.

3.10 FLUSHING OUT OF PIPING SYSTEMS

.1 Before start-up, conform to Section 23 08 02 – Cleaning and Start-up of Mechanical Piping Systems. Isolate heating equipment during flushing.

.2 Preparatory to acceptance, clean and refurbish equipment and leave in operating condition, including replacement of filters in piping systems.

3.11 PRESSURE TESTING OF EQUIPMENT AND PIPEWORK

.1 Advise Consultant minimum 48 hours prior to performance of pressure tests. Conduct tests in presence of Consultant as deemed necessary.

.2 Pipework: Test as specified in Section 23 08 01 – Performance Verification for Mechanical Piping Systems.

.3 Maintain specified test pressure without loss for 4 hours minimum unless specified for longer period of time in relevant sections of Division 23.

.4 Prior to tests, isolate equipment and other parts which are not designed to withstand test pressure or media.

.5 Pay costs for repairs or replacement, re-testing and making good. Consultant shall determine whether repair or replacement is appropriate.

.6 Insulate or conceal work only after approval and certification of tests by Consultant.

END OF SECTION

PART 1 General

1.1 GENERAL REQUIREMENTS

.1 Conform to Sections of Division 01 as applicable.

.2 Conform to Section 26 05 01 – Common Work Results Electrical, as applicable.

1.2 REFERENCES

ANSI/NFPA 90A	- Air Conditioning and Ventilating Systems, Installation of.
ANSI/NFPA 90B	- Warm Air Heating and Air Conditioning Systems.
ASTM C335	- Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulations.
CAN/ULC-S102	- Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
CGSB 51-GP-9M	- Thermal Insulation, Mineral Fibre, Sleeving for Piping and Round Ducting.
CGSB 51-GP-52M	- Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
CSA HA Series	- CSA Standards for Aluminum and Aluminum Alloys.

1.3 DESCRIPTION

.1 Furnish materials, equipment and labour required to apply thermal insulation to piping in accordance with full intent and meaning of Drawings and Specifications, including but not limited to the following:

- Hydronic Heating Piping
- Domestic Water Piping
- Refrigerant Piping

1.4 SUBMITTALS

.1 Shop Drawings: Before ordering any insulating materials, submit to the Owner a list of proposed insulation materials, exterior jackets and adhesive for the various services and equipment on the project. Deviation from the approved list will not be allowed.

.2 Insulating materials shall be new, undamaged and of the respective types specified for each specific application.

1.5 QUALIFICATIONS

.1 Use a recognized insulation applicator specializing in, and with an established reputation for, this type of work.

1.6 REGULATORY REQUIREMENTS

.1 Comply with all requirements of local and Provincial authorities having jurisdiction, Ontario Building Code and Underwriters' Laboratory of Canada.

.2 Fire retardant type insulation materials, coverings and adhesives with flame spread/smoke developed ratings not exceeding 25/50 when tested in accordance with CAN/ULC-S102.

.3 Properly identify insulation materials, coverings and adhesives when required by Federal and/or Provincial health and safety WHMIS legislation.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Retain insulation materials in original cartons or containers until immediately prior to application and keep dry during shipping and storage.

.2 Keep adhesives in their original containers with manufacturer's name and catalogue number clearly stated. Protect contents against freezing.

PART 2 Products

2.1 HYDRONIC HEATING PIPING

.1 Fibrous glass split sectional pipe insulation of thickness as listed on drawings with factory applied vapour barrier jacket and self-seal lap joint.

2.2 DOMESTIC WATER PIPING

.1 Fibrous glass split sectional pipe insulation of thickness as listed on drawings with factory applied vapour barrier jacket and longitudinal self seal lap joint.

2.3 REFRIGERANT PIPING

.1 Insulate refrigerant suction and liquid lines with 12mm (1/2”) nominal thickness fire retardant elastomeric closed cell foam or neoprene tubing applied in accordance with the manufacturer’s printed instructions using the recommended adhesive.

PART 3 Execution

3.1 GENERAL

.1 Perform insulation work using qualified insulation applicators, in accordance with latest trade application methods and to Owner's approval.

.2 Clean all surfaces to be insulated to remove grime, grease, oil, moisture or other matter to ensure that insulation is applied to clean dry surfaces.

.3 Apply insulation under ambient temperature conditions in accordance with insulation or adhesive manufacturer's recommendations.

.4 Do not apply insulation until piping has been tested, inspected, verified, and accepted by Owner.

.5 Apply insulation neatly and tightly in unbroken lengths and with ends of sections firmly and squarely butted or engaged together.

3.2 HYDRONIC HEATING PIPING

.1 Apply 75mm wide butt strips with same material as factory-applied jacket.

.2 Insulate fittings, flanges and valves with fibrous glass insulation and finish with pre-moulded PVC cover, securely fastened and sealed to adjoining pipe covering with adhesive to form a vapour-proof joint.

.3 Do not insulate screwed union or final connection to equipment.

3.3 DOMESTIC WATER PIPING

.1 Apply 75mm wide butt strips with same material as factory-applied jacket.

.2 Insulate fittings, flanges and valves with fibrous glass insulation and finish with pre-moulded PVC cover, securely fastened and sealed to adjoining pipe covering with adhesive to form a vapour proof joint.

.3 Do not insulate screwed union or final connection to equipment.

3.4 REFRIGERANT PIPING

.1 Apply and finish insulation in accordance with manufacturer’s printed instructions, using recommended adhesives and finishes.

3.5 SURFACE FINISHES

.1 Cover exposed piping insulation, valves and fittings with PVC jacketing for:

- Hydronic Heating Piping
- Domestic Water Piping

END OF SECTION

PART 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for thermometers and pressure gauges in piping systems.

1.2 RELATED SECTIONS

.1 Conform to Sections of Division 01 as applicable.

.2 Section 23 05 54 - Mechanical Identification.

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME).

.1 ASME B40.100, Pressure Gauges and Gauge Attachments.
.2 ASME B40.200, Thermometers, Direct Reading and Remote Reading.

.2 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-14.4, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
.2 CAN/CGSB-14.5, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

1.4 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Submit shop drawings and product data.

.3 Submit manufacturer's product data for following items:

.1 Thermometers.
.2 Pressure gauges
.3 Isolating ball valves.

PART 2 Products

2.1 GENERAL

.1 Design point to be at mid point of scale or range.

.2 Ranges: to suit service.

2.2 DIRECT READING THERMOMETERS

.1 Industrial, variable angle type, 230 mm (9.2”) diameter Valox impact resistant case, organic liquid filled tube, glass lens, 90mm (3.5”) stem and 19mm (3/4”) brass separable thermowell, dual scale. Range to suit service

2.3 PRESSURE GAUGES

.1 FNW mechanical contractors pressure gauge supplied with 115 mm (4-1/2”) white aluminum dial, 304 stainless steel case and ring, acrylic lens, brass socket, 6mm (1/4”) MNPT connection, phosphor bronze bourdon tube and brass movement.

.2 Black and red dual scale gauge, range to suit service.

.3 Provide:

.1 Snubber for pulsating operation.

.2 Mini-ball type isolation valve

PART 3 Execution

3.1 GENERAL

.1 Install gauging to be easily read from floor.

.2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

.1 Install in wells on piping as indicated. Provide heat conductive grease inside well.

.2 Use extensions where thermometers are installed through insulation if required.

3.3 PRESSURE GAUGES

.1 Install in following locations:

.1 Suction and discharge of pumps.

.2 In other locations as indicated.

.2 Install mini-ball valves for gauge isolation.

END OF SECTION

PART 1 General

.1 Conform to Sections of Division 01 as applicable.

.2 Conform to Section 23 05 00 Common Work Results – Mechanical as applicable.

1.2 RELATED SECTIONS

.1 Section 26 05 01 Common Work Results - Electrical.

1.3 REFERENCES

.1 CGSB 24.3-92 - Identification and Classification of Piping Systems.

1.4 SUBMITTALS

.1 Shop Drawings

.1 Submittals, product data and shop drawings to be in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

PART 2 Products

2.1 MANUFACTURERS

.1 Pipe Labels, Identification Tapes and Tags

-Brady
-Safety Supply Co.
-S.M.S.
-Revere-Seton

2.2 MANUFACTURERS NAMEPLATES

.1 Provide metal nameplate on each piece of equipment, mechanically fastened complete with raised or recessed letters.

.2 Indicate equipment tag number as indicated on Drawings and equipment size, model, manufacturer's name, serial number, performance rating, voltage, cycle, phase and power of motors.

2.3 EQUIPMENT LABELS

.1 Provide labels for all mechanical and electrical equipment installed under this Division, adequately describing the function or use of the particular equipment involved and including equipment number and equipment name generally as listed on the Drawing Schedules. Submit list of labels to the Consultant for review. Do not commence production of labels until after receipt of Consultant review.

.2 Fit labels to electrical equipment, including, but not limited to: motor starters, pushbutton stations, control panels, time switches, disconnect switches, and contactors or relays in separate enclosures.

2.4 PIPE IDENTIFICATION

.1 Label all piping installed under this Division to indicate the content and direction of flow.

.2 After finished painting is complete, identify each pipe with stencils and stencil paint. Alternatively, use SMS Coil-Mark or adhesive style building service pipe markers.

.3 Colour coding to be as per the following schedule. For all other services, provide colour coding in conformance with CAN/CGSB-24.3 and ANSI A131 as follows:

Pipe and Valve Identification				
Pipe Marker Legend	Valve Tag Legend	CGSB Hazzard Classification	Background Colour	Text Colour
Raw Water	RAW	Low	Green	White
Sea Water	SEA.W	Low	Green	White
City Water	CI.W	Low	Green	White
Cold Water	C.W.	Low	Green	White
Distilled Water	DI.W	Low	Green	White
Demineralized Water	DE.W	Low	Green	White
Condenser Water Supply	COND.W.S.	Low	Green	White
Condenser Water Return	COND.W.R.	Low	Green	White
Chilled Water Supply	CH.W.S.	Low	Green	White
Chilled Water Return	CH.W.R.	Low	Green	White
Chilled Water	CH.W	Low	Green	White
Domestic Cold Water Supply	D.W.S.	Low	Green	White

Domestic Hot Water Supply	D.H.W.S.	Low	Green	White
Domestic Hot Water Recirc.	D.H.W.R	Low	Green	White
Hot Water Heating Supply (up to 120C)	H.W.H.S	Hazardous	Yellow	Black
Hot Water Heating Return (up to 120C)	H.W.H.R	Hazardous	Yellow	Black
High Temp. Hot Water Heating Supply (above 120C)	H.T.H.S.	Hazardous	Yellow	Black
High Temp. Hot Water Heating Return (above 120C)	H.T.W.R	Hazardous	Yellow	Black
Make-Up Water	M.U.W	Low	Green	White
Boiler Feed Water	B.F.W	Hazardous	Yellow	Black
Condensate Return - Gravity	C.R.G.	Hazardous	Yellow	Black
Condensate Return - Pumped	C.R.P.	Hazardous	Yellow	Black
Blow Off	B.O.	Hazardous	Yellow	Black
Treated Water	T.W.	Low	Green	None
Brine	B.	Low	Green	None
Waste Water	W.W.	Low	Green	None
Storm Sewer	S.S.	Low	Green	None
Sanitary Sewer	SAN.S	Low	Green	None
Combination Sanitary Storm Sewer	C.S.S.S	Low	Green	None
Acid Drain	A.D.	Hazardous	Yellow	Black
Isotope Drain	I.D.	Hazardous	Yellow	Black
Refrigerant Suction (include refrigerant No.)	REF.S	Hazardous	Yellow	Black
Engine Exhaust	E.E.	Hazardous	Yellow	Black

Fuel Oil (show type No.)	F.P. (No.)	Hazardous	Yellow	Black
Steam (indicate pressure)	S.kPa (psig)	Hazardous	Yellow	Black
Lube Oil	L.O.	Hazardous	Yellow	Black
Hydraulic Oil	H.O.	Hazardous	Yellow	Black
Instrument Air	I.A.	Low	Green	White
Gasoline	G.	Hazardous	Yellow	Black
L.P. Gas	L.P.G.	Hazardous	Yellow	Black
Natural Gas	N.G.	Hazardous	Yellow	Black
Chlorine	CHLOR.	Hazardous	Yellow	Black
Nitrogen (pressure 700 kPa and lower)	NIT.	Low	Green	White
Oxygen (not medical gas)	OXY.	Hazardous	Yellow	Black
Vacuum (not medical gas)	VAC.	Low	Green	White
Compressed Air – indicate pressure (700 kPa and lower)	C.A. kPa	Low	Green	White
Compressed Air – indicate pressure (over 700 kPa)	C.A. kPa	Hazardous	Yellow	Black
Fire Protection Water	F.P.W.	Fire Protection	Red	White
Sprinkler Water	S.W.	Fire Protection	Red	White
Carbon Dioxide (fire protection)	CO	Fire Protection	Red	White
Vent (plumbing)	V.P.	Low	Green	White
Vent	V.	Hazardous	Yellow	Black
Soil Gas	SOIL GAS	Hazardous	Yellow	Black

.4 Where outside diameter of pipe (or insulation) exceeds 75 mm (3"), provide labels with a minimum width of 64 mm (2-1/2") and 50 mm (2") high letters. Where outside diameter of pipe (or insulation) is 75 mm (3") or less, provide labels of 29 mm (1-1/8") width and 25 mm (1") high lettering. Length of labels as dictated by legend.

.5 Supply and attach to each valve a 50mm x 50mm (2” x 2”) lamacoid tag with valve number. Provide a valve chart and co-ordinate valve numbers with the “As-built” plan and schematic drawings

.6 All control, drain, and test connection valves shall be provided with signs indicating their purpose.

.7 Identify all fans, pumps, air handling equipment, boilers, chillers, controls, starters, switches, pushbuttons, and all other equipment as to service by lamacoid engraved nameplate.

.8 All tags and nameplates shall be securely fastened to the device they identify.

.9 Identification font height shall be 20mm (0.8”) minimum.

2.5 CONTROLS IDENTIFICATION

.1 Identify each piece of equipment, including sensors, controlled devices, and control panels, with a nameplate identifying the equipment and functions with a letter and number designation.

.2 Provide a single line diagram for the control points located in each controls enclosure.

.3 Nameplates shall be minimum size 75mm x 25mm (3" x 1") plastic labelling tape with black letters. Nameplates shall be securely attached to the equipment and listed in the Operating and Maintenance manual.

.4 Printed nametags are acceptable for cabinet mounted components providing they are securely attached.

.5 Additional labeling requirements when applicable:

.6 Color code wiring consistently throughout the installation and generally match color coding of internal wiring of pre-wired components.

.7 Label wiring and pneumatic tubing with point name using Thomas & Betts 12-character polestar metalized labels with 3 rows of characters per label, or equal by Brady. Label to occur as a minimum at both ends and at pull boxes of the wiring/tubing run.

.8 Identify all pull boxes, junction boxes, etc. (installed as part of this project or used by this project) with the exact use of the box. Indelible felt pen marker is acceptable.

.9 Label sensors mounted in occupied spaces such as temperature, humidity and carbon dioxide sensors with point name (or TEC ID.) using Thomas & Betts 12 character label, or equal by Brady. Label to be black lettering on clear backing.

.10 Label relays and controllers inside panels using Thomas & Betts 12 character label, or equal by Brady.

.11 Provide blue, 50mm (1/2”) diameter, sticker on ceiling T-bar below ceiling mounted equipment such as VAV boxes controllers with VAV box # on the sticker with thin permanent black mark pen.

.12 Provide yellow, 50mm (1/2”) diameter, sticker on T-bar below fan equipment mounted in ceiling space such as exhaust fans. Include fan # on sticker with thin permanent black mark pen.

2.6 ELECTRICAL EQUIPMENT IDENTIFICATION

.1 As specified in Division 26.

PART 3 Execution

3.1 GENERAL

.1 Clean all surfaces before painting or attaching adhesive labels.

.2 Locate labels and identification in conspicuous location to facilitate easy reading from operating floor.

.3 Do not insulate, cover, or paint over labels.

3.2 EQUIPMENT LABELS

.1 Securely adhere labels to the equipment.

3.3 PIPE IDENTIFICATION

.1 Locate labels as follows:

.2 At every end of every pipe run, adjacent to the valve or item of equipment serviced.

.3 At all valves, tees and changes of direction.

.4 At intervals of 15 m (50 ft) along every exposed pipe run exceeding 15 m (50 ft) in length.

.5 Locate labels so they are visible from 1.5 m (5 ft) above the adjacent floor or platform.

END OF SECTION

PART 1 General

1.1 Conform to Sections of Division 01 as applicable.

.1 Conform to Section 23 05 00 - Common Work Results Mechanical as applicable.

1.2 RELATED SECTIONS

.1 Automatic Controls: Section 23 09 33 - Electric and Electronic Control System for HVAC.

1.3 REFERENCES

.1 Perform testing and balancing in accordance with the current issue of the Associated Air Balance Council Standards for Total System Balance and SMACNA Standards where applicable. Use recently calibrated instruments and state date of calibration in all reports.

1.4 DEFINITIONS

.1 "BALANCING" to proportion and regulate flows from and to the equipment at appropriate pressures in accordance with the design intent.

.2 "TESTING" to measure, interpret and report in writing, such parameters as may be required to verify design compliance and as hereafter specified.

1.5 DESCRIPTION

.1 The work to be performed under this Section includes the performance testing and balancing of heating, ventilating and air conditioning system equipment and of the air and duct systems, including all labour, materials and equipment required to carry out this work, and co-operating with the mechanical contractor who will operate the systems and upon request from this contractor, make any required adjustments to the systems to meet the specified and intended performance.

The principal items of work are as follows:

- Performance testing and balancing of all equipment
- Survey the installed automatic controls and verify their functional performance

1.6 DESIGN REQUIREMENTS, PERFORMANCE REQUIREMENTS

.1 Tolerances

.1 Balance all equipment to the performance parameters indicated on drawings and in the specifications. If interpretation, clarification or additions to performance parameters are required, request such information from the Consultant.

.2 Balance systems to within the following tolerances:

Equipment and Low pressure ducts	
0 to 0.5 kPa (0 to 2" W.G.)	5% of full flow
Hydronic Valves	5% of full flow

1.7 SUBMITTALS

.1 Reports

.1 Final report complete with design flows, measured flows, and % deviation between the two values.

.2 Record Drawings: Record, in red ink, any changes to the set of plans submitted with the review and recommendation report while the work progresses. At the completion of the work submit to the Consultant.

1.8 QUALITY ASSURANCE

.1 Qualifications: Use an independent Testing and Balancing Firm with a minimum of five years experience in this type of work to carry out performance testing and balancing.

1.9 SEQUENCING AND SCHEDULING

.1 Coordinate balancing work so as maintain turn-over schedule for facility. Advise Consultant 96 hours prior to the start of balancing work.

Part 2 Products

2.1 MATERIALS

.1 Supply all test equipment required to perform the work of this Section.

Part 3 Execution

3.1 GENERAL

.1 Coordination and Cooperation

.1 The Testing and Balancing Firm will co-operate with the Mechanical Contractor giving adequate prior notification of request for services of tradesmen, and co-ordinating his efforts so that items requiring replacement and/or delivery time (sheaves, motors, etc.) are tested as early as possible.

.2 The Mechanical Contractor and the pertinent trades shall co-operate with the Testing and Balancing Firm and shall provide the following assistance and/or services:

- Schedule sufficient time so that the initial testing and balancing can be completed and co-ordinate with the trades involved.
- Keep the Testing and Balancing Company informed of any major changes made during construction and provide them with a set of drawings and approved shop drawings.
- Provide immediate labour from pertinent mechanical trades and tools, equipment and materials to make equipment and system alterations and adjustments, as required including control adjustments.
- Make available all equipment data (Shop Drawing Performance Data and operating instructions) to the Testing and Balancing Firm.

.3 As part of the co-ordination effort, the Mechanical Contractor shall be fully responsible for the systems having been constructed and adjusted to provide optimum performance. Any re-adjusting required as the result of spot checks by the Consultant shall be done at no additional cost to the Owner.

3.2 PROCEDURE

.1 General

.1 Review all pertinent plans, specifications, shop drawings, interference drawings and other documentation to become fully familiar with the systems and their specified and intended performance.

.2 Report any objectionable noise or vibration.

.3 Operate, test and balance all equipment over their entire design range of operation including return air and supply air. Record sufficient data to verify compliance with design requirements.

.2 Data Required: Submit the following data as a minimum. If this contractor's standard forms provide for additional data, submit this data as well. Indicate where tests were not specifically made. Do not repeat design data or other values not specifically tested.

.1 Motors
Manufacturer
Model and Serial number
Rated amperage and voltage
Rated horsepower
Rated RPM
Corrected full load amperage
Measured amperage and voltage
Calculated kW (BHP)
Measured RPM
Sheave size, type and manufacturer

.2 Air Handling Units

Manufacturer
Model and Serial number
Rated L/S (CFM)
Rated RPM
Rated coil/filter pressures (suction and discharge)
Measured L/S (CFM)
Measured RPM
Measured coil/filter pressures (suction and discharge)
Pulley size, type and manufacturer
Belt size and quantity

.3 Heat/Energy Recovery Ventilators

Manufacturer
Model and Serial number
Rated L/s (CFM)
Rated RPM
Rated coil/filter pressures (suction and discharge)
Measured L/s (CFM)
Measured RPM
Measured coil/filter pressures (suction and discharge)
Pulley size, type and manufacturer
Belt size and quantity

.4 Air Systems (including inlets and outlets)

Grille, register or diffuser reference number and manufacturer
Grille, register or diffuser location
Design flow rates in L/s (CFM) at terminals
Measured flow rates in L/s (CFM) at terminals

.5 Hydronic Systems

Pump manufacturer and model number
Pump operating point
Balance valve reference number and manufacturer
Balance valve location
Design flow rate in L/s (GPM) at pump discharge
Design flow rate in L/s (GPM) at balancing valves
Measured flow rate in L/s (GPM) at pump discharge
Measured flow rate in L/s (GPM) at balancing valves

.3 Site Visits: Visit the site as required to carry out testing and balancing of the equipment to establish system flows.

.4 Final Report: Submit the final report to the Consultant and Owner. Submit one (1) electronic copy of the final report.

3.3 ACCEPTANCE AND FOLLOW-UP

.1 Deficiencies: Report any deficiencies in the equipment performance resulting in design requirements being unobtainable immediately to the Consultant. Include outstanding deficiencies in final report.

.2 The substantial performance of the Mechanical Contractor shall be considered reached when the final Balancing Reports from this Section are accepted by the Consultant and in the opinion of the Consultant all systems and equipment have been satisfactorily installed, operated tested, balanced, and adjusted to meet the specified and intended performance.

3.4 ADDITIONAL TESTING

.1 The Consultant may request such additional testing in connection with this project as is deemed necessary.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

.1 Section 23 05 00 - Common Work Results - Mechanical

.2 Section 23 05 12 - Thermal Insulation for Piping.

.3 Conform to Sections of Division 01 as applicable.

1.2 REFERENCES

ANSI/NFPA 90A	Installation of Air Conditioning and Ventilating Systems
ANSI/NFPA 90B	Warm Air Heating and Air Conditioning Systems.
ASTM A167-99	Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
ASTM C335-95	Test Method for Steady-State Heat Transfer Properties of Horizontal Pipe Insulations.
ASTM C411-97	Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
ASTM C547-00	Thermal Insulation, Mineral Fibre, Sleeving for Piping and Round Ducting
ASTM C553-02	Thermal Insulation, Mineral Fibre, Blanket for Piping, Ducting, Machinery and boilers. (replaces CGSB 51-11M)
CAN/ULC S701-01	Thermal Insulation, Polystyrene, Boards and Pipe Covering (replaces CAN/CGSB-51.20)
CAN/CGSB-51.12	Cement, Thermal Insulating and Finishing.
CAN/CGSB-51.40	Thermal Insulation, Flexible, Elastomeric, Unicellular, Sheet and Pipe Covering.
CAN/ULC-S102-1988(R2000)	Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
CGSB 51-GP-52M -	Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
CGSB 51-GP-53-95 -	Jacketing, Polyvinyl Chloride Sheet for Insulating Pipes, Vessels and Round Ducts.
CSA HA Series	CSA Standards for Aluminum and Aluminum Alloys.
MNECB 1997	Model National Energy Code of Canada for Buildings
ASHRAE 90.1-2001	Energy Standard for Buildings Except Low Rise Residential buildings.

1.3 DESCRIPTION

.1 Furnish materials, equipment and labour required to apply thermal insulation to ductwork and equipment in accordance with full intent and meaning of Drawings and Specifications, including but not limited to the following:

.1 Sheet metal work

1.4 SUBMITTALS

.1 Product Data:

.1 Submit product data in accordance with Section 01 33 00 – Submittal Procedures.

.2 Before ordering any insulating materials, submit to the Owner a list of proposed insulation materials, exterior jackets and adhesive for the various services and equipment on the project. Deviation from the approved list will not be allowed.

1.5 QUALITY ASSURANCE

.1 Insulating materials shall be new, undamaged and of the respective types specified for each specific application.

.2 Qualifications

.1 Use a recognized insulation applicator specializing in, and with an established reputation for, this type of work.

.3 Regulatory Requirements

.1 Comply with all requirements of local and Provincial authorities having jurisdiction, Ontario Building Code and Underwriters' Laboratory of Canada.

.2 Fire retardant type insulation materials, coverings and adhesives with flame spread/smoke developed ratings not exceeding 25/50 when tested in accordance with CAN/ULC-S102.

.3 Properly identify insulation materials, coverings and adhesives when required by Federal and/or Provincial health and safety WHMIS legislation.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Retain insulation materials in original cartons or containers until immediately prior to application and keep dry during shipping and storage.

.2 Keep adhesives in their original containers with manufacturer's name and catalogue number clearly stated. Protect contents against freezing.

PART 2 Products

2.1 SHEET METAL

.1 Apply insulation to the following ductwork systems and components:

.1 Concealed air conditioning supply air ducts downstream of air handling equipment.

.2 All fresh and exhaust air ductwork between air handling equipment and exterior of building.

.3 Other ductwork as noted on the drawings.

.2 Insulate exposed rectangular ductwork with rigid board of 48 kg/cu.m (3 lb/cu.ft.) density, 40 mm (1 1/2") thickness, and reinforced foil flame resistant kraft facing. Secure insulation to ductwork with fire resistant adhesive and impaling pins with speed clips of 305mm (12”) centres. Cut off protruding ends of pins and cover speed clips with scrim foil pressure sensitive tape. Provide corner beads to finish insulation edges.

.3 Insulate concealed rectangular ductwork as above, no corner beads.

.4 Insulate exposed and concealed round ductwork with flexible batt type insulation of 48 kg/cu.m (3 lb/cu.ft.) density, 40mm (1 1/2”) thickness with reinforced foil flame resistant kraft facing. Secure insulation to ductwork with fire resistant adhesive and scrim foil pressure sensitive tape.

PART 3 Execution

3.1 GENERAL

.1 Perform insulation work using qualified insulation applicators, in accordance with latest trade application methods and to approval of Consultant.

.2 Clean all surfaces to be insulated to remove grime, grease, oil, moisture or other matter to ensure that insulation is applied to clean dry surfaces.

.3 Apply insulation under ambient temperature conditions in accordance with insulation or adhesive manufacturer's recommendations.

.4 Do not apply insulation until ductwork has been tested, inspected, verified, and accepted by the Consultant.

.5 Apply insulation neatly and tightly in unbroken lengths and with ends of sections firmly and squarely butted or engaged together. Lap scrim foil pressure sensitive tape at all joints. Extend insulation through sleeves in walls (except fire walls) or other openings in building to make insulation and vapour barrier continuous and of uniform diameter.

.6 Terminate insulation at each side of fire walls and pack the space between wall sleeve and duct as specified in Section 23 05 00 - Common Work Results Mechanical.

3.2 SHEET METAL

.1 Secure insulation on exposed rectangular ductwork with welded impaling pins and speed washer type fasteners at 300 mm (12") centres. Provide a minimum of two rows of fasteners on each side of duct.

.2 In addition to mechanical fasteners, adhere insulation to the duct with Foster 85-20 or Bakor 230-38 fire resistive adhesive applied to the duct in 150 mm (6") wide strips at 450 mm (18") centres. Tightly butt all joints and breaks in insulation and seal with 75 mm (3") wide scrim foil pressure sensitive tape. Cut off protruding ends of welded pins and cover speed washers with same tape to ensure a smooth application of exterior jacket. Provide corner beads to finish insulation edges.

.3 Fasten insulation to concealed rectangular ductwork and to both concealed and exposed round ductwork with Foster 85-20 or Bakor 230-38 adhesive, applied in 150 mm (6") wide strips at 300 mm (12") centres. Tightly butt all edges and joints and seal with 75 mm (3") wide pressure sensitive scrim foil tape. Use tying cord only to temporarily secure insulation until adhesive has set.

.4 Insulate access doors or removable panels in ductwork as separate units to permit opening or removal without damage to adjoining insulation or provide pre-insulated units.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Related Sections:

.1 Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

.2 Conform to Sections of Division 01, as applicable.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM E202-04, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

1.3 CLEANING AND START-UP OF MECHANICAL PIPING SYSTEMS

.1 In accordance with Section 23 08 02 - Cleaning and Start-up of Mechanical Piping Systems.

1.4 HYDRONIC SYSTEMS - PERFORMANCE VERIFICATION (PV)

.1 Perform hydronic systems performance verification after cleaning is completed and system is in full operation.

.2 When systems are operational, perform a full scale test at maximum design flow rates, temperatures and pressures for continuous consecutive period of 48 hours to demonstrate compliance with design criteria.

1.5 HYDRONIC SYSTEM CAPACITY TEST

.1 Perform hydronic system capacity tests after:

.1 TAB has been completed

.2 Verification of operating, limit, safety controls.

.3 Verification of primary and secondary pump flow rates.

.4 Verification of accuracy of temperature and pressure sensors and gauges.

.2 Determine system capacity at test conditions.

.3 When capacity test is completed, return controls and equipment status to normal operating conditions.

1.6 GLYCOL SYSTEMS

.1 Test to prove concentration will prevent freezing to minus 18 degrees C (0 degrees F) Test inhibitor strength and include in procedural report. Refer to ASTM E202.

.2 Submit sample of system water to approved testing agency to determine if chemical treatment is correct. Include cost.

NATURAL GAS SYSTEMS

.3 Operation tests:

.1 Measure gas pressure at tank outlet and at burner manifold.

.2 Verify settings, operation, venting of high and low pressure cut-outs, alarms.

.3 Check terminals of vents for gas pressure regulators.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Procedures and cleaning solutions for cleaning mechanical piping systems.

.2 Conform to Sections in Division 01, as applicable.

1.2 REFERENCES

.1 American Society for Testing and Materials International (ASTM)

.1 ASTM E202-00, Standard Test Methods for Analysis of Ethylene Glycols and Propylene Glycols.

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

.1 Material Safety Data Sheets (MSDS).

1.3 CLEANING SOLUTIONS

.1 Tri-sodium phosphate: 0.40 kg (0.88 lb) per 100 L (26.4 Gal) water in system.

.2 Sodium carbonate: 0.40 kg (0.88 lb) per 100 L (26.4 Gal) water in system.

.3 Low-foaming detergent: 0.01 (0.88 lb) kg per 100 L (26.4 Gal) water in system.

Part 2 Execution

2.1 CLEANING HYDRONIC SYSTEMS

.1 Timing: systems operational, hydrostatically tested and with safety devices functional, before cleaning is carried out.

.2 Cleaning Agency:

.1 Retain qualified water treatment specialist to perform system cleaning.

.3 Install instrumentation such as flow meters, orifice plates, pitot tubes, flow metering valves only after cleaning is certified and complete.

.4 Cleaning procedures:

.1 Provide report outlining proposed cleaning procedures at least 4 weeks prior to proposed starting date. Report to include:

.1 Cleaning procedures, flow rates, elapsed time.

.2 Chemicals and concentrations used.

.3 Inhibitors and concentrations.

.4 Specific requirements for completion of work.

.5 Special precautions for protecting piping system materials and components.

.6 Analysis of water used to ensure water will not damage systems or equipment.

.5 Conditions at time of cleaning of systems:

.1 Systems: free from construction debris, dirt and other foreign material.

.2 Control valves: operational, fully open to ensure that terminal units can be cleaned properly.

.3 Strainers: clean prior to initial fill.

.4 Install temporary filters on pumps not equipped with permanent filters.

.5 Install pressure gauges on strainers to detect plugging.

.6 Isolate heating boilers and radiant floor manifolds and tubing during flushing procedures.

.6 Report on Completion of Cleaning:

.1 When cleaning is completed, submit report, complete with certificate of compliance with specifications of cleaning component supplier.

.7 Hydronic Systems:

.1 Fill system with water, ensure air is vented from system.

.2 Use water meter to record volume of water in system to +/- 0.5%.

.3 Add chemicals under direct supervision of chemical treatment supplier.

.4 Flush velocity in system mains and branches to ensure removal of debris. System pumps may be used for circulating cleaning solution provided that velocities are adequate.

.5 Add chemical solution to system.

.6 Establish circulation, raise temperature slowly to 82 degrees C (180 degrees F) minimum. Circulate for 12 h, ensuring flow in all circuits. Remove heat, continue to circulate until temperature is below 38 degrees C (100 degrees F). Drain as quickly as possible. Refill with clean water. Circulate for 6 h at design temperature. Drain and repeat procedures specified above. Flush through low point drains in system. Refill with clean water/propylene glycol mixture, to chemical treatment supplier recommendations.

.7 Test to prove glycol concentration will prevent freezing to minus 18 degrees C (0 degrees F). Test inhibitor strength and include in procedural report. Refer to ASTM E202.

2.2 START-UP OF HYDRONIC SYSTEMS

.1 After cleaning is completed and system is filled:

.1 Establish circulation and expansion tank pressure, set pressure controls.

.2 Ensure air is removed.

.3 Check pumps to be free from air, debris, possibility of cavitation when system is at design temperature.

.4 Inspect system pumps used for cleaning, replace worn parts if necessary.

.5 Clean out strainers until system is clean.

.6 Check water level in expansion tank with cold water with circulating pumps OFF and again with pumps ON.

.7 Repeat with water at design temperature.

.8 Check pressurization to ensure proper operation and to prevent water hammer, flashing, cavitation. Eliminate water hammer and other noises.

.9 Bring system up to design temperature and pressure slowly.

.10 Perform TAB as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.11 Adjust pipe supports, hangers, springs as necessary.

.12 Monitor pipe movement, performance of expansion joints, loops, guides, anchors.

.13 If bellows-type expansion joints flex incorrectly, shut down system, re-align, repeat start-up procedures.

.14 Re-tighten bolts using torque wrench, to compensate for heat-caused relaxation. Repeat several times during commissioning.

.15 Check operation of drain valves.

.16 Fully open balancing valves (except those that are factory-set).

.17 Check operation of over-temperature protection devices on circulating pumps.

.18 Adjust alignment of piping at pumps to ensure flexibility, adequacy of pipe movement, absence of noise or vibration transmission.

END OF SECTION

PART 1 GENERAL

1.1 Related Documents

.1 All work of this Division shall be coordinated and provided by a single Controls Building Management System (BMS) Contractor.

.2 The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades carrying out the related HVAC system upgrades. Reference the Division 23 Sections for details.

.3 The work of this Division shall be as required by the Specifications and Drawings.

.4 If the BMS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the Consultant.

1.2 Definitions

.1 Analog: A continuously variable system or value not having discrete levels. Typically exists within a defined range of limiting values.

.2 Binary: A two-state system where an “ON” condition is represented by one discrete signal level and an “OFF” condition is represented by a second discrete signal level.

.3 Building Management System (BMS): The total integrated system of fully operational and functional elements, including equipment, software, programming and associated materials to be provided by this Division BMS Contractor and to be interfaced to the associated work of other related trades.

.4 BMS Contractor: The single Contractor to provide the work of this Division. This Contractor shall be the primary manufacturer, installer, commissioner and ongoing service provider for the BMS work.

.5 Control Sequence: A BMS pre-programmed arrangement of software algorithms, logical computation, target values and limits as required to attain the defined operational control objectives.

.6 Direct Digital Control: The digital algorithms and pre-defined arrangements included in the BMS software to provide direct closed-loop control for the designated equipment and controlled variables. Inclusive of Proportional, Derivative and Integral control algorithms together with target values, limits, logical functions, arithmetic functions, constant values, timing considerations and the like.

.7 BMS Network: The total digital on-line real-time interconnected configuration of BMS digital processing units, workstations, panels, sub-panels, controllers, devices and associated elements individually known as network nodes. May exist as one or more fully interfaced and integrated sub-networks, LAN, WAN or the like.

.8 Node: A digitally programmable entity existing on the BMS network.

.9 BMS Integration: The complete functional and operational interconnection and interfacing of all BMS work elements and nodes in compliance with all applicable codes, standards and ordinances so as to provide a single coherent BMS as required by this Division.

.10 Provide: The term “Provide” and its derivatives when used in this Division shall mean to furnish, install in place, connect, calibrate, test, commission, warrant, document and supply the associated required services ready for operation.

.11 PC: IBM-compatible Personal Computer from a recognized major manufacturer.

.12 Furnish: The term “Furnish” and its derivatives when used in this Division shall mean supply at the BMS Contractor’s cost to the designated third party trade contractor for installation. BMS Contractor shall connect furnished items to the BMS, calibrate, test, commission, warrant and document.

.13 Wiring: The term “Wiring” and its derivatives when used in this Division shall mean provide the BMS wiring and terminations.

.14 Install: The term “Install” and its derivatives when used in this Division shall mean receive at the jobsite and mount.

.15 Protocol: The term “protocol” and its derivatives when used in this Division shall mean a defined set of rules and standards governing the on-line exchange of data between BMS network nodes Protocol will be open BACnet unless approved otherwise in writing by the owner.

.16 Software: The term “software” and its derivatives when used in this Division shall mean all programmed digital processor software, preprogrammed firmware and project specific digital process programming and database entries and definitions as generally understood in the BMS industry for real-time, on-line, integrated BMS configurations.

.17 The use of words in the singular in these Division documents shall not be considered as limiting when other indications in these documents denote that more than one such item is being referenced.

.18 Headings, paragraph numbers, titles, shading, bolding, underscores, clouds and other symbolic interpretation aids included in the Division documents are for general information only and are to assist in the reading and interpretation of these Documents.

The following abbreviations and acronyms may be used in describing the work of this Division:

ADC	-	Analog to Digital Converter
AI	-	Analog Input
AN	-	Application Node
ANSI	-	American National Standards Institute
AO	-	Analog Output
ASCII	-	American Standard Code for Information Interchange
ASHRAE	-	American Society of Heating, Refrigeration and Air Conditioning Engineers
AWG	-	American Wire Gauge
CPU	-	Central Processing Unit
CRT	-	Cathode Ray Tube
DAC	-	Digital to Analog Converter
DDC	-	Direct Digital Control
DI	-	Digital Input
DO	-	Digital Output
EEPROM	-	Electronically Erasable Programmable Read Only Memory
EMI	-	Electromagnetic Interference
FAS	-	Fire Alarm Detection and Annunciation System
GUI	-	Graphical User Interface
HOA	-	Hand-Off-Auto
ID	-	Identification
IEEE	-	Institute of Electrical and Electronics Engineers
I/O	-	Input/Output
LAN	-	Local Area Network
LCD	-	Liquid Crystal Display
LED	-	Light Emitting Diode
MCC	-	Motor Control Center
NC	-	Normally Closed
NIC	-	Not In Contract
NO	-	Normally Open
OWS	-	Operator Workstation
OAT	-	Outdoor Air Temperature
PC	-	Personal Computer
RAM	-	Random Access Memory
RF	-	Radio Frequency
RFI	-	Radio Frequency Interference
RH	-	Relative Humidity
ROM	-	Read Only Memory
RTD	-	Resistance Temperature Device
SPDT	-	Single Pole Double Throw
SPST	-	Single Pole Single Throw
XVGA	-	Extended Video Graphics Adapter
TBA	-	To Be Advised
TCP/IP	-	Transmission Control Protocol/Internet Protocol

TTD	-	Thermistor Temperature Device
UPS	-	Uninterruptible Power Supply
VAC	-	Volts, Alternating Current
VAV	-	Variable Air Volume
VDC	-	Volts, Direct Current
WAN	-	Wide Area Network

1.3 BMS Description

.1 The Building Management System (BMS) components shall be open native BACnet BTL tested listed on BTL website.

