



GRAFTON PUBLIC SCHOOL INTERIOR RENOVATIONS

654 Station Road, Colborne, ON.

Project 24006

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BARRY BRYAN ASSOCIATES
Architects, Engineers, Project Managers

250 Water Street
Suite 201
Whitby, Ontario
Canada
L1N 0G5

Telephone: 905 666-5252
Toronto: 905 427-4495
Fax: 905 666-5256
Email: bba@bba-archeng.com
Web Site: www.bba-archeng.com

DIVISION 00 PROCUREMENT AND CONTRACTING REQUIREMENTS

00 01 11	Table of Contents	3
----------	-------------------	---

DIVISION 01 – GENERAL REQUIREMENTS

01 11 00	Summary of Work	3
01 26 15	Requests for Information	2
01 31 00	Project Management and Coordination	2
01 32 00	Construction Progress Documentation	3
01 33 00	Submittal Procedures	4
01 35 43	Environmental Procedures	1
01 41 00	Regulatory Requirements	3
01 45 00	Quality Control	4
01 51 00	Temporary Utilities	3
01 52 00	Construction Facilities	3
01 61 00	Common Product Requirements	5
01 70 03	Safety Requirements	5
01 71 00	Examination and Preparation	2
01 73 00	Execution Requirements	4
01 74 11	Cleaning	2
01 74 19	Construction Waste Management and Disposal	3
01 77 00	Closeout Procedures	2
01 78 00	Closeout Submittals	6

DIVISION 02 – EXISTING CONDITIONS

02 41 19.13	Selective Building Demolition	9
-------------	-------------------------------	---

DIVISION 04 – MASONRY

04 05 19	Masonry Anchorage and Reinforcing	4
04 22 00	Concrete Unit Masonry	7

DIVISION 06 – WOOD, PLASTICS, AND COMPOSITES

06 10 00	Rough Carpentry	3
06 40 00	Architectural Woodwork	8

DIVISION 07 – THERMAL AND MOISTURE PROTECTION

07 92 00	Joint Sealants	6
----------	----------------	---

DIVISION 08 – OPENINGS

08 11 00	Metal Doors and Frames	5
08 71 10	Door Hardware	6
08 80 05	Glazing	4

DIVISION 09 – FINISHES

09 21 16	Gypsum Board	4
09 22 16	Non-Structural Metal Framing	5
09 51 13	Acoustic Panel Ceilings	3
09 53 00	Acoustical Suspension	4
09 65 19	Resilient Tile Flooring	5
09 91 23	Interior Painting	9

DIVISION 10 – SPECIALTIES

10 80 00	Miscellaneous Specialties	2
----------	---------------------------	---

DIVISION 12 – FURNISHINGS

12 24 13	Roller Shades	4
----------	---------------	---

DIVISION 20 – COMMON REQUIREMENTS FOR MECHANICAL

20 02 51	Mechanical Contract General Requirements	13
20 05 11	Mechanical Work Requirements	14
20 05 21	Demolition and Renovation	2
20 05 32	Thermometers and Pressure Gauges	3
20 05 34	Bases, Hangers and Supports (Indoor)	5
20 05 49	Vibration Control Measures	5
20 05 53	Identification of Mechanical Services	6
20 06 11	Testing, Adjusting, and Balancing (TAB) of Mechanical Systems	7
20 08 11	Mechanical Contractor Commissioning Requirements	5

DIVISION 22 – PLUMBING

22 07 19	Plumbing Piping Insulation	6
22 11 16	Domestic Water Piping – Copper	5
22 11 31	Potable Water Auxiliary Equipment	6
22 13 13	Sanitary Drains	4
22 13 16	Sanitary Waste and Vent Piping - Cast Iron and Copper	2
22 13 17	Sanitary Waste and Vent Piping – Plastic	3
22 36 13	Plumbing Auxiliary Equipment	1
22 37 13	Portable Fire Extinguishers	3
22 44 13	Plumbing Fixtures Combined With Drawing Schedule	4

DIVISION 23 - HEATING, VENTILATING AND AIR-CONDITIONING (HVAC)

23 05 81	Pipe Welding	4
23 07 13	Duct Insulation	5
23 07 19	HVAC Piping Insulation	7
23 21 13	Hydronic Piping- Screwed/Welded	8
23 25 13	Water Treatment for Closed-Loop Hydronic Systems	4
23 31 13	Metal Ducts	7
23 33 13	Duct Accessories	4
23 33 13.13	Volume-Control Dampers	3
23 33 16	Fire Dampers	4
23 33 17	Smoke Control Dampers	6
23 33 46	Flexible Ducts	2
23 33 53	Duct Liners	3
23 34 23	Packaged Exhausters	3
23 37 13	Diffusers, Registers, and Grilles	3
23 37 23	Louvres and Vents for Intake and Exhaust	2
23 82 16	Water to Air Coils	2
23 82 29	Radiators, Convectors, and Cabinet Heaters	3

DIVISION 25 – INTEGRATED AUTOMATION

25 20 11	Building Automation System	32
----------	----------------------------	----

DIVISION 26 – ELECTRICAL

26 01 13	Electrical Supplemental Tender Form	3
26 01 16	Electrical General Requirements	19
26 01 17	Demolition and Renovation	2
26 01 20	Commissioning and Integrated Testing of Life Safety and Fire Protection Systems	4
26 05 19	Wires and Cables	2
26 05 20	Splitters, Junction, and Pull Boxes	2
26 05 21	Outlet Boxes, Conduit Boxes and Fittings	2
26 05 22	Wire and Box Connectors - 0 - 1000 V	1
26 05 26	Grounding Secondary	2

26 05 33	Conduits, Conduit Fastenings and Conduit Fittings	3
26 05 75	Auxiliary Systems	4
26 24 16	Panelboards	2
26 24 17	Moulded Case Circuit Breakers	1
26 27 26	Wiring Devices	3
26 28 16	Disconnect Switches	2
26 51 13	Lighting Equipment	4
26 51 16	Digital Occupancy and Daylight Control Systems	7

DIVISION 27 – COMMUNICATIONS

27 31 40.1	ICT Infrastructure	16
------------	--------------------	----

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

28 31 25	Fire Alarm System (Addressable)	12
----------	---------------------------------	----

End of Section

PART 1 GENERAL

1.1 Section Includes

- .1 Work covered by contract documents
- .2 Location of the site
- .3 Site access .
- .4 Work sequence
- .5 Contractor use of premises
- .6 Engineer design
- .7 Designated substances: ACM and others
- .8 Building smoking environment
- .9 Special conditions
- .10 Site security
- .11 "By Others"
- .12 Protection of Drawings

1.2 Work Covered by Contract Documents

- .1 Work of this Contract comprises the Grafton Public School Interior Renovations for the Kawartha Pine Ridge District School Board as indicated on the Contract Drawings and specifications.

1.3 Location of the Site

- .1 654 Station Road, Colborne, Ontario

1.4 Site Access

- .1 Access to the site to be arranged by the Owner.
- .2 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

1.5 Work Sequence

- .1 Construct Work continuously.

1.6 Contractors Use of Premises

- .1 Contractor has restricted use of site until Substantial Performance.

1.7 Engineer Design

- .1 Where specifications require work to be designed by an engineer, engage an engineer licensed in the Province of Ontario to design such work. Refer to Section 01 78 00.

1.8 Designated Substances: ACM and Others

- .1 The Owner shall provide any prospective constructor or contractor a copy of building ACM surveys and information on designated substances that are known or suspected of being present within the area or scope of work.

- .2 The General Contractor shall ensure that a copy of the ACM survey is provided to each contractor and subcontractor who will be working on the Project.
- .3 Any findings of undeclared ACM, or damaged ACM that could pose a risk to workers is to be brought to the attention of the Owner immediately, and work is to be stopped.
- .4 All project design and construction activities must be carried out in compliance with the Regulations.
- .5 No asbestos-containing materials, as defined by O. Reg. 278/05, may not be specified or used in any project.

1.9 Verification

- .1 All dimensions shall be verified on site, and all necessary modifications and adjustments shall be made as necessary to suit.

1.10 Building Smoking Environment

- .1 Smoking and vaping are prohibited in all work places within the Owner's buildings and on the Owner's property.