.2 The new BMS system shall be Johnson Controls Facility Explorer (FX80). New field equipment controllers shall be BACnet MS/TP and incorporate digital displays. The new supervisory controller shall be Johnson Controls Facility Explorer FX80. The FX80 supervisory controller shall connect to the existing Johnson Controls Metasys Server via BACnet IP. The existing Metasys NAE shall be retained and re-used to import the FX80 points to the Metasys server.

.3 All points of user interface shall be on standard PCs that do not require the purchase of any special software from the BMS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.

.4 Where necessary and as dictated elsewhere in these Specifications, Servers shall be used for the purpose of providing a location for extensive archiving of system configuration data, and historical data such as trend data and operator transactions. All data stored will be through the use of a standard data base platform: Microsoft Data Engine (MSDE) or Microsoft SQL Server as dictated elsewhere in this specification.

.5 The work of the single BMS Contractor shall be as defined individually and collectively in all Sections of this Division specification together with the associated Drawings and interfacing work to HVAC manufacturers proprietary control systems through interface modules as referenced in the related documents.

.6 The BMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BMS for the Fort Frances Consolidated Elementary School.

.7 Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.

.8 Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

.9 The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:

.1 Operator information, alarm management and control functions.

.2 Information management including monitoring, transmission, archiving, retrieval, and reporting functions.

.3 Diagnostic monitoring and reporting of BMS functions.

.4 Offsite monitoring and management access.

.5 Energy management

.6 Standard control applications for terminal HVAC systems.

.7 Indoor Air Quality monitoring and control.

1.4 Quality Assurance

.1 General

.1 All IACM's must be manufacturers and shall be regularly engaged in engineering, programming, installation and service of such systems. IACM's must also be a Certified Systems Integrators for the products specified.

.2 All IACM's shall have a permanent, local engineering and service office within 5 hours travel by road of the job site and be able to support the project with the required manpower and equipment resources.

1.5 Quality Management Program

.1 Designate a competent and experienced employee to provide BMS Project Management. The designated Project Manger shall be empowered to make technical, scheduling and related decisions on behalf of the BMS Contractor. At minimum, the Project Manager shall:

.1 Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.

.2 Coordinate as necessary with other trades.

.3 Be responsible for the work and actions of the BMS workforce on site.

1.6 References

.1 All work shall conform to the following Codes and Standards, as applicable:

- Ontario Building Code
- National Fire Protection Association (NFPA) Standards.
- Ontario Electric Code and applicable local requirements.
- Underwriters Laboratories (ULc) listing and labels.
- ULC 916 Energy Management
- NFPA 90A - Standard For The Installation Of Air Conditioning And Ventilating Systems.
- Factory Mutual (FM).
- American National Standards Institute (ANSI).
- National Electric Manufacturer's Association (NEMA).
- American Society of Mechanical Engineers (ASME).
- American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE)
- Air Movement and Control Association (AMCA).
- Institute of Electrical and Electronic Engineers (IEEE).
- American Standard Code for Information Interchange (ASCII).
- Electronics Industries Association (EIA).
- Ontario Ministry of Labour
- American Society for Testing and Materials (ASTM).
- Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
- ANSI/EIA 909.1-A-1999 (LonWorks)
- ANSI/ASHRAE Standard 195-2004 (BACnet)

.2 In the case of conflicts or discrepancies, the more stringent regulation shall apply.

.3 All work shall meet the approval of the Authorities Having Jurisdiction at the project site.

1.7 Work By Others

.1 The demarcation of work and responsibilities between the BMS Contractor and other related trades shall be as outlined in the BMS RESPONSIBILITY MATRIX

BMS RESPONSIBILITY MATRIX				
WORK	FURNISH	INSTALL	Low Volt. WIRING/TUBE	LINE POWER
BMS low voltage control transformers	BMS	BMS	BMS	BMS
BMS low voltage and communication wiring	BMS	BMS	BMS	N/A
BMS conduits and raceway	BMS	BMS	BMS	BMS
BMS Field Controllers	BMS	BMS	BMS	N/A
BMS Sub Controllers	BMS	BMS	BMS	N/A
BMS BACNet Cards	23	BMS	BMS	N/A
BMS control relays	BMS	BMS	BMS	BMS
All BMS nodes, equipment, housings, enclosures and panels.	BMS	BMS	BMS	N/A
Temperature sensors	BMS	BMS	BMS	N/A
Space thermostats/CO2 Sensors	BMS	BMS	BMS	N/A
Current Sensing Relays	BMS	BMS	BMS	N/A
BMS control relays	BMS	BMS	BMS	BMS
Damper Actuators	BMS	BMS	BMS	N/A
Pressure Independent Terminal Unit Controllers	BMS	BMS	BMS	N/A
Smoke Detectors	26	BMS	BMS	N/A
CO2 Detectors	BMS	BMS	BMS	N/A
Pressure Sensors	BMS	BMS	BMS	N/A
Automatic Control Valves	BMS	23	BMS	N/A
Manual/Automatic Balancing Valves	23	23	N/A	N/A
Floor Heat Manifold Control Valves	23	BMS	BMS	N/A
Variable Frequency Drives	BMS	26	BMS	26
Built-up air handling unit limit controls	BMS	BMS	BMS	N/A
Fire alarm trouble indication and shutdown interlock wiring to BMS	BMS	BMS	BMS	N/A
Pipe insertion devices and taps including flow and pressure stations	BMS	23	BMS	
Energy Meters	BMS	26	BMS	BMS
UPS	BMS	BMS	BMS	BMS

1.8 Submittals

.1 Shop Drawings, Product Data, and Samples

.1 The BMS contractor shall submit a list of all shop drawings with submittals dates with reasonable promptness and in an orderly sequence so as not to cause delay in work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Work affected by submittal shall not proceed until review is complete.

.3 Review submittals prior to submission to Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and shall be considered rejected.

.4 Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the BMS Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Owner.

.5 Notify consultant in writing at time of submission, identifying deviation from requirements of Contract Documents stating reasons for deviations.

.6 The BMS Contractor shall correct any errors or omissions noted in the first review.

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

.8 Contractor’s responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultants review.

.9 At a minimum, submit the following:

.10 BMS network architecture diagrams including all nodes and interconnections.

.11 Systems schematics, sequences and flow diagrams.

.12 Points schedule for each point in the BMS, including: Point Type, Object Name, Expanded ID, Display Units, Controller type, and Address.

.13 Samples of Graphic Display screen types and associated menus.

.14 Detailed Bill of Material list for each system or application, identifying quantities, part numbers, descriptions, and optional features.

.15 Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close-off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.

.16 Product data sheets or marked catalog pages including part number, photo and description for all products including software.

1.9 Record Documentation

.1 The Consultant and property management stakeholders must be consulted and the O&M manual must be submitted to the Consultant in order to be able to properly operate the facility before release of the certificate of substantial performance.

1.10 Warranty

.1 Standard Material and Labor Warranty:

.1 Provide a one-year labor and material warranty on the BMS.

.2 If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the cost of the BMS Contractor.

PART 2 Products

2.1 Large General Description

.1 The BMS shall be Johnson Controls Facility Explorer and connected to existing campus Metasys system through existing on-site Metasys NAE controller.

.2 The Building Management System (BMS) shall be open native BACNet tested and Listed on BTL website. To accomplish this effectively, the BMS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with owner provided networks.

.3 The Building Management System shall consist of the following:

- Web-Enabled Standalone Supervisory Controller(s)
- Field Equipment Controller(s)
- Input/Output Module(s)
- Local Display Device(s)
- Distributed User Interface(s)
- Personal Computer
- Network processing, data storage and communications equipment

- Other components required for a complete and working BMS

.4 The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

.5 System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

.6 Acceptable Manufacturers

Johnson Controls – Facility Explorer

2.2 BMS Architecture

.1 Automation Network

.1 The IAS must provide an Open System solution that utilizes industry standard communications protocols consisting of peer-to-peer networked, stand-alone, distributed controls Open System communication protocol, so that system data is openly communicated utilizing BACnet® protocol communication standards in a non-proprietary format so that other 3rd party client systems can easily identify data points and interoperate per the following requirements:

.2 BACnet® ASHRAE Standard 135-2004 and Annexes A-L.

.3 BACnet® International and BACnet® Test Laboratory (BTL)

.4 Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.

.5 Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

.2 Control Network and BAS Requirements

.1 The BAS shall communicate over a separate LAN.

.2 The BAS supplier shall coordinate with the Owner IT Representative for all network requirements.

.3 The LAN will have copper and optical fibre 100/1000 Ethernet connectivity using TCP/IP network protocol. BAS to be configured to utilize the LAN transport for device-to-device and device-to-head end communications as required. Coordinate all network requirements, protocol requirements, testing and systems integration requirements to ensure a fully integrated, functional system.

.4 The control system shall interface with the existing KDSB Allerton BAS system and carry on the existing device numbering protocol to the approval of the Board Facilities Manager.

.5 The BAS shall consist of the following:

.6 Building Controllers (Native BACnet B-BC Controllers)

.7 Advanced Application Controller (Native BACnet B-AAC Controllers)

.8 Application Specific Controllers (Native BACnet B-ASC Controllers)

.9 Operator workstation

.10 All controllers shall be BTL (BACnet Testing Laboratories) listed and listed on the BTL website.

.11 The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, Building Controllers, Advanced Application Controllers, Application Specific Controllers, and operator devices.

.12 All points/BACnet Objects for control and monitoring must be available and open to the End User. .

.13 System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. Each DDC Controller shall operate independently by performing its own specified control, alarm management, operator l/O and data collection. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

.14 DDC Controllers shall be able to access any data from, or send control commands and alarm reports directly to, any other DDC Controller or combination of controllers on the network without dependence upon a central processing device. DDC Controllers shall also be able to send alarm reports to multiple operator workstations without dependence upon a central processing device.

.15 Provide English language and Metric operator interface.

.16 Future buildings and off-site monitoring stations must have the ability to communicate to this building using the open Native BACnet Protocol. The successful Controls Contractor shall provide a PICS (Protocol Implementation Conformance Statement) for the BACnet Gateway (Native BACnet). A BACnet Protocol Implementation Conformance Statement (PICS) shall be provided for each DDC controller device and Building Controllers that will communicate on the BACnet Bus.

.17 Surge transient protection shall be incorporated in design of system to protect electrical components.

.18 The BAS as provided shall incorporate, at minimum, the following integrated features, functions and services:

.19 Operator information, alarm management and control functions.

.20 Enterprise-multi level of control access.

.21 Information management including monitoring, transmission, archiving, retrieval, and reporting functions.

.22 Diagnostic monitoring and reporting of BAS function.

.23 Offsite monitoring and management access.

.24 Energy management.

.25 Applications for central and terminal HVAC systems.

.26 Indoor Air Quality monitoring and control.

2.3 User Interface

.1 Dedicated Web Based User Interface

.1 BMS Contractor shall provide and install a personal computer for command entry, information management, network alarm management, and database management functions. Computer shall be located in Mechanical Room. Provide table and wheeled computer chair for new operator workstation. All real-time control functions, including scheduling, history collection and alarming, shall be resident in the BMS supervisory controller to facilitate greater fault tolerance and reliability.

.2 The system shall be capable of supporting up to 8 simultaneous Operator Workstation connections using a TCP/IP Local Area Network (LAN). The Network connection must allow a limitless number of casual users access to the 8 connections on a first-come-first-served basis. The Operator Workstation shall comprise the following minimum hardware:

.3 Intel Quad Core 3.2Ghz or better

.4 8GB of DDR3 RAM or better

.5 A 1 Tera Byte Hard disk drive

.6 A 12 function-key keyboard

.7 A mouse pointing device

.8 2 x TCP/IP adaptor

.9 SB 3.0, Bluetooth 3.0, and WiFi N or AC compatibility with peripheral additions

.10 Remote Access Via Mobile or PDA Devices

.11 The IAS shall be available with an operator interface designed for use on a mobile or PDA device with network connectivity, such as but not limited to:

.12 Mobile telephone with internet access

.13 Blackberry

.14 iPhone or iPad

.15 Android Mobile Device (such as Samsung)

.16 Windows Mobile Device (such as Dell Axim, HTC Touch, or Symbol)

.17 This operator interface to be supplied as a standard feature, without the requirement of custom programming or graphics by the control system provider, to provide control access to system points via a clear text menu suitable for accessing via the a mobile or PDA device.

.18 Software: Windows 10 Professional 64-bit, Microsoft Office Professional (latest version), Anti-virus Software (McAfee or Equivalent)

.19 Printers: Printers shall be available for printing either reports or online alarms. Report printers shall be any Windows compatible printer such as a laser printer. Alarm printers shall be 132 column printers to allow real time alarms to be printed as they occur.

.20 System Database: Provide a real-time database incorporating data from analog, logical, or pulse inputs. The database shall be configurable by the end user without the need for any programming and shall be able to be modified on-line without interrupting operation of the system. The database shall provide historization capabilities for analog, digital, pulse, and event-based information. This information shall be accessible by all facilities of the system, such as custom displays, reports, trends, and user-written applications.

.2 User Interface Application Components

.3 Operator Interface

.1 The Controls Systems Operator Interfaces shall be user friendly, readily understood and shall make maximum use of colours, graphics, icons, embedded images text based information and data visualization techniques to enhance and simplify the use and understanding of the displays by authorized users at the Operator's Workstation (OWS).

.2 User access shall be protected by a flexible and Owner re-definable software-based password access protection. Password protection shall be multi-level and partitionable to accommodate the varied access requirements of the different user groups to which individual users may be assigned. Provide the means to define unique access privileges for each individual authorized user. Provide the means to on-line manage password access control under the control of a project specific Master Password. Provide an audit trail of all user activity on the Controls Systems including all actions and changes.

.3 The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:

.1 User access for selective information retrieval and control command execution.

.2 Monitoring and reporting.

.3 Alarm and non-normal condition annunciation.

.4 Selective operator override and other control actions.

.5 Information archiving, manipulation, formatting, display, and reporting.

.6 Controls Systems internal performance supervision and diagnostics.

.7 On-line access to user HELP menus.

.8 On-line access to current as-built records and documentation. At minimum, one (1) copy of all record documentation shall be stored on a designated OWS or Server and be accessible to the Owner.

.9 Means for the controlled re-programming, re-configuration of systems operation and for the manipulation of database information in compliance with the prevailing codes, approvals, and regulations for the component applications and elements.

.10 Means to archive all Controls Systems Contract Project specific configuration databases, software programs, and other pertinent operational data such that any component of the software and project specific operational databases may be reloaded on-site from archived data.

.11 Provide on-line reports and displays making maximized use of simple English language descriptions and readily understood acronyms, abbreviations, icons and the like to assist user understanding and interpretation. All text naming conventions shall be consistent in their use and application throughout the Controls Systems.

.2 Navigation Trees

.1 Provide the capability to display multiple navigation trees that aid the operator in navigating throughout all systems and points connected. At minimum, provide a tree that identifies all systems on the Controls Systems networks.

.2 Provide the capability for the Operator to add custom trees. The Operator shall be able to define any logical grouping of systems or points and arrange them on the tree in any selected order. Provide the capability to nest groups within other groups. Provide at minimum for five levels of nesting.

.3 The navigation trees shall be “dockable” to other displays in the Operator interface including graphic displays. The trees shall appear as part of the display and may be individually detached and minimized to the Windows task bar or closed. Provide for a single keystroke to reattach the navigation tree to a primary display.

.3 Divisible Display Windows

.1 Provide for the operator to divide the display area within a single Browser window into multiple display panels. The content of each display panel

can be any of the standard summaries and graphics provided in the Controls Systems Application.

.2 Provide each display panel with minimize, maximize, and close icons.

.4 Alarms

.1 The alarm management portion of the controls system software shall, at a minimum provide the following functions:

.2 Log date and time of alarm occurrence along with point description, type of alarm, value, point state and alarm priority.

.3 Generate a pop-up window on the browser display panel with audible alarm, informing the operator that an alarm has been received.

.4 Allow an Operator with the appropriate password to acknowledge, temporarily silence or cancel an alarm.

.5 Provide an audit trail on the hard drive for alarms by recoding user acknowledgement, deletion or cancellation of an alarm. The audit trail shall include the ID of the user, the alarm, the action taken on the alarm and a time/date stamp.

.6 Provide the ability to direct alarms to an e-mail address or alphanumeric pager. This feature must be provided in addition to the pop-up window described herein.

.7 Provide for any attribute of any object in the Controls System to be designated to report as an alarm.

.8 The Controls System application shall annunciate systems diagnostic alarms indicating system failures and non-normal operating conditions.

.9 Provide the on-line means to display alarms within the browser windows by date/time occurrence, priority class, point designation, value or other defined text keywords.

.10 Nuisance alarms, for Priority 3 and greater alarms, will be disabled during system start-up and until the system has stabilized or been operating for at least 30 minutes. This time period may be adjustable based on the particular system and point.

.11 Alarming of points shall be assigned that indicated priority and sent to printer, pager and designated e-mail addresses for each of priorities 1 to 3 inclusive (based on system having 6 or more levels of alarming priorities), printer and designated e-mail addresses for each of priorities 4 to 5 inclusive, printer only of other priorities. BAS operators with access level 3 or higher (based on a system having 6 or more access levels) will be able to acknowledge the alarms.

.12 Priority 1 alarms are reserved for “Life or Death Safety” situations (Purple colour)

.13 Priority 2 alarms are reserved for “Building Damage” situations such as sump levels, etc. (Red Colour)

.14 Priority 3 – 5 alarms are dependent on system by system parameters (Pink Colour)

.15 Sample of Priority 3 Alarm: When any component fails to achieve its commanded status for more than 2 minutes; for example when fan is off when it is to be on (alarm 3 priority) for more than 1 minute.

.16 Sample of Priority 4 Alarm: When room temperature is greater than 26 degrees C (79 degrees F) or less than 20 degrees C (68 degrees F) for more than 15 minutes during occupied mode. Alarm will clear when temperature has returned more than 0.5 degrees C (1 degrees F) into non-alarm state for more than 1 minute.

.17 Sample of Priority 5 Alarm: When filter pressure differential is greater than 249 Pa or less than 25 Pa for more than 15 minutes during when main supply fan is operating. Alarm will clear when pressure has returned more than 10 Pa into non-alarm state for more than 1 minute.

.18 Alarms shall be e-mailed to an alarm e-mail server. A minimum of 6 e-mail addresses shall receive alarm notifications. Coordinate e-mail link set up details with Maintenance Manager.

.5 Operator Transaction Archiving

.1 Provide the means to automatically archive all Operator activities on the Controls System Application and for the recall of same for reporting.

.2 Transaction log shall store the latest 1000 actions as a minimum.

.3 Provide the means to sort and report archived activities by Operator, date/time, activity type and system area.

.4 Provide access to protection to preclude the unauthorized removal or tampering with archived records.

.5 .5 Provide management support facilities for the deletion and re-initialization of archived record logs under Master Password control or equal means.

.6 Reports and Summaries

.1 Reports shall be generated and directed to one or more of the following: User interface displays, printers archived at the Owner's defined option. As a minimum, the Controls Systems Application shall provide the following reports:

.2 All points in controls system application.

.3 All points in a specific Controls System.

.4 All points in a user-defined group of points.

.5 All points currently in alarm.

.6 All points locked out.

.7 All Controls System Application schedules.

.8 All user defined and adjustable variables, schedules, interlocks, diagnostics, system status reports and the like.

.9 Provide all applicable original manufacturers standard reports for the Controls System.

.7 Schedules

.1 Provide multiple schedule input forms for automatic time of day scheduling and override scheduling of operations. At a minimum, the following spreadsheet types shall be accommodated:

.2 Weekly schedules

.3 Temporary override schedules.

.4 Special “Only Active If Today Is A Holiday” schedules

.5 Monthly Schedules

.6 Schedules shall be provided for each group, system and sub-system in the Controls Systems Application. It shall be possible to include all or any commandable points residing within the Controls Systems in any custom schedule. Each point shall have a unique schedule of operation relative to the system use schedule, allowing for sequential starting and control of equipment within the system. Scheduling and rescheduling of points shall be accomplished easily via the system schedule spreadsheets.

.7 Multiple monthly calendars for a 12-month period shall be provided that allow for simplified scheduling of holidays and special days in advance. Holidays and special days shall be user-selected with the pointing device or keyboard and shall automatically reschedule equipment operation as previously defined on the weekly schedules.

.8 Operator Access Security (Combined Password and User ID)

.1 BAS access levels will be setup by designers of the project for BAS. A complete list of access usernames will be created in Excel and provided to the Facility Manager.

.2 The following access matrix will be completed:

Administrator	All rights and privileges, only one user per site. One for the lead tech.
BAS Tech	All rights and privileges, dedicated for OEM only
Operator	Access to schedules, overwrites, status changes, set-point changes, reset schemes, trending and report creation. For all regular technicians, managers or HVAC Service Provider.
Service Tech	Access to schedules, overwrites, status changes, reset schemes, trending and report creation. Also, access to sequences and base level programming but cannot replace or upgrade software. Dedicated for projects where higher level access is needed.
View Only	View only, cannot make changes. For consultants or non-technical review.

.3 Stored password/user ID definitions shall be stored in encrypted formats whether at the Controls Server or at the application node.

.4 Password logins shall not be echoed on any screen or printer except during Master Password definition processes. An Operator defining a password shall be required to re-enter to confirm authenticity.

.5 As part of the access privileges definition for each user, the Owner shall be able to define at minimum the following:

.6 Access times by day.

.7 Permanent or temporary, with expiry date, password.

.8 Number of incorrect access attempts allowed before the password is disabled.

.9 Whether or not the Operators are able to redefine their own password.

.10 A field for the Operator's e-mail address.

.11 A field for the Operator's contact phone number.

.12 Definition of the Operator's access privilege functionalities including viewing only, full control, selected functions, etc.

.9 Paging/e-mail Notification CNCN/A

.1 Provide the means of automatic alphanumeric paging of personnel for Owner defined events.

.10 System Configuration CNCN/A

.1 Contractor shall thoroughly and completely configure IAS system software, supplemental software, network communications, CSS, OWS, remote operator workstation, portable operator terminal, printer, and remote communications.

.11 Dynamic Color Graphics

.1 On floor plan, background colour indicates which main air handling system serves which zone. Identify each colour zone with main supply fan number. Clicking on fan number will jump the user to the main air system graphic.

.2 Provide temperature, humidity and carbon dioxide actual values on floor plan for all sensors mounted in the space. Clicking on a value will jump you to a detailed graphic of the rooms served by that sensor. Set points etc. to be shown on the graphic.

.3 On floor plan room graphic, clicking on VAV or reheat coil, etc. shall jump the user to HVAC detailed data for the air system.

.4 Provide links between graphics to aid building operator in viewing and troubleshooting system problems. This includes retuning to previous graphic, floor plan graphic and system main graphic.

.5 Detail graphics are to clearly indicate if a particular point is in Auto or Manual state. Manual state means that a building operator has forced a set point into the system.

.6 Graphics shall indicate any variables displayed as to whether they are in alarm or normal mode. Alarm mode will be considered to be non-flashing background colour as indicated for alarming, unless it has been agreed otherwise and approved by the Facility Manager.

.7 Graphics shall include all input/output field points, set points and calculated points used for monitoring and control purposes. Animation is not a substitute for putting values/states on the graphics.

.8 Lettering/number font on the graphics must be Arial or Times New Roman, minimum height of 6 mm (1/4").

.9 Graphics shall be created to fit the monitor at site without the use of "sliding bars" to see items that are off the monitor view.

.10 Building operator will be able to open control system Sequence of Operation description screen using a button, SOOP/SOP, for the particular graphic displayed, on each main air and water system graphic. Button is located in same relative location on graphic; for example, upper right corner.

.11 Graphics shall be based on Niagara AX standard base library for consistent Tridium enabled enterprise graphics.

.12 Values of real time attributes displayed on the graphics shall be dynamic and updated on the displays.

.13 Provide for the owner to be able to change values (setpoints) and states in system controlled equipment directly from the graphic display.

.14 Provide a graphic editing tool that allows for the creation and editing of graphic files. It shall be possible to edit the graphics directly while they are on line or at an off line location for later downloading on the AN.

.12 Historical trending and data collection

.1 Analog input/output and associated set point as Change of Value (COV). Store minimum of 500 values in on-line trend and 5000 in history file.

.2 Temperatures as COV of 0.5 degrees C (1.0 degrees F).

.3 Humidity as COV of 2% R.H.

.4 CO_2 as COV of 25 ppm.

.5 Pressure as COV of 5% of normal operating range in Pa, kPa or in. W.G. or psig depending on operating range.

.6 kW power as COV of 5 % of normal operating range.

.7 Control valves and dampers as COV of 5% open.

.8 VFD fan and pump speed as COV of 5%.

.9 Fan and pump etc. 'change of state' as COV. Store minimum of 50 values in on-line trend and 500 in history file.

.10 Provide a symbol/button beside each point on graphic that is being trended that will immediately jump the operator to on-line trend for that point. Symbol to clearly indicate that it is for trend log information.

.11 Trend and store point history data for all actual and virtual (software) points and values as required by the Owner.

.12 The trend data shall be stored in a manner that allows custom queries and reports using industry standard software tools.

.13 At a minimum, provide the capability to perform statistical functions on the historical database as follows:

.14 Average

.15 Arithmetic mean

.16 Maximum/minimum values

.17 Range – difference between minimum and maximum values

.18 Standard deviation

.19 Sum of all values

.20 Variance

2.4 Web-Enabled Supervisory Controller

.1 The web-enabled supervisory controller shall be a fully user-programmable, supervisory controller. It shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other web-enabled supervisory controllers.

.2 Automation network – The supervisory controller shall reside on the automation network and shall support a subnet of system controllers.

.3 User Interface – Each supervisory controller shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the automation network shall have access to the web based UI.

.1 The web based UI software shall be imbedded in the supervisory controller. Systems that require a local copy of the system database on the user's personal computer are not acceptable.

.2 The supervisory controller shall support up four (4) concurrent users.

.3 The web based user shall have the capability to access all system data through one supervisory controller.

.4 Remote users connected to the network through an Internet Service Provider (ISP) or telephone dial up shall also have total system access through one supervisory controller.

.5 Systems that require the user to address more than one supervisory controller to access all system information are not acceptable.

.6 The supervisory controller shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the supervisory controller.

.7 Systems that support UI Graphics from a central database or require the graphics to reside on the user's personal computer are not acceptable.

.8 The web based UI shall support the following functions using a standard version of Microsoft Internet Explorer:

- Configuration
- Commissioning
- Data Archiving
- Monitoring
- Commanding
- System Diagnostics

.9 Systems that require workstation software or modified web browsers are not acceptable.

.10 The supervisory controller shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.

.4 Processor – The supervisory controller shall be microprocessor-based with a minimum word size of 32 bits. The supervisory controller shall be a multi-tasking, multi-user, and real-time digital control processor. Standard operating systems shall be employed. Supervisory controller size and capability shall be sufficient to fully meet the requirements of this Specification.

.5 Memory – Each supervisory controller shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.

.6 Hardware Real Time Clock – The supervisory controller shall include an integrated, hardware-based, real-time clock.

.7 The supervisory controller shall include troubleshooting LED indicators to identify the following conditions:

.1 Power - On/Off

.2 Ethernet Traffic – Ethernet Traffic/No Ethernet Traffic

.3 Ethernet Connection Speed – 10 Mbps/100 Mbps

.4 FC Bus – Normal Communications/No Field Communications

.5 Peer Communication – Data Traffic Between Supervisory Devices

.6 Run – Supervisory Controller Running/In Startup/Shutting Down/Software Not Running

.7 Bat Fault – Battery Defective, Data Protection Battery Not Installed

.8 Fault – General Fault

.9 Modem RX – Supervisory Controller Modem Receiving Data

.10 Modem TX – Supervisory Controller Modem Transmitting Data

.8 Communications Ports – The supervisory controller shall provide the following ports for operation of operator Input/Output (I/O) devices, such as industry-standard computers, modems, and portable operator's terminals.

.1 Up to two (2) USB port

.2 Up to two (2) URS-232 serial data communication port

.3 Up to two (2) RS-485 port

.4 One (1) Ethernet port

.9 Diagnostics – The supervisory controller shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The supervisory controller shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.

.10 Power Failure – In the event of the loss of normal power, the supervisory controller shall continue to operate for a user adjustable period of up to 10 minutes after which there shall be an orderly shutdown of all programs to prevent the loss of database or operating system software.

.1 During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.

.2 Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

.11 Certification – The supervisory controller shall be listed by Underwriters Laboratories (ULC).

.12 Controller network – The supervisory controller shall support the following communication protocols on the controller network:

.1 The supervisory controller shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.

- A BACnet Protocol Implementation Conformance Statement shall be provided for each controller device (master or slave) that will communicate on the BACnet MS/TP Bus.
- The supervisory controller shall support a minimum of 100 control devices.

2.5 Network Controller

.1 The Network Controller (NC) shall be a Native BACnet® controller to provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NC. The NC shall physically connect to the LAN without the need for additional Router hardware. It shall be capable of executing application control programs to provide:

.2 Calendar functions

.3 Scheduling

.4 Trending

.5 Alarm monitoring and routing

.6 Time synchronization

.7 Integration of BACnet® devices and BACnet® controller data

.8 The Network Controller must provide the following hardware features:

.9 One Ethernet Port -10 / 100 Mbps RJ45

.10 One RS-232 port

.11 One RS 485 port

2.6 Advanced Application Controllers

.1 Advanced Application Controller (AAC) shall be microprocessor based BACnet® Advanced Application Controller in accordance with the ANSI/ASHRAE Standard 135-2004. Advanced Application Controllers shall be provided for Air Handling Units, Variable Air Volume (VAV) Terminals and other applications. The application control program shall be resident within the same enclosure as the input/output circuitry, which translates the sensor signals.

.2 All Advanced Application Controllers shall be fully programmable with the help of Windows based software programming tool and shall at all times maintain their BACnet® compliance.

.3 Stand-alone, Native BACnet®, Application Controllers shall be used to provide direct digital control of HVAC equipment. In addition to their standalone capabilities, they shall also provide the ability networked in a peer-to-peer, BACnet® field network to other controllers, and zone controllers on the single channel. These controllers may be used to optimize the energy consumption by implementing various control strategies such as temperature setup/setback etc.

.4 Standard features for all Advanced Application Controllers shall include:

.5 Microprocessor based controllers

.6 Must support BACnet, baud rates from 9600 to 76.8 bps

.7 Stand-alone or networked peer-to-peer capabilities on single channel, Masters to slave devices are not acceptable

.8 Must have on-board Real Time Clock

.9 Must support BACnet® intrinsic alarm reporting

.10 Must support calendar objects for scheduling

.11 Must comply to BACnet® B-AAC device profile

.12 Must support BACnet® Change of Value (COV) which is a function that allows a controller to communicate when a value of a point has changed by an adjustable amount.

.13 Flexibility to be used and connected to Network Controller to expand the I/O capacity of network controller.

.2 Field Devices

.1 Input/Output Module (IOM)

.1 The Input/Output Module (IOM) provides additional inputs and outputs for use in the AAC.

.2 The IOM shall communicate with the AAC over either the FC Bus or the SA Bus using BACnet Standard protocol SSPC-135, Clause 9.

.3 The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.

.4 The IOM shall have a minimum of four (4) points to a maximum of seventeen (17) points.

.5 The IOM shall support the following types of inputs and outputs:

- Universal Inputs - shall be configured to monitor any of the following:
- Analog Input, Voltage Mode

- Analog Input, Current Mode
- Analog Input, Resistive Mode
- Binary Input, Dry Contact Maintained Mode
- Binary Input, Pulse Counter Mode
- Binary Inputs - shall be configured to monitor either of the following:
- Dry Contact Maintained Mode
- Pulse Counter Mode
- Analog Outputs - shall be configured to output either of the following
- Analog Output, Voltage Mode
- Analog Output, current Mode
- Binary Outputs - shall output the following:
- 24 VAC Triac
- Configurable Outputs - shall be capable of the following:
- Analog Output, Voltage Mode
- Binary Output Mode

.6 The IOM shall include troubleshooting LED indicators to identify the following conditions:

- Power On
- Power Off
- Download or Startup in progress, not ready for normal operation
- No Faults
- Device Fault
- Normal Data Transmission
- No Data Transmission
- No Communication

.2 VAV Modular Assembly (VMA)

.1 The VAV Modular Assembly shall provide both standalone and networked direct digital control of pressure-independent, variable air volume terminal units. It shall address both single and dual duct applications.

.2 The VAV Modular Assembly shall communicate over the FC Bus using BACnet Standard protocol SSPC-135, Clause 9.

.3 The VAV Modular Assembly shall have internal electrical isolation for AC power, DC inputs, and MS/TP communications. An externally mounted isolation transformer shall not be acceptable.

.4 The VAV Modular Assembly shall be a configurable digital controller with integral differential pressure transducer and damper actuator. All components shall be connected and mounted as a single assembly that can be removed as one piece.

.5 The VAV Modular Assembly shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.

.6 The integral damper actuator shall be a fast response stepper motor capable of stroking 90 degrees in 30 seconds for quick damper positioning to speed commissioning and troubleshooting tasks.

.7 The controller shall determine airflow by dynamic pressure measurement using an integral dead-ended differential pressure transducer. The transducer shall be maintenance-free and shall not require air filters.

.8 Each controller shall have the ability to automatically calibrate the flow sensor to eliminate pressure transducer offset error due to ambient temperature / humidity effects.

.9 The controller shall utilize a proportional plus integration (PI) algorithm for the space temperature control loops.

.10 Each controller shall continuously, adaptively tune the control algorithms to improve control and controller reliability through reduced actuator duty cycle. In addition, this tuning reduces commissioning costs, and eliminates the maintenance costs of manually re-tuning loops to compensate for seasonal or other load changes.

.11 The controller shall provide the ability to download and upload VMA configuration files, both locally and via the communications network. Controllers shall be able to be loaded individually or as a group using a zone schedule generated spreadsheet of controller parameters.

.12 Control setpoint changes initiated over the network shall be written to VMA non-volatile memory to prevent loss of setpoint changes and to provide consistent operation in the event of communication failure.

.13 The controller firmware shall be flash-upgradeable remotely via the communications bus to minimize costs of feature enhancements.

.14 The controller shall provide fail-soft operation if the airflow signal becomes unreliable, by automatically reverting to a pressure-dependent control mode.

.15 The controller shall interface with balancer tools that allow automatic recalculation of box flow pickup gain (“K” factor), and the ability to directly command the airflow control loop to the box minimum and maximum airflow setpoints.

.16 Controller performance shall be self-documenting via on-board diagnostics. These diagnostics shall consist of control loop performance measurements executing at each control loop’s sample interval, which may be used to continuously monitor and document system performance. The VMA shall calculate exponentially weighted moving averages (EWMA) for each of the following. These metrics shall be available to the end user for efficient management of the VAV terminals.

- Absolute temperature loop error.
- Signed temperature loop error.
- Absolute airflow loop error.
- Signed airflow loop error.
- Average damper actuator duty cycle.

.17 The controller shall detect system error conditions to assist in managing the VAV zones. The error conditions shall consist of:

- Unreliable space temperature sensor.
- Unreliable differential pressure sensor.
- Starved box.
- Actuator stall
- Insufficient cooling.
- Insufficient heating.

The controller shall provide a flow test function to view damper position vs. flow in a graphical format. The information would alert the user to check damper position. The VMA would also provide a method to calculate actuator duty cycle as an indicator of damper actuator runtime.

.18 The controller shall provide a compliant interface for ASHRAE Standard 62-1989 (indoor air quality), and shall be capable of resetting the box minimum airflow Based on the percent of outdoor air in the primary air stream.

.19 The controller shall comply with ASHRAE Standard 90.1 (energy efficiency) by preventing simultaneous heating and cooling, and where the control strategy requires reset of airflow while in reheat, by modulating the box reheat device fully open prior to increasing the airflow in the heating sequence.

.20 Inputs:

- Analog inputs with user defined ranges shall monitor the following analog signals, without the addition of equipment outside the terminal controller cabinet:

  0-10 VDC Sensors

  1000 Ohm RTDs

  NTC Thermistors
- Binary inputs shall monitor dry contact closures. Input shall provide filtering to eliminate false signals resulting from input “bouncing.”
- For noise immunity, the inputs shall be internally isolated from power, communications, and output circuits.
- Provide side loop application for humidity control.

.21 Outputs

- Analog outputs shall provide the following control outputs:
- 0-10 VDC
- Binary outputs shall provide a SPST Triac output rated for 500 mA at 24 VAC.
- For noise immunity, the outputs shall be internally isolated from power, communications, and other output circuits.

.22 Application Configuration

- The VAV Modular Assembly shall be configured with a software tool that provides a simple Question/Answer format for developing applications and downloading.

.23 Sensor Support

- The VAV Modular Assembly shall communicate over the Sensor-Actuator Bus (SA Bus) with a Network Sensor.
- The VMA shall support an LCD display room sensor.
- The VMA shall also support standard room sensors as defined by analog input requirements.
- The VMA shall support humidity sensors defined by the AI side loop.

2.7 Input Devices

.1 General Requirements

.1 Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

.2 Temperature Sensors

.1 General Requirements:

- Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations.
- The temperature sensor shall be of the resistance type, and shall be either two-wire 1000 Ohm nickel RTD, or two-wire 1000 Ohm platinum RTD.
- The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion:

Point Type	**Accuracy**
Hot Water	+/- 0.5°F.
Room Temp	+/- 0.5°F.
Duct Temperature	+/- 0.5°F.
All Others	+/- 0.75°F.

- Temperature sensors for measurement of fluid temperatures. Sensors shall incorporate a separate well of a material suitable for the service.
- Water service – brass
- Steam service - 304 SS
- Propylene glycol service - 304 SS.

Pressure Sensors

- Suitable for continuous contact with the material being measured (i.e., air, water, glycol, or steam as applicable).
- Pressure transmitters shall have a linear output of 0-5 VDC or 4-20 mA. Pressure transmitters shall have a span of not greater than twice the static pressure at maximum flow or differential pressure at shut-off as applicable.

.3 Room Temperature Sensors with Integral Display

- Room sensors shall be constructed for either surface or wall box mounting.
- Room sensors shall be communicating, adjustable from BAS server and have an integral LCD display and four button keypad with the following capabilities:

- Display room and outside air temperatures.
- Display and adjust room comfort setpoint.
- Display and adjust fan operation status.

- Timed override request push button with LED status for activation of after-hours operation.
- Display controller mode.
- Display room CO2 level where noted

.4 Outside Air Sensors

- Outside air sensors shall be designed to withstand the environmental conditions to which they will be exposed. They shall also be provided with a solar shield.
- Sensors exposed to wind velocity pressures shall be shielded by a perforated plate that surrounds the sensor element.
- Temperature transmitters shall be of NEMA 3R construction and rated for ambient temperatures.

.5 Duct Mount Sensors

- Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.
- Temperature sensors for measuring duct temperatures. Sensors shall incorporate an averaging style temperature element (RTD) of sufficient length to ensure a proper average of the variation across each square foot full cross section of the duct. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.
- For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

.6 Averaging Sensors

- For ductwork greater in any dimension than 1219 mm (48”) and/or where air temperature stratification exists, an averaging sensor with multiple sensing points shall be used.
- For plenum applications, such as mixed air temperature measurements, a string of sensors mounted across the plenum shall be used to account for stratification and/or air turbulence. The averaging string shall have a minimum of 4 sensing points per 12-foot long segment.
- Capillary supports at the sides of the duct shall be provided to support the sensing string.

.7 Differential Pressure Transmitters

.1 Air Pressure Transmitter Requirements:

.1 Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.

.2 Pressure transmitters shall transmit a 0 to 5 VDC, 0 to 10 VDC, or 4 to 20 mA output signal.

.3 A minimum of a NEMA 1 housing shall be provided for the transmitter. Transmitters shall be located in accessible local control panels wherever possible.

.8 Static Pressure Traverse Probe

- Duct static traverse probes shall be provided where required to monitor duct static pressure. The probe shall contain multiple static pressure sensors located along exterior surface of the cylindrical probe.

.9 Status and Safety Switches

.1 General Requirements

- Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.

.2 Current Sensing Switches

- The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.
- Current sensing switches shall be used for run status for secondary heating water pumps and other miscellaneous motor loads.
- Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.

.3 Low Temperature Limit Switches

- The low temperature limit switch shall be of the automatic reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120 VAC.
- The sensing element shall be a minimum of 4.6 m (15 ft.) in length and shall react to the coldest 457 mm (18”) section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.
- For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.

2.8 Local Control Panels

.1 Construction

- All control panels shall be factory constructed, incorporating the BMS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed in cabinet with perforated sub-panel, locking hinged door and slotted flush latch.
- In general, the control panels shall consist of the DDC controller(s) and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function.
- All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.
- Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
- All wiring shall be neatly installed in plastic trays or tie-wrapped.
- A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.

.2 Power Supplies

- Obtain power from a source that feeds the equipment being controlled such that both the control component and the equipment are powered from the same panel. Where equipment is powered from a 600 V source, obtain power from the electrically most proximate 120 V source fed from a common origin.
- Where control equipment is located inside a new equipment enclosure, coordinate with the equipment manufacturer and feed the control with the same source as the equipment. If the equipment's control transformer is large enough and is the correct voltage to supply the controls, it may be used. If the equipment's control transformer is not large enough or of the correct voltage to supply the controls, provide separate transformer.
- Where possible, all controllers that control multiple systems shall be fed by the highest level of power reliability (Eg. Emergency Power).

.3 Uninterruptible Power Supply

- Provide an uninterruptible power supply system (UPS) providing battery backup for each operator workstation, server and peripheral devices.
- UPS shall protect against blackouts, brownouts, surges, and noise.
- UPS shall include LAN port and modem like surge protection.
- UPS shall be sized for a 7-minute full load runtime, 23-minute 1/2 load runtime, with a typical runtime of up to 60 minutes. Transfer time shall be 2-4 milliseconds.

- UPS shall provide a 480 Joule suppression rating and current suppression protection for 36,000 Amps and provide 90 percent recharge capability in two to four hours. Suppression response time shall be instantaneous.

PART 3 Performance/Execution

3.1 BMS Specific Requirements

.1 Actuation / Control Type

.1 Primary Equipment

- Controls shall be provided by equipment manufacturer as specified herein.
- All damper and valve actuation shall be electric.

.2 Installation Practices

.1 BMS Wiring

- All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the BMS Contractor unless specifically shown on the Electrical Drawings under Division 26 Electrical. Provide new conduit and control wiring. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this section.
- Communication wiring shall be provided in a customized colour jacketing material. In addition, all wiring jackets shall be labeled at each end of the wiring run with a descriptive name and point name if applicable.
- Local Supervisory LAN: For any portions of this network use multimode fiber (62.5 micron) or Category 5E cable per TIA/EIA 68 (10BaseT). Network shall be run with no splices and separate from any wiring over 30V.
- Primary and Secondary Controller LANs: Communication wiring shall be individually 100% shielded pairs with overall PVC cover, Class 2, plenum-rated run with no splices and separate from any wiring over 30V.
- Signal wiring to all field devices, including, but not limited to, all sensors, transducers, transmitters, switches, etc. shall be twisted, 100% shielded pair, minimum 18-gage wire, with PVC cover. Signal wiring shall be run with no splices and separate from any wiring above 30V
- The sizing, type and provision of new cable along with conduit, cable trays, and raceways shall be the design responsibility of the BMS Contractor. If complications arise, however, due to the

incorrect selection of new cable cable trays, raceways and/or conduit by the BMS Contractor, the Contractor shall be responsible for all costs incurred in replacing the selected components.

.2 Class 2 Wiring

- Run all wiring in a protective conduit.
- Class 2 signal wiring and 24 VAC power can be run in the same conduit. Power wiring 120 VAC and greater cannot share the same conduit with Class 2 signal wiring.
- Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

.3 BMS Raceway

- All wiring shall be installed in conduit or raceway. Minimum control wiring conduit size 13 mm (1/2”).
- All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.
- Flexible Metal Conduit shall be used for vibration isolation and shall be limited to 3 feet in length when terminating to vibrating equipment. Flexible Metal Conduit may be used within partition walls. Flexible Metal Conduit shall be UL listed.

.4 Penetrations

- Provide fire stopping for all penetrations used by dedicated BMS conduits and raceways.
- All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.
- All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.
- Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

.5 BMS Identification Standards

- Identify each piece of equipment, including sensors, controlled devices, and control panels, with a nameplate identifying the equipment and functions with a letter and number designation.
- Provide a single line diagram for the control points located in each controls enclosure.

- Nameplates shall be minimum size 75mm x 25mm (3" x 1") printed plastic labelling tape white face and black letters. Nameplates shall be securely attached to the equipment and listed in the Operating and Maintenance manual.
- Color code wiring consistently throughout the installation and generally match color coding of internal wiring of pre-wired components.
- Label wiring with point name using Thomas & Betts 12 character polestar metalized labels with 3 rows of characters per label, or equal by Brady. Label to occur as a minimum at both ends and at pull boxes of the wiring/tubing run.
- Identify all pull boxes, junction boxes, etc. (installed as part of this project or used by this project) with the exact use of the box. Indelible felt pen marker is acceptable.
- Label sensors mounted in occupied spaces such as temperature, humidity and carbon dioxide sensors with point name using Thomas & Betts 12 character label, or equal by Brady. Label to be black lettering on clear backing.
- Label relays and controllers inside panels using Thomas & Betts 12 character label, or equal by Brady.
- Provide blue, 13 mm (1/2”) diameter, sticker on ceiling T-bar below ceiling mounted equipment such as VAV boxes controllers with VAV box # on the sticker with thin permanent black mark pen.
- Provide red, 13 mm (1/2”) diameter, sticker on ceiling T-bar below fire protection equipment mounted in ceiling space such as fire dampers.
- Provide red, 13 mm (1/2”) diameter, sticker on emergency light fixture frame. Include circuit # on sticker with thin permanent black mark pen.
- Provide yellow, 13 mm (1/2”) diameter, sticker on T-bar below fan equipment mounted in ceiling space such as exhaust fans. Include fan # on sticker with thin permanent black mark pen.”

.6 Input Devices

1 All Input devices shall be installed per the manufacturer recommendation

2 Locate components of the BMS in accessible local control panels wherever possible.

.7 HVAC Input Devices – General

- All Input devices shall be installed per manufacturer recommendation.
- Locate components of the BMS in accessible local control panels wherever possible.

3 Outside Air Sensors

- Sensors shall be mounted on the North wall to minimize solar radiant heat impact.
- Sensors shall be installed with a rain proof, perforated cover.
- Coordinate final mounting location with Consultant and Owner.

4 Duct Temperature Sensors:

- Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned to be easily accessible for repair or replacement.
- The sensors shall be insertion type and constructed as a complete assembly including lock nut and mounting plate.
- For ductwork greater in any dimension than 48 inches or where air temperature stratification exists such as a mixed air plenum, utilize an averaging sensor.
- The sensor shall be mounted to suitable supports using factory approved element holders.

.8 HVAC Output Devices

1 All output devices shall be installed per the manufacturers' recommendations. The mechanical contractor shall install all in-line devices such as control valves, dampers, etc.

2 Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a heating boiler) or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems.

.9 Training

.1 Provide one (1) on-site training session including classroom and terminal hands on, one full day, for personnel designated by the Facility Manager prior at substantial completion.

.2 Train the designated staff to enable them to do the following:

.1 Proficiently operate the system

.2 Understand control system architecture and configuration

.3 Understand DDC system components

.4 Understand system operation, including DDC system control and optimizing routines (algorithms)

.5 Operate the workstation and peripherals

.6 Log on and off the system

.7 Access graphics, point reports, and logs

.8 Adjust and change system set points, time schedules, and holiday schedules

.9 Recognize malfunctions of the system by observation of the printed copy and graphical visual signals

.10 Understand system drawings and Operation and Maintenance manual

.11 Understand the job layout, location of control components.

.12 Access data from DDC controllers and ASCs

.13 Operate portable operator's terminals

.14 Advanced Operator (in addition to above)

.15 Make and change graphics on the workstation

.16 Create, delete, and modify alarms, including annunciation and routing of these

.17 Create, delete, and modify point trend logs and graph or print these both on an ad-hoc basis and at user-definable time intervals

.18 Create, delete, and modify reports

.19 Add, remove, and modify system's physical points

.20 Create, modify, and delete programming

.21 Add panels when required

.22 Add operator interface stations

.23 Create, delete, and modify system displays, both graphical and others

.24 Perform DDC system field checkout procedures

.25 Perform DDC controller unit operation and maintenance procedures

.26 Perform workstation and peripheral operation and maintenance procedures

.27 Perform DDC system diagnostic procedures

.28 Configure hardware including PC boards, switches, communication, and I/O points

.29 Maintain, calibrate, troubleshoot, diagnose, and repair hardware

.30 Adjust, calibrate, and replace system components • System Managers/Administrator (in addition to above)

.31 Maintain software and prepare backups

.32 Interface with job-specific, third-party operator software

.33 Add new users and understand password security procedures

.3 The instructor(s) shall provide one copy of training material per student.

.4 The instructor(s) shall be factory-trained instructors experienced in presenting this material.

.5 Training shall include classroom and onsite training, using the installed system working controllers without affecting the space conditions.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for piping, valves and fittings for gas fired equipment.

.2 Related Sections:

.1 Section 23 05 01 - Installation of Pipework.

.2 Section 23 08 01 - Performance Verification of Mechanical Piping Systems.

.3 Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

.4 Conform to Sections of Division 01, as applicable.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.5-03, Pipe Flanges and Flanged Fittings.

.2 ASME B16.18-01, Cast Copper Alloy Solder Joint Pressure Fittings.

.3 ASME B16.22-01, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

.4 ASME B18.2.1-96, Square and Hex Bolts and Screws Inch Series.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A47/A47M-99(2004), Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M-04, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

.3 ASTM B75M-99, Standard Specification for Seamless Copper Tube Metric.

.4 ASTM B837-01, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.

.3 Canadian Standards Association (CSA International)

.1 CSA W47.1-03, Certification of Companies for Fusion Welding of Steel.

.4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)

.1 CAN/CSA B149.1HB-00, Natural Gas and Propane Installation Code Handbook.

.2 CAN/CSA B149.2-00, Propane Storage and Handling Code.

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

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Submittals, product data and shop drawings to be in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

Part 2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Schedule 40, seamless as follows:

- .1 NPS 13 mm (1/2”) to 50mm (2”), screwed.
- .2 NPS 64 mm (2-1/2”) and over, plain end.

.2 Copper tube: to ASTM B837.

2.2 JOINTING MATERIAL

.1 Screwed fittings: pulverized lead paste.

.2 Welded fittings: to CSA W47.1.

.3 Flange gaskets: non-metallic flat.

.4 Brazing: to ASTM B837.

2.3 FITTINGS

.1 Steel pipe fittings, screwed, flanged or welded:

- .1 Malleable iron: screwed, banded, Class 150.
- .2 Steel pipe flanges and flanged fittings: to ASME B16.5.
- .3 Welding: butt-welding fittings.
- .4 Unions: malleable iron, brass to iron, ground seat, to ASTM A47/A47M.
- .5 Bolts and nuts: to ASME B18.2.1.
- .6 Nipples: schedule 40, to ASTM A53/A53M.

.2 Copper pipe fittings, screwed, flanged or soldered:

- .1 Cast copper fittings: to ASME B16.18.
- .2 Wrought copper fittings: to ASME B16.22.

2.4 VALVES

.1 Provincial Code approved, lubricated plug ball type.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 PIPING

.1 Install in accordance with Section 23 05 05 - Installation of Pipework, and CAN/CSA B149, supplemented as specified.

.2 Install drip points: at low points in piping system and at connections to equipment.

3.3 VALVES

.1 Install valves with stems upright or horizontal unless otherwise approved by Consultant.

.2 Install valves at branch take-offs to isolate pieces of equipment, and as indicated.

3.4 ADJUSTING

.1 Purging: purge after pressure test in accordance with CAN/CSA B149.

.2 Pre-Start-Up Inspections:

.1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.

.2 Check gas trains, entire installation is approved by authority having jurisdiction.

.3 Perform testing and start-up to applicable requirements of Section 23 08 01 – Performance Verification of Mechanical Piping Systems and Section 23 08 02 – Cleaning and Start-up of Mechanical Piping Systems.

.4 Perform pressure test to maximum allowable level. Ensure system holds pressure without leakage of gas to the surrounding environment.

3.5 CLEANING

.1 Cleaning: in accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, waste, tools and equipment.

END OF SECTION

PART 1 General

1.1 GENERAL REQUIREMENTS

.1 Conform to Sections of Division 01 as applicable.

.2 Conform to Section 23 05 00 - Common Work Results Mechanical, as applicable.

1.2 RELATED SECTIONS

.1 Section 23 05 12 – Thermal Insulation for Piping.

.2 Section 23 08 01 - Performance Verification of Mechanical Piping.

1.3 REFERENCES

CSA B51-95 - Boiler, Pressure Vessel and Pressure Piping Code

CSA B52-95 - Mechanical Refrigeration Code

ASME Unfired Pressure Vessel Code, Section VIII

1.4 SUBMITTALS

.1 Submittals, product data and shop drawings to be in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.5 QUALITY ASSURANCE

.1 Regulatory Requirements: Boilers, pressure vessels and all fittings installed in pressurized system must be constructed, tested, approved and installed in accordance with CSA B51 and with the Laws and Regulations of the Ontario Technical Standards and Safety Authority - Pressure Vessels Safety Branch.

Part 2 Products

2.1 PIPE, FITTINGS AND VALVES

.1 For types of pipe, fittings and valves for services in this Section refer to the appropriate specification section.

.2 Wherever possible, provide all valves supplied by one manufacturer.

2.2 GENERAL

.1 Applicable requirements specified in Section 23 05 00 - Common Work Results – Mechanical form a part of this Section to the same extent as if stated herein in full.

.2 Supply and install all miscellaneous structural supports, platforms, braces and tie-rods as may be required to hang or support all equipment, piping, etc., installed under this Section, in accordance with the drawings and/or as directed by the Owner.

2.3 AIR VENTS

.1 Install automatic air vents at high points of piping systems and also in any other location noted on Drawings. Provide isolation ball valve(s) and piping to inlet connection of air vent.

.2 Construction: brass body and vent head, non-ferrous float, Viton seals, FNPT inlet and NPT outlet connections (sizes as indicated on Drawings)

.3 Provide Spirotherm Spirotop Model VTP050FT or approved equivalent.

.4 Connect discharge to glycol feeder as shown on Drawings.

.5 Provide manual air vents in locations noted on Drawings.

2.4 AIR SEPARATOR

.1 Amtrol Model 461 (or approved equivalent) air separator supplied complete with cast iron body, 38 mm (1 1/2”) NPT vent tapping & drain tapping with 125 mm (5”) diameter flanged inlet/outlet connections.

2.5 AIR PURGERS

.1 Screwed connections for sizes up to NPS 25 mm (2”).

.2 Flanged connections for sizes above NPS 64 mm (2 1/2”).

.3 Construction: cast iron body, ductile iron disc with electroless nickel coating, EPDM seat, 416 stainless streel stem seal, 316 stainless steel bearings with TFE lining, locking lever handle and rolled grooved end connections.

.4 Provide Victaulic series 300 or 700 or approved equivalent.

2.6 CHECK VALVES – BOILER

.1 Provide Victaulic Series 716 (or approved equal) supplied complete with ductile iron body, stainless steel disc, EPDM disc seal and coating, 316 stainless steel shaft, 416 stainless steel shaft plug, 302/304 stainless steel spring and rolled grooved end connections.

2.7 STRAINERS – BOILER

.1 Screwed connections for sizes up to NPS 50mm (2”). Flanged connections for sizes above NPS 64mm (2-1/2”).

.2 Construction: lead-free ‘Y” type strainer with cast bronze body and cap, 304 stainless steel screen #20 mesh, PTFE O-ring and gasket, FNPT threaded connections (size as indicated on Drawings).

.3 Provide Apollo Valves Model YB3LF part number 59LF-010-01-(E1) or approved equivalent.

2.8 STRAINERS – MAIN PUMPS

.1 Flanged connections for sizes above NPS 2-1/2.

.2 Provide Victaulic Series 730 or approved equivalent.

.3 Construction: “tee” type strainer supplied complete with ductile iron body and cap, 304 stainless steel frame and 12x12 mesh, EPDM coupling gasket and access cap (size as indicated on Drawings) with Victaulic coupling.

2.9 MAGNETIC DIRT SEPARATOR

.1 DS1: Caleffi model N4546512A;M Dirtmag magnetic dirt separator (or approved equivalent.

.2 Construction: epoxy resin painted steel body, non-asbestos fiber hydraulic seal, brass drain valve, stainless steel and HDPE internal element, neodymium rare-earth magnet, brass magnet probe drywell.

.3 19mm (3/4”) top connection with brass cap, 25mm (1”) drain valve and 125mm (5”) flanged inlet/outlet connections.

2.10 CHECK VALVES

.1 Construction: ductile iron body, stainless steel disk, EPDM disc seal and coating, 316 stainless steel shaft, 416 stainless steel shaft plug, 302/304 stainless steel spring and grooved end connections.

.2 Provide Victaulic 716 or approved equivalent.

2.11 BUTTERFLY VALVES

.1 Construction: cast iron body, ductile iron disc with electroless nickel coating, EPDM seat, 416 stainless steel stem, EPDM stem seal, 316 stainless steel bearings with TFE lining, locking lever handle and rolled grooved end connections.

.2 Provide Victaulic Series 300 or 700 or approved equivalent.

2.12 GLYCOL FEEDERS

.1 Construction: Storage/mixing tank with lid, pump suction hose with inlet strainer, pressure pump with thermal cutout, integral pressure switch, integral check valve, cord and plug, pre-charged accumulator tank with EPDM diaphragm, manual diverter valve for air purging and agitating, 35-380 kPa (5-55.1 PSIG) adjustable pressure regulator with gauge, built-in check valve, union connection, 12mm (1/2") diameter x 914mm (36") long flexible connection hose with check valve, low level pump cut-out, alarm panel with pump/alarm relay, power on and alarm indicating lights, alarm buzzer, test switch, silence/off switch, float switch, receptacle, dry contacts for remote monitoring.

.2 Capacity: 55 L (14.5 Gal)

.3 Power: 120/1/60.

.4 Shall be used to maintain a full operating charge of propylene glycol/water mixture in the hydronic heating loop system,

.5 Provide Axiom Model SF-100 or approved equivalent.

2.13 EXPANSION TANKS

.1 Construction: supplied complete with steel shell, urethane top coat, heavy butyl/ EPDM diaphragm, air valve, 276 kPa (40 PSIG) factory precharge, propylene linear material and 32mm (1-1/4") FNPT connections.

.2 165L (43.5 Gal) total tank volume with 129L (34 Gal) acceptance volume.

.3 Provide Amtrol Extrol Model SX-90V or approved equivalent.

2.14 CHEMICAL POT FEEDER AND SIDESTREAM FILTER

.1 By-pass filter, General Filtration Model PX-2x4 or approved equal. Complete with carbon steel body and cast iron cap construction with epoxy paint finish, Buna-N O ring cap seal, four 19mm (3/4") FNPT inlet/outlet connections. 7.6L (2 Gal) capacity.

.2 Filter cartridge housing, General Filtration Model GF010. Complete with 304 stainless housing, cast iron head, carbon steel center post and nut, Buna-N head gasket, PTFE cap nut gasket, 19mm (3/4") FNPT inlet/outlet connections, 6mm (1/4") FNPT drain connection. Supply twelve (12) 20 micron filter cartridges.

2.15 CONTROL VALVES

.1 For flows and specific sizes, see Control/Balancing Valve Schedule on Drawings.

.2 For 1/2" control valves, provide Belimo Model Z2050QPT-F+CQKB24-SR-RL Zonetight control valve, or approved equal.

.3 For 3/4” control valves, provide Belimo Model Z2075QPT-G+CQKB24-SR-RL Zonetight control valve, or approved equal.

.4 For 1" and up control valves, provide Belimo Model P2___-S-___AKRX24 electronic pressure independent control valve or approved equal.

.5 Construction: ball-type, pressure independent 2-way characterized control valve with multi-function technology, 24 VAC spring return actuator, 0-10VDC control input, brass body, chrome-plated brass ball and stem, with NPT connections. To be provided by controls contractor.

2.16 PIPING ENCLOSURE

.1 Construction: 4” wide, primer coated supplied complete with all fittings and accessories to make a working system.

.2 Provide Speedichannel line set cover system or approved equivalent.

Part 3 EXECUTION

3.1 GENERAL

.1 Install in accordance with manufacturers' recommendations.

.2 Maintain proper clearance around equipment to permit maintenance.

3.2 STRAINERS

.1 Install as indicated.

.2 Ensure clearance for removal of basket.

.3 Install blow-down valves as indicated.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes.

.1 Materials and installation for steel piping, valves and fittings for hydronic systems in building services piping.

.2 Sustainable requirements for construction and verification.

.2 Related Sections.

.1 Section 23 05 00 - Common Work Results Mechanical.

.2 Section 23 05 05 - Installation of Pipework.

.3 Section 23 05 16 - Expansion Loops for HVAC Piping and Equipment.

.4 Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

.5 Section 23 08 01 - Performance Verification of Mechanical Piping Systems.

.6 Conform to Sections of Division 01, as applicable.

.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME).

.1 ASME B16.1-98, Cast Iron Pipe Flanges and Flanged Fittings.

.2 ASME B16.3-98, Malleable Iron Threaded Fittings.

.3 ASME B16.5-03, Pipe Flanges and Flanged Fittings.

.4 ASME B16.9-01, Factory-Made Wrought Buttwelding Fittings.

.5 ASME B18.2.1-03, Square and Hex Bolts and Screws (Inch Series).

.6 ASME B18.2.2-87(R1999), Square and Hex Nuts (Inch Series).

.2 American Society for Testing and Materials International, (ASTM).

.1 ASTM A47/A47M-99, Standard Specification for Ferritic Malleable Iron Castings.

.2 ASTM A53/A53M-02, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated Welded and Seamless.

.3 ASTM A536-84(1999)e1, Standard Specification for Ductile Iron Castings.

.4 ASTM B61-02, Standard Specification for Steam or Valve Bronze Castings.

.5 ASTM B62-02, Standard Specification for Composition Bronze or Ounce Metal Castings.

.6 ASTM E202-00, Standard Test Method for Analysis of Ethylene Glycols and Propylene Glycols.

.3 American Water Works Association (AWWA).

.1 AWWA C111-00, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

.4 Canadian Standards Association (CSA International).

.1 CSA B242-M1980(R1998), Groove and Shoulder Type Mechanical Pipe Couplings.

.2 CAN/CSA W48-01, Filler Metals and Allied Materials for Metal Arc Welding (Developed in cooperation with the Canadian Welding Bureau).

.5 Manufacturer's Standardization of the Valve and Fittings Industry (MSS).

.1 MSS-SP-67-025, Butterfly Valves.

.2 MSS-SP-71-97, Cast Iron Swing Check Valves Flanged and Threaded Ends.

.3 MSS-SP-80-03, Bronze Gate, Globe, Angle and Check Valves.

.4 MSS-SP-85-02, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

Part 2 Products

2.1 PIPE

.1 Steel pipe: to ASTM A53/A53M, Grade B as follows:

.1 To NPS6: Sch. 40.

2.2 PIPE JOINTS

.1 NPS 50 mm (2”) and under: screwed fittings with PTFE tape or lead-free pipe dope.

.2 NPS 64 mm (2-1/2”) and over: Roll grooved, rigid coupling to CSA B242.

.3 Flanges: split, plain face.

.4 Pipe thread: taper.

.5 Bolts and nuts: to ASME B18.2.1 and ASME B18.2.2.

.6 Roll grooved coupling gaskets: type EPDM.

.7 Expansion joints: see Section 23 05 16 - Expansion Loops for HVAC Piping and Equipment.

2.3 FITTINGS

.1 Screwed fittings: malleable iron, to ASME B16.3, Class 150.

.2 Pipe flanges and flanged fittings:

.1 Cast iron: to ASME B16.1, Class 125.

.2 Steel: to ASME B16.5.

.3 Unions: malleable iron, to ASTM A47/A47M and ASME B16.3.

.4 Fittings for roll grooved piping: malleable iron to ASTM A47/A47M, ductile iron to ASTM A536.

2.4 VALVES

.1 Connections:

.1 NPS 50 mm (2”) and smaller: screwed ends.

.2 NPS 64 mm (2 1/2”) and larger: grooved ends.

.2 Butterfly valves: to MSS-SP-67

.1 Application: Isolating section of pipe or equipment:

.2 NPS 64 mm (2 1/2”) and over: Grooved ends: as specified.

.3 Construction: cast iron body, ductile iron disc with nickel coating, stainless steel stem and bearings, locking lever handle.

.3 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc.

.4 Swing check valves: to MSS-SP-71.

.1 NPS 50mm (2”) and under:

.1 Class 125, swing, with soft disc seat.

.2 Construction: cast bronze body and cap, stainless steel hanger and pin, lead-free brass seat and plug, FNPT threaded connections.

.2 NPS 64mm (2 1/2”) and over:

.1 Grooved ends: as specified.

.2 Construction: ductile iron body, stainless steel plug, shaft and spring, EPDM disc seal and coating.

.5 Miscellaneous ball valves:

.1 NPS 50mm (2”) and under: Conbraco Series 70 or equal.

Part 3 Execution

3.1 PIPING INSTALLATION

.1 Install pipework in accordance with Section 23 05 05 - Installation of Pipework.

3.2 CONTROL/CIRCUIT BALANCING VALVES

.1 Install flow balancing valves as indicated.

3.3 CLEANING, FLUSHING AND START-UP

.1 In accordance with Section 23 08 02 - Cleaning and Start-Up of Mechanical Piping Systems.

3.4 TESTING

.1 Test system in accordance with Section 23 05 00 - Common Work Results - Mechanical and Section 23 08 01 – Performance Verification of Mechanical Piping Systems.

.2 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair leaking joints, fittings or valves.

.3 Provide test kit for owner to permit future glycol testing by building operations staff.

3.5 GLYCOL CHARGING

.1 Provide mixing tank and positive displacement pump for glycol charging.

.2 Retest for concentration to ASTM E202 after cleaning.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Electrical wiring: Division 26.

.2 23 05 00 – Common Work Results – Mechanical

.3 Conform to Sections of Division 01, as applicable.

1.2 REFERENCES

ASME Standards	
CSA B51-03	Boiler, Pressure Vessel and Pressure Piping Codes
CSA Standards	
National Electric Code Standards	
MNECB 1997	Model National Energy Code of Canada for Buildings
ASHRAE 90.1-2001	Energy Standard for Buildings Except Low-Rise Residential Buildings

PART 2 PRODUCTS

.1 Furnish circulating pumps as listed hereinafter, of the size, capacity and head characteristics and motor characteristics indicated on the Design Drawings.

2.2 MAIN HYDRONIC CIRCULATING PUMPS

.1 Install line mounted circulators where indicated and as specified on the Design Drawings.

.2 P1A/P1B: For main circulator pumps: Provide Armstrong Series 4380 (or approved equal) slit coupled vertical in-line centrifugal pump.

.1 Supplied complete with cast iron pump housing, 50 mm (2”) flanged connections, bronze impeller, 316 stainless steel shaft, braided stainless steel flush line, carbon steel motor shaft, confined non-asbestos fiber casing gasket, resin bonded carbon rotating face seal, sintered silicon carbide stationary seat, EPDM secondary seal.

.2 Motor: 5 hp, TEFC NEMA premium efficiency inverter motor, 208/3/60 power. NOTE: Each pump shall be outfitted with a variable frequency drive (VFD) as specified in Division 26 and on Design Drawings.

.3 Refer to drawings for capacity.

2.3 BOILER CIRCULATING PUMPS

.1 BCP-1-3: Provide Grundfos Magna3 variable speed canned rotor type circulating pump (or approved equivalent). Sizes, model, capacity as indicated on drawings.

.1 Supplied complete with cast iron pump housing, aluminum stator housing, EPDM stator housing O-rings, polycarbonate control box, PPS rotor can, PES impeller, stainless steel shaft, stainless steel neck ring, stainless steel bearing plate, aluminum oxide/carbon thrust bearing.

.2 Electrical: integral controller, built-in differential pressure and temperature sensor, flanged connections, 4-pole synchronous permanent magnet motor, 208-230/1/60 power.

PART 3 EXECUTION

3.1 GENERAL

.1 Install work of this Section to applicable requirements of Section 26 05 01 – Common Work Results Electrical.

3.2 PUMP INSTALLATION

.1 Set pumps in place, align, connect and place in operation.

.2 Protect pumps from damage during and after installation, and on completion of work ensure that equipment is free from cracks, scratches, discolorations, tool marks and other defects. Thoroughly clean finished surfaces before acceptance of work.

.3 Support pumps independent of piping such that no loads are transmitted to pumps.

END OF SECTION.

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for copper tubing and fittings for refrigerant.

.2 Sustainable requirements for construction and verification:

.2 Related Sections:

.1 Section 23 05 01 - Installation of Pipework.

.2 Conform to Sections of Division 01, as applicable.

1.2 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

.1 ASME B16.22-01, Wrought Copper and Copper Alloy Solder - Joint Pressure Fittings.

.2 ASME B16.24-02, Cast Copper Pipe Flanges and Flanged Fittings: Class 150, 300, 400, 600, 900, 1500 and 2500.

.3 ASME B16.26-88, Cast Copper Alloy Fittings for Flared Copper Tubes.

.4 ASME B31.5-01, Refrigeration Piping and Heat Transfer Components.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM A307-04, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.

.2 ASTM B280-03, Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

.3 Canadian Standards Association (CSA International)

.1 CSA B52-99, Mechanical Refrigeration Code.

.4 Environment Canada (EC)

.1 EPS 1/RA/1-96, Environmental Code of Practice for the Elimination of Fluorocarbon Emissions from Refrigeration and Air Conditioning Systems.

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

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's printed product literature, specifications and datasheet for piping, fittings and equipment.

.2 Submit WHMIS MSDS. Indicate VOC's for adhesive and solvents during application and curing.

.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.5 Instructions: submit manufacturer's installation instructions.

.6 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 77 00 – Closeout Procedures.

1.4 QUALITY ASSURANCE

.1 Health and Safety:

.1 Do construction occupational health and safety in accordance with Ministry of Labour Requirements.

Part 2 Products

2.1 Not Applicable

2.2 MATERIALS

.1 Materials and resources in accordance with specifications.

2.3 TUBING

.1 Processed for refrigeration installations, deoxidized, dehydrated and sealed.

.1 Hard copper: to ASTM B280, type ACR.

.2 Annealed copper: to ASTM B280, with minimum wall thickness as per CSA B52 and ASME B31.5.

2.4 FITTINGS

.1 Service: Design pressure of 2070 kPa (300 PSIG) and temperature 121 degrees C.

.2 Brazed:

.1 Fittings: wrought copper to ASME B16.22.

.2 Joints: silver solder, 15% Ag-80% Cu-5%Por copper-phosphorous, 95% Cu-5%P and non-corrosive flux.

.3 Flanged:

.1 Bronze or brass, to ASME B16.24, Class 150 and Class 300.

.2 Gaskets: suitable for service.

.3 Bolts, nuts and washers: to ASTM A307, heavy series.

.4 Flared:

.1 Bronze or brass, for refrigeration, to ASME B16.26.

2.5 PIPE SLEEVES

.1 Hard copper or steel, sized to provide 6 mm (1/4”) clearance around between sleeve and uninsulated pipe or between sleeve and insulation.

2.6 PIPE SUPPORTS

.1 UV resistant supports, complete with 100% recycled rubber and galvanized steel fastening strut. Provide Clearline Technologies C-port C10 Series or equal.

2.7 VALVES

.1 22 mm (0.89”) and under: Class 500, 3.5 MPa (508 PSIG), globe or angle non-directional type, diaphragm, packless type, with forged brass body and bonnet, moisture proof seal for below freezing applications, brazed connections.

.2 Over 22 mm (0.89”): Class 375, 2.5 MPa (363 PSIG), globe or angle type, diaphragm, packless type, back-seating, cap seal, with cast bronze body and bonnet, moisture proof seal for below freezing applications, brazed connections.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 GENERAL

.1 Install in accordance with CSA B52, EPS1/RA/1 and ASME B31.5 Section 23 05 01 - Installation of Pipework.

3.3 BRAZING PROCEDURES

.1 Bleed inert gas into pipe during brazing.

.2 Remove valve internal parts, solenoid valve coils, sight glass.

.3 Do not apply heat near expansion valve and bulb.

3.4 PIPING INSTALLATION

.1 General:

.1 Soft annealed copper tubing: bend without crimping or constriction. Hard drawn copper tubing: do not bend. Minimize use of fittings.

.2 Install isolation valves at locations recommended by air conditioning system manufacturer to permit component service without requiring evacuation of complete system refrigerant charge.

.2 Hot gas lines:

.1 Pitch at least 1:240 down in direction of flow to prevent oil return to compressor during operation.

.2 Provide trap at base of risers greater than 2400 mm (96") high and at each 7600 mm thereafter.

.3 Provide inverted deep trap at top of risers.

.4 Provide double risers for compressors having capacity modulation.

.1 Large riser: install traps as specified.

.2 Small riser: size for 5.1 m/s (16.7 ft/s) at minimum load. Connect upstream of traps on large riser.

3.5 PRESSURE AND LEAK TESTING

.1 Close valves on factory charged equipment and other equipment not designed for test pressures.

.2 Leak test to CSA B52 before evacuation to 2 MPa (290 PSIG) and 1MPa (145 PSIG) on high and low sides respectively.

.3 Test Procedure: build pressure up to 35 kPa (5 PSIG) with refrigerant gas on high and low sides. Supplement with nitrogen to required test pressure. Test for leaks with electronic or halide detector. Repair leaks and repeat tests.

3.6 FIELD QUALITY CONTROL

.1 Site Tests/Inspection:

.1 Close service valves on factory charged equipment.

.2 Ambient temperatures to be at least 13 degrees C (55 degrees F) for at least 12 hours before and during dehydration.

.3 Use copper lines of largest practical size to reduce evacuation time.

.4 Use two-stage vacuum pump with gas ballast on 2nd stage capable of pulling 5Pa absolute and filled with dehydrated oil.

.5 Measure system pressure with vacuum gauge. Take readings with valve between vacuum pump and system closed.

.6 Triple evacuate system components containing gases other than correct refrigerant or having lost holding charge as follows:

.1 Twice to 14 Pa (0.06 W.C.) absolute and hold for 4 h.

.2 Break vacuum with refrigerant to 14 kPa (0.06 W.C.).

.3 Final to 5 Pa (0.02 W.C.) absolute and hold for at least 12 h.

.4 Isolate pump from system, record vacuum and time readings until stabilization of vacuum.

.5 Submit test results to Consultant.

.7 Charging:

.1 Charge system through filter-drier and charging valve on high side. Low side charging not permitted.

.2 With compressors off, charge only amount necessary for proper operation of system. If system pressures equalize before system is fully charged, close charging valve and start up. With unit operating, add remainder of charge to system.

.3 Re-purge charging line if refrigerant container is changed during charging process.

.8 Checks:

.1 Make checks and measurements as per manufacturer's operation and maintenance instructions.

.2 Record and report measurements to Consultant.

3.7 DEMONSTRATION

.1 Instructions:

.1 Provide operation and maintenance instructions in accordance with Section 01 77 00 – Closeout Procedures and CSA B52.

3.8 CLEANING

.1 Perform cleaning operations in accordance with manufacturer's recommendations.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 Conform to Sections of Division 01 as applicable.

.1 Conform to Section 23 05 00 - Common Work Results Mechanical as applicable.

1.2 RELATED SECTIONS

.1 Section 23 33 00 – Air Duct Accessories.

.2 Section 23 07 13 – Thermal Insulation for Ducting.

.3 Section 23 37 13 – Diffusers, Registers and Grilles.

1.3 REFERENCES

ASTM A167-99	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
ASTM A653/A653M-02	Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process
NFPA 90A	Installation of Air Conditioning and Ventilation Systems
NFPA 90B	Installation of Warm Air Heating And Air Conditioning Systems
SMACNA	HVAC Duct Constrictions Standards, Metal and Flexible (1985).
SMACNA	HVAC Duct Conscription Leakage Test Manual (1985)

1.4 REGULATORY REQUIREMENTS

.1 Conform to the requirements of local by-laws, Ministry of Labour Regulations, and authorities having jurisdiction.

1.5 SUBMITTALS

.1 Submittals, product data and shop drawings to be in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

PART 2 PRODUCTS

2.1 SHEET METAL WORK - GENERAL

.1 Furnish sheet metal work in accordance with material specifications and construction details specified herein and conforming to standard and recommended practices as defined by SMACNA Duct Construction Standards.

.2 Furnish all ductwork constructed to SMACNA 25mm (1") standards for pressure classification, unless noted otherwise on Drawings.

.3 Furnish ductwork of galvanized steel sheet with Z-275 (G90) designation zinc coating to ASTM A653/A653M.

.4 Furnish ducts of sizes shown on Drawings. For acoustically lined ducts, do not adjust duct size to accommodate liner thickness, actual dimensions are shown on Drawings.

.5 Fabricate ductwork free from vibration, rattle or drumming under operating conditions. Furnish necessary reinforcements, bracing, framing, gasketing, etc., to comply with performance criteria.

.6 Furnish sleeves at duct penetrations through walls and floors, fabricated from same material and thickness sheet material as for ductwork. Furnish closure plates each side of wall to cover sleeve. Provide sleeve as per fire damper manufacturer’s recommendations if duct passes through a rated assembly.

.7 Seal all transverse and longitudinal joints with water based high pressure duct sealant to Class A requirements.

.8 Rectangular Ductwork Type I - Low Pressure - Medium Pressure

.1 Fabricate rectangular ductwork to metal thickness and construction methods as specified herein for various size ranges of ducts. Given dimensions represent widest side of duct.

Galvanized Steel Gauges and Equivalent Thicknesses

Gauge (gsg)	mm (in)	Low Pressure	Medium Pressure	Slip
26	0.49 (0.020)	Up to 300 (Up to 12)	—	—
24	0.64 (0.025)	330 – 762 (13 – 30)	Up to 457 (Up to 18)	Up to 762 (Up to 30)
22	0.84 (0.033)	787 – 1372 (31 – 54”)	483 – 1219 (19”-48”)	787 - 1524 (31 – 60)
20	0.94 (0.037)	1397 – 2134 (55 – 84)	1245 – 1829 (49 – 72)	1549 & over (61 & Over)
18	1.24 (0.049)	2134 & over (84 & over)	1854 & over (73 & over)	—

.9 Supports and Hangers - Rectangular Ductwork

.1 Except where shown otherwise on Drawings, Furnish strap hangers one gauge heavier than ductwork x 1" wide for ducts up through 760 mm (30") width. Bend strap hanger around bottom of duct for a minimum of 38 mm (1-1/2") and attach to sides and bottom of duct. Furnish galvanized steel rod hangers of 10 mm (3/8") dia. minimum size for ducts over 760 mm (30") in width and furnish 38 mm x 38 mm x 3 mm (1-1/2" x 1-1/2" x 1/8") galvanized steel angle across bottom of duct and attach hanger to angle (not the duct).

.10 Round Ductwork Type III - Low Pressure

.1 Construct round ductwork to specifications established by National Warm Air Heating Association. Use snap lock seam type duct conforming to following gauges:

Duct Diameter	Thickness of Sheet Metal
203 mm (8”) and under	0.5 mm (0.020”) (26 ga.)
229 (9”) to 330mm (13”)	0.5 mm (0.020”) (26 ga.)
356 mm (14”) and above	0.6 mm (0.024”) (26 ga.)

.2 Girth joints as follows:

Duct Diameter	Type of Construction
203 mm (8”) and under	Crimped and beaded
229 mm (9”) and above	Crimped and beaded

.3 Lap slip joints in direction of flow. Make external diameter of edged end same as internal diameter of belled end on slip joints. Seal entire surface of overlap with water based high velocity duct

sealer compound. Provide butterfly disc type balancing dampers of 16 gauge metal, complete with locking quadrant (ECCO KS-145 or equal).