1.11 Special Conditions

- .1 The following general and special conditions apply:
 - .1 All existing surfaces and finishes are to be repaired wherever damaged during the course of the Work.
 - .2 Wherever existing floor and wall finishes are to be removed, include full removal down to the existing substrate of all tile, base, mortars, grouts, waterproofing membranes and adhesives in accordance with TTMAC recommended procedures. Patch and repair existing substrate to the quality required by the new finish material manufacturer for the installation of their products.
 - .3 All openings in existing fire rated assemblies or fire separations which are created by the removal of existing services, plumbing, conduit, ductwork, fittings fixtures or accessories are to be firestopped to maintain the integrity of the existing construction.
 - .4 All exposed interior surfaces except prefinished surfaces shall be painted whether referred to in the specifications and drawings or not.

1.12 Site Security

- .1 Daily Inspection: Provide inspection of the work areas daily while the work is in progress and take whatever measures are necessary to secure the construction zones from theft, vandalism and unauthorized entry.

1.13 "By Others"

- .1 The term "by others" where it is used in the contract documents means that work shown or described in the contract documents and labeled with this designation is not included in the specific sub-trade's scope of work but will be required to be done within the General Contractor's contract.

1.14 Use of Drawings

- .1 Drawings are not to be scaled.
- .2 Copies of architectural and structural "issued for construction" drawings in digital format will be made available for the contractors use under the following conditions.
 - .1 Copyright remains with BBA.
 - .2 The drawings will only be used for shop drawings for this project and not be put to any other use.
 - .3 BBA assumes no liability for errors or omissions in the drawings. The Contractor assumes all risk and expenses associated with the use of drawings in the production of his work.
 - .4 References to BBA and other Consultants must be deleted from the title block.
 - .5 The Contractor signs a release available from BBA that addresses the above items in more detail. (Sample attached as Appendix 'A')
- .3 Arrangements for use of sub-consultant drawings must be made with the appropriate sub-consultant.

1.15 Protection of Drawings

- .1 Copyright of electronic document belongs to the Consultant. Electronic documents may not be forwarded to others, transmitted, downloaded or reproduced in any format, whether print or electronic, without the express, written permission of the copyright owner.
- .2 Drawings, specifications and other contract related documents which are posted on Contractor controlled websites for access by sub-trades and suppliers, shall be posted only on password expressed interest in the Project.
- .3 Provide Consultant and Owner with access to such websites as noted above.

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 Requests for Information.
- .2 Submittal Procedures.
- .3 Screening of RFI's.
- .4 Response to RFI's.
- .5 Response Timing.

1.2 Request for Information (RFI)

- .1 A request for information (RFI) is a formal process used during the Work to obtain an interpretation of the Contract Documents or to obtain additional information.
- .2 An RFI shall not constitute notice of claim for a delay.

1.3 Submittal Procedures

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Number RFI's consecutively in one sequence in order submitted, in numbering system as established by the Contractor.
- .3 Submit one distinct subject per RFI form. Do not combine unrelated items on one form.
- .4 RFI Form:
 - .1 Submit a draft "Request for Information" form to be approved by the Owner and Consultant.
 - .2 Submit RFI's to the Consultant on approved "Request for Information" form. The Consultant shall not respond to an RFI except as submitted on this form.
 - .3 Where RFI form does not have sufficient space to provide complete information thereon, attach additional sheets as required.
 - .4 Submit with RFI form all necessary supporting documentation.
- .5 RFI Log:
 - .1 Maintain log of RFI's sent to and responses received from the Consultant, complete with corresponding dates.
 - .2 Submit updated log of RFI's at each construction meeting.
- .6 Submit RFI's sufficiently in advance of affected parts of the Work so as not to cause delay in the performance of the Work. Costs resulting from failure to do so will not be paid by the Owner.
- .7 Only the Contractor shall submit RFI's to the Consultant.
- .8 RFI's submitted by Subcontractors or Suppliers directly to the Consultant will not be accepted.

1.4 Screening of RFI's

- .1 Contractor shall satisfy itself that an RFI is warranted by undertaking a thorough review of the Contract Documents to determine that the claim, dispute, or other matters in question relating to the performance of the Work or the Interpretation of the Contract Documents cannot be resolved by direct reference to the Contract Documents. Contractor shall describe in detail this review on the RFI form as part of the RFI submission. RFI submittals that lack such detailed review description, or where the detail provided is, in the opinion of the Consultant, insufficient, shall not be reviewed by the Consultant and shall be rejected.