2.2 FLEXIBLE TYPE ROUND DUCTS

.1 Furnish flexible type round ductwork for final connection to ceiling diffusers.

.2 Furnish insulated flexible duct of non-collapsible, coated aluminum foil/mylar construction with flame spread rating not to exceed 25 and a smoke developed rating not to exceed 50. Minimum length 910mm (3'-0") max length 1830mm (6' – 0"),

.3 Furnish flexible duct bearing ULC approved labels and conforming to flame spread and smoke developed ratings as required by code.

.4 Furnish sealed joints between flexible duct and rigid ductwork or equipment, made with water based high velocity duct sealer, applied in accordance with duct manufacturer's recommendations and gear type nylon strap connectors.

2.3 ACOUSTIC DUCT INSULATION

.1 Furnish rigid coated duct liner conforming to NFPA 90A and 90B, of 25 mm (1") thickness and 72 kg/cu.m (4.5 lb/cu.ft) density.

.2 Fasten duct liner with plate type impaling pins and self-locking washers.

Furnish fasteners for securing pins of size and length as required by insulation weight, thickness, fastener spacing and design.

.3 Adhere insulation to sheet metal work with fire retardant adhesive. Seal all joints with mastic sealant.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

.1 Refer to and comply with applicable requirements specified in Section 23 05 00 - Common Work Results - Mechanical.

.2 Install miscellaneous steel framing, supports, braces, etc., as may be required to hang or support ductwork as specified herein, and as shown on Drawings.

.3 Install ductwork in arrangement shown on Drawings in accordance with standards and recommended practices off ASHRAE and SMACNA. Provide required offsets and transitions, whether specifically indicated or not, to facilitate duct arrangement and to avoid interference with building

structure, piping, equipment and services.

.4 Coordinate ductwork location with other trades work to ensure all services are accommodated in available ceiling space.

.5 Install ductwork in locations and at elevations appropriate to ceiling height shown on Drawings. Where required to be concealed, install ductwork in furred spaces provided in walls and ceilings. Where there is no provision for concealed ductwork, install as close as possible to walls, partitions and overhead structures to attain maximum headroom and clearance.

.6 Install sleeves where ducts pass through walls or floors. Pack space between duct and sleeve with mineral wool and seal both ends with non-inflammable fire resistant sealing compound. Install sheet metal closure plates on each side of wall to cover sleeve.

.7 Install beam clamps or supplementary steel to secure hanger rods, angles and straps to structural steel framing.

.8 Where shape of duct changes, install transition piece so that angle of side of transition piece does not exceed 15 degrees from straight run of duct being connected, unless shown otherwise on Drawings.

.9 Slope fresh air intake ducts down at 1:100 to permit moisture induced by air intake to be drained.

.10 Seal all transverse and longitudinal joints with water based high pressure duct sealant to Class A requirements. Seal open duct ends with adhesive film during construction to prevent entry of dirt and debris until work is finished.

3.2 SUPPORTS AND HANGERS - RECTANGULAR DUCTWORK

.1 Install supports and hangers at intervals not over 2400mm (8'-0") centres for ducts up to 1500 mm (5'-0") in width and at 1200 mm (4'-0") centres for ducts 1500 mm (5'-0") in width and over.

.2 Install miscellaneous steel angles or channels as required between joists or building steel for structural support of duct where building framing spacing does not coincide with the required hanger spacing.

3.3 ROUND DUCTWORK

.1 Secure joints with sheet metal screws and seal with sealant.

3.4 ACOUSTIC DUCT INSULATION

.1 Install internal acoustic insulation minimum 3m (10’-0”) from equipment inlet/outlets and in specific sections of ductwork and/or plenums as shown on Drawings. Co-ordinate with Section 23 07 13 – Thermal Insulation for Ducting.

.2 Adhere insulation to ductwork or plenums by bedding in strips of adhesive supplemented by impaling clips or weld pins spaced at 300 mm (12") centres with self-locking washers. Apply adhesive at 50% coverage, in 150 mm (6") strips. Cut off ends of welded impaling pins after application of self-locking washers.

3.5 CLEANING AND TESTING OF DUCTWORK

.1 Inspect and test ductwork for air leakage at joints and connections to equipment, under normal operating conditions.

.2 Test ductwork before ducts are insulated or concealed.

.3 Immediately correct defects discovered during tests and retest systems to complete satisfaction of Owner.

.4 Clean interior of ductwork as system is constructed to remove construction debris as system is assembled. Clean interior of air handing equipment with industrial type vacuum cleaner prior to final turnover. On completion of cleaning process, install new filter media before placing systems in final operation.

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Fire and smoke dampers, and fire stop flaps.

.2 Sustainable requirements for construction and verification.

.1 Material Safety Data Sheets (MSDS) indicating VOC emissions.

.2 Related Sections:

.1 Section 01 33 00 - Submittal Procedures.

.2 Section 23 05 00 – Common Work Results – Mechanical

1.2 REFERENCES

ASHRAE	American Society of Heating Refrigerating And Air-Conditioning engineers INC.
ASTM A167-99	Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip.
ASTM A653/A653M-02	Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot Dip Process
NFPA 96 (1991)	Vapour Removal From Cooking Equipment
NFPA 90A	Installation of Air Conditioning and Ventilation Systems
NFPA 90B	Installation of Warm Air Heating And Air Conditioning Systems
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
WHIMIS	Workplace Hazardous Materials Information System
MSDS	Material Safety Data Sheet
ULC	Underwriters Laboratories of Canada

1.3 SUBMITTALS

.3 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.1 Submit two (2) copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures.

.4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.

.1 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.2 Instructions: submit manufacturer's installation instructions.

.1 Consultant will make available one (1) copy of systems supplier's installation instructions.

.5 Closeout Submittals:

.1 Provide maintenance data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 QUALITY ASSURANCE

.1 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 29.06 - Health and Safety Requirements.

.2 Certificates:

.1 Catalogue or published ratings those obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards.

Part 2 Products

2.1 GENERAL

.1 Manufacture in accordance with SMACNA - HVAC Duct Construction Standards.

2.2 BALANCING DAMPERS

.1 Furnish butterfly blade balancing dampers for round ducts fabricated of 1.6 mm (16 ga) metal and with locking type quadrant. (Ecco KS-145 or equal) Refer to Design Drawings for sizes and placements.

2.3 FIRE DAMPERS

.1 Furnish Type A UL labeled fire dampers of dynamic steel curtain-type, (NCA Model FDD or approved equal) with channel frames, 1 1/2 hour fire rated unless otherwise indicated, 74 degrees C (165 degrees F) fusible link, stainless steel spring, access door, ULC labeled and conforming to NFPA 90A, Ontario Fire Protection and Prevention Act, Fire Commisioner of Canada (FCC) and CFFM requirements.

.2 Furnish fire dampers and frame constructed of same material as duct in which they are installed. Refer to Design Drawings for sizes, types and placements.

2.4 ACCESS DOORS IN DUCTWORK

.1 Furnish access doors in ductwork and for plenums to allow servicing, maintenance, and inspection of heating/cooling coils, control dampers, fire detectors, fire dampers, control elements, bearings and as shown on Drawings. Furnish access doors at least 406 mm x 406 mm (16" x 16") unless duct dimensions prevent, or as required to provide proper access to equipment.

.2 For installation in insulated ductwork and plenums, furnish access doors of 0.81 mm (20 ga) thick galvanized steel sheet double panel construction with approved 50 mm (2") thick insulating filler, in flanged collar flush with face of finished insulation.

.3 Furnish access doors in air conditioning and ventilation systems with heavy continuous hinges, three heavy sash fasteners and sponge neoprene gaskets to ensure air-tight fit at operating pressure. Include #4 satin polish, universal self-latching bolt, spring closer, and knurled release.

Part 3 Execution

3.1 INSTALLATION

.1 Refer to and comply with applicable requirements specified in Section 23 05 00 - Common Work Results Mechanical.

.2 Install miscellaneous steel framing, supports, braces, etc. as may be required to hang or support equipment and ductwork as specified herein, and as shown on Drawings.

.3 Balancing Dampers

.1 Install dampers at locations in supply and return ductwork where indicated.

.4 Fire Dampers

.3 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.

.4 Maintain integrity of fire separation.

.5 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.

.6 Install access door adjacent to each damper.

.7 Co-ordinate with installer of firestopping.

.8 Ensure access doors/panels, fusible links, damper operators are easily observed and accessible.

.9 Install break-away joints of approved design on each side of fire separation.

.5 Access Doors in Ductwork

.1 Install access doors in ductwork and in plenums to allow servicing, maintenance, and inspection of heating coils, control dampers, fire dampers, fire detectors, control elements, bearings and as shown on Drawings.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Fans, motors, accessories and hardware for commercial use.

.2 Related Sections

.1 23 05 13 - Common Motors Requirements for HVAC Equipment.

.2 23 33 46 – Flexible Ducts.

.3 Conform to Sections in Division 01, as applicable.

1.2 REFERENCES

.1 Air Conditioning and Mechanical Contractors (AMCA)

.1 AMCA Publication 99-2003, Standards Handbook.

.2 AMCA 300-1996, Reverberant Room Method for Sound Testing of Fans.

.3 AMCA 301-1990, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.

.2 American National Standards Institute (ANSI)/American Society of Mechanical Engineers (ASME)

.1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.3 Canadian General Standards Board (CGSB)

.1 CAN/CGSB 1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

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

.1 Material Safety Data Sheets (MSDS).

1.3 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from independent testing agency signifying adherence to codes and standards in force.

.2 Capacity: flow rate, static pressure, W, efficiency, revolutions per minute, power, model, size, sound power data and as indicated on schedule.

.3 Fans: statically and dynamically balanced, constructed in conformity with AMCA 99.

.4 Sound ratings: comply with AMCA 301, tested to AMCA 300.

.5 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210.

Part 2 Products

2.1 FANS GENERAL

.1 Motors:

.1 Sizes as indicated specified.

.2 Factory primed before assembly in colour standard to manufacturer.

2.2 DESTRATIFICATION PADDLE FANS

.1 AHU-1,2 Return Fan

.1 Daikin double width double inlet centrifugal class I, forward curved with top horizontal discharge.

.2 AHU-1,2 Supply Fan

.1 Daikin double width double inlet centrifugal class I, forward curved with up blast discharge.

.3 ERV-1 Return Fan

.1 EH Price Model 39M rear inlet class I, centrifugal, forward curved fan with down blast front discharge.

.2 Control: VFD

.4 ERV-1 Supply Fan

.1 EH Price Model 39M rear inlet class I, centrifugal, forward curved fan with down blast front discharge.

.2 Control: VFD

.5 RTU-1,2,3,4 Exhaust Fan

.1 Greenheck direct-drive, backward-inclined plenum blowers using ball-bearing motors of ODP type, NEMA premium efficiency type.

.2 Control: Factory-installed VFD

.6 RTU-1,2,3,4 Supply Fan

.1 Greenheck direct-drive, backward-inclined plenum blowers using ball-bearing motors of ODP type, NEMA premium efficiency type.

.2 Control: Factory-installed VFD

Part 3 Execution

3.1 FAN INSTALLATION

.1 Install fans as indicated, complete with resilient mountings specified in appropriate sections with flexible electrical leads and flexible connections in accordance with Section 23 33 00 – Air Duct Accessories.

.2 Access doors and access panels to be easily accessible.

3.2 ANCHOR BOLTS AND TEMPLATES

.1 Size anchor bolts to withstand design conditions as specified.

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Variable volume boxes.

.2 Conform to Sections in Division 01, as applicable.

.3 Conform to 23 05 00 – Common Work Results – Mechanical as applicable.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)

.1 ANSI/AMCA 210-1999, Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

.2 ANSI/NFPA 90A-2002, Standard for the Installation of Air Conditioning and Ventilating Systems.

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

.1 Material Safety Data Sheets (MSDS).

.3 International Organization of Standardization (ISO)

.1 ISO 3741-2001, Acoustics-Determination of Sound Power Levels of Noise Sources Using Sound Pressure - Precision Methods for Reverberation Rooms.

.4 Underwriter's Laboratories (UL)

.1 UL 181-2003, Factory-Made Air Ducts and Air Connectors.

1.3 SYSTEM DESCRIPTION

.1 Performance Requirements:

.1 Catalogued or published ratings for manufactured items: obtained from tests carried out by manufacturer or those ordered by manufacturer from certified ADC (Air Diffusion Council) testing agency signifying adherence to codes and standards.

PART 2 Products

2.1 MANUFACTURED UNITS

.1 Terminal units of the same type to be product of one manufacturer.

2.2 TERMINAL UNITS

.1 Construction: Construction: galvanized steel casing, 13 mm (1/2”) internal insulation with density of 24 kg/cu.m (1.5 lb/cu.ft.), control shroud and multi-point sensor and gauge taps.

.2 Provide: E.H Price model SDV-5000 single duct pressure independent terminal unit.

PART 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 Refer to and comply with applicable requirements specified in Section 23 05 00.

.2 Install miscellaneous steel framing, supports, braces, etc. as may be required to hang or support equipment and ductwork as specified herein, and as shown on Drawings.

.3 Install air terminal units (TU) independently of ductwork, with rods or angles of sizes adequate to support load.

.4 Install beam clamps or supplementary steel to secure hanger rods, angles and straps to structural steel framing.

.5 In suspended ceiling areas, adjust final location of grilles and diffusers to suit reflected ceiling plan.

3.3 AIR TERMINAL UNITS

.1 Install air terminal units with specified duct diameters of straight duct upstream of inlet.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Pipe, fittings and valves: refer to piping standards appended to Section 23 05 00 – Common Work Results – Mechanical.

.2 Conform to Section 23 05 00 – Common Work Results – Mechanical and relevant Sections of Division 01, as applicable.

.3 Section 23 07 13 – Thermal Insulation for Ducting.

PART 2 Products

2.1 DIFFUSERS, REGISTERS AND GRILLES

.1 General

.1 Refer to Drawings for neck size, dimensions, capacity, etc. of grilles, registers and diffusers.

.2 Furnish items to deliver indicated air quantities shown with throw to reach intended space limits without increasing sound level of room. Furnish blank-off baffles where required. Furnish equalizing deflectors on diffusers and in other locations as shown or required.

.3 Coordinate placing of diffusers, registers and grilles in ceilings with electrical and ceiling installation trades and exact location to final approval of Architect.

.4 Unless otherwise noted, furnish other grilles, registers and diffusers factory painted.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Refer to and comply with applicable requirements specified in Section 23 05 00 – Common Work Results – Mechanical.

.2 Install miscellaneous steel framing, supports, braces, etc. as may be required to hang or support equipment and ductwork as specified herein, and as shown on Drawings.

.3 Install beam clamps or supplementary steel to secure hanger rods, angles and straps to structural steel framing.

.4 In suspended ceiling areas, adjust final location of grilles and diffusers to suit reflected ceiling plan.

.5 In occupied areas paint interior of ductwork for at least 600 mm (24") behind supply and exhaust grilles with matte black paint so as to render ductwork invisible from occupied space.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Mechanical louvers; intakes; vents; and reinforcement and bracing for air vents, intakes and gooseneck hoods.

.2 Conform to Sections in Division 01 and Division 09, as applicable.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/ National Fire Protection Association (NFPA)

.1 ANSI/NFPA 96-04, Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations.

.2 American Society for Testing and Materials International (ASTM)

.1 ASTM E90-04, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.

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

.1 Material Safety Data Sheets (MSDS).

.4 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA)

.5 Society of Automotive Engineers (SAE)

1.3 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures.

.2 Provide maintenance data for incorporation into manual specified in Section 01 78 00 –Closeout Submittals.

.3 Indicate following:

.1 Pressure drop.
.2 Face area.
.3 Free area.

Part 2 Products

2.1 GOOSENECK HOODS

.1 Refer to Design Drawings for gooseneck sizes and locations.

.2 Thickness, Fabrication and Joints: to ASHRAE and SMACNA.

.3 Supports: as indicated.

.4 Complete with integral birdscreen of SS wire mesh.

.5 Vertical backdraft dampers where required.

Part 3 Execution

3.1 INSTALLATION

.1 In accordance with manufacturer's and SMACNA recommendations.

.2 Anchor securely into opening. Seal with caulking to ensure weather tightness.

END OF SECTION

PART 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials, accessories and installation for breechings, chimneys and stacks.

.2 Conform to Sections of Division 01 and Division 03, as applicable.

1.2 REFERENCES

.1 Sheet Metal and Air Conditioning Contractors National Association (SMACNA)

.2 Underwriters' Laboratories of Canada (ULC)

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

.1 Material Safety Data Sheets (MSDS).

1.3 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01330 - Submittal Procedures.

.2 Indicate following:

.1 Methods of sealing sections.

.2 Methods of expansion.

.3 Details of thimbles.

.4 Bases/Foundations.

.5 Supports.

.6 Rain caps.

PART 2 Products

2.1 BREECHING

.1 Boiler breeching shall be CPVC certified to ULC S636 and CSAB149.1. Solvent cement shall conform to CAN/CSA B181.2 or to certified system.

.2 Dimensions: as indicated.

.3 Hot water heater venting shall be PVC certified to ULC S636 and CSAB149.1. Solvent cement shall conform to CAN/CSA B181.2 or to certified system.

.4 Dimensions: as indicated

.5 Standard of Acceptance: IPEX System 636 or equal.

.6 Boiler and hot water heater combustion air piping shall be PVC to CAN/CSA-B181.2-M90.

2.2 ACCESSORIES

.1 Hangers and supports: in accordance with recommendations of Sheet Metal and Air Conditioning Contractors National Association Inc. (SMACNA), or as indicated.

PART 3 Execution

3.1 INSTALLATION - GENERAL

.1 Follow manufacturer's and SMACNA installation recommendations for shop fabricated components.

.2 Support venting as per manufacturers recommendations and as indicated.

.3 Install flashings on chimneys penetrating roofs, as indicated.

END OF SECTION

PART 1 General

1.1 REFERENCES

.1 American Boiler Manufacturer's Association (ABMA)

.2 American National Standards Institute (ANSI)

.1 ANSI Z21.13/CSA 4.9 latest edition, Gas-Fired Low-Pressure Steam and Hot Water Boilers.

.3 American National Standards Institute (ANSI)/ American Society of Mechanical Engineers (ASME)

.1 ANSI/ASME Boiler and Pressure Vessel Code, Section IV, latest edition.

.4 Canadian Gas Association (CGA)

.1 CAN1-3.1-77, Industrial and Commercial Gas-Fired Package Boilers.

.2 CAN/CSA-B149.1, latest edition, Natural Gas and Propane Installation Code.

.5 Canadian Standards Association (CSA International)

.1 CSA B51-latest edition, Boiler, Pressure Vessel, and Pressure Piping Code.

.2 CSA B139-latest edition, Installation Code for Oil Burning Equipment.

.3 CSA B140.7-latest edition, Oil Burning Equipment: Steam and Hot-Water Boilers.

.6 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

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

.1 Material Safety Data Sheets (MSDS).

1.2 SUBMITTALS

.1 Shop Drawings:

.1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.

.2 Indicate the following:

.1 General arrangement showing terminal points, instrumentation test connections.

.2 Clearances for operation, maintenance, servicing, tube cleaning, tube replacement.

.3 Foundations with loadings, anchor bolt arrangements.

.4 Piping hook-ups.

.5 Equipment electrical drawings.

.6 Burners and controls.

.7 All miscellaneous equipment.

.8 Flame safety control system.

.9 Breeching and stack configuration.

.3 Engineering data to include:

.1 Boiler efficiency at 25%, 50%, 75%, 100%, of design capacity.

.2 Radiant heat loss at 100% design capacity.

PART 2 Products

2.1 SUSTAINABLE REQUIREMENTS

.1 Materials and products in accordance with requirements specified in Division 01.

2.2 ACCEPTABLE MANUFACTURERS

.1 Furnish and install factory “packaged” low pressure hot water boiler(s) as manufactured by Harsco Industrial, Patterson Kelley or as approved and accepted by Consultant.

.2 Each factory “packaged” boiler shall be complete with all components and accessories necessary for a complete and operable boiler as hereinafter specified. Each boiler shall be furnished factory assembled with the required wiring and piping as a self contained unit. Each boiler shall be readily transported and ready for installation.

.3 All “Approved Equal” or “Approved Alternate” boilers must demonstrate compliance with the requirements of this specification.

.4 Furnish Harsco Industrial Patterson-Kelley Model SC1000 NG P-K Sonic boiler with 293kW (1,000 MBH) input and 270 kW (923 MBH) output or Consultant-approved equal.

2.3 CABINET ENCLOSURE

.1 Each boiler shall feature a fully assembled cabinet enclosure fabricated from Carbon Steel or Aluminum sheet metal (minimum 18 Gauge) with powder coat finish.

.2 The boiler’s cabinet enclosure shall not exceed 700 mm (28”) in width and the completed boiler shall fit through a standard 800 mm (32”) wide doorway.

.3 The boiler’s cabinet enclosure shall feature removable access panels / doors with quarter-turn type latches that can be easily opened with a coin or flathead screwdriver.

.4 The boiler’s cabinet enclosure shall eliminate the use of refractory or other insulating materials outside the heat exchanger and the enclosure’s surface temperature shall not exceed 20 degrees C (68 degrees F) above ambient temperature.

.5 The boiler’s cabinet enclosure shall prominently display all required safety, instruction, compliance and factory runout labels.

2.4 HEAT EXCHANGER

.1 Each water-tube boiler shall contain an ASME Section IV heat exchanger with an "H" stamp designed for a maximum allowable working pressure of 1,103 kPA (160 PSIG) and a maximum allowable temperature of 100 degrees C (210 degrees F).

.2 The completed heat exchanger shall consist of welded 316L SS helical water tubes and provide no less than 8 m^2 (87 ft^2) of total fireside heating surface area.

.3 Each completed heat exchanger shall include an integral stainless steel condensate pan/collector, condensate drain, removable burner assembly, inlet temperature sensor, outlet temperature sensor, flue gas temperature sensor, heat exchanger temperature sensor, automatic air vent, thermowell for high temperature limit capillary, low water cutoff probe or flow switch, and all necessary assembly hardware.

.4 Each Stainless Steel heat exchanger shall be designed to maintain water turbulence at the full published range of acceptable flow rates at various boiler conditions as described below:

.1 The maximum allowable flow rate will generate a 20 degrees C (degrees F) ΔT when the boiler is operating at full capacity.

.2 The minimum allowable flow rate will generate a 60 degrees C (degrees F) ΔT when the boiler is operating at full capacity.

.5 The boiler's completed heat exchanger shall be capable of operating with a minimum outlet water temperature of 6 degrees C (42 degrees F).

.6 Each heat exchanger must be hydrostatically tested by the manufacturer to a minimum of 1-1/2 times the maximum allowable working pressure for a minimum of 5 minutes. During this hydrostatic pressure test, the operator will inspect the pressure gauge and visually verify there are no water leaks.

2.5 MAIN GAS TRAIN

.1 Boilers configured for single fuel operation shall be equipped with an integral main gas valve train capable of burning either Natural Gas or Propane Gas.

.2 Each gas train shall be completely independent and include dedicated safety devices, shutoff valves, etc. Each gas train shall be individually identified by the manufacturer with labels and dedicated paint colors (Yellow = Natural Gas & Red = Propane Gas).

.3 Each single fuel gas valve train shall include at least the following:

.1 One (1) upstream manual shutoff valve for field connection.

.2 One (1) combination Air-Gas control and safety shutoff valve with duels solenoids (in-series) that can be independently energized for leak testing and integrated into a single body design. The combination gas valve shall operate as "Zero Governor" and control to a neutral gas pressure inside the valve.

.3 One (1) low gas pressure switch (manual reset).

.4 One (1) high gas pressure switch (manual reset).

.5 Two (2) gas pressure test ports.

.6 One (1) downstream manual shutoff valve.

.4 The main gas valve train(s) shall be factory assembled, piped, and wired and allow for operation at full rated boiler capacity from 0.9 kPa (3.5" W.C.) up to the maximum inlet gas pressure of 3.5 kPa (14.0" W.C.)

.5 If the supplied gas pressure exceeds 3.5 kPa (14" W.C.), the contractor shall supply a suitable intermediate gas pressure regulator of the lock-up type to reduce the gas pressure to acceptable levels.

2.6 POWER BURNER

.1 The boiler manufacturer shall furnish an integral power type fuel burner with each boiler. The complete power fuel burner assembly shall consist of a gas burner, combustion air blower, main gas valve train, and ignition system. The burner manufacturer shall fully coordinate the burner design with the boiler's heat exchanger and the boiler control system in order to provide the required capacities, efficiencies, and performance specified. Boilers shipped without a power burner and field-equipped with a 3rd party power burner are not acceptable.

.2 Each burner shall be installed horizontally inside the combustion chamber with combustion gases flowing downward through the heat exchanger. The burner shall consist of a stainless steel flange and perforated stainless steel cylinder.

.3 Each boiler shall be equipped with direct spark ignition. Main flame shall be monitored and controlled by a flame rod / ionization probe (rectification) system.

2.7 BOILER SAFETY AND TRIM DEVICE

.1 The boiler manufacturer shall furnish and test the following safety and trim devices with each boiler.

.1 Safety relief valve shall be provided in compliance with the ASME code. Contractor is required to pipe the relief valve discharge piping to an acceptable drain. Provide 345 kPa (50 PSIG) relief valve.

.2 Water pressure/temperature gauge.

.3 Low Water / Flow cutoff switch.

.4 Manual reset high limit water temperature controller.

.5 Operating temperature control to control the sequential operation of the burner.

.6 High and Low Gas Pressure switches.

.7 Flame rod / ionization probe flame detection.

.2 The boiler manufacturer shall provide a CSD-1 form identifying each safety and trim device.

.3 The boiler shall be capable of interfacing with the following external safety devices:

.1 Auxiliary Low Water Cutoff device.

.2 Combustion Air Damper End Limit Switch.

.3 Emergency Stop (E-Stop) switch.

.4 External Safety Device w/ contact closure.

2.8 BOILER CONTROL SYSTEM

.1 Each boiler shall be provided with all necessary controls, all necessary programming sequences, and all safety interlocks. Each boiler control system shall be properly interlocked with all safeties.

.2 Provide Model 10-0490-6943 normally closed combustion air damper (or equal).

.3 Each boiler shall be provided with a “Full Modulating” firing control system whereby the firing rate is infinitely proportional at any firing rate between low fire and high fire as determined by the pulse width modulation input control signal. Both fuel input and air input must be sequenced in unison to the appropriate firing rate without the use of mechanical linkage.

.4 The boiler’s control system shall provide the minimum capabilities:

.1 178 mm (7”) color touchscreen display with one or more USB ports.

.2 Standard on-board Ethernet port for wired internet connectivity and embedded wireless driver for optional wireless internet connectivity to remote monitoring and software update services.

.3 Parameter uploads and downloads via external USB flash drive.

.4 Software updates via external USB flash drive.

.5 Capture screen shots from the control’s display by saving digital image files to external USB flash drive.

.6 Local Representative Screen can be programmed to provide contact information for the local boiler manufacturer’s representative.

.7 Programmable Relay Outputs for direct control of pumps, control valves, dampers and other auxiliary devices.

.8 Multiple boiler “cascade” network up to 24 boilers without any external control panel. The installation of external sequencing control panels is not acceptable.

.9 Automatic hybrid system control for multiple boiler “cascade” systems with both condensing and non-condensing boilers. This control logic prioritizes condensing boilers at low water temperatures and prioritizes non-condensing boilers at high water temperatures.

.10 Auxiliary Boiler Relay for multiple boiler “cascade” systems which can be used to enable a 3rd party boiler platform in the event the “cascade” system is unable to satisfy the heating load.

.11 Programmable Boiler and System pump control for multiple boiler “cascade” systems installed in a Primary-Secondary piping arrangement.

.12 Programmable Control Valve logic for multiple boiler “cascade” systems installed in a Primary-Only piping arrangement.

.13 Integration with external Building Management Systems (BMS) via MODBUS® RTU protocol. NOTE: Optional Protocol Converter for communication via LONWORKS® and BACnet® must be available for purchase from the boiler manufacturer.

.14 Hardwire integration with Building Management Systems (BMS) via 4-20mA analog control signal for temperature or firing rate control.

.15 Intuitive “Setup Wizards” ask the user a series of questions and allow for step-by-step configuration of the boiler control.

.16 On-Screen error notifications with a comprehensive description of all alarm conditions and several troubleshooting steps.

.17 Automatic flue gas temperature and outlet (supply) temperature compensation to prevent over-firing of the boiler equipment.

.18 Automatic differential temperature compensation to prevent over-firing of the boiler equipment in a low flow condition.

.19 Automatically adjust the temperature set point and shutdown the boiler based on the outdoor air temperature conditions.

.20 Night Setback functionality via external point of closure (or BMS integration) for unique “Occupied” and “Unoccupied” temperature setpoint values.

.21 Maintain single temperature set point with a minimum outlet (supply) water temperature of 6 degrees C (42 degrees F) up to a maximum outlet (supply) water temperature of 90 degrees C (194 degrees F).

.22 On-Board DHW Priority capable of seamless transition between Comfort Heat (CH) and Domestic Hot Water (DHW) operation.

.23 On-Board CH and DHW operation for simultaneous Comfort Heat (CH) and Domestic Hot Water (DHW) operation.

.24 Alarm Relay Output to announce alarm conditions which require manual reset.

.25 Programmable Low Fire Delay to prevent excessive short-cycling of the boiler equipment.

.26 Local Manual Operation.

.5 The boiler control system shall be capable of interfacing with the following external control devices:

.6 Building Management System (MODBUS®). NOTE: Optional Protocol Converter for communication via LONWORKS® and BACnet® must be available for purchase from the boiler manufacturer.

.1 Domestic Hot Water Break-on-Rise Aquastat (Normally Closed).

.2 Domestic Hot Water Tank Temperature Sensor (12kΩ).

.3 External Header Temperature Sensor (12kΩ).

.4 Outdoor Air Temperature Sensor (12kΩ).

PART 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

.1 The contractor shall install gas-fired boilers in accordance with NFPA 54/ANSI Z223.1 (United States), or CAN/CSA B/149.1 (Canada), and per manufacturer's recommendations.

.2 Install boilers on cast-in-place concrete equipment base in compliance with the requirements for equipment bases and foundation.

.3 Make required piping connections to inlets and outlets recommended by boiler manufacturer.

.4 Maintain clearances as indicated or if not indicated, as recommended by manufacturer for operation, servicing and maintenance without disruption of operation of any other equipment/system.

.5 Mount unit level.

.6 Pipe hot water relief valves full size to glycol feeder.

.7 Each boiler shall feature 75mm (3") steel piping inlet (supply) and outlet (return) connections. The steel piping shall terminate with 75mm (3") grooved connections.

.8 Check manufacturer's installation manual for clearance dimensions and install piping that will allow for service and ease of maintenance.

.9 Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection and adhere to proper codes for neutralization.

3.3 MOUNTINGS AND ACCESSORIES

.1 Safety valves and relief valves:

- .1 Run separate discharge from each valve.
- .2 Terminate discharge pipe as indicated.
- .3 Run drain pipe from each valve outlet and drip pan elbow to above nearest drain.

.2 Blowdown valves:

- .1 Run discharge to terminate as indicated.

3.4 EXHAUST VENTING

.1 The boilers shall be dual certified as Category II or IV appliances and are capable of operating with slightly negative to slightly positive exhaust vent pressure, and the vent gas temperature is likely to cause condensate production in the vent.

.2 Install the exhaust/flue venting system in accordance with NFPA 54/ANSI Z223.1 (United States), or CAN/CSA B/149.1 (Canada) and per the manufacturer's recommendations in the installation manual.

3.5 ELECTRICAL

.1 Install an external disconnect and overload protection for each boiler in accordance with the requirements of NFPA 70.

.2 The voltage requirements for the boilers shall be 120 VAC, Single Phase, 60Hz.

END OF SECTION

PART 1 General

1.1 RELATED SECTIONS

.1 Section 23 33 00– Air Duct Accessories.

.2 Conform to Sections of Division 01, as applicable.

1.2 REFERENCES

.1 American Society of Heating, Refrigeration and Air-Conditioning Engineers (ASHRAE)

.2 ASHRAE 84-1991, Method of Testing Air-to-Air Heat Exchangers.

1.3 CERTIFICATION

.1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.

.2 Provide confirmation of testing.

1.4 MAINTENANCE

.1 Extra Materials:

.2 Furnish list of individual manufacturer's recommended spare parts for equipment include:

.1 Bearings and seals.
.2 Suction and discharge side filters.
.3 Addresses of suppliers.
.4 List of specialized tools necessary for adjusting, repairing or replacing.

PART 2 Products

2.1 GENERAL

.1 Comply with ASHRAE 84.

2.2 ENTHALPY TYPE, AIR-TO-AIR, ROTARY ENERGY RECOVERY VENTILATORS

.1 ERV-1

.1 Cabinet: 50mm (2”) thick double wall insulated cabinet, 18ga. Galvanized steel interior wall, 22ga. pre-painted galvanized steel exterior wall, pre/post heating coil piping vestibules, 18ga. 356mm (14”) high insulated galvanized steel prefabricated insulated roof curb, fresh and exhaust air

hoods, motorized insulated fresh and exhaust air dampers with end switches, fresh and exhaust air damper terminal boards, access doors with quarter turn handles.

.2 Filters: twelve (12) MERV8 fresh and exhaust air filters, sizes on drawings.

.3 Internals: enthalpy wheel using 0.25hp wheel motor, forward curved fresh and exhaust air fans, 7.5hp ODP inverter ready premium efficiency fresh and exhaust air motors with spring isolation and magnetic starters.

.4 Controls: dirty filter contacts, terminal boards for exhaust air damper, BacNET compatible controller, power supply for external accessories, start/stop dry contact, general alarm dry contact, free cooling dry contact, fan interlock, BACnet communication module and variable frequency drive controlling enthalpy wheel.

.5 Additional sensors: temperature sensors located between pre-heat coil and enthalpy wheel, between enthalpy wheel and post-heating coil, after post-heating coil, inside return air plenum and inside exhaust air plenum.

.6 Electrical: non-fused disconnect switch, factory mounted 120V GFI service outlet, 208/3/60 power.

.7 Pre-heat Coil: to provide specified capacity using 35/65% propylene glycol/water solution. Pipe chase on coil is located at the back of the unit.

.8 Post-heat Coil: to provide specified capacity using 35/65% propylene glycol/water solution. Pipe chase on coil is located at the back of the unit.

.9 Performance characteristics: capacity as indicated on Design Drawings.

.10 Provide Aldes model CW8000e energy recovery ventilator.

PART 3 Execution

3.1 INSTALLATION

.1 Install in accordance with manufacturers recommendations.

.2 Provide fabricated supports where required and as indicated.

.3 Install access doors in accordance with Section 23 33 00 – Air Duct Accessories for access to coils.

.4 Connect units to BMS control system to control operation as per Sequence of Operation.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS.

.1 Section 23 33 00 - Air Duct Accessories.

.2 Section 23 34 00 - HVAC Fans.

.3 Conform to Sections in Division 01 and Division 09, as applicable.

1.2 REFERENCES

.1 American National Standards Institute/National Fire Prevention Association (ANSI/NFPA)

.1 ANSI/NFPA-90A-1999, Standard for the Installation of Air Conditioning and Ventilating Systems.

.2 Canadian General Standards Board (CGSB)

.1 CGSB 1-GP-181M-99, Ready-Mixed Organic Zinc-Rich Coating.

.3 Sheet Metal and Air-Conditioning Contractors' National Association (SMACNA)

1.3 SUBMITTALS

.1 Submittals, product data and shop drawings to be in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

.3 Indicate the following on shop drawings, product data:

.1 Fans.
.2 Casing.
.3 Insulation.
.4 Coils with product data.
.5 Mixing box sections.
.6 Filter box.
.7 Vibration isolation.
.8 Electrical data.

1.4 EXTRA MATERIALS

.1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Furnish list of individual manufacturer's recommended spare parts for equipment such as bearings and seals, and addresses of suppliers, together with list of specialized tools necessary for adjusting, repairing or replacing, for placement into operating manual.

Part 2 Products

2.1 BUILT-UP AIR HANDLING UNITS

.1 Air Handling Unit AHU-1

.2 Air Handling Unit AHU-2

2.2 GENERAL DESCRIPTION

.1 Configuration: Provide as indicated on Design Drawings.

.2 Performance: Conform to AHRI 430. See schedules on prints.

.3 Acoustics: Sound power levels (dB) for the unit shall not exceed the specified levels shown on the unit schedule. The manufacturer shall provide the necessary sound treatment to meet these levels if required.

2.3 UNIT CONSTRUCTION

.1 Fabricate unit with heavy gauge channel posts and panels secured with mechanical fasteners. All panels, access doors, and ship sections shall be sealed with permanently applied bulb-type gasket. Shipped loose gasketing is not allowed.

.2 Panels and access doors shall be constructed as a 50mm (2") nominal thick; thermally broken double wall assembly, injected with foam insulation with an R-value of not less than R-13.

.1 The inner liner shall be constructed of galvanized steel.

.2 The outer panel shall be constructed of G90 galvanized steel.

.3 The floor plate shall be constructed as specified for the inner liner.

.4 Unit will be furnished with solid inner liners.

.3 Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, 1.24 kPa (5 W.C.) static pressure. Deflection shall be measured at the panel midpoint. The casing leakage rate shall not exceed 0.0025 m^3/s (0.088 ft^3/s) per square foot of cabinet area at 1.24 kPa (5 W.C.) static pressure.

.4 Module to module field assembly shall be accomplished with an overlapping, full perimeter internal splice joint that is sealed with bulb type gasketing on both mating modules to minimize on-site labor and meet indoor air quality standards.

.5 Access doors shall be flush mounted to cabinetry, with minimum of two hinges, latch and full size handle assembly. Access doors shall swing outward for unit sections under negative pressure. Access doors on positive pressure sections, shall have a secondary latch to relieve pressure and prevent injury upon access.

.6 Module base to be constructed of 200mm (4") formed channel.

.7 A round window inspection port with marine light kit and switch shall be provided on unit section(s) as indicated on Design Drawings.

2.4 FAN ASSEMBLIES

.1 Acceptable fan assembly shall be a double width, double inlet, class I, belt-drive type housed forward curved fan dynamically balanced as an assembly, as shown in schedule. Maximum fan RPM shall be below first critical fan speed. Fan assemblies shall be dynamically balanced by the

manufacturer on all three planes and at all bearing supports. Copper lubrication lines shall be provided and extended from the bearings and attached with grease fittings to the fan base assembly near access door. If not supplied at the factory, contractor shall mount copper lube lines in the field. Fan and motor shall be mounted internally on a steel base. Provide access to motor, drive, and bearings through hinged access door.

.2 Fan and motor shall be mounted internally on a steel base. Factory mount motor on slide base that can be slid out the side of the unit if removal is required. Provide access to motor, drive, and bearings through hinged access door. Fan and motor assembly shall be mounted on deflection spring vibration type isolators inside cabinetry.

2.5 BEARINGS, SHAFTS, AND DRIVES

.1 Bearings: Basic load rating computed in accordance with AFBMA - ANSI Standards. The bearings shall be designed for service with an L-50 (200K) life of 1,000,000 hours and shall be a heavy duty pillow block, self-aligning, grease-lubricated ball or spherical roller bearing type.

.2 Bearings: Basic load rating computed in accordance with AFBMA - ANSI Standards. The bearings shall be designed for service with an L-50 life of 200,000 hours and shall be a heavy duty pillow block, self-aligning, grease-lubricated ball or spherical roller bearing type.

.3 Shafts shall be solid, hot rolled steel, ground and polished, keyed to shaft, and protectively coated with lubricating oil. Hollow shafts are not acceptable.

.4 V-Belt drives shall be cast iron or steel sheaves, dynamically balanced, bored to fit shafts and keyed. Fixed sheaves, matched belts, and drive rated based on motor horsepower. Standard drive service factor minimum shall be 1.1 S.F. for 0.19kW (1/4 hp) – 5.60 kW (7.5 hp), 1.3 S.F. for 7.46 kW (10 hp) and larger, calculated based on fan brake horsepower.