1.5 Response to RFI's

- .1 Consultant shall review RFI's from the Contractor submitted in accordance with this section with the following understandings:
 - .1 Consultant's response shall not be considered as a Change Order or Change Directive, nor does it authorize changes in the Contract Price or Contract Time or changes in the Work.
 - .2 Only the Consultant shall respond to RFI's. Responses to RFI's received from entities other than the Consultant shall not be considered.

1.6 Response Timing

- .1 Allow 5 Working Days for review of each RFI by the Consultant.
- .2 Consultant's review of RFI commences on date of receipt of RFI submission by the Consultant from Contractor and extends to date RFI returned by Consultant.
- .3 When the RFI submission is received by Consultant before noon, review period commences that day. When RFI submittal is received by Consultant after noon, review period begins on the next Working Day.
- .4 If, at any time, the Contractor submits a large enough number of RFI's or the Consultant considers the RFI to be of such complexity that the Consultant cannot process these RFI's within 5 Working Days, the Consultant will confer with the Contractor within 3 Working Days of receipt of such RFI's, and the Consultant and the Contractor will jointly prepare an estimate of the time necessary for processing same as well as an order of priority among the RFI's submitted. The Contractor shall accommodate such necessary time at no increase in the Contract Time and at no additional cost to the Owner.

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 Preconstruction Conference
- .2 Project Meetings
- .3 On Site Documents
- .4 Cost Breakdown

1.2 Preconstruction Conference

- .1 The Consultant will call for and administer a Preconstruction Conference at time and place to be announced.
- .2 Contractor, all major Subcontractors, and major suppliers shall attend the Preconstruction Conference.
- .3 Agenda will include, but not be limited to, the following items.
 - .1 Lines of communication and contact information
 - .2 Submittal and RFI procedures
 - .3 Schedules
 - .4 Personnel and vehicle permit procedures
 - .5 Use of premises
 - .6 Location of any Contractor on-site facilities
 - .7 Security
 - .8 Housekeeping
 - .9 Inspection and testing procedures, on-Site and off-Site
 - .10 Control and reference point survey procedures
 - .11 Health and safety
 - .12 Contractor's Schedule of Values
 - .13 Contractor's Schedule of Submittals
- .4 The Consultant will distribute copies of minutes to attendees. Attendees shall have seven days to submit comments or additions to minutes. Minutes will constitute final documentation of results of Preconstruction Conference.

1.3 Project Meetings

- .1 The Contractor will arrange project meetings and assume responsibility for setting times and recording and distributing minutes.
- .2 Meetings will be held minimum bi-weekly.

1.4 On-Site Documents

- .1 Maintain at job site, one copy each of the following:
 - .1 Contract drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed shop drawings.
 - .5 Requests for Information (RFI's)
 - .6 Change orders.
 - .7 Other modifications to Contract.
 - .8 Field test reports.

- .9 Geotechnical reports
- .10 DSS reports
- .11 Approved Work schedule.
- .12 Manufacturers' installation and application instructions.
- .13 Safety Data Sheets (SDS).
- .14 Health and Safety Plan and other safety related documents.
- .15 Other documents as specified.

1.5 Cost Breakdown

- .1 Submit a detailed cost breakdown to Consultant at least ten working days prior to the submission of the first progress claim. After approval by Consultant the cost breakdown will be used as basis for progress payment.

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 Submittals.
- .2 Schedules.
- .3 Format.
- .4 Submission.
- .5 Critical Path Scheduling.
- .6 Submittals Schedule.

1.2 Submittals

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

1.3 Schedules Required

- .1 Submit schedules as follows:
 - .1 Construction Progress Schedule.
 - .2 Submittal Schedule for Shop Drawings and Product Data.
 - .3 Submittal Schedule for Samples.
 - .4 Product Delivery Schedule.
 - .5 Cash Allowance Schedule for purchasing Products or Services.
 - .6 Shutdown or closure activity.

1.4 Format

- .1 Prepare schedule in form of a horizontal bar chart using Microsoft Project 2016 or later.
- .2 Provide a separate bar for each major item of work, trade or operation.
- .3 Split horizontally for projected and actual performance.
- .4 Provide horizontal time scale identifying first work day of each week.
- .5 Format for listings: chronological order of start of each item of work.
- .6 Identification of listings: By Systems description.