2.6 ELECTRICAL

.1 Fan motors shall be manufacturer provided and installed, Open Drip Proof, NEMA premium efficiency (meets or exceeds EPAct requirements), 1750 RPM, single speed, 200V / 60HZ / 3P. Complete electrical characteristics for each fan motor shall be as shown in schedule.

.2 The air handler(s) shall be ETL and ETL-Canada listed by Intertek Testing Services, Inc. Units shall conform to bi-national standard ANSI/UL Standard 1995/CSA Standard C22.2 No. 236.

.3 Wiring Termination: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclosed terminal lugs in terminal box sized to NFPA 70.

.4 Manufacturer shall provide ASHRAE 90.1 Energy Efficiency equation details for individual equipment to assist Building Engineer for calculating system compliance.

.5 Provide marine light, in each section as shown on project schedule, mounted and wired to a junction box with an on-off switch and GFI receptacle mounted on the outside of the cabinet.

.6 Installing contractor shall provide GFI receptacle within 7.6 m (25 ft) of unit to satisfy National Electrical Code requirements.

.7 All electrical connection components shall be field provided and mounted as shown on project schedule.

2.7 COOLING AND HEATING COILS

.1 Direct expansion refrigerant cooling coil shall NOT be provided. However, room shall be left inside AHU cabinet for future DX cooling coil.

.2 Provide access to coil(s) for service and cleaning. Enclose coil headers and return bends fully within unit casing. Unit shall be provided with coil connections that extend a minimum of 75mm (3") beyond unit casing for ease of installation. Coil connections must be factory sealed with grommets on interior and exterior panel liners to minimize air leakage and condensation inside panel assembly. If not factory packaged, Contractor must supply all coil connection grommets and sleeves. Coils shall be removable through side and/or top panels of unit without the need to remove and disassemble the entire section from the unit.

.1 Fins shall have a minimum thickness of 0.19 mm (0.0075") aluminum plate construction. Fins shall have full drawn collars to provide a continuous surface cover over the entire tube for maximum heat transfer. Tubes shall be mechanically expanded into the fins to provide a continuous primary to secondary compression bond over the entire finned length for maximum heat transfer rates. Bare copper tubes shall not be visible between fins.

.2 Coil tubes shall be 16mm (0.625") OD seamless copper, 0.5mm (0.02") nominal tube wall thickness, expanded into fins on 38mm (1.5") centers, brazed at joints.

.3 Connections to be drive-side, threaded and made of carbon steel.

.4 Coil casing shall be a formed channel frame of galvanized steel.

2.8 FILTERS

.1 Furnish flat panel filter section with 50mm (2") pleated MERV 8 filter with microbial resistant coating. Provide side loading and removal of filters.

.2 Filter media shall be UL 900 listed, Class I or Class II.

.3 Filter Magnehelic gauge(s) shall be furnished and mounted by equipment manufacturer.

2.9 ADDITIONAL SECTIONS

.1 Economizer section shall be provided with outside air opening and return air opening and exhaust air opening with or without parallel low leak airfoil damper blades. Dampers shall be insulated core aluminum airfoil blades, fully gasketed and have continuous silicone seals between damper blades in an aluminum frame. Dampers shall have silicone jamb seals along end of dampers. Linkage and ABS plastic end caps shall be provided when return and outside air dampers sized for full airflow. Return and outside air dampers of different sizes or very large dampers and exhaust dampers will be driven separately. Damper Leakage: Leakage rate shall be less than two tenths of one percent leakage at 50mm (2") static pressure differential. Leakage rate tested in accordance with AMCA Standard 500.

2.10 ACCEPTABLE MANUFACTURERS

.1 Daikin or equal approved by consultant.

2.11 INSTALLATION

.1 Install in accordance with manufacturer's Installation & Maintenance instructions.

2.12 ENVIRONMENTAL REQUIREMENTS

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

2.13 EXTRA MATERIALS

.1 Provide one extra set of fan belts and filters for each unit as shown on project schedule.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

.1 Conform to Sections of Division 01 as applicable.

.2 Conform to Section 23 05 00 – Common Work Results-Mechanical as applicable.

1.2 RELATED WORK

.1 Electrical wiring: Division 26.

.2 Thermal insulation for Ducting: Section 23 23 00 – Copper Tubing & Fittings Refrigerant

1.3 INFORMATION REQUIREMENT

.1 Advise General Contractor of actual size requirements for products provided under this Section, taken from certified shop drawings prior to construction of roof/wall openings and curbs. Bear costs for modifications to curbs or openings resulting from delay of this information.

1.4 SUBMITTALS

.1 Submittals, product data and shop drawings to be in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

1.5 SYSTEM DESCRIPTION

.1 The air conditioning system shall be a split system type. The system shall consist of duct mounted evaporator sections with remote condensers.

1.6 QUALITY ASSURANCE

.1 The units shall be listed by Electrical Laboratories (ETL) and bear the ETL label.

.2 All wiring shall be in accordance with the National Electrical Code (N.E.C.).

.3 The units shall be rated in accordance with ARI Standard 210 and bear the ARI label.

.4 The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

.5 A full charge of R-410A for 7.6 m (25 feet) of refrigerant tubing shall be provided in the condensing unit.

.6 A dry air holding charge shall be provided in the evaporator.

.7 System efficiency shall meet or exceed 10.0 SEER.

.8 **Regulatory Requirements**: Conform to the requirements of local by-laws, Ministry of Labour Regulations, and authorities having jurisdiction.

1.7 DELIVERY STORAGE AND HANDLING

.1 Unit shall be stored and handled according to the manufacturer's recommendation.

Part 2 Products

2.1 CEILING CASSETTE SPLIT AIR CONDITIONING SYSTEM

.1 Performance data and sizing of units can be found on Design Drawings. Provide Mitsubishi P-series split air conditioning system or approved equal.

.2 **Outdoor Condensing Unit**

- .1 Compressor in condensing unit shall be of the inverter-driven, hermetic scroll type.
- .2 Condensing unit shall use variable-flow R-410a refrigerant system and be outfitted with pre-coated galvanized steel sheet metal, Munsell finish, salt-resistant cross-fin, aluminum tubes, snow hood attachment.
- .3 Compressor shall use 208-230/3/60 power with over-current protection.

.3 **Ceiling Cassette Units**

- .1 Ceiling Cassette unit shall be supplied with variable capacity output technology.
- .2 Unit shall be supplied with built-in condensate lift mechanism, turbo fan and single-phase induction motor.
- .3 Unit shall have white Munsell grille external finish with cross-fin coil, aluminum plate fins and copper tubing.
- .4 Filter for ceiling cassette shall be polypropylene honeycomb.
- .5 Units shall contain BACnet MS/TP control module, with IT terminal plug.
- .6 Unit shall have liquid, gas and drain connections. Sizes can be found on Design Drawings.
- .7 208-230/1/60 power.

Part 3 Execution

3.1 GENERAL

.1 Applicable requirements specified in Section 23 05 00 – Common Work Results – Mechanical form part of this Section to same extent as if stated herein in full.

3.2 CONDENSING UNITS

.1 Install disconnect switch and provide wiring from disconnect switch to equipment.

.2 Install safety and operating controls and provide necessary power and control wiring for complete installation.

3.3 INSTALLATION

.1 Install miscellaneous steel framing, supports, braces, etc. as may be required to hang or support equipment as specified herein, and as shown on Drawings.

.2 Install power and control wiring between each air conditioning unit and its air cooled condenser, including necessary power transformers.

.3 Install interconnecting refrigerant piping between each air conditioning unit and air cooled condenser and install line mounted refrigerant specialties furnished with units. Perform system purge. Following system purge, test and fill refrigerant lines with full operating charge of refrigerant.

END OF SECTION

Part 1 General

1.1 SUMMARY

.1 Section Includes:

.1 Materials and installation for self-contained multizone and single zone, gas, electric, hot water and refrigeration packaged rooftop HVAC units.

.2 Conform to Sections of Division 01, as applicable.

1.2 REFERENCES

.1 American National Standards Institute (ANSI)/Air Conditioning and Refrigeration Institute (ARI)

.1 ANSI/ARI 210/240-03, Unitary Air-Conditioning and Air-Source Heat Pump Equipment.

.2 ARI 270-95, Sound Rating of Outdoor Unitary Equipment.

.2 ANSI/UL 1995 B-1998, Standard for Heating and Cooling Equipment.

.3 National Fire Protection Association

.1 NFPA 90A-02, Standard for the Installation of Air Conditioning and Ventilating Systems.

1.3 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00 - Submittal Procedures.

.2 Shop Drawings:

.1 Submitted shop drawings must indicate:

.1 Equipment, piping, and connections, together with valves, strainers, control assemblies, thermostatic controls, auxiliaries and hardware, and recommended ancillaries which are mounted, wired and piped ready for final connection to building system, its size and recommended bypass connections.

.2 Piping, valves, fitting shipped loose showing final location in assembly.

.3 Control equipment shipped loose, showing final location in assembly.

.4 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, mounting curb details, sizes and location of mounting bolt holes; include mass distribution drawings showing point loads.

.5 Detailed composite wiring diagrams for control systems showing factory installed wiring and equipment on packaged equipment or required for controlling devices of ancillaries, accessories, controllers.

.6 Pump and fan performance curves.

.7 Details of vibration isolation.

.8 Estimate of sound levels to be expected across individual octave bands in dB referred to A rating.

.3 Test Reports: submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.4 Closeout submittals: submit maintenance and engineering data for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Greenheck

2.2 ROOFTOP UNITS

.1 RTU-1,2,3,4: Packaged hydronic rooftop units:

.1 Unit shall be supplied with exterior galvanized steel housing, internally lined double-walled galvanized steel with 2” insulation, Painted permatector concrete gray, stainless steel drain pan.

.2 Cabinet mounted on prefabricated roof curb.

.3 Supply and return openings to be located on bottom of unit complete with motorized low leakage return air dampers & controls, outdoor air opening on end and exhaust box opening on side with downturned weatherhood and exhaust gravity backdraft damper.

.4 Supply and exhaust fans to be direct-drive backward-inclined plenum blower with premium efficiency ODP motors, factory mounted and installed VFDs.

.5 Filters shall be 2” MERV 8, pleated.

.6 Unit to be sized to include economizer complete with dampers and controls.

.7 Controls: Microprocessor controls, BACnet MS/TP network protocol, dirty filter sensor, phase and brown-out protection, RAI expansion board, 24VAC control transformers, control circuit fusing, unit disconnect, damper controls and unit-mounted NEMA 3R 120V outlet.

.8 Unit to include packaged R410a DX cooling section complete with, crankcase heater, thermal expansion valve, variable capacity digital scroll compressor(s), direct-drive condensing fans with molded fan blades and external rotors, liquid-line filter drier, high and low-pressure manual reset cutouts, time delay relays, service/charging valve, moisture-indicating sight glass.

.9 Unit to include hot water heating coil with galvanized steel casing, hand-brazed construction.

.10 Furnish unit of size, model and capacity as indicated on Design Drawings.

.2 RTU-1,2: In addition to above, unit shall include internal motor control center with built-in motor starters and cooling section vibration isolators.

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

.2 Install as per manufacturers' instructions.

3.2 FIELD QUALITY CONTROL

.1 Verification requirements in accordance with Section 01 47 17 - Sustainable Requirements: Contractor's Verification, including:

- .1 Materials and resources.
- .2 Storage and collection of recyclables.
- .3 Construction waste management.
- .4 Resource reuse.
- .5 Recycled content.
- .6 Local/regional materials.

.2 Verify accessibility, serviceability of components including motorized dampers, filters coils, fans, motors, operators, humidifiers, sensors, electrical disconnects.

.3 Verify accessibility, cleanability, drainage of any drain pans for coils, humidifiers.

.4 Performance Verification:

- .1 Roof-top and Energy Recovery Ventilator Units:
  - .1 Check for smooth, vibration-less, correct rotation of supply fan impeller.
  - .2 Measure supply fan capacity.
  - .3 Adjust impeller speed as necessary-repeat measurement of fan capacity.
  - .4 Measure pressure drop each component of air handling unit.
  - .5 Measure DBT, WBT of SA.
  - .6 Measure flow rates (minimum and maximum) of SA.
  - .7 Simulate maximum heating load and:
    - .1 Verify temperature rise across heat exchanger.
    - .2 Simulate minimum heating load and repeat measurements.

.5 Commissioning Reports in accordance with Section 01 91 13 - General Commissioning (Cx) Requirements.

3.3 CLEANING

.1 Perform cleaning operations in accordance with Owner’s requirements and manufacturer's recommendations.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, garbage, dirt/dust, tools and equipment.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

.1 Conform to Sections of Division 01 as applicable.

.2 Conform to Section 23 05 00 - Common Work Results Mechanical, as applicable.

1.2 REFERENCES

.1 ACMA Standards

.2 ARI Standard 410-72

.3 ARI Standard 430-66

.4 ASME

.5 ASHRAE

.6 CSA

.7 ULC

1.3 INFORMATION REQUIREMENT

.1 Advise General Contractor of actual size requirements for products provided under this Section, taken from certified shop drawings prior to construction of ducts and curbs. Bear costs for modifications to ducts or curbs resulting from delay of this information.

1.4 SUBMITTALS

.1 **Shop Drawings**: Prepare and submit shop drawings for all equipment and systems covered by this Section.

.2 **Operational and Maintenance Data**: Provide equipment literature, operating instructions, maintenance instructions, parts lists, and other pertinent data for all equipment and systems covered by this Section.

1.5 QUALITY ASSURANCE

.1 **Regulatory Requirements**: Conform to the requirements of local by-laws, Ministry of Labour Regulations, and authorities having jurisdiction.

Part 2 Products

2.1 ACCEPTABLE MANUFACTURERS

.1 Carrier

.2 Greenheck

.3 Trane

.4 Modine

2.2 FAN-POWERED TERMINAL UNITS

.1 E.H. Price model FDV-5000 (or approved equal) variable volume parallel flow fan powered terminal unit

.2 Supply complete with ECM motor, motor vibration isolation, solid state speed controller, 19 mm (3/4") thick 0.7 kg (1.5 lb) density internal insulation, bottom access panel, control shroud, 120/24V transformer factory mounted in control shroud with 120V terminal strip, hot water heating coil with top and bottom access doors, inlet attenuator section, MERV 3 clip-on disposable filter,

.3 120/1/60 power. Refer to terminal unit schedule for size and hot water heating coil requirements.

2.3 COILS

.1 **Heating Coils**

.1 Furnish plate type coil with aluminum fins on seamless copper tube.

.2 Furnish coils with fins tightly fitted onto seamless copper tubes to provide firm mechanical bond between fins and tubes. Furnish coils with flat aluminum fins. Mount coil cores in galvanized frames with adequate provision for expansion and drainage of tubes. Furnish coil type, number of rows and face area of coil as shown on Drawings.

Part 3 Execution

3.1 INSTALLATION

.1 Refer to and comply with applicable requirements specified in Section 23 05 00 - Common Work Results Mechanical.

.2 Install miscellaneous steel framing, supports, braces, etc. as may be required to hang or support coils.

.3 Install coils to manufacturers recommendations and where shown on Drawings.

END OF SECTION.

Part 1 General

1.1 RELATED SECTIONS

.1 Section 23 09 33 – Electric Heating and Cooling Controls.

.2 Section 23 34 00 – HVAC Fans.

.3 Conform to Sections in Division 01, as applicable.

1.2 SUBMITTALS

.1 Submit shop drawings in accordance with Section 01 33 00 – Submittal Procedures. Include product characteristics, performance criteria, and limitations.

.2 Provide maintenance data for incorporation into manual specified in Section 01 78 00 – Closeout Submittals.

.3 Product data/shop drawings to include:

- .1 Mounting methods.
- .2 Physical size.
- .3 Layout and diagrams of unit heaters.
- .4 kW rating, voltage, phase.
- .5 Cabinet material thickness.
- .6 Finish.

Part 2 Products

2.1 CABINET UNIT HEATERS

.1 CUH-1: Cabinet Unit Heater

- .1 Construction: 16 Ga. Front panel, ivory epoxy coating, quarter turn front panel fasteners, cam-lock access door, coin-operated vents, 25 mm (1”) aluminum filter and split capacitor motor supplied with 13 mm (1/2”) shaft.
- .2 Coil: 1 row of copper/aluminum coil with 13 mm (1/2”) diameter nominal finned tubes.
- .3 Power: 120/1/60
- .4 Provide Rittling model RS-200 ‘Size 3’ floor mounted sloped top cabinet heater or approved equal.

.2 CUH-2: Cabinet Unit Heater

- .1 Construction: 16 Ga. Front panel, neutral eggshell baked powder coating, quarter turn front panel fasteners, left hand side valve access chase, cam-lock access door, coin-operated vents and split capacitor motor supplied with 13 mm (1/2”) shaft.
- .2 Coil: 1 row of copper/aluminum coil with 13 mm (1/2”) diameter nominal finned tubes.

.3 Power: 120/1/60

.4 Provide Vulcan model FS-1005 ‘Size 2’ floor mounted sloped top cabinet heater or approved equal.

.3 CUH-3: Cabinet Unit Heater

.1 Construction: 16 Ga. Front panel, neutral eggshell baked powder coating, quarter turn front panel fasteners, left hand side valve access chase, cam-lock access door, coin-operated vents, 25 mm (1”) aluminum filter and split capacitor motor supplied with 13 mm (1/2”) shaft.

.2 Coil: 1 row of copper/aluminum coil with 13 mm (1/2”) diameter nominal finned tubes.

.3 Power: 120/1/60

.4 Provide Vulcan model RW-1120 ‘Size 2’ recessed wall cabinet heater or approved equal.

.4 CUH-4: Cabinet Unit Heater

.1 Construction: 16 Ga. front panel, neutral eggshell baked powder coating, quarter turn front panel fasteners, left hand side valve access chase, cam-lock access door, coin-operated vents, 25 mm (1”) aluminum filter and split capacitor motor supplied with 13 mm (1/2”) shaft.

.2 Coil: 1 row of copper/aluminum coil with 13 mm (1/2”) diameter nominal finned tubes.

.3 Power: 120/1/60

.4 Provide Vulcan model FS-1005 ‘Size 2’ floor mounted sloped top cabinet heater or approved equal.

2.2 BASE BOARD HEATER

.1 Type ‘A’ Baseboard Heater

.1 Construction: 16 Ga. enclosure with access door, extruded aluminum pencil proof grille, enclosure access door and all accessories required for mounting. Enclosure is to be powder coated and grille with clear anodized finish.

.2 Coil: 2 rows of 19 mm (3/4”) copper tube with 32 fins per foot.

.3 Provide Rittling model IBG5 with 508 mm (20”) enclosure height or approved equal.

.2 Type ‘B’ Baseboard Heater

.1 Construction: 16 Ga. enclosure with access door, extruded aluminum pencil proof grille, enclosure access door and all accessories required for mounting. Enclosure is to be powder coated and grille with clear anodized finish.

.2 Coil: 1 row of 19 mm (3/4”) copper tube with 32 fins per foot.

.3 Provide Rittling model IBG3 with 356 mm (14”) enclosure height or approved equal.

.3 Type ‘C’ Baseboard Heater

.1 Construction: 16 Ga. enclosure with access door, extruded aluminum pencil proof grille, enclosure access door and all accessories required for

mounting. Enclosure is to be powder coated and grille with clear anodized finish.

.2 Coil: 1 row of 19 mm (3/4") copper tube with 32 fins per foot.

.3 Provide Rittling model IBG3 with 356 mm (14") enclosure height or approved equal.

.4 Type 'C' Baseboard Heater

.1 Construction: 16 Ga. enclosure with access door, extruded aluminum pencil proof grille, enclosure access door and all accessories required for mounting. Enclosure is to be powder coated and grilled with clear anodized finish.

.2 Coil: 1 row of 19 mm (3/4") copper tube with 48 fins per foot.

.3 Provide Rittling model IBG3 with 356 mm (14") enclosure height or approved equal.

Part 3 Execution

3.1 INSTALLATION

.1 Suspend unit heaters from ceiling or mount on wall as indicated.

3.2 FIELD QUALITY CONTROL

.1 Ensure that heaters and controls operate correctly.

END OF SECTION

1 GENERAL

1.1 Conform to Sections of Division 01, as applicable.

1.1.1 Section 26 05 01 shall apply to and govern work of all Sections of Division 26 as applicable.

1.1.2 Provide a complete electrical system including all materials, equipment, services and labour necessary as shown or implied for a complete installation.

1.2 RELATED SECTIONS

1.2.1 Canadian Electrical Code (23rd edition) 2015.

1.2.2 Ontario Electrical Safety Code (26th edition) 2015.

1.2.3 Firestopping and smoke seals: as specified.

1.2.4 Flashings for electrical work located on or passing through roof: as specified.

1.2.5 Temporary sheet steel covers: as specified.

1.2.6 Excavating, Backfilling and Rough Grading for electrical work: as specified.

1.2.7 Concrete for electrical work: as specified.

1.2.8 Base courses and paving over backfilled and graded electrical work: as specified.

1.3 SYSTEM DESCRIPTION

1.3.1 Incoming Service Data

1.3.1.1 Available electric service is 120/208 volts, 60 Hz, 3 phase, 4 wire.

1.3.1.2 Coordinate ratings and characteristics of all pertinent electrical equipment to ensure safe and satisfactory operations.

1.3.1.3 Incoming utilization supply for communication system, signal and television systems is as indicated on Drawings.

1.4 SHOP DRAWINGS

1.4.1 Submit shop drawings in accordance with the General Conditions of the Contract and as specified in each section of Division 26.

1.4.1.1 When equipment and apparatus of one system must be coordinated with or installed in a given area with equipment and apparatus of other system(s), prepare and submit necessary coordinated composite drawings for checking interferences.

1.5 AS-BUILT DRAWINGS

1.5.1 Submit "as built" drawings in accordance with the specifications.

1.5.1.1 For underground installations, dimension location with respect to building walls and mark levels with respect to elevation of finished floor below where wiring is buried.

1.5.1.2 Colour code changes using red for additions, and green for deletions.

1.6 OPERATION AND MAINTENANCE DATA

1.6.1 Submit operation and maintenance data in accordance with the specifications. Make changes or submit additional information if required.

1.6.2 Review instructions with Owner's Designee to ensure a thorough understanding of equipment and its operation.

1.7 REGULATORY REQUIREMENTS

1.7.1 Materials and workmanship shall be in accordance with requirements and recommendations of applicable rules, regulations, standards and codes as specified hereunder. All products shall bear certification label of CSA, ULC, The Electrical Safety Authority, as applicable.

The Electrical Safety Code (OESC)-publication containing Canadian Electrical Code and The Electrical Safety Authority Supplements.

Canadian Standards Association (CSA)

Underwriter's Laboratories of Canada (ULC)

Electrical and Electronic Manufacturers Association of Canada (EEMAC)

Joint Industrial Council (JIC)

Ontario Building Code (0BC)

Ontario Fire Code (OFC)

Association of Edison Illuminating Companies (AEIC)

American Society for Testing and Materials (ASTM)

Insulated Power Cable Engineers Association (ICEA)

Boards, Service Companies or other Authorities having jurisdiction.

1.7.2 Permits, Fees and Certificates: Except as provided in the General Conditions of the Contract, give notices, obtain permits, pay fees required for work of Division 26. Before final certificate of payment is issued by Owner, furnish certificates as evidence that work installed conforms with laws and regulations of all governing authorities. Determine detailed requirements of local authorities having jurisdiction and conform to those requirements.

1.8 QUALIFICATIONS

1.8.1.1 Work shall be executed by Electrical Contractor or his designated sub-contractor, holding a valid Contractors' license (Master License).

1.8.1.2 Work shall be performed by qualified Electricians holding valid Ontario certificates of qualifications.

1.8.1.3 Work on signal, communication, related control and other similar systems shall be performed by relevant competent tradesmen.

1.9 PROJECT/SITE CONDITIONS

1.9.1 Existing Conditions

1.9.1.1 Examine Site and Contract Documents in accordance with Instructions to Bidders.

1.9.1.2 Electrical installations in areas classified as hazardous locations, corrosive environments, and other special area application, shall be governed by relevant Industry Standards and Regulatory Requirements.

2 PRODUCTS

2.1 MATERIALS

2.1.1 **Inserts:** Supply and deliver inserts, anchors, bolts, sleeves, ferrules and other items to be built into work of other Divisions, with necessary templates, adequate instructions and assistance for locating and installing.

2.1.2 **Access Panels:** For ceilings and/or masonry walls, 12 gauge steel, size 460 mm x 460 mm unless indicated on Drawings, concealed hinges, key-locked type, prime coated, to match ceiling and/or wall finish.

2.1.3 **"Lamacoid" Nameplates:** 3 mm thick, white capitalized inscribed letterings against black background, sized to accommodate specified nomenclature, as described in other Sections of Division 26, or as indicated on Drawings.

Nameplate sizes shall be as follows;

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

Nameplates for panelboards indicating panel identifier, fed from and voltage.

Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

Disconnects, starters and contactors: indicate equipment being controlled and

voltage.

Terminal cabinets and pull boxes: indicate system and voltage.

Transformers: Indicate capacity, primary and secondary voltages.

2.1.4 Duplex Receptacle Identification: Identify panel and circuit number on all duplex receptacles face plates with black printed lettering on clear labelling tabs (P-tabs).

2.1.5 **Wall Mounting Panels:** 19 mm thick minimum, "Fir" plywood panel, good 1-side painted with 2-coats standard equipment grey colour, cut size to suit, for group-mounting any combinations of surface wall-mounted enclosed disconnect switches and/or circuit breakers, motor starters and/or contractors, small control cabinets or control panels, utility metering cabinets, panelboards and other similar device enclosures.

3 EXECUTION

3.1 EXAMINATION

3.1.1 Where any parts of systems and/or pieces of equipment are located by dimensions on Drawings, check and verify such dimensions at Site.

3.1.2 Notify Owner's Designee before proceeding further if any discrepancy or interference with other equipment is found which will necessitate revision in or deviation from Work as indicated or specified.

3.1.3 Location of conduit, raceways, wiring and other equipment shall be altered without charge to Owner if so directed by Owner's Designee provided change is ordered before installation, and does not necessitate additional labour and material.

3.2 CUTTING AND PATCHING

3.2.1 Cutting of holes up to 200 mm (8") in diameter and related patching shall be done under Division 26.

3.2.2 Holes and other openings larger than 200 mm (8") in diameter, chases, bulkheads, furring and related patching will be done under Sections whose work is to cut and patched.

3.2.3 Supply measurements of equipment to other Sections to allow for necessary openings to be left in work of other Sections.

3.3 FIRESTOPPING AND SMOKE SEAL

3.3.1 Be responsible for installation of Firestopping and smoke seal inside electrical assemblies (i.e. inside bus ducts).

3.3.2 Firestopping and smoke seals around outside of electrical assemblies, where they penetrate fire rated separations, and Penetration Firestopping shall be carried out under supervision of this Division.

3.3.3 Be responsible for any additional cost incurred as a result of over sizing of openings during cutting and patching operation of openings to be fire stopped up to 200 mm (8") in diameter.

3.3.4 Install sheet steel covers and Miscellaneous Metals over temporarily unused sleeves provided in fire separations for future electrical installations.

3.4 **INSTALLATION**

3.4.1 Verify dimensions of equipment to be installed.

3.4.2 Each room containing electrical equipment and each working space around equipment shall have unobstructed means of egress per OESC Rule 2-310.

3.4.3 Maintain a minimum working space of 1 meter with secure footing about electrical equipment such as switchboards, panelboards, control panels and motor control centers which are enclosed in metal per OESC Rule 2-308.

3.4.4 Protect existing work and equipment during construction.

3.4.5 Co-ordinate electrical requirements for all equipment supplied by owner or other trades. Notify engineer of any conflicts prior to installation.

3.4.6 Instruct and supervise other Sections doing related work.

3.4.7 Electrical products and methods of installation shall be in accordance with relevant Sections of Division 26, and applicable requirements of other Divisions.

3.4.8 Correct installed work as directed by authorized inspector of such authorities.

3.4.9 Notwithstanding the General Conditions of the Contract, no increase to Contract Price shall apply for electrical items relocated from location indicated and prior to installation requiring extra labour and material up to 3 meters (10'-0") from original location, nor will decrease to Contract Price apply where relocation up to 3 meters (10'-0") reduces materials and labour.

3.4.10 Electrical drawings are to be read in conjunction with the mechanical drawings to determine overall extent of work.

3.5 EQUIPMENT IDENTIFICATIONS

3.5.1 Electrical equipment and auxiliaries shall be identified in accordance with designations indicated on Drawings or as specified in other Sections of Division 26.

3.5.2 Identify electrical equipment, control cabinets, panels, enclosures, switchboards, switchgears, motor control centres, starters, designated boxes, and other similar items, using Lamacoid plates.

3.5.3 Fasten Lamacoid nameplates using self-tapping screws for metal sheet enclosures or glued to PVC or fibreglass construction.

3.5.4 Panelboards shall have Lamacoid plates mounted on top outside trim of door indicating function and voltage of panelboard.

3.5.5 Disconnect switches and motor starters shall have Lamacoid nameplates mounted on front cover indicating name of equipment, horsepower, voltage and phase.

3.5.6 Terminal boards, blocks, and strips, shall have group marker and indexed markers, as applicable.

3.5.7 Mark clearly and permanently all feeder phase identifications at both ends, using standard colour or letter designations.

3.5.8 Identify wiring, as required, using standard indelible wire markers at each termination, in accordance with schematic and/or connection wiring diagrams.

3.6 PAINTING WORK SUPPLIED UNDER DIVISION 26

3.6.1 Touch up minor chips or damage to electrical equipment, installed in this Division, with standard, factory supplied, enamel finish.

3.6.2 Colour code, as specified herein, outlet boxes, pull boxes, junction boxes by applying a small dab of paint to inside of each item during installation.

3.6.2.1 Colour code, as specified herein, all exposed ducts, conduits, outlet boxes, and similar items by applying a 25 mm (1") wide band of paint around ducts and conduits adjacent to boxes described in above paragraph and on both sides of wall penetration.

3.6.2.2 Use following paint colour-code:

- Red: Fire Detection and Alarm System
- Blue: Communication System (Voice, Data, Electronics, etc.)
- Yellow: Emergency Power System
- Purple: Security System
- Green: Life Communications System

3.7 PAINTING WORK

3.7.1 Priming and finish painting of exposed unfinished raceways, fitting, outlet boxes, junction boxes, pull boxes and similar items.

3.7.2 Division 26 shall assist in form of supervision, painting works by other project specifications.

3.8 SYMBOLS

3.8.1 Electrical work is indicated generally on Drawings using standard symbols.

3.8.2 For lighting layout Drawings, letters in a circle indicate type of fixture to be supplied. Letters and numbers outside and adjacent to circle indicate panel and circuit number.

3.9 MOUNTING HEIGHTS

3.9.1.1 Measure mounting height dimension from operator's working floor level (finish) to centre-line of electrical device or enclosure, unless otherwise indicated or specified herein.

3.9.2 Heights are subject to change to suit structural requirements, and other Site conditions, and therefore as work progresses, and before installing equipment, obtain instructions or directions from Owner’s Designee for alternative heights or relocation.

3.10 MOUNTING OF EQUIPMENT

3.10.1 Lighting panels, power panels, annunciators, control panels and cabinets, electrical enclosures, boxes, and other similar items, indicated to be installed in areas with finished walls, shall be flush-mounted and fitted with suitable flush trim and doors.

3.10.2 Lighting panels, power panels, annunciators, control panels and cabinets, electrical enclosures, boxes, and other similar items indicated to be installed in pipe spaces or other areas where an exposed type of wiring is specified shall be surface mounted.

3.10.3 Use wall mounting panel for surface wall group-mounting of electrical control equipment, enclosures, and similar devices as indicated in Drawings, specified herein, or as directed on Site by Owner’s Designee.

3.11 Grounding

3.11.1 Ground electrical equipment in accordance with requirements of The Electrical Safety Authority Electrical Safety Code.

3.11.2 Arrange grounds so that under normal operating conditions, no injurious amount of current will flow in any grounding conductor. Connect single phase loads so that there is least possible unbalance of supply.

3.11.3 Grounding equipment to CSA C22.2 No. 41.

3.11.4 Copper grounding conductors to: CSA 22.2 Section 10 latest edition.

3.11.5 For standard duplex receptacles provide insulated ground conductor, size for equipment ground in accordance with electrical code minimum conductor size #12 with green insulation. Ground conductor to be connected under a bonding screw to outlet box(es) and panelboard.

3.11.6 For isolated ground duplex receptacles provide equipment grounding conductor as for standard receptacles and separate insulated ground conductor; size to match line conductors with green insulation and yellow strip. Isolated ground conductor to be connected to isolated ground terminal strip provided in panel.

3.11.7 In panelboard isolated ground bus and equipment ground bus to be tied together with #1/0 insulated conductor.

3.11.8 Install separate "green" ground conductor in same conduit with circuit (power wiring) conductors. Bond securely to ground screw in each outlet, junction, pull box, and equipment enclosure ground conductor equal in ampacity to size of circuit ampacity or in accordance with code for equipment grounding.

3.11.9 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

3.12 FIELD QUALITY CONTROL

3.12.1 Trial Usage

3.12.1.1 Trial usage by Owner's Designee of any electrical device, machinery, apparatus, equipment and other work supplied under this Division before final completion and written acceptance by Owner's Designee is not to be construed as evidence of acceptance by Owner.

3.12.1.2 Owner shall have privilege of such trial usage as soon as Contractor claims that said work is completed, in accordance with Drawings and specifications for such reasonable length of time as Owner's Designee deems sufficient for making a complete test.

3.12.1.3 No claim for damage shall be made for injury to or breaking of any parts of such tested work, whether caused by weakness or inaccuracy of structural parts or by defective materials or workmanship of any kind whatsoever.

3.12.2 Tests

3.12.2.1 At completion of installation, conduct grounding resistance test, voltage test, and empty conduit test in presence of Owner's Designee and make corrections where necessary and as directed.

3.12.2.2 Resistance of ground electrodes shall not exceed maximum permissible values for each type of installation or equipment concerned and if necessary change arrangement until satisfactory results are obtained.

3.12.2.3 Voltage provided to equipment in installation shall not exceed minimum and maximum permissible limits for equipment.

3.12.2.4 Perform insulation tests for installed wiring and equipment with appropriate "Megger" testing equipment. Megger lighting and power circuit feeders and if resistance to ground is less than recommendations on any lighting or power circuit, consider such circuit defective and replace it.

3.12.2.5 Test performance of equipment for mechanical and electrical defects. Make adjustments necessary for such equipment. When equipment has been placed in permanent operation give to operating personnel all necessary tuition and instructions for its operation and maintenance.

3.12.2.6 Test conduits which are required to be installed but left empty for clear bore, using ball mandrel, brushes and snake. Use lignum vitae ball of diameter equal to approximately 85% of conduit inside diameter. Clear any conduit which rejects ball mandrel in an approved manner and without damage thereto.

3.12.2.7 Furnish labour, materials, instruments and bear other costs in connection with all tests, obtain required certificates of approval, acceptance, and compliance with regulations of agencies having jurisdiction and as specified. Work shall not be deemed complete and final certificate of acceptance will not be issued, until such certificates have been delivered to Owner's Designee.

3.13 CLEANING

3.13.1 Before starting and commissioning operations, installed new electrical enclosures, equipment and control devices, open-frame motors shall be air-blown and/or vacuum-cleaned.

3.13.2 Ensure no foreign objects, tools, and materials are left inside switchgears, cabinets, panelboards, control panels and similar enclosures before such equipment is energized.

3.13.3 Refer to specifications for other applicable final clean-up requirements.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

.2 Section 26 05 29 – Hangars and Supports for Electrical Systems.

1.2 REFERENCES

.1 Canadian Standards Association, (CSA International)

.1 CSA-T529-[95(R2000)], Telecommunications Cabling Systems in Commercial Buildings (Adopted ANSI/EIA TIA 568a with modifications).

.2 CSA-C22.2 No. 214-[02], Communications Cables (Bi-national Standard, with UL 444).

.3 CAN/CSA-C22.2 No. 182.4-[M90(R2001)], Plugs, Receptacles, and Connectors for Communication Systems.

.2 Telecommunications Industry Association (TIA)

.1 TIA/EIA-568-[2001], Commercial Building Telecommunications Cabling Standards Set.

1.3 SYSTEM DESCRIPTION

.1 Structured system of telecommunications cables (copper and optical fibre) installed within buildings for distributing voice and data signals.

.2 All voice and data cables shall be certified CAT6 end-to-end solution (i.e. Belden certified solution).

.3 All cabling shall be FT6 plenum rated.

Part 2 Products

2.1 IN-BUILDING TELECOMMUNICATIONS CABLE

.1 CAT6 cable to be FT6, plenum rated. Description as follows;

- BELDEN/CDT 2413 D151000
- CAT6+ 4PR U/UTP CMP
- FRPO/FEP Blue Jacket

.2 Provide new CAT6 cable drop for each Wireless Area Controller indicated on lighting drawings.

Part 3 Execution

3.1 INSTALLATION OF IN-BUILDING CABLING

.1 Cables shall be mounted in conduit, cable tray or “J” hooks.

.2 For cables mounted in cable tray, lay cables into cable tray and secure cables at appropriate locations with Velcro straps.

.3 For cable supported with “J” hooks, lay cables in “J” hook supports. Ensure that the cable sag between fasteners is no more than 305mm midspan (actual cable sag will depend on the number of cables in each bundle and the weight of the cable). If the cable sag is greater than 305mm, add additional fasteners. During the installation of the cables, keep cable pulling tension constant and ensure that it stays below the specification guidelines for the cable being installed. Cables to be strapped using Velcro throughout.

.4 The maximum allowable length of CAT6 cable is 100 meters. This consists of 90 meters of solid “horizontal” cabling between patch panel and the wall jack, plus 10 meters of stranded patch cable between each jack and the attached device.

.5 CAT 6 cable must not be kinked or bent too tightly. The bend radius should be at least four times the outer diameter of the cable. The wire pairs must not be untwisted and the outer jacket must not be stripped back more than 12.7mm.

3.2 TESTING OF IN-BUILDING CABLES

.1 Provide tools, equipment, labour and materials required to inspect and test all voice/data cabling in accordance with industry standard and T529 procedures.

.2 Test all voice/data cabling runs for end-to-end attenuation, noise, resistance and next measurements for CAT6 link compliance in accordance with CAN/CSA-T529 procedures.

.3 Fibre optic cable shall be tested with less than 1db of acceptable loss.

.4 Provide installation and supervision work supervised by telecommunication technicians qualified to install voice/data cabling systems and to perform related tests as required by the manufacturer.

.5 Provide fully qualified telecommunication technicians, trains and certified in the installation and testing of equipment specified. Provide evidence upon requests in writing prior to work commencement of manufacturer’s certification of supplier’s ability to properly install structured cabling for buildings.

.6 Results of testing shall be downloaded on a DVD, CD or memory stick and turned over to the engineer.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for wire and box connectors.

1.2 RELATED SECTIONS

.1 Section 26 05 01 – Common Work Results - Electrical

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

.1 CAN/CSA-C22.2 No.18 - 92 (R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

.2 CSA C22.2No.65 -13 Wire Connectors.

.2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)

.1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).

.3 National Electrical Manufacturers Association (NEMA)

Part 2 Products

2.1 MATERIALS

.1 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of copper and aluminum sized to fit copper and aluminum conductors as required.

.2 Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.

.3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:

.1 Connector body and stud clamp for copper and aluminum conductors.
.2 Clamp for copper conductors.
.3 Clamp for stranded aluminum conductors.
.4 Stud clamp bolts.
.5 Bolts for copper conductors.
.6 Bolts for aluminum conductors.
.7 Sized for conductors as indicated.

.4 Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable,flexible conduit, non-metallic sheathed cable as required to: CAN/CSA-C22.2 No.18.

Part 3 Execution

3.1 INSTALLATION

.1 Remove insulation carefully from ends of conductors and:

.1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.

.2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.

.3 Install fixture type connectors and tighten. Replace insulating cap.

.4 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 01 – Common Work Results for Electrical.