1.5 Submission

- .1 Submit initial format of schedules within 10 working days after award of Contract.
- .2 Submit schedules in electronic format, by email as PDF files.
- .3 Consultant will review schedule and return reviewed copy within 10 days after receipt.
- .4 Resubmit finalized schedule within 7 days after return of reviewed copy.
- .5 During progress of Work revise and resubmit schedule as directed by Consultant.
- .6 Submit revised progress schedule with each application for payment.
- .7 Distribute copies of revised schedule to:
 - .1 Job site office.
 - .2 Subcontractors.
 - .3 Other concerned parties.
 - .4 Instruct recipients to report to Contractor within 10 days, any problems anticipated by timetable shown in schedule.
- .8 Table current and up to date schedule at each regular site meeting.

1.6 Critical Path Scheduling

- .1 Include complete sequence of construction activities.
- .2 Schedules shall represent a practical plan to complete the work within the Contract period, and shall convey the plan to execute the work. Schedules as developed shall show the sequence and interdependencies of activities required for complete performance of the work.
- .3 The submittal of schedules shall be understood to be the Contractor's representation that the schedule meets the requirements of the Contract Documents and that the work will be executed in the sequence and duration indicated in the schedule.
- .4 Failure to include any element of work required for performance of the Contract or failure to properly sequence the work shall not excuse the Contractor from completing all work within the Contract Time.
- .5 All schedules shall be developed utilizing industry standard 'best practices' including, but not limited to:
 - .1 No open-ended activities.
 - .2 No use of constraints other than those defined in the Contract Documents without the prior approval of the Consultant.
 - .3 No negative leads or lags.
 - .4 No excessive leads or lags without prior justification and approval from the Consultant.
 - .5 For individual schedule construction activities, do not exceed 14 days in duration without prior approval of the Consultant. Subdivide activities exceeding 14 days in duration to an appropriate level.
 - .6 Sufficiently describe schedule activities to include what is to be accomplished in each work area. Express activity durations in whole days. Clearly define work that is to be performed by subcontract.
 - .7 Create the schedule in conformance with the work-hours and constraints set forth in these Contract Documents.
- .6 Include dates for commencement and completion of each major element of construction.
- .7 Show projected percentage of completion of each item as of first day of month.
- .8 Indicate progress of each activity to date of submission schedule.
- .9 Show changes occurring since previous submission of schedule:
 - .1 Major changes in scope.
 - .2 Activities modified since previous submission.
 - .3 Revised projections of progress and completion.
 - .4 Other identifiable changes.
- .10 Provide a narrative report to define:
 - .1 Problem areas, anticipated delays, and impact on schedule.
 - .2 Corrective action recommended and its effect.
 - .3 Effect of changes on schedules of other prime contractors.

1.7 Submittals Schedule

- .1 Include schedule for submitting shop drawings, product data, and samples. Indicate manufacture and delivery lead times into the shop drawing submittal schedule.
- .2 Indicate dates for submitting, review time, resubmission time, and last date for meeting fabrication schedule.

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 Administrative
- .2 Requests for Information
- .3 Shop Drawings and Product Data
- .4 Interference Drawings
- .5 Progress Photographs
- .6 Samples
- .7 Mock-Ups
- .8 Certificates and Transcripts

1.2 Administrative

- .1 Submit to Consultant submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for 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, product data, samples and mock-ups in metric units.
- .4 Where items or information is not produced in 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 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 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 affected adjacent work are coordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant's review.
- .10 Keep one reviewed copy of each submission on site.

1.3 Requests for Information (RFI's)

- .1 Refer to Section 01 26 15 – Requests for Information

1.4 Shop Drawings and Product Data

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures, product data and other data which the Contractor provides to illustrate details of a portion of Work.

- .2 Coordinate each submission with requirements of Work and Contract Documents. Individual submissions will not be reviewed until all related information is available.
- .3 Submit shop drawings bearing stamp and signature of qualified professional Engineer registered or licensed in the Province of Ontario where required by the individual specification sections. Each submittal and each resubmittal must bear the stamp of the Engineer
- .4 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .5 Prior to submission to Consultant, review all submitted drawings. By this review, Contractor represents to have determined and verified field measurements, site conditions, materials, catalogue number and similar data and to have checked and coordinated each drawing with the requirements of Work and of Contract Documents. Contractor's review of each drawing shall be indicated by stamp, date and signature of a responsible person.
- .6 At time of submission, notify Consultant in writing of any deviations in drawings from the requirements of the Contract Documents.
- .7 Allow ten days for Consultant's review of each submission.
- .8 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.
- .9 Make any changes in submitted drawings which Consultant may require, consistent with Contract Documents and resubmit unless otherwise directed by Consultant. When resubmitting, notify Consultant in writing of any revisions other than those requested by Consultant.
- .10 Accompany submissions with transmittal letter 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.
- .11 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 Contractor's 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.
 - .12 After Consultant's review, distribute copies.
 - .13 Submit one electronic copy in PDF format of shop drawings for each requirement requested in specification Sections and as Consultant may reasonably request.
 - .14 Submit electronic copy in PDF format 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.
 - .15 Delete information not applicable to project.
 - .16 Supplement standard information to provide details applicable to project.
 - .17 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.
 - .18 The review of shop drawings by the Consultant is for sole purpose of ascertaining conformance with general concept.
 - .1 This review shall not mean that the Consultant approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
 - .2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.
- 1.5 Interference Drawings
- .1 Prepare interference drawings to coordinate the installation of the work of all sections, within available space. Conflicts between trades which could be determined beforehand, by the careful coordination and preparation of interference drawings, shall be corrected at no expense to the Owner.
 - .2 Prepare interference drawings of all buried services as necessary to avoid conflicts with new or existing structures, foundations or services.
 - .3 Submit interference and equipment placing drawings as specified in Section 01 71 00, when requested by the Consultant.
- 1.6 Progress Photographs
- .1 Progress photograph to be electronically formatted and labelled as to location and view.

1.7 Samples

- .1 Submit for review samples as requested in respective specification Sections. Label samples with origin, manufacturer, product information, applicable specification section, and intended use.
- .2 Notify Consultant in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .3 Where colour, pattern or texture is criterion, submit full range of manufacturer's samples.
- .4 Adjustments made on samples 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.
- .5 Make changes in samples which Consultant may require, consistent with Contract Documents.
- .6 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.8 Mock-Ups

- .1 Erect mock-ups in accordance with 01 45 00 - Quality Control.

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 Administrative
- .2 Fires
- .3 Disposal of Wastes

1.2 References

- .1 Statutes of Canada 1999 Chapter 33.
 - .1 Canadian Environmental Protection Act 1999.
 - .2 SOR/2003-289. Federal Halocarbon Regulations, 2003.
 - .3 Transportation of Dangerous Goods Act, 1992 (1992, c. 34)

1.3 Administrative

- .1 Comply with all federal, provincial, and municipal regulatory requirements and guidelines for environmental protection and natural resource conservation, including those referenced above.
- .2 Failure to comply with environmental requirements may result in a stop work order or assessment of damages commensurate with repair of damage.
- .3 It is the Contractor's responsibility to be aware of environmental requirements and the best management practices and pollution control measures necessary to meet them.
- .4 It is the Contractor's responsibility to obtain and abide by permits, licenses and compliance certificates at appropriate times and frequencies as required by the authorities having jurisdiction.
- .5 All hazardous materials are to be stored with secondary containment

1.4 Fires

- .1 Fires and burning of rubbish on site not permitted.

1.5 Disposal of Wastes

- .1 Refer to Section 01 74 19 – Construction Waste Management and Disposal.

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
- .2 Owner's Regulations
- .3 Standards and Definitions
- .4 Designated Substances
- .5 Hazardous Materials
- .6 Spills Reporting
- .7 Protection of Water Quality
- .8 Potable Water Systems
- .9 Access for Inspection and Testing
- .10 Other Regulatory Requirements

1.2 References

- .1 Perform Work in accordance with Ontario Building Code (OBC), National Fire Code of Canada (NFC), the Canadian Electrical Code CSA C22.1-18, including all Supplements and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Where a material is designated in the Contract Documents for a certain application, unless otherwise specified, that material shall conform to standards designated in the Code. Similarly, unless otherwise specified, installation methods and standards of workmanship shall also conform to standards invoked by the aforementioned Code.
- .3 Meet or exceed requirements of:
 - .1 Contract documents.
 - .2 Specified standards, codes and referenced documents.
 - .3 Manufacturer's instructions.
- .4 Where requirements of Contract Documents exceed Code requirements provide such additional requirements.
- .5 Where the Building Code or the Contract Documents do not provide all information necessary for complete installation of an item, then the manufacturer's instructions for first quality workmanship shall be strictly complied with.