.2 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

1.2 REFERENCES

.1 CSA C22.2 No .0.3 – 09 (R2014), Test Methods for Electrical Wires and Cables.

.2 CAN/CSA-C22.2 No. 131-14, Type TECK 90 Cable.

Part 2 Products

2.1 BUILDING WIRES

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 600 or 1000 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90 or RWU90 as indicated.

2.2 TECK CABLE

.1 Cable: to CAN/CSA-C22.2 No. 131.

.2 Single or multi-conductor Teck 90 cables, 1000V insulation, aluminum sheath and overall PVC jacket. Insulation to be 1000V cross-linked polyethylene suitable for installation at a temperature down to minus 40 degrees Celsius. Teck 90 cables to be copper unless otherwise indicated.

.3 Fastenings:

.1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.

.4 Connectors:

.1 Watertight approved for TECK cable.

2.3 ARMOURED CABLES

.1 Conductors: insulated, copper size as indicated.

.2 Type: AC90 - lead sheath over cable assembly and under armour.

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

.1 15 amp, 120 volt receptacle branch circuit home runs shall be minimum #12 AWG. Home runs over 22 meters shall be minimum #10 AWG. Maximum length of branch circuit feeder from panel to furthest receptacle shall be 36 meters.

.2 Ensure voltage drop does not exceed 2 percent.

.3 Conductors required for the operation of life safety systems, as described in OESC Rule 46-002, shall be kept entirely independent of all other conductors and equipment and shall not enter luminaire, raceway, box, cabinet or unit equipment occupied by other conductors except where necessary in generator transfer switches, exit signs and emergency lights supplied by two sources, as detailed in OESC Rule 46-108(4).

3.2 INSTALLATION OF TECK CABLE 0 -1000 V

.1 Group cables wherever possible on channels.

.2 Install cable in trenches as indicated.

.3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

3.3 INSTALLATION OF ARMOURED CABLES

.1 Group cables wherever possible.

.2 Install only in concealed ceiling space for final connection from a junction box or distribution box to luminaries, receptacles and all other electrical devices to a maximum length of 5 meters. AC90 cable shall not be used from distribution or junction boxes to a second junction box.

.3 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 Section 26 05 01- Common Work Results- Electrical

.2 Copper grounding conductors to CSA 22.1 Section 10 latest edition.

.3 Canadian Standards Association (CSA)

.1 CSA C22.2 No.0.41 13, Grounding and bonding of equipment.

Part 2 Products

2.1 EQUIPMENT

.1 Clamps for grounding of conductor: size as indicated or as required to electrically conductive underground water pipe.

.2 Grounding conductors: bare stranded copper, soft annealed, size as indicated.

.3 Insulated grounding conductors: green, Type RW90

.4 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.

.5 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:

.1 Grounding and bonding bushings.
.2 Protective type clamps.
.3 Bolted type conductor connectors.
.4 Thermite welded type conductor connectors.
.5 Bonding jumpers, straps.
.6 Pressure wire connectors.

Part 3 Execution

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding system including, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.

.2 Install connectors in accordance with manufacturer's instructions.

.3 Protect exposed grounding conductors from mechanical injury.

.4 Make buried connections, and connections to conductive water main, using copper welding by thermite process.

.5 Use mechanical connectors for grounding connections to equipment provided with lugs.

.6 Soldered joints not permitted.

.7 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.8 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.

.9 Install separate ground conductor to outdoor lighting standards.

.10 Connect building structural steel and metal siding to ground by welding copper to steel.

.11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

.12 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.

3.2 EQUIPMENT GROUNDING

.1 Install grounding connections to typical equipment included in, but not necessarily limited to following list: service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Engineer and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

Part 2 Products

2.1 SUPPORT CHANNELS

.1 **Power wiring support channels**: U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted, suspended or set in poured concrete walls and ceilings.

.2 **Communications wiring support channels**: Wide-base “J” hook fasteners.

Part 3 Execution

3.1 INSTALLATION – Power Wiring

.1 Secure equipment to hollow or solid masonry, tile and plaster surfaces with lead anchors.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.

- .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
- .2 Two-hole steel straps for conduits and cables larger than 50 mm.
- .3 Beam clamps to secure conduit to exposed steel work.

.7 Suspended support systems.

- .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
- .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.

.8 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.9 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.10 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.11 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.

.12 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

3.2 INSTALLATION – Non Power Wiring

.1 The section relates to video surveillance wiring, security wiring, voice/data wiring, life safety communications wiring.

.2 Install wiring in conduit areas if the building accessible to the public.

.3 For all other locations install wiring in conduit or attach the appropriate sized “J” hook fastener, whether for wall, stud, beam, flange or drop-wire mounting, to the supporting structure. Space fasteners to fall every 1220mm to 1524mm.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

1.1.1 Conform to Section 26 05 01 – Common Work Results-Electrical, as applicable.

1.1.2 Products described herein shall be suitable for dry indoor, non-hazardous area application, unless noted otherwise.

1.2 REFERENCES

CSA C22.2 No. 40 - M1989 (R2014) – Cutout, Junction and Pull Boxes

CSA C22.2 No. 94 - M91 (R2011) - Special Purpose Enclosures

1.3 SUBMITTALS

1.3.1 Submit shop drawings for splitters, pull boxes, and other special enclosures used for mounting control devices and instruments, showing dimensional outline, details of cutouts if required, and mounting lugs or feet and accessories.

Part 2 Products

2.1 FABRICATIONS

2.3.1 **Special Purpose Enclosures**: CSA C22.2 No. 94, classified in accordance with EEMAC, JIC, and CSA Standards.

2.3.2 **Box Covers**: Types and sizes to match respective boxes, as required. Provide screwed covers, unless noted otherwise.

2.3.3 Provide approved neoprene gaskets, or applicable sealing materials, in boxes specified for damp, wet, weatherproof/tight, outdoor application, and other areas classified by OESC and other Authorities having jurisdiction.

Part 3 Execution

3.3 INSTALLATION

3.3.1 **General**

3.3.1.1 Size and install boxes, splitters, and enclosures in accordance with applicable section(s) of Ontario Electrical Safety Code (OESC) and manufacturer's recommended installation procedures.

3.3.1.2 Fasten and support boxes and enclosures independent from raceway supports and ensure rigid installation.

3.3.1.3 Cut and drill entrance holes into boxes and enclosures for raceways and cutouts as per approved shop drawings on specified special boxes and enclosures.

3.3.1.4 Install boxes and enclosures so as to be accessible after building is complete, set flush with finished surface where recessed, aligned and levelled where surface mounted.

3.3.1.5 Use bushing and double locknuts to terminate conduits in metallic sheet boxes with conduit knockouts or drilled holes.

3.3.1.6 Provide approved hole plugs in unused conduit openings and holes.

3.3.1.7 Furnish boxes and enclosures with corrosion resistant machine screws.

3.3.1.8 Boxes and enclosures embedded in concrete for flush-mounting, shall be secured properly with connecting conduits and related works set in place before concrete is poured. Forms, when used, shall be able to be removed without disturbing installed boxes or enclosures.

3.3.1.9 In general, install boxes and enclosures to suit raceway installation, and location of communication, signal, and electrical equipment, luminaires, and operational requirement, as shown on Drawings.

3.3.1.10 Provide correct size of openings in boxes for conduit, armoured and non-metallic sheathed cables and terminate with approved connectors or clamps. Do not use reducing washers.

3.3.1.11 Openings in all electrical metal boxes shall be punched or cut. Burring of holes is not permitted.

3.3.1.12 Identify source, voltage and load on all junction boxes. Use of indelible marker for these locations is acceptable.

3.4 TESTING AND INSPECTION

3.4.1 Test overall installation using megger instrument for ground continuity after boxes and raceways are completely installed.

END OF SECTION

Part 1 General

1.1 REFERENCES

.1 CSA C22.1-2015, Canadian Electrical Code, Part 1.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required for special devices.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 120/208 V outlet boxes for 120/208 V switching devices.

.6 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

.1 Electro-galvanized steel single and multi-gang flush device boxes for flush installation. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit.

.3 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.4 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished walls.

2.3 MASONRY BOXES

.1 Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

.1 Electro-glavanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 FLOOR BOXES

.1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brushed aluminum faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 28 mm for receptacles; 73 mm for communication equipment.

.2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 12 mm and 19 mm conduit. Minimum size: 73 mm deep.

2.6 CONDUIT BOXES

.1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

2.7 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

.1 Electro-galvanized, sectional, screw ganging steel boxes with two double clamps to take non-metallic sheathed cables.

2.8 FITTINGS - GENERAL

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

END OF SECTION

1 GENERAL

1.0 Conform to Sections of Division 01, as applicable.

1.0.1 Conform to Section 26 05 01 – Common Work Results - Electrical, as applicable.

1.0.2 Conform to Section 26 05 32 – Outlet Boxes, Conduit Boxes and Fittings, as applicable.

1.1 REFERENCES

CSA C22.2 No. 18-92 (R2003)	Outlet Boxes, Conduit Boxes, and Fittings
CSA C22.2 No. 26-1952	Construction and Test of Wireways, Auxiliary Gutters and Associated Fittings
CSA C22.2 No. 40-M1989 (R2009)	Cutout, Junction and Pull Boxes
CSA C22.2 No. 45-M1981 (R2012)	Rigid Metal Conduit
CSA C22.2 No. 56-04	Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit
CSA C22.2 No. 62-93	Surface Raceway Systems
CSA C22.2 No. 83-M1985 (R2013)	Electrical Metallic Tubing
CAN/CSA C22.2 No. 85-M89	Rigid PVC Boxes and Fittings
CSA C22.2 No. 211.2-06 (R2011)	Rigid PVC (Unplasticized) Conduit
CSA C22.2 No. 227.1-06 (R2011)	Electrical Non-Metallic Tubing
CSA C22.2 No. 211.1-06 (R2011)	Rigid Types EB1 and DB2/ES2 PVC Conduit

1.2 SUBMITTALS

1.2.1 Product Data

1.2.1.1 Ensure that raceway system manufacturers provide complete information regarding raceway assembly requirements. Owner will not be responsible for added cost of raceways and changes due to additional manufacturer's requirements.

1.3 QUALITY ASSURANCE

1.3.1 Use only products of one manufacturer for any or combination of packaged-type system such as surface raceways assembly, wireway system, cable trough for tray system.

2 PRODUCTS

2.1 MATERIALS

2.1.1 **Electrical Metallic Tubing (EMT), Couplings and Connectors**: CSA C22.2 No. 83.

2.1.2 **Rigid Metal Conduits and Fittings**: Steel, galvanized heavy wall, CSA C22.2 No. 45.

2.1.3 **Flexible Metallic Conduits**: CSA C22.2 No. 56.

2.1.4 **Liquid-Tight Flexible Metal Conduits**: CSA C22.2 No. 56.

2.1.5 **Rigid Poly Vinyl Chloride (PVC) Conduits**: CSA C22.2 No. 211.2, unplasticized, schedule (40) (80), and **Rigid PVC Boxes and Fittings:** CAN/CSA C22.2 No. 85.

2.1.6 **Poly Vinyl Chloride (PVC) DB2 duct**: CSA C22.2 No. 211.1.

2.1.7 **Outlet Boxes and Fittings:** CSA C22.2 No. 18, electro-galvanized sheet steel, sizes and types in accordance with OESC requirement.

2.1.8 **Conduit Boxes and Fittings:** CSA C22.2 No. 18, cast-type feraloy, type 'FS' 50mm (2") deep or type 'FD' 70mm (2-3/4") deep, standard factory-threaded hubs or EMT-to-conduit adapters ,as required.

2.1.9 **Junction Boxes:** C22.2 No. 40, galvanized sheet steel construction, with screwed- on covers, and standard knockouts.

2.1.10 **Rigid PVC Boxes and Fittings:** CAN**/**CSA C22.2 No. 85.

2.1.11 **Box Covers:** Types and sizes to match respective boxes and wiring devices as required. Provide screwed covers, unless noted otherwise.

2.1.12 **Splitter Boxes/Troughs:** CSA C22.2 No. 76, welded sheet metal enclosure, complete with required mains and branch aluminium bus bars and lugs or terminal blocks, 600V max.

2.1.13 Sizes indicated on Drawings are minimum. Do not reduce without written approval of Owner's Designee.

2.1.14 Use only products of one manufacturer for any or combination of assembled system such as surface raceways assembly, wireway system, and cable tray system.

2.2 **Accessories**

2.2.1 Pulling cord, polypropylene, 800lb - 2700lb tensile strength, Ideal "Pro-Pull".

2.2.2 Expansion Fittings, weatherproof, with integral bonding assembly.

3 EXECUTION

3.1 EXAMINATION

3.1.1 Raceway runs are indicated diagrammatically on Drawings. Co-ordinate with other

Divisions concerned and field-verify routing to check for possible obstruction or interference.

3.2 INSTALLATION

3.2.1 General

3.2.1.1 Install raceways system and boxes complete with appropriate fittings such as connectors, bushings, elbows, couplings, locknuts, expansion fittings, fasteners and supports and accessories supplied as necessary to comply with OESC and other Regulatory Authorities requirements.

3.2.1.2 Neatly install exposed raceway running parallel to and at right angles to building lines and equally spaced in groups.

3.2.1.3 Keep raceway ends parallel and on proper spacing to suit knockouts or raceway openings in equipment or enclosure.

3.2.1.4 Keep raceways at least 150 mm clear of steam pipes, flues and hot item surfaces. Locate conduits behind infrared or gas fire heaters with 1.5 meter clearance.

3.2.1.5 Conceal raceways in floor, wall and ceiling construction unless otherwise specified or indicated. Raceways may run exposed in crawl spaces, fan rooms, penthouses, electrical and mechanical rooms. Do not install horizontal runs in masonary walls. Obtain approval from the Owner's Designee prior to installation of any surface raceway in locations other than above specified areas.

3.2.1.6 Provide expansion couplings, with bonding jumper and ground clamps where raceways cross building control joints.

3.2.1.7 Use only metallic, enclosed raceway on installation that required shielding of electrical cables or where installed in ceiling used as return air plenum, as specified or indicated on Drawings.

3.2.1.8 Raceways shall have established positive low resistance paths to ground and effectively isolate conductors so that any short-circuit arc is confined.

3.2.1.9 Select appropriate fittings, such as grounding bushings, bonding and grounding straps, to maintain continuity and effectiveness of grounding of raceway system.

3.2.1.10 Provide necessary fasteners and supports acceptable for type and size of raceways and boxes, to ensure rigid and complete assembly.

3.2.1.11 Provide suitable inserts or expansion type machine bolts for fastening raceways, fittings, boxes and equipment to concrete surfaces. Do not use wood screws, lag screws, expansion shields, rawl plugs and nylon inserts.

3.2.1.12 Secure raceway and other associated work on tile and concrete block walls with approved toggle bolts.

3.2.1.13 Thoroughly clean raceway and dry clear obstructions before pulling cable or wire.

3.2.1.14 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

3.2.2 **Conduits and Tubing**

3.2.2.1 In general, install power, control, lighting and signal wirings in EMT, unless otherwise specified herein or indicated on Drawings.

3.2.2.2 EMT and fittings: Use within the interior of the building for exposed and concealed surface installation not subject to mechanical stress or injury. Use concrete-tight type fittings where used in cast concrete. Provide ground wire for sizes over 50 mm (2").

3.2.2.3 Rigid metal conduits and fittings: Use where exposed installation is subject to mechanical injury, and other installation as permitted by Authorities having jurisdiction. Use rigid galvanized steel conduit for exterior use.

3.2.2.4 PVC DB2 Duct and fittings: Use for underground installations unless otherwise indicated.

3.2.2.5 PVC conduits and fittings: Use for exposed installation in corrosive area, under concrete slab, and where specified or indicated on Drawings, within limits as recommended by Authorities having jurisdiction.

3.2.2.6 Flexible metallic conduits: Use for connection to motors, recessed light fixtures, in indoor, dry locations, to maximum lengths as allowed by OESC and other regulatory standards.

3.2.2.7 Liquid-tight flexible metal conduits: Use for connection to motors, in damp or wet location.

3.2.2.8 Electrical non-metallic tubing: Use only when specified herein or shown on Drawings, in accordance with OESC and other regulatory standards.

3.2.2.9 Do not use smaller than 13 mm (1/2") trade size, tubing, conduits and fittings.

3.2.2.10 Properly ream conduit ends. Provide necessary fittings, couplings, locknuts and bushings.

3.2.2.11 Use only concentric bends. Do not use angle fittings together with bends. Bends improperly formed not accepted. Do not bend over sharp objects.

3.2.2.12 Do not install conduits in terrazzo or in concrete toppings.

3.2.2.13 Concrete-encased conduit connections shall be made concrete tight.

3.2.2.14 Locate conduit to clear reinforcing steel when installing conduits in cast-in-place concrete.

3.2.2.15 Conduit runs below floor slab shall be encased in at least 75 mm concrete envelope, then filled with 50 mm of sand between top of such envelope and underside of slab.

3.2.2.16 Protect conduits from damage where they stub out of concrete.

3.2.2.17 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.

3.2.2.18 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.

3.2.2.19 Encase conduits completely in concrete with minimum 25 mm concrete cover.

3.2.2.20 Organize conduits in slab to minimize cross-overs.

3.2.2.21 Install nylon or propylene fish cord in empty tubing or conduits, fasten cord at both ends and cap.

3.2.2.22 Use explosion proof flexible connection for connection to explosion proof motors.

3.2.2.23 Install sealing fittings in hazardous areas. Fill with compound.

3.2.2.24 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

3.2.2.25 Mechanically bend steel conduit over 19 mm diameter.

3.2.2.26 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

3.2.2.27 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.

3.2.2.28 Dry conduits out before installing wire.

3.2.2.29 Underground conduits shall be sloped to provide drainage. Waterproof joints (PVC accepted) with heavy coat of bituminous paint.

3.2.2.30 Conduit identification: Code with plastic tape or paint at points where conduits enter walls, ceilings or floors. Apply in 3.0 meter intervals. Refer to Section 26 05 01 – Common Works, Subsection 3.6.2.2.

3.2.3 **Boxes and Covers**

3.2.3.1 Install boxes and accessories in accordance with applicable sections of OESC and box manufacturers' recommended installation methods.

3.2.3.2 Fasten and support boxes and similar enclosures independent from raceway supports.

3.2.3.3 Set boxes flushed when recessed in finished surface and aligned and levelled when surface mounted. Boxes shall be made accessible after completion of work.

3.2.3.4 Use bushing and double locknuts to terminate conduit in metallic sheet boxes.

3.2.3.5 Provide approved hole plugs in unused conduit openings and knockouts.

3.2.3.6 Supply corrosion-resistant machine screws for boxes and mounting accessories.

3.2.3.7 Flush-mounted boxes embedded in concrete: Set in-place and secure boxes and respective conduits before pouring concrete. Forms, when used, shall be removable without disturbing installed boxes and raceways.

3.2.3.8 Surface-mount boxes to suit EMT installation.

3.2.3.9* Use conduit boxes for surface installation on unfinished wall.

3.2.3.10 Ensure boxes mounted in ceiling cavities do not interfere with laying-in or removal of ceiling tiles.

3.2.3.11 Provide correct box opening sizes for conduits and sheathed cables to be terminated with approved clamps or connectors. Do not use reducing washers.

3.2.3.12 Use square outlet boxes for more than 1 conduit entering one side, and for outlets intended for luminaires.

3.2.3.13 Use masonry boxes for flush-mounting in block walls; concrete boxes for flush-mounting in concrete walls.

3.2.3.14 Provide neoprene gaskets in boxes installed outdoor.

3.2.4 **Surface Metallic Raceway**

3.2.4.1 Use surface metallic raceway assembly for accessible, dry, exposed wiring having not more than #6 AWG, maximum of 10 conductors, 300V and below.

3.2.4.2 Install each type and size with complementary fittings barriers and accessories, along walls, inside ceiling, as required for power wiring, light, telephone, signal and/or instrumentation system.

3.2.4.3 Boxes, covers, fittings, receptacles and other wiring devices shall be integrally supplied and installed with multi-outlet type distribution system as specified or indicated on Drawings.

3.2.4.4 Insert protective bushings at raceway entrances.

3.2.4.5 Use appropriate cover removal tool for each type of surface raceway.

3.2.4.6 Mount raceway base to wall using raceway manufacturers recommended drive pin fasteners.

3.2.4.7 Use overfloor pancake type raceway to extend floor or wall-mounted wiring system across open spaces only, where ceiling cavities are not available.

3.2.4.8 Do not combine power and communications in one raceway, unless provided with barrier for this purpose.

3.2.4.9 Ceiling cavity distribution type raceways may be combined with pole type vertical raceway for power and telephone communication systems. Use only one manufacturer's products.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for standard and custom breaker type panelboards.

1.2 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CSA C22.2 No.29 -15, Panelboards and enclosed Panelboards.

1.4 SHOP DRAWINGS

.1 Submit shop drawings as noted.

.2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

Part 2 Products

2.1 PANELBOARDS

.1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 208 V panelboards: bus and breakers rated for the following minimum (symmetrical) interrupting capacity;

- All 208 Volt panelboards are to have main (if applicable) and distribution circuit breakers rated for 18 KA.

.3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.5 Two keys for each panelboard and key panelboards alike.

.6 Aluminum bus with rating as indicated.

.7 Neutral of same ampere rating as mains.

.8 Mains: suitable for bolt-on breakers.

.9 Ground Bar: Standard bolted aluminum, aluminum or copper cable.

.10 Trim with concealed front bolts and hinges.

.11 Trim and door finish: baked grey enamel.

.12 All surface mounted panelboards are to be complete with a drip shield (sprinkler proof).

.13 NEMA Type 1 enclosure.

.14 Free standing, dead front, mounted on concrete pad as indicated.

.15 Surface wall mount as indicated.

.16 Recessed wall mount as indicated.

.17 Box and trim finish: ASA 61.

2.2 BREAKERS GENERAL

.1 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

.2 Common-trip breakers: with single handle for multi-pole applications.

.3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

.4 Circuit breakers with interchangeable trips as indicated.

.5 120/208 volt circuit breakers to have a minimum of 18,000A symmetrical rms interrupting capacity rating.

2.3 THERMAL MAGNETIC BREAKERS

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.4 SOLID STATE TRIP BREAKERS – MAIN SERVICE BREAKER

.1 Refer to Section 26 24 02 – Service Entrance Board

2.5 BREAKERS

.1 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.2 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

.3 Lock-on devices for emergency lighting and fire alarm circuits.

2.6 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Nameplate for each panelboard Size 7 engraved. Nameplate to include;

- Panel identifier
- Fed From
- Voltage

.3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit.

2.7 PANELBOARD ACCESSORIES

.1 Provide the following accessories to project panelboards as follows;

Drip Shields

Provide drip shields for all surface mounted panelboards.

Part 3 Execution

3.1 INSTALLATION

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards on plywood backboards. Where practical, group panelboards on common backboard.

.3 Mount panelboards to height specified in Section 26 05 01 - Common Work Results - Electrical or as indicated.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

.6 Provide two empty 32mm conduits from each recessed mounted panelboard stubbed into the accessible ceiling space for future wiring.

.7 For multiple section panelboards, provide interconnecting cables from the through-feed lugs in first section to main lugs in 2nd section and terminate. Provide conduit nipple for cross wiring between panelboards as required.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

.1 Switches, receptacles, wiring devices, cover plates and their installation.

1.2 RELATED SECTIONS

.1 Section 26 05 00 - Common Work Results - Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International)

- .1 CSA-C22.2 No.42-10 (R2015), General Use Receptacles, Attachment Plugs and Similar Devices.
- .2 CSA-C22.2 No.42.1-13, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
- .3 CSA-C22.2 No.55-15, Special Use Switches.
- .4 CSA-C22.2 No.111-10 (R2015), General-Use Snap Switches.

1.4 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00 - Submittal Procedures.

Part 2 Products

2.1 RECEPTACLES

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15A, U ground, to: CSA-C22.2 No.42 with following features:

- .1 Grey colour.
- .2 Suitable for No. 10 AWG for back and side wiring.
- .3 Break-off links for use as split receptacles.
- .4 Eight back wired entranchates, four side wiring screws.
- .5 Triple wipe contacts and rivetted grounding contacts.

.2 Duplex receptacles, CSA type 5-20 R, 125 V, 20A, U ground, to: CSA-C22.2 No.42 with following features:

- .1 Grey colour.
- .2 Suitable for No. 10 AWG for back and side wiring.
- .3 Eight back wired entrances, four side wiring screws.
- .4 Triple wipe contacts and rivetted grounding contacts.

.3 GFCI duplex receptacles, CSA type 5-15 R, 125 V, 15A, ground fault circuit interrupting to: CSA-C22.2 No.42 with following features:

- .1 Grey colour.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Eight back wired entrances, four side wiring screws.

.4 Triple wipe contacts and rivetted grounding contacts.

.4 GFCI duplex receptacles, CSA type 5-20 R, 125 V, 15A, ground fault circuit interrupting to: CSA-C22.2 No.42 with following features:

.1 Grey colour.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Eight back wired entrances, four side wiring screws.

.4 Triple wipe contacts and rivetted grounding contacts.

.5 Isolated ground duplex receptacles, CSA type 5-15R, 125 V, 15A, isolated ground to: CSA-C22.2 No.42 with following features:

.1 Red colour.

.2 Suitable for No. 10 AWG for back and side wiring.

.3 Eight back wired entrances, four side wiring screws.

.4 Triple wipe contacts and rivetted grounding contacts.

.6 Other receptacle configurations, ampacities and voltages as indicated (i.e. dryer receptacle, range receptacle, welding receptacle, etc.). All devices to be specification grade.

.7 Specification grade tamper resistant receptacles as indicated.

.8 Receptacles of one manufacturer throughout project.

.9 Leviton 5200, 5300, 7500 and 7800 series or approved equal.

2.2 COVER PLATES

.1 Cover plates for wiring devices to: CSA-C22.2 No.42.1.

.2 Cover plates from one manufacturer throughout project.

.3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.4 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.

.5 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.6 Where exposed to the weather, receptacles of configurations 5-15R, 5-20R, 5-20RA, 6-15R, 6-20R and 6-20A shall be provided with cover plates suitable for wet locations. Reference rule OESC 26-702.

Part 3 Execution

3.1 INSTALLATION

.1 WallStation Switches:

.1 Install switches in gang type outlet box when more than one switch is required in one location.

.2 Mount switches at height in accordance with Section 26 05 00 - Common Work Results – Electrical.

.2 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Mount receptacles at height in accordance with Section 26 05 00 - Common Work Results - Electrical.

.3 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.3 Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

.4 Identify panel and circuit number on all duplex receptacles face plates with black printed lettering on clear labelling tabs (P-tabs).

END OF SECTION

.

Part 1 General

1.1 SECTION INCLUDES

.1 Materials and installation for fused and non-fused 208 volt and 120 volt disconnect switches.

1.2 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

1.3 REFERENCES

.1 Canadian Standards Association (CSA International).

.1 CAN/CSA C22.2 No.4-04 (R2014), Overcurrent Protection, Enclosed Switches.

.2 CSA C22.2 No.39-13, Overcurrent Protection, Fuseholder Assemblies.

Part 2 Products

2.1 DISCONNECT SWITCHES - GENERAL

.1 Fusible and non-fusible, horsepower rated as required disconnect switch in CSA Enclosure, to CAN/CSA C22.2 No.4, size as indicated.

.2 Provision for padlocking in “OFF” switch position by one lock.

.3 Mechanically interlocked door to prevent opening when handle in “ON” position.

.4 Fuses: size as indicated.

.5 Fuseholders: to CSA C22.2 No.39 for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 ON-OFF switch position indication on switch enclosure cover.

.8 CSA enclosure to be Nema 1 or Nema 3R as indicated.

2.2 DISCONNECT SWITCHES – ELEVATOR MOTOR AND VFD’S

.1 Fusible and non-fusible, horsepower rated as required disconnect switch in CSA Enclosure, to CAN/CSA C22.2 No.4, size as indicated.

.2 Provision for padlocking in “OFF” switch position by one lock.

.3 Mechanically interlocked door to prevent opening when handle in “ON” position.

.4 Fuses: size as indicated.

.

.5 Fuses for elevator motor to be dual element time delay fuses.

.6 Fuseholders: to CSA C22.2 No.39 for type and size of fuse indicated.

.7 Quick-make, quick-break action.

.8 ON-OFF switch position indication on switch enclosure cover.

.9 CSA enclosure to be Nema 1 or Nema 3R as indicated.

.10 Auxiliary contact that is positively opened mechanically and is Normally Closed (N.C.) when the main power is in the 'ON' position, and is Normally Open (N.O.) when the power is in the 'OFF' position.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Indicate name of load controlled on size 4 nameplate.

Part 3 Execution

3.1 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 01 - Common Work Results - Electrical.

1.2 REFERENCES

.1 International Electrotechnical Commission (IEC)

.1 IEC 947-4-1-Latest Edition, Part 4: Contactors and motor-starters.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings.

.2 Indicate:

.1 Mounting method and dimensions.
.2 Starter size and type.
.3 Layout of identified internal and front panel components.
.4 Enclosure types.
.5 Wiring diagram for each type of starter.
.6 Interconnection diagrams.

Part 2 Products

2.1 MATERIALS

.1 Starters: to IEC 947-4 with AC4 utilization category.

2.2 MANUAL MOTOR STARTERS

.1 Single and three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:

.1 Switching mechanism, quick make and break.
.2 One or three overload heater(s), manual reset, trip indicating handle.

.2 Accessories:

.1 Toggle switch: heavy duty labelled as indicated, grey colour.
.2 Indicating light: heavy duty type and red colour.
.3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 COMBINATION MOTOR STARTER

.1 Combination type starters to be provided with motor disconnect function, Hand-Off-Auto, red run light, green ready light, thermal overload protection, magnetic short circuit protection, 24 volt coil, 24 volt control transformer and 2 – NO auxiliary contacts, Nema 1 rating.

Eaton IEC series or approved equal.

2.4 MAGNETIC MOTOR STARTER

.1 Magnetic type starters to be provided with Hand-Off-Auto, red run light, green ready light, thermal overload protection, magnetic short circuit protection, 24 volt coil, 24 volt control transformer and 2 – NO auxiliary contacts, Nema 1 rating.

Eaton IEC series or approved equal.

2.5 CONTROL TRANSFORMER

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

2.6 FINISHES

.1 Apply finishes to enclosure in accordance with Section 26 05 01 - Common Work Results - Electrical.

2.7 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results - Electrical.

.2 Manual starter designation label, white plate, black letters, Size 3, engraved as indicated.

Part 3 Execution

3.1 INSTALLATION

.1 Install starters, connect power and control as indicated.

.2 Ensure correct fuses and overload devices elements installed.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 01 - Common Work Results - Electrical and manufacturer's instructions.

.2 Operate switches, contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

END OF SECTION

1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to 26 05 01 – Common Work Results - Electrical as applicable.

1.2 **REFERENCES**

CSA C22.2 No. 9 – 1996 (R2012)	Luminaires
CSA C22.2 No. 43- 08 (R2013)	Lampholders
CSA C22.2 No. 74-16	Equipment for Use with Electric Discharge Lamps
CAN/CSA C861-10 (R2015)	Performance of Compact Fluorescent Lamps and Ballasted Adapters
C866-12	Performance of LED luminaires
CAN/CSA-C22.2 No. 250.13-14	LED Equipment for Lighting Applications

1.3 **SUBMITTALS**

1.3.1 **Shop Drawings**: Submit shop drawings in accordance with General Conditions of Contract for each type of luminaires, indicating following:

1.3.2 Product data, including installation instructions and details.

2 Products

2.1 **MANUFACTURED UNITS**

2.1.1 Light Fixtures

Type ‘A1’

1’ x 4’ Metalux 14FP LED flat panel troffer for mounting in T-bar ceiling, 4400 lumen LED array (38 watts), 3500K, 120 volt driver, 0-10V (10% to 100%) dimming and includes an integrated Wavelinx wireless control. Fixture must carry a minimum 5 year warranty and must be DLC certified.

Metalux Cat. No. 14FP4235C-SWPD1 or Approved Equivalent

Type ‘A2’

Same as Type ‘A’ but complete with surface frame kit.

Metalux Cat. No. 14FP4235C-SWPD1 c/w FPSURF14 or Approved Equivalent.

Type ‘A3’

1’ x 4’ Eaton Fail-Safe surface mounted wet location rated LED fixture, 5379 lumen LED array (47 watts), 3500K, 120 volt driver, 0-10V (10% to 100%) dimming and includes an integrated wireless control. Fixture must carry a minimum 5 year warranty and must be DLC certified.

Eaton Cat. No. HVSL12-4-LD4-2-LO-35-UV-C-EDD-1-IP63 or Approved Equivalent

Type ‘B1’

1’ X 8’ Metalux linear wavestream LED WSL fixture for suspended installations. 6934 lumen LED array (63.6 watts), 3500K, 120 volt driver, 0-10V (10% to 100%) dimming includes integrated Wavelinx wireless control. Fixture must carry a minimum 5 year warranty and must be DLC certified. Provide suspension hardware as required.

Metalux Cat. No. 8WSL-LD2-80-SPS-UPL15-UNV-L835-CD1-SWPD1 or Approved Equivalent.

Type ‘C1’

2’ x 2’ integral flat panel LED troffer for surface mounting on the ceiling, 3417 lumen LED array (29 watts), 3500K, 120 volt driver, 0-10V (10% to 100%) dimming and integrated Wavelinx wireless control. Fixture must carry a minimum 5 year warranty and must be DLC certified.

Metalux Cat. No. 22FP3235C-SWPD1 c/w FPSURF22 or Approved Equivalent

Type ‘D1’

3” x 4’ Metalux SNLED lensed striplight for use with wall mounted or surface mounted installations. 3567 lumen LED array (25 watts), 3500K, 120 volt driver, 0-10V (10% to 100%) dimming includes integrated Wavelinx wireless control. Fixture must carry a minimum 5 year warranty and must be DLC certified. Provide suspension hardware as required.

Metalux Cat. No. 4SNLED-LD5-34SL-LC-UNV-L835-CD1-U or Approved Equivalent.

2.1.2 **Wiresless Occupancy Sensors**

.1 Occupancy Sensor

.1 Ceiling mount, ultrasonic, low voltage occupancy sensor c/w circular coverage pattern up to 1500 ft^2. Sensors to be approximately mounted in locations indicated. Install sensors as per manufacturer recommendations. Eaton Wavelinx occupancy sensors with battery powered and up to 10 years battery life.

Eaton Cat No. CWPD-1500 or Approved Equivalent.

2.1.3 **Wireless Wallstation**

.1 Wallstation

.1 Wireless 4 button wallstation with raise/lower controls, 120V powered.
.2 Scenes to be programmed as follows:
Scene 1 = 25%
Scene 2 = 50%
Scene 3 = 75%
Scene 4 = 100%

Eaton Cat. No. W4S-RL-W

2.1.4 **Wireless Controller**

.1 Wavelinx Controller

.1 Ceiling mount, ultrasonic, low voltage occupancy wireless controller. To be utilized to communicate to wireless wallstations, wireless occupancy sensors, and wireless LED light dimmers. Power over ethernet powered.

Eaton Cat No. WAC-POE or Approved Equivalent.

3 EXECUTION

3.1 INSTALLATION – Lighting and Accessories

3.1.1 Install luminaires to conform to Ontario Electrical Safety Code and Ontario Building Code requirements, and in accordance with manufacturer's recommended installation procedures.

3.1.2 Install luminaires accurately, in line and level, complete with mounting appurtenances and hardware, free from undue interferences.

3.1.3 Align luminaires mounted in continuous rows to form straight uninterrupted line.

3.1.4 Align individually-mounted luminaires parallel or perpendicular to building grid lines.

3.1.5 Any luminaire which, in opinion of Owner’s Designee are not installed properly shall be corrected to his satisfaction, with no change to Contract Sum.

3.1.6 Luminaires indicated on Drawings shall be located to agree with approved reflected ceiling plan drawings. Co-ordinate installation of luminaires, plaster frames, and rings with metal furring, lath and plaster trades.

3.1.7 Confirm compatibility of specified luminaires with ceiling types used.

3.1.8 Preserve sufficient space during construction for proper installation of fixtures co-ordinate with related Sections to ensure clearances are maintained to accommodate luminaires.

3.1.9 Provide plaster frames and rings required for recessed fixtures for installation under the

metal furring, lath and plaster contract.

3.1.10 Install luminaires after mechanical ducts, piping, and equipment in vicinity have been installed. Number of luminaires indicated on drawings shall be checked for exact location as approved by Owner's Designee prior to installation.

3.1.11 Verify catalogue numbers of luminaires prior to ordering. Check final ceiling finish in areas where recessed luminaires are indicated, in order to purchase correct ceiling trims, flanges and mounting brackets for particular ceiling construction.

3.1.12 Install lighting contactors per manufacturer's instructions.

3.1.13 Provide standard FS type outdoor rated junction box for installation of photocell.

3.2 **INSTALLATION – Wireless Devices.**

3.2.1 All sensor locations are approximate. Refer to manufacturer's instructions for best installation practices.

3.2.2 Ultrasonic ceiling mount sensors should be located a minimum of 2743mm from HVAC supply/return grills.

3.2.3 Sensors mounted over doorways should be placed a minimum of 305mm inside threshold.

END OF SECTION

1 General

1.1 GENERAL REQUIREMENTS

1.1.1 Conform to 26 05 01 – Common Work Results - Electrical as applicable.

1.2 REFERENCES

Refer to relevant specifications sections in divisions 21, 22, 23 and 26 as required.

2 Products

2.1 GENERAL REQUIREMENTS

2.1.1 In accordance with specification sections in division 26.

3 EXECUTION

3.1 INSTALLATION

3.1.1 Service switches, disconnect switches, manual motor starters, magnetic motor starters, combination motor starters and variable frequency drives (VFD) are to be provided and installed by the electrical contractor unless explicitly stated otherwise.

3.1.2 Provide 208V, three phase power to rooftop terminal unit RTU-3 factory supplied disconnect switch.

3.1.3 Provide 208V, three phase power to rooftop terminal unit RTU-4 factory supplied disconnect switch.

3.1.4 Provide 120V power feed through junction box and service outlet to fan power terminal units FPT-2.1 through FPT-2.5.

3.1.5 Provide 208V, single phase power to air conditioning units AC-1 through AC-6.

3.1.6 Provide 208V, three phase power to new distribution panel ‘MR’ sourced from new 225A three pole breaker installed in existing Westinghouse 120/208V, 3 phase, distribution panel #1 located the basement boiler room.

3.1.7 Provide 120V power feed to air handling unit AHU-1 marine light kit and unit mounted utility switch.

3.1.8 Provide 208V, three phase power to air handling unit AHU-1 supply fan wired through motor starter and local non-fused disconnect.

3.1.9 Provide 208V, three phase power to air handling unit AHU-1 return fan wired through motor starter and local non-fused disconnect.

3.1.10 Provide 120V power feed to air handling unit AHU-2 marine light kit and unit mounted utility switch.

3.1.11 Provide 208V, three phase power to air handling unit AHU-2 supply fan wired through motor starter and local non-fused disconnect.

3.1.12 Provide 208V, three phase power to air handling unit AHU-2 return fan wired through motor starter and local non-fused disconnect.

3.1.13 Provide 208V, three phase power to energy recover unit ERV-1 factory supplied non-fused disconnect switch.

3.1.14 Provide 208V, single phase power to cabinet unit heaters CUH-1 through CUH-5.

3.1.15 Disconnect existing 208V, three phase power feed for RTU-1. Provide new NEMA 3R fused disconnect switches with 110A fuses, as per electrical drawings. Re-connect existing power feed to new RTU-1. Extend power feed as required.

3.1.16 Disconnect existing 208V, three phase power feed for RTU-2. Provide new NEMA 3R fused disconnect switches with 110A fuses, as per electrical drawings. Re-connect existing power feed to new RTU-1. Extend power feed as required.

3.1.17 Provide 208V, three phase power wired through local NEMA 3R disconnect for condensing unit CU-1. Provide power and control wiring from the outdoor unit to the indoor power source in accordance with manufacturer's recommendations.

3.1.18 Provide 120V power feed and GFI receptacle to gas fired water heaters WH-1 through WH-4.

3.1.19 Provide 120V power feed wired through magnetic motor starter to domestic hot water recirculation pump P-2.

3.1.20 Provide 120V power feed to thermostatic mixing valve MV-1.

3.1.21 Provide 208V, three phase power wired through local disconnect switch for heating loop circulation pump P1-A.

3.1.22 Provide 208V, three phase power wired through local disconnect switch for heating loop circulation pump P1-B.

3.1.23 Provide 208V, single phase power feed wired through local service switch for boiler circ pumps BCP-1, BCP-2 and BCP-3.

3.1.24 Provide 120V, single phase power feed and GFI receptacle for glycol feeder GF-1.

3.1.25 Provide 120V power through local service switch to boilers B1 through B3.

3.1.26 Provide 120V power from each boiler to its respective combustion air damper.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

.1 Section 26 05 01 – Common Work Results - Electrical

1.2 REFERENCES

.1 Underwriter's Laboratories of Canada (ULC)

.1 CAN/ULC-S524-[2014], Installation of Fire Alarm Systems.
.2 CAN/ULC-S525-[2016], Audible Signal Appliances.
.3 CAN/ULC-S526-[2007], Visual Signal Appliances, Fire Alarm.
.4 CAN/ULC-S527-[2011], Control Units.
.5 CAN/ULC-S528-[2014], Manual Pull Stations.
.6 CAN/ULC-S529-[2016], Smoke Detectors.
.7 CAN/ULC-S530-[1991], Heat Actuated Fire Detectors.
.8 CAN/ULC-S536-[2013], Inspection and Testing of Fire Alarm Systems.
.9 CAN/ULC-S537-[2013], Verification of Fire Alarm Systems.

1.3 DESCRIPTION OF SYSTEM

.1 System includes:

.1 Control panel to carry out fire alarm and protection functions including receiving alarm signals, initiating general alarm, supervising system continuously, actuating zone annunciators, and initiating trouble signals.
.2 Trouble signal devices.
.3 Power supply facilities.
.4 Manual alarm stations.
.5 Automatic alarm initiating devices.
.6 Audible signal devices.
.7 End-of-line devices.
.8 Annunciators.
.9 Visual alarm signal devices.
.10 Ancilliary devices.

1.4 REQUIREMENTS OF REGULATORY AGENCIES

.1 System:

.1 Subject to Fire Commissioner of Canada (FC) approval.
.2 Subject to FC inspection for final acceptance.
.3 To Canadian Forces Fire Marshal approval.

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with specifications.

.2 Include:

.1 Layout of equipment.

.2 Zoning.

.3 Complete wiring diagram, including schematics of modules.

1.6 CLOSEOUT SUBMITTALS

.1 Provide operation and maintenance data for Fire Alarm System for incorporation into manual.

.2 Include:

.1 Operation and maintenance instructions for complete fire alarm system to permit effective operation and maintenance.

.2 Technical data - illustrated parts lists with parts catalogue numbers.

.3 Copy of approved shop drawings.

.4 List of recommended spare parts for system.

1.7 MAINTENANCE

.1 Provide one year's free maintenance with two inspections by manufacturer during warranty period. Inspection tests to conform to CAN/ULC-S536. Submit inspection report to Owner.

Part 2 Products

2.1 MATERIALS

.1 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.

.2 Power supply: to CAN/ULC-S524.

.3 Audible signal devices: to ULC-S525.

.4 Visual signal devices: to CAN/ULC-S526.

.5 Control unit: to CAN/ULC-S527.

.6 Manual pull stations: to CAN/ULC-S528.

.7 Thermal detectors: to CAN/ULC-S530.

.8 Smoke detectors: to CAN/ULC-S529.

2.2 SYSTEM OPERATION

.1 Single stage operation. Operation of any alarm initiating device to:

.1 Cause audible signal devices to sound throughout building.

.2 Transmit signal to fire department via monitoring station.

.3 Cause zone of alarm device to be indicated on control panel and remote annunciators.

2.3 EQUIPMENT

.1 Fire Alarm Control Panel

Existing fire alarm control panel is an Edwards EST Quickstart fire alarm panel and is located in the basement boiler room.

.2 Annunciator

Existing fire alarm annunciator is located in the main entrance lobby. Replace existing surface mounted annunciator enclosure with a new larger surface mounted enclosure and provide additional zone LED to accommodate additional fire alarm zones (7 new zones to be added) for new duct type smoke detectors to be installed in new mechanical equipment. Patch/paint wall surface to match surrounding conditions upon completion.

Edwards or approved equal

.3 Fault Isolator Module

Fault isolator module providing protection for the system against wire-to-wire short circuits on the SLC loops. It is the responsibility of the contractor to provide an appropriate number of isolation modules to comply with CAN-UC-S524 Section 5.14.

Edwards SIGA-IM or approved equal

.4 Photo electric smoke detectors

Intelligent photo electric smoke detector;
Edwards SIGA2-PS or approved equal.

All smoke detectors to be complete with associated detector bases.

Smoke detectors associated with elevator shall be wired to addressable relays and/or relay bases.

.5 Thermal heat detectors

Intelligent rate-of-rise heat detector;
Edwards SIGA2-HRS or approved equal.

All heat detectors to be complete with associated detector bases.

.6 Duct type smoke detectors

Duct type smoke detectors;

Detector: Edwards SIGA-SD
Housing: Edwards SIGA-DH

Sampling Tube: Edwards SD-T’X’ - Verify the length of sampling tube required prior to ordering.

Duct type smoke detectors to be wired to addressable relays to shutdown air handling equipment in the event of a fire.

.7 Relays

Provide relay type to suite purpose as required. It shall be the responsibility of the contractor to provide an appropriate number of relays to be used for fan shutdowns.

Edwards SIGA-CR series or approved equal

2.4 END-OF-LINE DEVICES

.1 End-of-line devices to control supervisory current in alarm circuits and signalling circuits, sized to ensure correct supervisory current for each circuit. Open short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.

2.5 MOUNTING OF FIRE ALARM DEVICES

.1 Audible Devices

Where the ceiling heights allow, audible signal devices shall be installed so that the top of the device will not be less than 2300 mm above the finished floor level. Wall mounted audible signal devices shall be installed at least 150 mm below the ceiling measured to the top edge of the audible device.

.2 Duct Type Smoke Detectors

Duct type smoke detectors shall be installed in the main supply duct, downstream of the mixing box, filters and fan. Where duct type smoke detectors cannot be installed in the main supply duct, they shall be installed in each of the branch lines as close as practical to the supply fan downstream of the mixing box, filters and fan. Refer to figure 24 of the CAN/ULC-S524-14.

Duct type smoke detectors shall also be installed in the return duct as indicated.

2.6 ANCILLARY DEVICES

.1 Ensure that the fire alarm equipment listed is supplied with all required accessories for a complete system.

2.7 FIRE ALARM MAP

.1 Provide a fire alarm floor map adjacent to each fire alarm annunciator panel. The Fire alarm map to have colour graphics and be CAD based.

2.8 FIRE ALARM SYSTEM WIRING

.1 Provide new wiring for a complete fire alarm system. Fire alarm wiring shall be installed in conduit.

.2 Fire alarm cable shall comply with CSA C22.2 No. 208.

.3 The number of conductors and guage of the fire alarm cable for the wiring of the fire alarm system to be determined by the manufacturer. The installation of the fire alarm cables to be performed by the contractor.

.4 Wiring required for the operation of life safety systems, as described in OESC Rule 46-002, shall be kept entirely independent of all other conductors and equipment and shall not enter luminaire, raceway, box cabinet or unit equipment occupied by other conductors.

.5 Ensure voltage drop does not exceed 2 percent.

Part 3 Execution

3.1 INSTALLATION

.1 Install systems in accordance with CAN/ULC-S524.

.2 Install main control panel and connect to ac power supply.

.3 Locate and install manual alarm stations and connect to alarm circuit wiring.

.4 Locate and install detectors and connect to alarm circuit wiring. Do not mount detectors within 1 m of air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.

.5 Connect alarm circuits to main control panel.

.6 Locate and install horns and horn/strobes and connect to signalling circuits.

.7 Connect signalling circuits to main control panel.

.8 Install end-of-line devices as per manufacturer’s instructions.

.9 Install remote annunciator panels and connect to annunciator circuit wiring.

.10 Sprinkler system: wire alarm and supervisory switches and connect to control panel.

.11 Floor mounted electromagnetic door hold open devices to be connected to the fire alarm panel. Provide power feed and all necessary low voltage transformers, fire alarm relays and required accessories for a complete and functioning installation.

3.2 FIELD QUALITY CONTROL

.1 Perform tests in accordance with CAN/ULC-S537.

.2 Fire alarm system:

.1 Test each device and alarm circuit to ensure manual stations, thermal and smoke detectors, sprinkler system transmit alarm to control panel and actuate general alarm.

.2 Check annunciator panels to ensure zones are shown correctly.

.3 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of system.

.4 Class A circuits.

.1 Test each conductor on all circuits for capability of providing alarm signal on each side of single open-circuit fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.2 Test each conductor on all circuits for capability of providing alarm signal during ground-fault condition imposed near midmost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.5 Class B circuits.

.1 Test each conductor on all circuits for capability of providing alarm signal on line side of single open-circuit fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

.2 Test each conductor on all circuits for capability of providing alarm signal during ground-fault condition imposed at electrically most remote device on circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.

3.3 TRAINING

.1 Arrange and pay for on-site lectures and demonstrations by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

END OF SECTION

APPENDIX 1

PROJECT SPECIFIC DESIGNATED SUBSTANCE SURVEY

Project Specific Designated Substance Survey

Bora Laskin Building
Bora Laskin Lane
THUNDER BAY, ONTARIO

Prepared for
Lakehead University

Prepared By:

TBT Engineering
1918 Yonge Street
Thunder Bay, Ontario
P7E 6T9

April 19, 2018

TBTE Ref. No. 18-038

APPENDICES

1 INTRODUCTION

TBT Engineering Limited (TBTE) has completed a limited Project Specific Designated Substance Survey (DSS) for proposed upgrades at the Bora Laskin Building at 955 Oliver Road in Thunder Bay, Ontario (hereinafter referred to as the "Site"). TBTE was retained by Lakehead University (hereinafter referred to as the "Client") to perform the DSS. It is understood that the DSS is required in preparation for a total replacement of the Heating, Ventilation, and Air Conditioning (HVAC) system.

The Occupational Health & Safety Act requires that before a construction or demolition project can begin, it is the responsibility of the property owner to properly identify the presence of any of eleven Designated Substances on the project site and provide contractors with a Designated Substance Report prior to initiating any work.

Most designated substances used in construction materials in Canada began to be phased out in the 1980's, therefore materials installed prior to 1990 should principally be considered suspect of containing these substances.

The Ontario Regulation 490/09 (O. Reg. 490/09) under the Occupational Health and Safety Act of Ontario identifies the following as designated substances:

- Asbestos
- Acrylonitrile
- Arsenic
- Benzene
- Coke Oven Emissions
- Ethylene Oxide
- Isocyanates
- Mercury
- Silica
- Vinyl Chloride
- Lead

The purpose of the DSS was to inspect the Site and to report the findings; properly identifying the presence, type, and location of any observed Designated Substances so that applicable measures can be taken prior to rehabilitation work, to ensure the safety of those working on the Site as well as that of the public.

1.1 Scope of Work

The DSS site inspection was completed February 6th, 2018. The scope of work consisted of an assessment to identify the potential presence of designated substances and common hazardous materials prior to demolition / renovation activities. In addition to the O. Reg. 490/09 designated substances, this survey included observations but not formal assessments for other substances considered to be hazardous. The hazardous materials included in this survey were:

- Polychlorinated Biphenyls (PCBs);
- Ozone-Depleting Substances (ODSs);
- Mould;
- Bird and Rodent Droppings (fungal diseases and viruses), and

The Project Specific Designated Substance Survey (DSS) included:

- A visual inspection of building interior features designated for demolition and/or renovation;
- Determination and limited sampling of building materials considered to be potentially designated substances and/or potentially hazardous; and,
- Analysis of sampled materials by an accredited laboratory.

The Project Specific Designated Substance Survey was limited to designated project area as defined by the Client (HVAC upgrades). Indoor air quality testing was not requested and is outside the scope of this survey.

2 METHODOLOGY

The DSS procedure included an initial Site investigation (visual and intrusive) for those suspect construction materials which can be reasonably anticipated to be disturbed during the proposed demolition/renovation work. This was completed in accessible project-specific areas, including destructive sampling when required, as approved by the Client. If materials were suspected to contain Designated Substances, then sampling was undertaken following industry standards and regulatory sampling protocols.

2.1 Asbestos Containing Material (ACMs) Sampling

Materials that were identified as possibly containing asbestos were collected in bulk samples. The number of samples collected for each material followed the requirements of O. Reg. 278/05 – *Asbestos on Construction Projects and In Buildings and Repair Operations*. This regulation states the required number of samples to be taken based on the size of an area of homogenous materials.

2.2 Lead Sampling

Paint chip samples were collected from the interior walls and doors to verify the presence of lead. If work is to involve activities that may cause the painted surfaces and/or lead containing materials to become air-borne then the practices outlined in the Occupational Health and Safety Act and the Ministry of Labour's Guideline to Lead on Construction Projects document should be followed.

2.3 Other Designated Substances

The potential presence of silica, mercury, and/or benzene were investigated visually during the Site visit, and identified with details (i.e. location, quantity, and condition) documented, if any evidence was found.

Based on the age of the building, site history and property use, no other Designated Substances sampling was carried out. Acrylonitrile, arsenic, coke oven emissions, ethylene oxide, isocyanates, and vinyl chloride were not anticipated to be found at the Site and no evidence of any of these substances was observed during the Site visit.

2.4 Hazardous Materials

Other designated substances and hazardous materials (i.e. PCBs, mould, bird droppings and ODSs) were investigated visually during the Site visit with details (i.e. location, quantity, and condition) documented, if applicable.

2.5 Previous Environmental Reports

TBTE received one (1) applicable document from the client:

- Digitally named: *BL DSS Jan 31 2018*

A review of this document shows that ACMs are confirmed or presumed throughout the building according to the room number. The document lists various ACM piping, ceiling, wall and flooring materials in the building. Below each ACM listed by room number in the document are detailed notes about lead paint and other designated substances. The attached figures in this report (Appendix A) highlight the rooms that have documented designated substances for reference during the HVAC upgrades. Table 1 below summarized the ACMs identified previously from the document provided to TBTE by the client.

Table 1. Previously Identified ACMs

Room Identification	Asbestos Containing Material
BL0001B (Mechanical)	• Parging Cement on Piping and Elbows • Acoustic Spray
BL0001BA (Mechanical)	Acoustic Spray on piping
BL0001BB (Mechanical)	Parging Cement on piping
BLX0004 (Mechanical)	Plaster on wall
BLX1001 (Stairwell)	Ceiling and Wall Plaster
BL1001 (Auditorium)	• Ceiling texture coating • Sweat wrap pipe insulation
BLX1011 (Lobby)	Ceiling texture coating
BL1016 (Office)	Vinyl floor tile and mastic
BL1018A (Mail Room)	Vinyl floor tile and mastic
BL1018 (Staff Room)	Vinyl floor tile and mastic
BL1022 (Classroom)	Vinyl floor tile and mastic (two types)
BL1024 (Classroom)	Vinyl floor tile and mastic
BL1023 (Storage)	Vinyl floor tile and mastic
BL1025 (Office)	Vinyl floor tile and mastic
BL1026 (Office)	Vinyl floor tile and mastic
BL1027 (Office)	Vinyl floor tile and mastic
BL1028 (Office)	Vinyl floor tile and mastic

Room Identification	Asbestos Containing Material
BL1029 (Office)	Vinyl floor tile and mastic
BL1019 (Classroom)	Vinyl floor tile and mastic (two types)
BL1019A (Student Lounge)	Vinyl floor tile and mastic (two types)
BL1019B (Office)	Vinyl floor tile and mastic (two types)
BL1015 (Washroom)	Wall Plaster
BL1013 (Janitorial)	Wall Plaster
BL1011 (Washroom)	Wall Plaster
BLX1003 (Stairway)	Vinyl floor tile and mastic
BLX2011 (Corridor)	Vinyl floor tile and mastic
BL2039 (Classroom)	Vinyl floor tile and mastic (two types)
BL2036 (Classroom)	Vinyl floor tile and mastic
BL2039A (Storage)	Vinyl floor tile and mastic (two types)
BL2037A (Washroom)	Wall plaster
BL2035 (Janitorial)	• Wall transite • Wall plaster • Hot water piping aircell
BL2033A (Washroom)	Wall Plaster
BL2031 (Classroom)	Vinyl floor tile and mastic (two types)
BL2032 (Classroom)	Vinyl floor tile and mastic (two types)
BL2029 (Office)	Vinyl floor tile and mastic (two types)
BL2028 (Mechanical)	• Parging cement – rain water leader • Sweat wrap insulation – rain water leader • Parging cement – Steam and condensate supply/return • Magnesia block – Steam and condensate supply/return
BLX1019-X1021 (corridor)	Vinyl floor tile and mastic
Crawlspace	Parging cement debris

Room Identification	Asbestos Containing Material
	Dirt debris on floor Aircell debris on floor Sweat wrap pipe insulation (cold water piping) Parging cement (cold water piping) Parging cement (hot water) Parging cement (heating water return/supply piping) Aircell (heating water return/supply piping straights) Aircell (domestic hot water straights)

Note: Table 1 results based on information received from client.

Please note that while the provided document identifies ACM by location, it does not include any analytical reports, asbestos characterization, contaminant concentrations or summaries thereof.

2.6 Quality Assurance/Quality Control

Field QA/QC protocol were followed to ensure the integrity of the samples obtained. A new pair of nitrile gloves was worn for each sample collected during the Site investigation. Samples of suspected asbestos and lead containing materials were collected by scoring through all layers of material, with the appropriate tools such as utility knife, putty knife, pliers, and/or key-hole saw. Each tool was cleaned with a detergent and water solution between sampling. Prior to collection, sample areas were sprayed with a detergent and water solution, to minimize the potential of producing air borne dust during sampling. Samples were placed into designated, individually labelled sample bags.

All confirmatory samples were submitted to AGAT Laboratories for analysis. AGAT is located in Mississauga, Ontario and is accredited and certified by the Canadian Association for Laboratory Accreditation (CALA) and the Standards Council of Canada (SCC).

3 SITE INSPECTION and ANALYTICAL RESULTS

The Site survey information provided in this section reflects conditions as observed by TBTE on February 6th, 2018.
The Site investigation included inspection of the construction materials along with intrusive and destructive sampling as required of suspect materials in safely accessible areas.

Please refer to relevant site photographs in Appendix A.

3.1 Asbestos

Various building materials throughout the subject building were considered suspect and sampled for verification. Suspect materials observed at the Site within the Project Area include:

- Ceiling tiles;
- Pipe and duct insulation;
- Grout;
- Drywall mud;
- Floor tiles & Mastic;
- Caulking.

A number of suspected ACM's were sampled (48 total samples) and submitted to AGAT Laboratories for analysis of asbestos content by Polarized Light Microscopy (PLM), in accordance with U.S. Environmental Protection Agency Test Method EPA/600/R-93/116: Method for the Determination of Asbestos in Bulk Building Materials (June 1993) as specified under O. Reg. 278/05. The Ontario Health and Safety Act defines asbestos-containing materials (ACMs) as those materials that contain 0.5% or more asbestos by dry weight. Note that sample analysis of each material was instructed to be stopped at the first positive result for asbestos as stated in O. Reg. 278/05.

As indicated in Section 2.1, the number of samples for each suspect ACM was dependent on the size of the area of homogenous material. The number of samples submitted for each material type was collected in accordance with Table 1 of O. Reg. 278/05.

Laboratory analysis of the submitted samples confirmed that two of the samples collected during the Site inspection contain asbestos. Please refer to Table 2 for an analytical summary of the asbestos results and Appendix B for all Laboratory Certificates of Analysis.

Table 2. Analytical Results – Asbestos (bulk)

Sample ID	Material / Location	Bulk Asbestos (%)
100A	**Boiler Exhaust insultation – Boiler Room (0001B)**	**50 - 75**
100E	**Pipe Elbow – east addition crawlspace**	**SP**
100C	**Pipe Elbow – Boiler Room (0001B)**	**SP**
101A	Mortar in between cinder block walls in Boiler Room (0001B)	ND
101B	**Mortar in between cinder block walls in Boiler Room (0001B)**	**0.5 - 5**
101C	**Mortar in between cinder block walls in Boiler Room (0001B)**	**SP**
102A	12” x 12” White Ceiling Tile – Corridor (X1001)	ND
102B-C	12” x 12” White Ceiling Tile – Corridor (X1011)	ND
103A	Drywall Seam Mud – on walls (1012C)	ND
103B	Drywall Seam Mud – on walls (1022G)	ND
103C	Drywall seam mud – on walls in corridor (X2011A)	ND
104A-C *Phase 1*	Grey Floor Tile – Office (1016)	ND
104A-C *Phase 2*	Mastic from Grey Floor Tile – Office (1016)	ND
106A-C *Phase 1*	Cream Floor Tile – Office Storage Room (1018)	ND
106A-B	Mastic from Cream Floor Tile – Office Storage Room (1018)	ND

Sample ID	Material / Location	Bulk Asbestos (%)
Phase 2		
106C *Phase 1*	Cream Floor Tile – Office Storage Room (1018A)	ND
106C *Phase 2*	Mastic from Cream Floor Tile – Office Storage Room (1018A)	ND
107A-C	Mortar in between bricks – Walls (1013A)	ND
108A-C	Drop ceiling tile in Men's Washroom – Ceiling (1015)	ND
112A-C *Phase 1*	Pink Floor Tile – Corridor (X2011A)	ND
112A-C *Phase 2*	Mastic from Pink Floor Tile – Corridor (X2011A)	ND
113A-C *Phase 1*	Dark Grey Floor Tile – Floor (2034)	ND
113A-C *Phase 2*	Mastic from Dark Grey Floor Tile – Floor (2034)	ND
114A-C	Plaster material underneath 12" x 12" ceiling tile – Ceiling (2031)	ND
115A-C	Red caulking on seams of venting in crawlspace	ND

ND – Not detected.

SP – "Stop Positive." Testing halted due to positive asbestos result from prior sample of homogenous material.

Prior to sample submission, a review of the "BL DSS Jan 31 2018" document Lakehead University provided TBTE was completed. Materials identified as "Confirmed Asbestos" were not submitted for analysis. Materials that were identified as "Presumed Asbestos" and materials not noted in the document were submitted for analysis. Please refer to Appendix A – Enclosure 1 - Sample Location Plan for locations of asbestos samples submitted for analysis following the Site visit.

The laboratory identified ACMs in samples 100A,C,E & 101A-C as the chrysotile form of asbestos.

3.2 Lead

Lead was historically used as an additive to paints until its use was restricted in 1976 by the Government of Canada. Under the Surface Coating Materials Regulations SOR/2005-109 made under the Canada Consumer Product Safety Act (formerly under the Hazardous Products Act), a paint or other similar material that dries to a solid film that contains over 90 mg/kg (0.009%) dry weight of lead is deemed hazardous. Lead was also used in solder for plumbing until 1990 when the National Plumbing Code of Canada banned this use.

Other common uses of lead in buildings include but limited to the following:

- Acoustic dampening baffles;
- Batteries;
- Cable and wire casing;
- Cast iron pipe gaskets and connections;
- Decorative pieces;
- Flashing;
- Gaskets;
- Glazing;
- Lead glass;
- Tinted mortar at stone cladding;
- Pipes;
- Radiation shielding (bricks or sheeting);
- Electrical solder connections;
- Stained glass and window came; and
- Structural steel primer.

Eleven (11) confirmatory paint samples were collected and submitted to AGAT Laboratories for lead analysis by the Inductively Coupled Plasma – Optical Emission Spectrometer (ICP/OES) test method. Analytical results returned with lead concentrations exceeding applicable standards in 7 of 11 samples. Please refer to Table 3 for analytical data, and Appendix B for all Laboratory Certificates of Analysis.

Table 3. Analytical Results – Lead in paint

Sample ID	Material / Location	Lead in Paint (mg/kg)
200	**Green paint on wooden door in basement (0001B)**	**5,360**
202	**Cream paint on registers along north wall in Auditorium (1001)**	**4,600**
203	**White paint on walls (1012C)**	**2,080**
205	**Grey paint by door (1022)**	**298**
207	**Brown paint on walls (1021)**	**389**
208	Purple paint in office (Vice Principal)	<10
209	Peach paint in office vault	<10
210	Peach/yellow paint in cafeteria	<10
213	**Green paint in change rooms**	**1,490**
214	**Orange paint in change rooms**	**284**
215	Red paint in girls' washroom	57

Prior to sample submission, a review of the "BL DSS Jan 31 2018" document Lakehead University provided TBTE was completed. Previous room paint colours have been identified in the "Notes" section below each room number in the document. If the paint colour was identified previously, samples were not submitted for analysis. All other remaining paint samples found during the Site visit were submitted for analysis. Please refer to Appendix A – Enclosure 1 - Sample Location Plan for locations of Lead Paint samples submitted for analysis following the Site visit.

3.3 Benzene

Benzene may be present as a component in boiler fuels in Room 0001. No large quantities or spills were observed during the site visit.

3.4 Mercury

The lighting system consisted mainly of fluorescent lights throughout the building. According to Environment Canada, fluorescent light tubes contain between 3 to 50 milligrams of mercury and High Intensity Discharge (HID) lamps and contain 25 to 225 milligrams depending on wattage of the lamp. No lighting systems were inspected during the Site visit as it was not within the scope of the Project.

Several mercury containing thermostats were observed during the site visit. Those observed within the Project Area are not marked on the sample location plan as these are easily identifiable. It is understood that any pneumatic switches within the project limits will be removed.

3.5 Silica

Silica is the second most common mineral in the earth's crust and is commonly found in sand, rock and mineral ores. Silica becomes a concern in situations where it can be inhaled. Crystalline silica is of most concern from the various forms of silica, and known to be a primary component of many construction products such as (but not limited to) masonry block, brick, mortar and concrete. The following building materials known to contain silica were observed during the site inspection:

- Concrete building materials.

If silica-containing building materials are to be disturbed during renovations, the Ministry of Labour, Occupational Health and Safety Branch's: "*Guideline – Silica on Construction Projects*" (April 2011) should be consulted for further information.

3.6 Other Designated Substances

There was no evidence of acrylonitrile, arsenic, coke oven emissions, ethylene oxide, isocyanates, or vinyl chloride observed during the Site visit.

3.7 Hazardous Materials

3.7.1 Polychlorinated Biphenyls (PCBs)

According to Environment Canada, PCBs were used in the manufacturing of electrical equipment, heat exchangers, hydraulic systems, and several other specialized applications up to the late 1970's. For example, light ballasts used in fluorescent and high intensity discharge lighting were known to contain various amounts of PCBs for cooling purposes prior to approximately 1980.

Fluorescent lights were observed throughout the building during the site visit. No ballasts were inspected during the Site visit as it was not within the scope of the Project.

3.7.2 Ozone Depleting Substances (ODSs)

Certain chemicals such as chlorofluorocarbons, hydrochlorofluorocarbons and halons are known as Ozone Depleting Substances (ODSs) and are regulated under O.Reg 463/10 "Ozone Depleting Substances and Other Halocarbons". Most ODSs are used as refrigerants in air conditioners, refrigerators, aerosol spray propellants and foam blowing agents. O.Reg. 463/10 requires owners to act to prevent leaks of ODSs to the natural environment and to ensure that only persons certified under Section 34 of 463/10 shall service, dispose or test refrigeration equipment.
The following equipment listed for removal contain the refrigerants R-22 (hydrochlorofluorocarbon) or R-410A which will require proper disposal:

- West Addition Rooftop Air Handling Units (RTU-1 and RTU-2): Refrigerant R-22
- East Addition Rooftop Air Handling Unit (AHU-3): Refrigerant R-410A
- Split Air Conditioning System (CU-1, 2 & 3 and AC-1, 2, 3, 4, 5 &6): Refrigerant R-22

3.7.3 Mould

Mould spores may become airborne and long-term exposure could lead to adverse health effects. The most common cause of mould in building materials (i.e. drywall, wood, etc.) is when they have become exposed to water from leaks (i.e. roof) or flooding.

No mould was observed during the site visit. Although a distinct musty scent was noted during the inspection of the crawlspace.

A full mould assessment (including intrusive sampling and testing) and/or an indoor air quality testing was not requested and is outside the scope of this Survey. If a future mould assessment indicates the potential exposure of to mould throughout the demolition process, proper engineering controls and work practises should be followed for protection of human health. Please refer to the Mould Guidelines for the Construction Industry (Canadian Construction Agency, 2004).

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3.7.4 Bird Droppings

Disturbance of any bird droppings present may cause the release of “spore” particles into the air causing serious infections called *Histoplasmosis* or *Cryptococcosis*.

At the time of the Site survey no bird droppings or nests were noted.

In the event bird droppings are observed prior to demolition activities, proper personal protection equipment should be utilized for the protection of any person exposed during the demolition process. For direction on the approach for handling bird droppings please refer to the Infrastructure Health and Safety Association (IHSA), Safety Talks – Working around Bird and Bat Droppings (www.isha.ca).

3.7.5 Other Potential Hazardous Materials

No other potential hazardous materials were observed during the site visit.

Is should be noted that urea foam formaldehyde insulation was not investigated as a part of this Project Specific DSS.

4 CONCLUSIONS AND RECOMMENDATIONS

4.1 Conclusions

Designated and Hazardous substances were observed as follows:

Table 4. DSS Summary

Designated Substances	Presence	Location
Asbestos	**Present**	• Mortar in between cinder blocks in the basement interior walls (assume all interior cinder block wall mortar in building is ACM); • Older style pipe-elbow insulation in the basement boiler room (0001B) and throughout the crawlspace (newer insulation is visually different than the older pipe-elbow insulation and an example is visible in the boiler room); • Several ACMs were identified in a previous report (See Table 1, Section 2.5) o Pipe-elbow insulation (*previously identified*), o pipe-straights insulation (*previously identified*); o acoustic spray (*previously identified*); o wall plaster (*previously identified*); o ceiling plaster (*previously identified*); o ceiling texture coating (*previously identified*); o floor vinyl asbestos tile (VAT) in Room 1019, 1022 (*previously identified*)); o *Other areas of building outside current project scope and previously indicated by Lakehead University documents*

Acrylonitrile	Not Observed	
Arsenic	Not Observed	
Benzene	Potentially Present	• Fuels used in Boilers in Room 0001
Coke Oven Emissions	Not Observed	
Ethylene Oxide	Not Observed	
Isocyanates	Not Observed	
Mercury	**Present**	• Thermostats (wall mounted)
Silica	**Present**	• Concrete Block
Vinyl Chloride	Not Observed	
Lead	**Present**	• Cream paint on registers in Room 1001/1001A • Green paint on basement door – Room 000B • White paint on First Floor walls (Room 1012C and similar) • Grey paint near door in Room 1022 • Brown paint on walls in Room 1021 • Light green paint in Room 2029A and similar • Orange wall paint in Room 2026A • Blue paint on registers, Room X1001 (*previously identified*) • Pink paint on plaster, Room 1016 (*previously identified*) • Green paint in Room 1019 (*previously identified*) • Blue paint (LU Blue) in Room 2031 (*previously identified*) • Dark green paint in Room 2029 (*previously identified*)

Hazardous Substances		
Polychlorinated Biphenyls (PCBs)	Not Observed	
Ozone-Depleting Substances (ODSs)	**Present**	• West Addition Rooftop Air Handling Units (RTU-1 and RTU-2): Refrigerant R-22 • East Addition Rooftop Air Handling Unit (AHU-3): Refrigerant R-410A • Split Air Conditioning System (CU-1, 2 & 3 and AC-1, 2, 3, 4, 5 &6): Refrigerant R-22
Mould	Potentially Present	• Musty odor noted throughout crawlspace
Bird and Rodent Droppings (fungal diseases and viruses)	Not Observed	
Urea Formaldehyde Foam Insulation	Not Observed	

The findings of the DSS indicated the presence of asbestos, mercury, lead, ozone depleting substances, and silica containing materials, and the potential presence of benzene and mould for the Project.

If additional suspect materials are encountered during demolition, work is to **STOP** and the suspect materials left undisturbed until testing can confirm the presence or absence of asbestos or other designated/hazardous materials. In the event that such suspect materials are inadvertently disturbed, work must **STOP** and proper exposure control measures must be implemented and maintained until confirmation testing can be conducted.

4.2 Recommendations

Observations during the Site survey confirmed the presence of designated substances and/or hazardous materials asbestos, lead and silica containing materials, and the potential presence of mercury and mould, that workers will or potentially be exposed to

during the demolition/renovation of the building. Based on a review of available record information, the Site survey and analytical results, the following recommendations are presented by TBTE:

Asbestos

Asbestos is present in the interior walls cinder block mortar, along pipes and pipe-elbow insultation throughout the building. Some pipe asbestos has been removed and replaced with newer insulation in the basement boiler room and are easily differentiated visually. Most of the original ACM pipe insultation in the basement and crawlspace remains. The cinder block mortar was only accessible in the basement, but this mortar should be assumed ACM everywhere on the interior walls if encountered. Analytical testing of other materials did not identify any other ACMs within the Project Area.

Lakehead University records indicate the further presence of ACMs in pipe-elbow insulation, pipe-straights insulation, acoustic spray, wall plaster, ceiling plaster, ceiling texture coating, and floor vinyl asbestos tile (VAT) in various rooms and highlighted on the Sample Location Plans in Appendix A - Enclosure 1.

TBTE recommends that abatement of ACMs be completed prior to any demolition work is to commence. The abatement work must be done in accordance with the procedures as indicated in O. Reg. 278/05 and the Ontario Ministry of Labour's – *A Guide to the Regulation Respecting Asbestos on Construction Projects and in Buildings and Repair Operations* (May 2011).

All asbestos-containing and suspect materials should be disposed of in accordance to O. Reg. 347 General - Waste Management; Section 17 - Management of Asbestos Waste and local city by-laws. Disposal methods should be planned and arrangements with the applicable licensed waste facility should be made prior to abatement execution.

Lead

The analytical results confirm the presence of exceeding levels of lead in seven (7) paint samples at various locations observed within the Project Area (Please refer to Section 3.2 –Lead and Table 2 above). Note that it is assumed that these paints are located at

other locations throughout the Project Area, as outlined in Appendix A – Enclosure 1. Additional paints were identified as lead-containing in a report provided by the client. These areas are outlined in Table 3 and Enclosure 1 as well.

TBTE recommends that engineering controls and safe work practices are in place during the demolition process as disturbance to lead based materials may result in exposure to lead dust or fumes. The work should be done in accordance with the procedures as indicated in O. Reg. 490/09 and the Ontario Ministry of Labour's (Occupational Health and Safety Branch) – *Guideline of Lead on Construction Projects* (April 2011).
Lead containing materials may be hazardous and should be disposed of in accordance to O. Reg. 347 (amended 2014) General - Waste Management. Disposal methods should be planned and arrangements with the applicable licensed waste facility should be made prior to abatement execution. Testing for leachable lead may be required prior to disposal.

Silica

Any work that results in the disturbance of the above materials noted in Section 3.5 may result in exposure to workers of silica dust and should be performed in accordance with Revised Regulations of Ontario (R.R.O) 1990, Reg. 845 and the Ministry of Labour Guideline: Silica on Construction Projects. Engineering controls may be most important to protect the health of the workers and general public.

Please note that if working or disturbing any cinder block bricks, the mortar was confirmed to be ACM as noted above in Section 3.1 – Table 2.

Mercury

Thermostats that may contain mercury were observed in the building during the site inspection. The specific location of thermostats was not noted on the Sample Location Plan but are easily identifiable.

Ozone Depleting Substances (ODSs)

If removal of any refrigeration units present onsite that potentially contain ODSs it should be completed in compliance to O. Reg. 463/10, and local City by-laws.

Construction Waste

TBTE recommends that a resource management plan (i.e. waste audit, waste management, recycling program) be implemented in the renovation project to help reduce the amount of waste under both O. Reg. 102/94 and O. Reg. 103/94. Handling and disposal of demolition waste should be done in accordance to the Environmental Protection Act, O. Reg. 347 guidelines, and local City by-laws.

Control measures should be in place so to minimize human exposure to demolition dust of concrete materials removal.

5 LIMITATIONS

This report was prepared for the exclusive use of Lakehead University and intended to provide an assessment of the presence and condition of designated substances and other hazardous materials discussed in this report and as observed at the time of the Site survey. No third party is entitled to rely upon this report without the knowledge and consent of TBT Engineering Limited (TBTE). Any such consensual reliance upon this report would be subject to the same contractual, technological and other limitations that governed the assessment and report.

The report is based on information collected and reviewed during the Project Specific Designated Substance Survey (DSS) conducted by TBTE as discussed above at limited areas of Bora Laskin Building in Thunder Bay, ON. The conclusions of this report are based solely on the site conditions observed at the time of the Site investigation supplemented by historical information and data from the sources described in this report. No assurance is made regarding changes in condition subsequent to the time of the investigation.

In evaluating the property, TBTE has relied in good faith upon information provided by others; specifically including but not limited to the contents of the owner provided “BL DSS Jan 31 2018”. TBTE accepts no responsibility for any deficiency, misstatement or inaccuracy contained in this report as a result of omission, misinterpretation or fraudulent act of the persons interviewed. The result of an investigation of this kind should in no way be constructed as a warranty or guarantee with respect to the data, observations, finding or conclusions reported as they are sole based on the conditions at the time of the Site survey. TBTE accepts no responsibility for the consequential effects of this factual report, the real or perceived property value of this site, on its saleability, or on the ability to gain financing or insurance. Where references have been made to regulatory statutes, codes, guidelines and the like, note that these regulations are subject to interpretation and the regulations and their interpretations can change over time.

If new information is discovered during future work or other studies, TBTE should be retained to re-evaluate the conclusions presented in this report and to provide

amendments as required. This Designated Substance report is not intended to define the scope of work and/or for a specification section in remedial or construction Tender documentation.

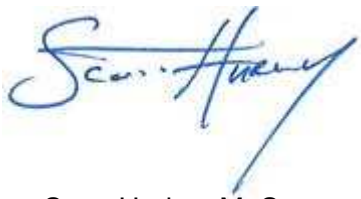
6 CLOSURE

Should there be any questions or concerns regarding the information presented in this report, please do not hesitate to contact us at your convenience.