1.3 Owner's Regulations

- .1 Conform to requirements, regulations and procedures of the Owner.

1.4 Standards and Definitions

- .1 Where a reference is made to specification standards produced by various organizations and agencies, conform to latest edition of standards, as amended and revised to date of Contract.
- .2 Have a copy of each specified standard which relates to your work available on the site to be produced immediately on Consultant's request.

1.5 Designated Substances

- .1 Known designated substances are identified in the Designated Substance Report provided by the Owner.

- .2 Stop work immediately when material resembling asbestos, mould or any other designated substance which is not identified in the Designated Substance Report is encountered during the course of the work. Notify Owner and Consultant immediately.
- .3 The Owner will arrange for independent testing of suspected designated substances and removal of such substances encountered on the site during the course of the work which are not identified in the Designated Substance Report.

1.6 Hazardous Materials

- .1 Definition: "Hazardous Material" is material, in any form, which by its nature, may be flammable, explosive, irritating, corrosive, poisonous, or may react violently with other materials, if used, handled or stored improperly. Included are substances prohibited, restricted, designated or otherwise controlled by law.
- .2 Provide SDS for all materials brought to the Place of Work.
- .3 Hazardous Materials will not be introduced for experimental or any other use prior to being evaluated for hazards.
- .4 Make known to the Consultant those hazardous materials or designated substances intended to be used in the workplace and receive permission to use before introducing to the Owner's property.
- .5 Many common construction materials such as asbestos pipe and various insulations are designated substances and shall not be used under any circumstances.

1.7 Spills Reporting

- .1 Spills or discharges of pollutants or contaminants under the control of the Contractor, and spills or discharges of pollutants or contaminants that are a result of the Contractor's operations that cause or are likely to cause adverse effects shall forthwith be reported to the Consultant. Such spills or discharges and their adverse effects shall be as defined in the Environmental Protection Act R.S.O. 1999.
- .2 All spills or discharges of liquid, other than accumulated rain water, from luminaries, internally illuminated signs, lamps, and liquid type transformers under the control of the Contractor, and all spills or discharges from this equipment that are a result of the Contractor's operations shall, unless otherwise indicated in the Contract, be assumed to contain PCB's and shall forthwith be reported to the Consultant.
- .3 This reporting will not relieve the Contractor of his legislated responsibilities regarding such spills or discharges.

1.8 Protection of Water Quality

- .1 No waste or surplus organic material including topsoil is to be stored or disposed of within 30 metres of any watercourses. Run-off from excavation piles will not be permitted to drain directly into watercourses. Where this measure is not sufficient or feasible to control sediment entering the watercourses, sedimentation traps or geo-textile coverage will be required.

1.9 Potable Water Systems

- .1 Potable water systems in completed buildings must meet criteria and guidelines established by Provincial and Municipal authorities, prior to occupancy by the Owner.

- .2 Upon completion, submit testing certificates verifying water quality and water systems meets all applicable Provincial and Legislated Standards

1.10 Access for Inspection and Testing

- .1 Cooperate fully with and provide assistance to, all outside authorities including Building Inspectors, utilities, testing agencies and consultants, with the inspection of the Work.

1.11 Other Regulatory Requirements

- .1 Conform to the requirements of the Ontario Ministry of Transportation and Local authorities regarding transportation of materials.
- .2 Conform to the requirements of the Ontario Ministry of the Environment.
- .3 Conform to the requirements of the Ontario Ministry of Labour.
- .4 Conform to all applicable local by-laws, regulations and ordinances.

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 Inspection
- .2 Independent Inspection Agencies.
- .3 Access to Work
- .4 Procedures
- .5 Rejected Work
- .6 Reports
- .7 Contractors Responsibilities
- .8 Tests and Mix Designs
- .9 Mock-Ups
- .10 Equipment and Systems.

1.2 Inspection

- .1 Contractor is responsible for Quality Control (QC).
- .2 Allow Owner and 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 will order 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.

1.3 Independent Inspection Agencies

- .1 Independent Inspection and Testing Agencies will be engaged by Contractor for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by the Contractor and paid from the cash allowances specified in Section 01 21 13. Refer to Section 01 29 83 - Payment Procedures for Testing Laboratory Services.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4 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 Owner. Pay costs for retesting and re-inspection.

1.4 Access to Work

- .1 Allow inspection and testing agencies access to Work, off site manufacturing and fabrication plants.

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

1.5 Procedures

- .1 Notify Owner and Consultant 48 hours in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples

1.6 Rejected Work

- .1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Consultant as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .2 Make good other work damaged by such removals or replacements promptly.
- .3 If in opinion of Consultant it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Consultant will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Consultant.

1.7 Reports

- .1 Submit electronic .pdf format inspection and test reports to Consultant.
- .2 Provide copies to Subcontractor of work being inspected or tested or manufacturer or fabricator of material being inspected or tested.

1.8 Contractors Responsibilities

- .1 Be responsible for the execution of the Construction Quality Plan and is to pay all costs for the execution of the Construction Quality Plan. Designate an experienced site representative for carrying out the Construction Quality Plan.
- .2 Provide the Owner with a completed quality product for the Work. Contractor shall be responsible for any costs associated with re-testing and reperforming the Work as a result of the Contractor's poor performance or workmanship or other failure to comply with the Contract Documents.
- .3 All Work shall be done by persons qualified in their respective trades, and the workmanship shall be first-class in every respect. Contractor is responsible for ensuring employees are appropriately trained. All materials and equipment furnished shall be the best of their respective kinds for the intended use and unless otherwise specified, same shall be new and of the latest design.
- .4 The Consultant will have the authority to reject Work that does not conform to the Contract Documents or may require special inspection or testing, whether or not such Work is to be then fabricated, installed or completed.

- .5 Failure by a Contractor to conduct its operations, means and methods and coordinate proper sequencing of the Work may cause the Owner to withhold payment or any other means deemed necessary to correct non-conforming Work.
- .6 The Owner shall engage a testing firm to perform such engineering laboratory services and on-site inspection as deemed necessary by the Owner. The testing firm will determine compliance with the requirements of the Contract Documents. This Work will not be a service to the Contractors for the performing of tests and checking of materials required of the Contractors.
- .7 Copies of test and inspection reports will be furnished to the Contractor. The laboratory and its representatives will be instructed to promptly call to the attention of the Contractor, any instance of non-compliance with the requirements of the Contract Documents. Failure to so notify the Contractor shall not relieve the Contractor of any of its responsibilities for compliance or making good workmanship or materials which are not in compliance with the requirements of the Contract Documents. The agency shall notify the Consultant and the Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services
- .8 Contractor's construction materials, procedures and work shall be subject to specified testing procedures and shall be in conformance with the Contract Documents as verified by Testing Agency.
- .9 Cooperate with the testing firm and provide labor to assist with sample preparations where applicable.
- .10 Except where specifically indicated to be provided by another entity as identified, inspections, tests, and similar quality control services including those specified to be performed by independent agency are the Contractor's responsibility, and costs thereof are not to be included in contract sum.
- .11 Cooperate with independent agencies performing required inspections, tests, and similar services. Provide auxiliary services as reasonably requested, including access to Work, the taking of samples or assistance with the taking of samples, delivery of samples to test laboratories, and security and protection for samples and test equipment at Project site.
- .12 Coordination: Contractor and each engaged independent agency performing inspections, tests, and similar services for project are required to coordinate and sequence activities so as to accommodate required services with minimum delay of Work and without the need of removal/replacement of work to accommodate inspections and tests. Scheduling of times for inspections, tests, taking of samples, and similar activities is Contractor's responsibility.
- .13 Where sampling and testing is required for Sections of Work listed in the Contract Documents, the tests shall be performed by an independent testing lab and paid for by the Contractor.
- .14 Test procedures to be used shall be submitted for approval of the Consultant where other than those specified are recommended by the testing agency.
- .15 Testing Agency Duties: The independent Testing Agency engaged to perform inspections, sampling and testing of materials and construction specified in individual Specification Sections shall cooperate with the Owner, the Consultant and Contractors in performance of its duties, and shall provide qualified personnel to perform required inspections and tests.
- .16 Contractor is responsible for scheduling times for inspections, tests, taking samples and similar activities.

1.9 Tests and Mix Designs

- .1 Furnish test results and mix designs as requested.

1.10 Mockups

- .1 Prepare mockups for