For TBT Engineering Limited

Prepared by:

Sarah Croft, B. Sc.
Environmental Technician



Scott Hurley, M. Sc.
Environmental Scientist

Reviewed by:

Diarmid J. MacKintosh, P.Eng.
Assistant Manager – Environmental Services

APPENDIX A

Maps, Figures and Photographs

MAIN FLOOR PLAN

LEGEND

- ● 1XX ASBESTOS SAMPLE
- ■ 2XX LEAD PAINT SAMPLE
- ● 1XX **ASBESTOS SAMPLE (>0.5%)**
- ■ 2XX **LEAD PAINT SAMPLE (>90mg/kg Lead)**
- **ASBESTOS CONTAINING MATERIAL (>0.5%)**
- **LEAD PAINT (>90mg/Kg)**
- PREVIOUSLY IDENTIFIED DESIGNATED SUBSTANCE

DWG. TITLE: First Floor Sample Location Plan	TBT ENGINEERING CONSULTING GROUP	APPROVED BY: SH	DRAWN BY: SC	PROJECT NO.: 18-038
PROJECT: Project Specific Designated Substance Survey Bora Laksin Building Thunder Bay, Ontario	CLIENT: Lakehead University	DATE: Mar 2018		
		SCALE: NTS	ENCLOSURE: 1	

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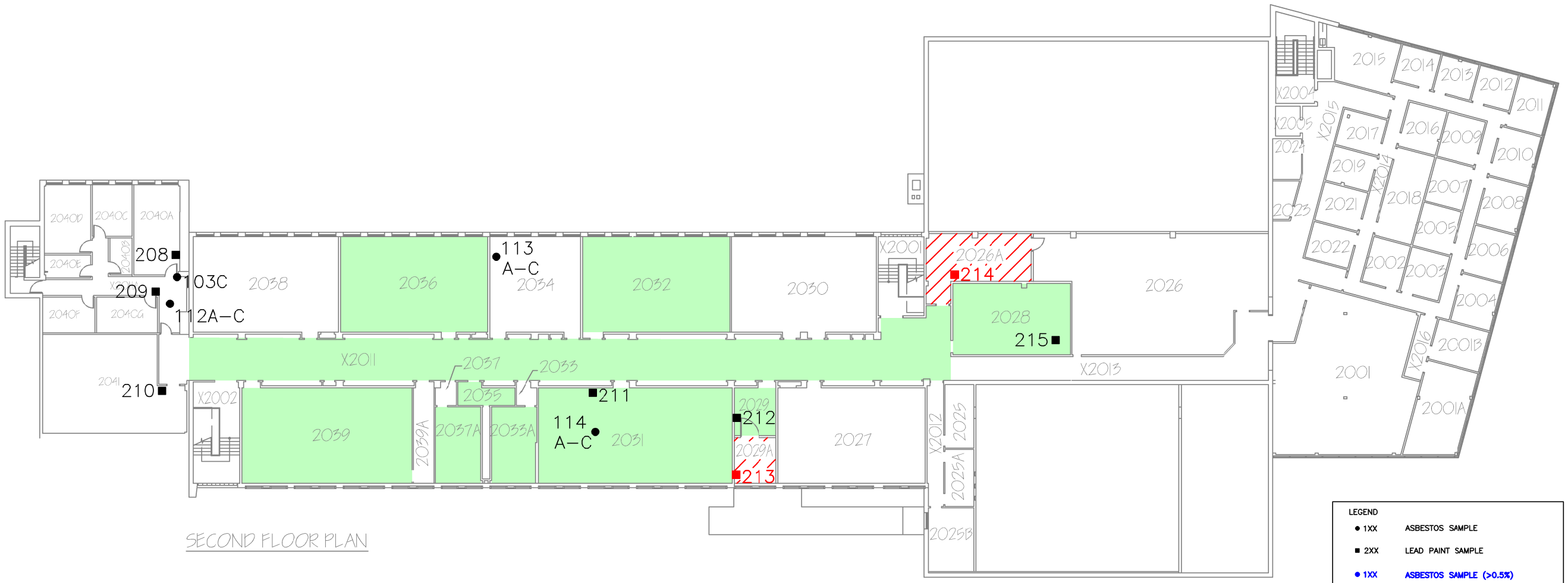

DWG. TITLE: Second Floor Sample LocationPlan

PROJECT: Project Specific Designated Substance Survey
Bora Laskin Building
Thunder Bay, Ontario

TBT ENGINEERING CONSULTING GROUP

CLIENT: Lakehead University

APPROVED BY:	DRAWN BY:	PROJECT NO.
SH	SC	18-038

DATE: Mar 2018

SCALE:	ENCLOSURE
NTS	1

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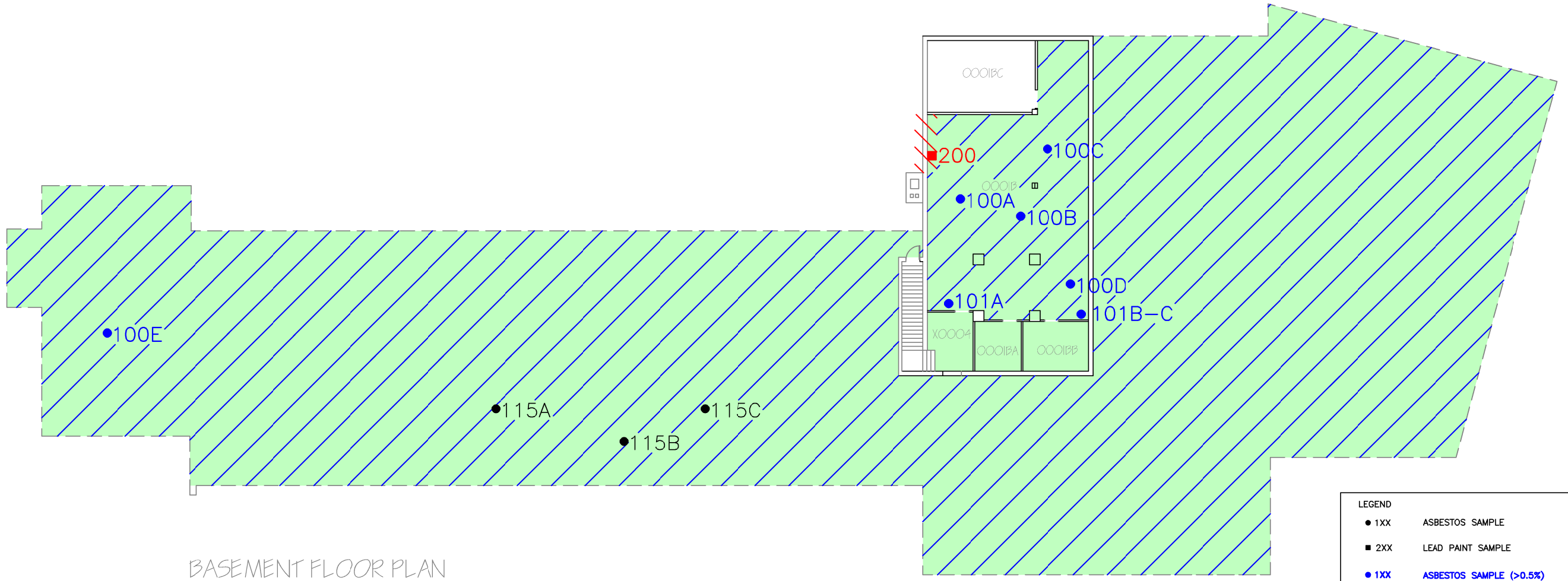

BASEMENT FLOOR PLAN

LEGEND

● 1XX	ASBESTOS SAMPLE
■ 2XX	LEAD PAINT SAMPLE
● 1XX	ASBESTOS SAMPLE (>0.5%)
■ 2XX	LEAD PAINT SAMPLE (>90mg/kg Lead)
	ASBESTOS CONTAINING MATERIAL (>0.5%)
	LEAD PAINT (>90mg/Kg)
	PREVIOUSLY IDENTIFIED DESIGNATED SUBSTANCE

DWG. TITLE: Basement & Crawlspace Sample Location Plan

PROJECT: Project Specific Designated Substance Survey
Bora Laskin Building
Thunder Bay, Ontario

TBT ENGINEERING CONSULTING GROUP

CLIENT: Lakehead University

APPROVED BY.	DRAWN BY:	PROJECT NO.
SH	SC	18-038

DATE: Mar 2018

SCALE: NTS

ENCLOSURE 1

File Path: Y:\Projects\2018\18-038 LU Bora Laskin Building HVAC Upgrades\DSS\TBT AutoCAD\ File Name: BUILDING.dwg

Photo 1 (February 6, 2018) – View of exhaust insultation from the boiler in Boiler Room 0001B
(Sample 100A: 50% - 75% Asbestos Containing Material)

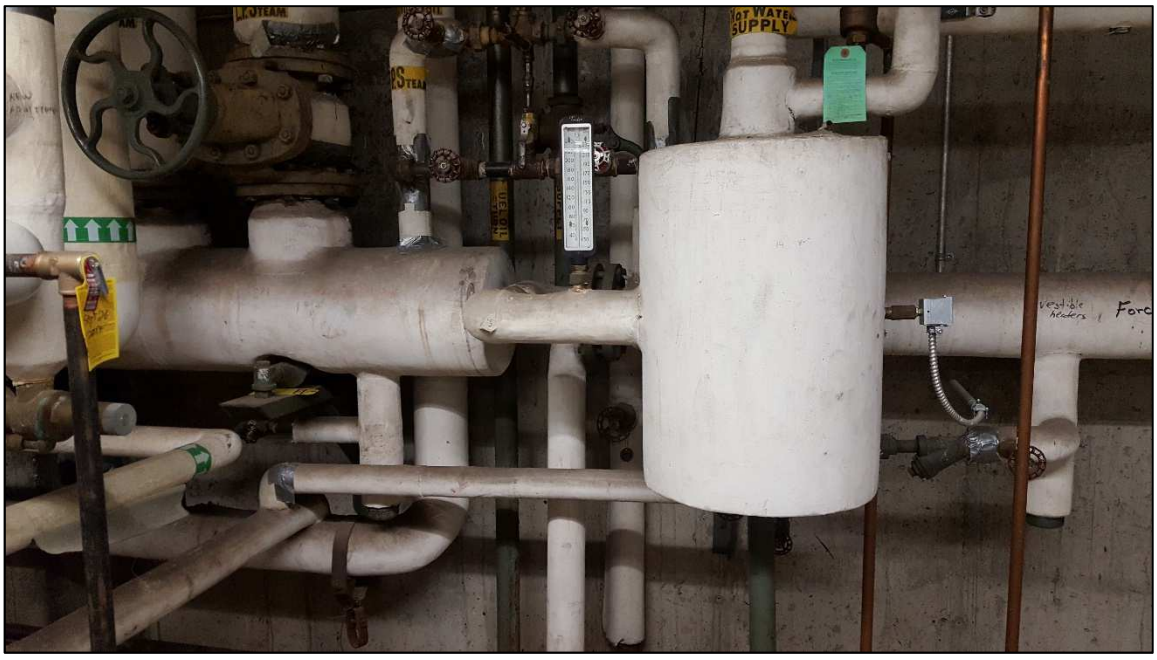

Photo 2 (January 3, 2018) – View of pipe-elbow insulation in Boiler Room 0001B
(Sample 100D: Assumed 50% - 75% Asbestos Containing Material)

Photo 3 (January 3, 2018) – View of pipe-elbow insulation in crawlspace of east addition
(Sample 100E: 50% - 75% Asbestos Containing Material)

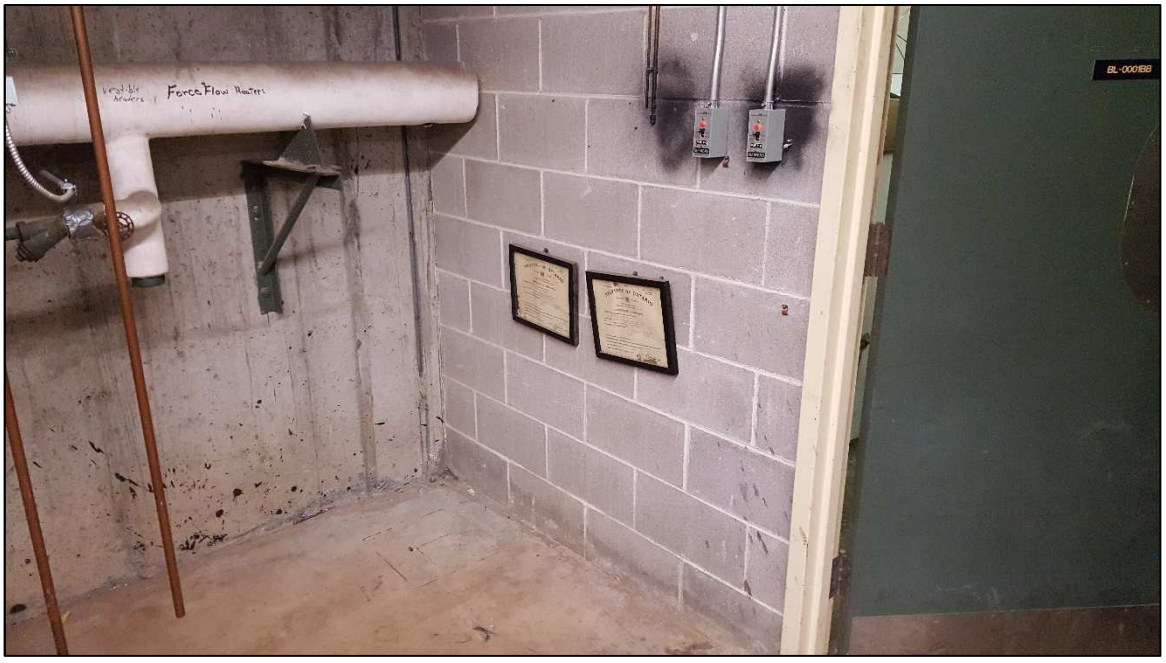

Photo 4 (February 6, 2018) – View of mortar in between cinder blocks in Boiler Room 0001B
(Sample 101C: 0.5% - 5% Asbestos Containing Material)

Photo 5 (February 6, 2018) – View of green paint on exterior wooden door in Boiler Room 0001B
(Sample 200 (Green): 5,360 mg/kg lead paint)

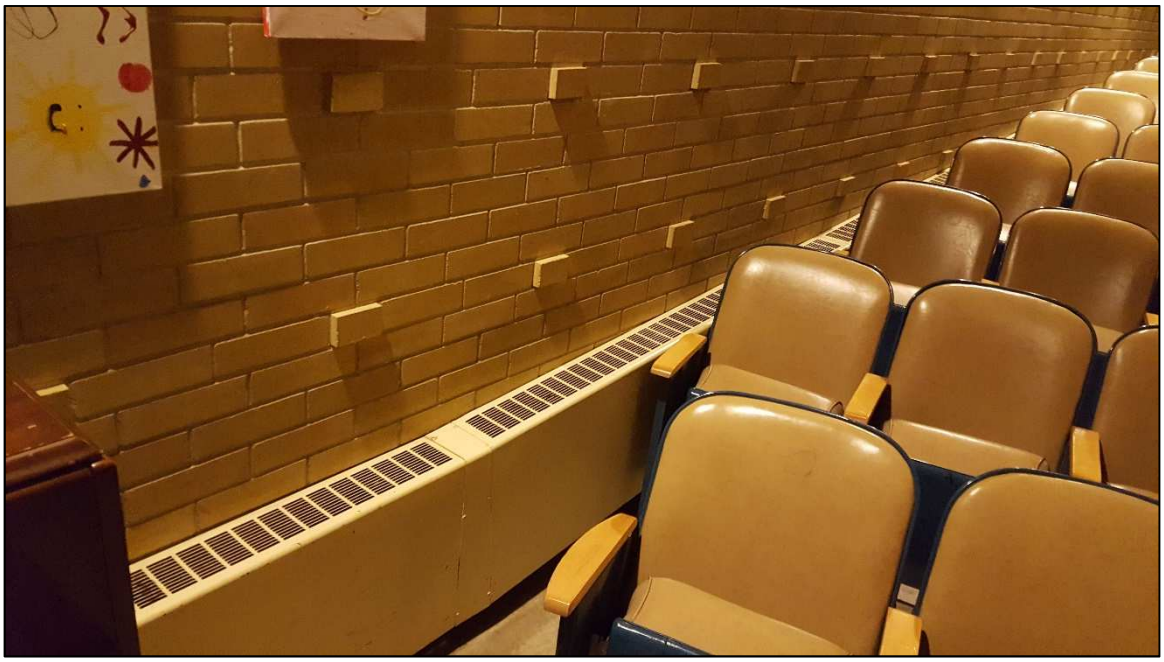

Photo 6 (February 6, 2018) – View of cream paint on heat registers in Auditorium Room 1001
(Sample 202 [Cream]: 4,600 mg/kg lead paint)

Photo 7 (February 6, 2018) – View white wall paint in Room 1012C
(Sample 203 [White]: 2,080 mg/kg lead paint)

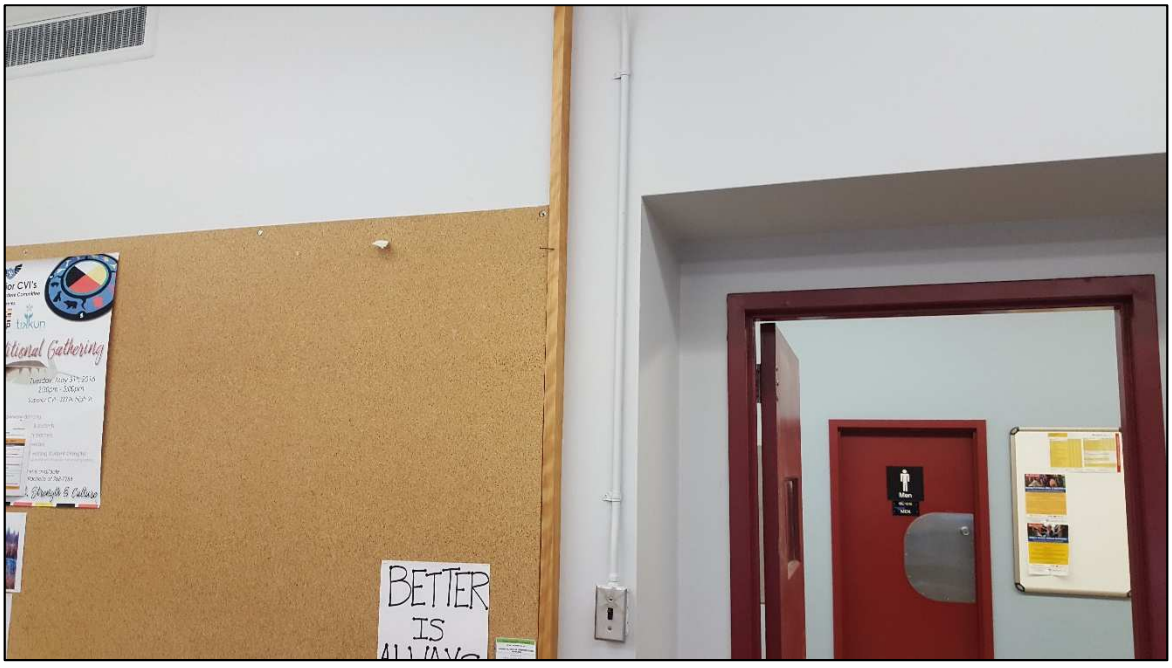

Photo 8 (February 6, 2018) – View of grey paint by door in Room 1022
(Sample 205 [Grey]: 298 mg/kg lead paint)

Photo 9 (February 6, 2018) – View of main colour brown paint in Room 1021
(Sample 207 [Brown]: 389 mg/kg lead paint)

Photo 10 (February 6, 2018) – View of light green wall paint in Room 2029A
(Sample 213 [Light Green]: 1,490 mg/kg lead paint)

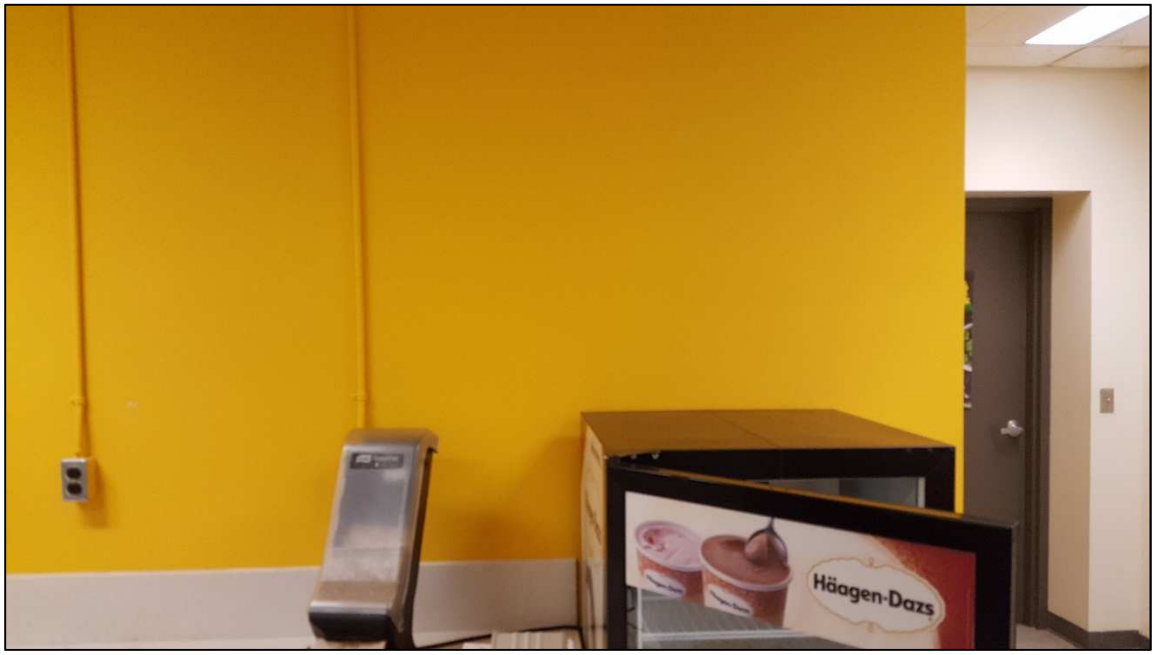

Photo 11 (February 6, 2018) – View of orange wall paint in Room 2026A
(Sample 214 [Orange]: 284 mg/kg lead paint)

APPENDIX B

Analytical Data

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

CLIENT NAME: TBT ENGINEERING LTD.
1918 YOUNGE STREET
THUNDER BAY, ON P7E6T9
(807) 624-5160

ATTENTION TO: Scott Hurley

PROJECT: 18-038

AGAT WORK ORDER: 18T310572

ASBESTOS REVIEWED BY: Whenhong Zou, Lab Analyst

OCCUPATIONAL HYGIENE REVIEWED BY: Yris Verastegui, Report Reviewer

DATE REPORTED: Feb 20, 2018

PAGES (INCLUDING COVER): 10

VERSION*: 1

Should you require any information regarding this analysis please contact your client services representative at (905) 712-5100

NOTES

All samples will be disposed of within 30 days following analysis. Please contact the lab if you require additional sample storage time.

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 18T310572

PROJECT: 18-038

CLIENT NAME: TBT ENGINEERING LTD.

ATTENTION TO: Scott Hurley

SAMPLING SITE:

SAMPLED BY:

Bulk Asbestos

DATE RECEIVED: 2018-02-09 **DATE REPORTED: 2018-02-20**

		SAMPLE DESCRIPTION:		100-A	100-E	100-C	101-A	101-B	101-C	102-A	102-B
		SAMPLE TYPE:		Asbestos	Asbestos	Asbestos	Asbestos	Asbestos	Asbestos	Asbestos	Asbestos
		DATE SAMPLED:		2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06
Parameter	Unit	G / S	RDL	9062335	9062339	9062340	9062342	9062344	9062346	9062347	9062348
Asbestos (Bulk)	%	0.5	0.5	50-75	SP	SP	ND	0.5-5	SP	ND	ND

		SAMPLE DESCRIPTION:		102-C	103-A	103-B	103-C	107-A	107-B	107-C	108-A
		SAMPLE TYPE:		Asbestos	Asbestos	Asbestos	Asbestos	Asbestos	Asbestos	Asbestos	Asbestos
		DATE SAMPLED:		2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06
Parameter	Unit	G / S	RDL	9062350	9062351	9062355	9062356	9062413	9062416	9062418	9062459
Asbestos (Bulk)	%	0.5	0.5	ND	ND	ND	ND	ND	ND	ND	ND

		SAMPLE DESCRIPTION:		108-B	108-C	114-A	114-B	114-C	115-A	115-B	115-C
		SAMPLE TYPE:		Asbestos	Asbestos	Asbestos	Asbestos	Asbestos	Asbestos	Asbestos	Asbestos
		DATE SAMPLED:		2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06
Parameter	Unit	G / S	RDL	9062461	9062462	9062507	9062509	9062511	9062512	9062514	9062516
Asbestos (Bulk)	%	0.5	0.5	ND	ND	ND	ND	ND	ND	ND	ND

Certified By: Wenhong Zou

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 18T310572

PROJECT: 18-038

CLIENT NAME: TBT ENGINEERING LTD.

ATTENTION TO: Scott Hurley

SAMPLING SITE:

SAMPLED BY:

Bulk Asbestos

DATE RECEIVED: 2018-02-09 **DATE REPORTED: 2018-02-20**

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ON OHSA - Reg. 278
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9062335 Condition of sample was satisfactory at time of arrival in laboratory. Analysis done at AGAT 5623 McAdam Road Mississauga location.

Asbestos Present: Chrysotile

9062339-9062340 Condition of sample was satisfactory at time of arrival in laboratory. Analysis done at AGAT 5623 McAdam Road Mississauga location.

"SP": Stop Positive

9062342 Condition of sample was satisfactory at time of arrival in laboratory. Analysis done at AGAT 5623 McAdam Road Mississauga location.

"ND" - Not Detected

9062344 Condition of sample was satisfactory at time of arrival in laboratory. Analysis done at AGAT 5623 McAdam Road Mississauga location.

Asbestos Present: Chrysotile

9062346 Condition of sample was satisfactory at time of arrival in laboratory. Analysis done at AGAT 5623 McAdam Road Mississauga location.

"SP": Stop Positive

9062347-9062516 Condition of sample was satisfactory at time of arrival in laboratory. Analysis done at AGAT 5623 McAdam Road Mississauga location.

"ND" - Not Detected

Certified By: Wenhong Zou

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 18T310572

PROJECT: 18-038

CLIENT NAME: TBT ENGINEERING LTD.

ATTENTION TO: Scott Hurley

SAMPLING SITE:

SAMPLED BY:

Bulk Asbestos

DATE RECEIVED: 2018-02-09 **DATE REPORTED: 2018-02-20**

		SAMPLE DESCRIPTION:		104-A	104-B	104-C	106-A	106-B	106-C	112-A	112-B
		SAMPLE TYPE:		Asbestos	Asbestos	Asbestos	Asbestos	Asbestos	Asbestos	Asbestos	Asbestos
		DATE SAMPLED:		2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06
Parameter	Unit	G / S	RDL	9062358	9062367	9062369	9062372	9062374	9062412	9062463	9062466
Asbestos (Bulk) Phase 1	%	0.5	0.5	ND	ND	ND	ND	ND	ND	ND	ND
Asbestos (Bulk) Phase 2	%	0.5	0.5	ND	ND	ND	ND	ND	ND	ND	ND

		SAMPLE DESCRIPTION:		112-C	113-A	113-B	113-C
		SAMPLE TYPE:		Asbestos	Asbestos	Asbestos	Asbestos
		DATE SAMPLED:		2018-02-06	2018-02-06	2018-02-06	2018-02-06
Parameter	Unit	G / S	RDL	9062467	9062468	9062505	9062506
Asbestos (Bulk) Phase 1	%	0.5	0.5	ND	ND	ND	ND
Asbestos (Bulk) Phase 2	%	0.5	0.5	ND	ND	ND	ND

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard: Refers to ON OHSA - Reg. 278
Guideline values are for general reference only. The guidelines provided may or may not be relevant for the intended use. Refer directly to the applicable standard for regulatory interpretation.

9062358-9062506 Condition of sample was satisfactory at time of arrival in laboratory. Analysis done at AGAT 5623 McAdam Road Mississauga location.

"ND" - Not Detected

Phase1: VFT Phase2: Mastic

Certified By: Wenhong Zou

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Certificate of Analysis

AGAT WORK ORDER: 18T310572

PROJECT: 18-038

CLIENT NAME: TBT ENGINEERING LTD.

ATTENTION TO: Scott Hurley

SAMPLING SITE:

SAMPLED BY:

Lead, Arsenic and Mercury in Paint by ICP-OES - µg/g

DATE RECEIVED: 2018-02-09

DATE REPORTED: 2018-02-20

		SAMPLE DESCRIPTION:		200 Green	202 Cream	203 White	205 Grey	207 Brown	208 Purple	209 Peach	210 Green
		SAMPLE TYPE:		Paint	Paint	Paint	Paint	Paint	Paint	Paint	Paint
		DATE SAMPLED:		2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06	2018-02-06
Parameter	Unit	G / S	RDL	9062518	9062521	9062522	9062523	9062524	9062525	9062527	9062528
Lead	µg/g		10	5360	4600	2080	298	389	<10	<10	<10

		SAMPLE DESCRIPTION:		213 Lt Green	214 Orange	215 Red
		SAMPLE TYPE:		Paint	Paint	Paint
		DATE SAMPLED:		2018-02-06	2018-02-06	2018-02-06
Parameter	Unit	G / S	RDL	9062530	9062531	9062533
Lead	µg/g		10	1490	284	57

Comments: RDL - Reported Detection Limit; G / S - Guideline / Standard

Certified By: Iris Verástegui

AGAT Laboratories
5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Quality Assurance

CLIENT NAME: TBT ENGINEERING LTD.

AGAT WORK ORDER: 18T310572

PROJECT: 18-038

ATTENTION TO: Scott Hurley

SAMPLING SITE:

SAMPLED BY:

Occupational Hygiene Analysis

RPT Date: Feb 20, 2018			DUPLICATE				REFERENCE MATERIAL			METHOD BLANK SPIKE			MATRIX SPIKE		
PARAMETER	Batch	Sample Id	Dup #1	Dup #2	RPD	Method Blank	Measured Value	Acceptable Limits		Recovery	Acceptable Limits		Recovery	Acceptable Limits	
								Lower	Upper		Lower	Upper		Lower	Upper
Lead, Arsenic and Mercury in Paint by ICP-OES - µg/g															
Lead	9062523	9062523	298	273	8.9%	< 10	106%	80%	120%	98%	80%	120%	97%	70%	130%

Certified By:

AGAT Laboratories

5835 COOPERS AVENUE
MISSISSAUGA, ONTARIO
CANADA L4Z 1Y2
TEL (905)712-5100
FAX (905)712-5122
http://www.agatlabs.com

Method Summary

CLIENT NAME: TBT ENGINEERING LTD.

AGAT WORK ORDER: 18T310572

PROJECT: 18-038

ATTENTION TO: Scott Hurley

SAMPLING SITE:

SAMPLED BY:

PARAMETER	AGAT S.O.P	LITERATURE REFERENCE	ANALYTICAL TECHNIQUE
Asbestos (Bulk)	INORG 93-6010	EPA 600/R-93/116 & NIOSH 9002	PLM
Asbestos (Bulk) Phase 1	INORG 93-6010	EPA 600/R-93/116 & NIOSH 9002	PLM
Asbestos (Bulk) Phase 2	INORG 93-6010	EPA 600/R-93/116 & NIOSH 9002	PLM
Occupational Hygiene Analysis			
Lead	MET-93-6106	EPA SW 846 3050B & 6010C	ICP/OES

AGAT Laboratories
5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Laboratory Use Only

Work Order #:

Cooler Quantity:

Arrival Temperatures:

Custody Seal Intact: ☐Yes ☐No ☐N/A

Notes:

Report Information:

Company: TBT Engineering
Contact: Scott Hurley
Address: 1918 Yonge Street
Thunder Bay, ON P7E 6T9
Phone: 807-620-5160 Fax: 807-620-5161
Reports to be sent to:
1. Email: Shurley@tbte.ca
2. Email: Scroft@tbte.ca

Regulatory Requirements:

☐ No Regulatory Requirement

(Please check all applicable boxes)

☐ Regulation 153/04
Table _____ *Indicate One*
☐ Ind/Com
☐ Res/Park
☐ Agriculture
Soil Texture *(Check One)*
☐ Coarse
☐ Fine

☐ Sewer Use
☐ Sanitary
☐ Storm
Region _____ *Indicate One*
☐ MISA

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☑ Other
O.Reg 490
O.Reg 278
Indicate One

Turnaround Time (TAT) Required:

Regular TAT ☑ 5 to 7 Business Days

Rush TAT (Rush Surcharges Apply)

☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day

OR Date Required (Rush Surcharges May Apply):

Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*

For 'Same Day' analysis, please contact your AGAT CPM

Project Information:

Project: 18-038
Site Location: Bora Laskin
Sampled By: SC + LF
AGAT Quote #: TBTE PO: 2040
Please note: If quotation number is not provided, client will be billed full price for analysis.

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Invoice Information:

Bill To Same: Yes ☑ No ☐

Company:
Contact:
Address:
Email:

Sample Matrix Legend

B	Biota
GW	Ground Water
O	Oil
P	Paint
S	Soil
SD	Sediment
SW	Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Field Filtered - Metals, Hg, CrVI Y/N	O. Reg 153: Metals and Inorganics (☐All Metals ☐153 Metals (excl. Hydrides) ☐Hydride Metals ☐153 Metals (Incl. Hydrides))	O. Reg 153: ORPs: ☐B-HWS ☐Cl⁻ ☐CN ☐Cr⁶⁺ ☐EC ☐FOC ☐Hg ☐pH ☐SAR	O. Reg 153: Full Metals Scan	O. Reg 153: Regulation/Custom Metals	O. Reg 153: Nutrients: ☐TP ☐NH_3 ☐TKN ☐NO_3 ☐NO_2 ☐NO_3+NO_2	O. Reg 153: Volatiles: ☐VOC ☐BTEX ☐THM	O. Reg 153: PHCs F1 - F4	O. Reg 153: ABNs	O. Reg 153: PAHs	O. Reg 153: PCBs: ☐Total ☐Aroclors	O. Reg 153: Organochlorine Pesticides	O. Reg 153: TCLP: ☐M&I ☐VOCs ☐ABNs ☐B(a)P ☐PCBs	O. Reg 153: Sewer Use	Bulk Asbestos (Please I.D. type of Asbestos)
100A,E,C	Feb 6		3		Stop Positive														✓
101 A-C			3																✓
102 A-C			3																✓
103 A-C			3																✓
104 A-C (Tile + Mastic)			3																✓
106 A-C (Tile + Mastic)			3																✓
107 A-C			3																✓
108 A-C			3																✓
112 A-C (Tile + Mastic)			3																✓
113 A-C (Tile + Mastic)			3																✓
114 A-C			3																✓

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Sarah Croft SCroft	Feb 9/18	2pm	Simon	18/2/12	8 35

Page 1 of 3

N°:

AGAT Laboratories
5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Laboratory Use Only
Work Order #: _____
Cooler Quantity: _____
Arrival Temperatures: _____ _____ _____ _____
Custody Seal Intact: ☐Yes ☐No ☐N/A
Notes: _____

Report Information:
Company: TBT Engineering
Contact: Scott Hurley
Address: 1918 Yonge Street, Thunder Bay, ON P7E 6T9
Phone: 807-620-5160 Fax: 807-620-5161
Reports to be sent to:
1. Email: shurley@tbte.ca
2. Email: scroft@tbte.ca

Regulatory Requirements: ☐ No Regulatory Requirement
(Please check all applicable boxes)
☐ Regulation 153/04 — Table (Indicate One): ☐Ind/Com ☐Res/Park ☐Agriculture; Soil Texture (Check One): ☐Coarse ☐Fine
☐ Sewer Use — ☐Sanitary ☐Storm; Region (Indicate One): ☐MISA
☐ Regulation 558 ☐ CCME ☐ Prov. Water Quality Objectives (PWQO) ☑ Other: O.Reg 490, O.Reg 278 (Indicate One)

Turnaround Time (TAT) Required:
Regular TAT ☑ 5 to 7 Business Days
Rush TAT (Rush Surcharges Apply)
☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day
OR Date Required (Rush Surcharges May Apply): _____
Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*
For 'Same Day' analysis, please contact your AGAT CPM

Project Information:
Project: 18-038
Site Location: Bora Laskin
Sampled By: SC + LF
AGAT Quote #: TBTE PO: 2040
Please note: If quotation number is not provided, client will be billed full price for analysis.

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Invoice Information: Bill To Same: Yes ☑ No ☐
Company: _____
Contact: _____
Address: _____
Email: _____

Sample Matrix Legend
B Biota
GW Ground Water
O Oil
P Paint
S Soil
SD Sediment
SW Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Y/N	Field Filtered - Metals, Hg, CrVI	O. Reg 153: Metals and Inorganics (☐ All Metals ☐ 153 Metals (excl. Hydrides) ☐ Hydride Metals ☐ 153 Metals (Incl. Hydrides))	ORPs: ☐B-HWS ☐Cr ☐CN⁻ ☐Cr⁶⁺ ☐EC ☐FOC ☐Hg ☐pH ☐SAR	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐TP ☐NH₃ ☐TKN ☐NO₂ ☐NO₃ ☐NO₃+NO₂	Volatiles: ☐VOC ☐BTEX ☐THM	PHCs F1 - F4	ABNs	PAHs	PCBs: ☐Total ☐Aroclors	Organochlorine Pesticides	TCLP: ☐M&I ☐VOCs ☐ABNs ☐B(a)P ☐PCBs	Sewer Use	Bulk Asbestos (Please I.D. type)	Lead in Paint
115 A-C	Feb 6		3		Stop Positive																	/	/
200 (Green)	↓		1																				/
202 (Cream)			1																				/
203 (White)			1																				/
205 (Grey)			1																				/
207 (Brown)			1																				/
208 (Purple)			1																				/
209 (Peach)			1																				/
210 (Green)			1																				/
213 (Light Green)			1																				/
214 (Orange)			1																				/

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
SCroft					
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time

Page 2 of 3
No:

AGAT Laboratories
5835 Coopers Avenue
Mississauga, Ontario L4Z 1Y2
Ph: 905.712.5100 Fax: 905.712.5122
webearth.agatlabs.com

Chain of Custody Record

If this is a Drinking Water sample, please use Drinking Water Chain of Custody Form (potable water consumed by humans)

Laboratory Use Only
Work Order #:
Cooler Quantity:
Arrival Temperatures:
Custody Seal Intact: ☐Yes ☐No ☐N/A
Notes:

Report Information:
Company: TBT Engineering
Contact: Scott Hurley
Address: 1918 Yonge Street
Thunder Bay, ON P7E 6T9
Phone: 807-620-5160 Fax: 807-620-5161
Reports to be sent to:
1. Email: shurley@tbte.ca
2. Email: scroft@tbte.ca

Regulatory Requirements: ☐ No Regulatory Requirement
(Please check all applicable boxes)

☐ Regulation 153/04
Table (Indicate One) ☐ Ind/Com ☐ Res/Park ☐ Agriculture
Soil Texture (Check One) ☐ Coarse ☐ Fine

☐ Sewer Use
☐ Sanitary ☐ Storm
Region (Indicate One) ☐ MISA

☐ Regulation 558
☐ CCME
☐ Prov. Water Quality Objectives (PWQO)
☑ Other O.Reg 490 O.Reg 278 (Indicate One)

Is this submission for a **Record of Site Condition?** ☐ Yes ☐ No

Report Guideline on *Certificate of Analysis* ☐ Yes ☐ No

Turnaround Time (TAT) Required:
Regular TAT ☑ 5 to 7 Business Days
Rush TAT (Rush Surcharges Apply)
☐ 3 Business Days ☐ 2 Business Days ☐ Next Business Day
OR Date Required (Rush Surcharges May Apply):
Please provide prior notification for rush TAT
**TAT is exclusive of weekends and statutory holidays*
For 'Same Day' analysis, please contact your AGAT CPM

Project Information:
Project: 18-038
Site Location: Bora Laskin
Sampled By: SC + LF
AGAT Quote #: TBTE PO: 2040
Please note: If quotation number is not provided, client will be billed full price for analysis.

Invoice Information:
Bill To Same: Yes ☑ No ☐
Company:
Contact:
Address:
Email:

Sample Matrix Legend
B Biota
GW Ground Water
O Oil
P Paint
S Soil
SD Sediment
SW Surface Water

Sample Identification	Date Sampled	Time Sampled	# of Containers	Sample Matrix	Comments/ Special Instructions	Y/N	Field Filtered - Metals, Hg, CrVI	O. Reg 153: Metals and Inorganics (☐ All Metals ☐ 153 Metals (excl. Hydrides) ☐ Hydride Metals ☐ 153 Metals (Incl. Hydrides))	ORPs: ☐ B-HWS ☐ Cl ☐ CN ☐ Cr^{6+} ☐ EC ☐ FOC ☐ Hg ☐ pH ☐ SAR	Full Metals Scan	Regulation/Custom Metals	Nutrients: ☐ TP ☐ NH_3 ☐ TKN ☐ NO_3 ☐ NO_2 ☐ NO_3+NO_2	Volatiles: ☐ VOC ☐ BTEX ☐ THM	PHCs F1 - F4	ABNs	PAHs	PCBs: ☐ Total ☐ Aroclors	Organochlorine Pesticides	TCLP: ☐ M&I ☐ VOCs ☐ ABNs ☐ B(a)P ☐ PCBs	Sewer Use	Lead in Paint
215 (Red)	Feb 16		1																		/

Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Scroft					
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time
Samples Relinquished By (Print Name and Sign):	Date	Time	Samples Received By (Print Name and Sign):	Date	Time

Page 3 of 3
N°: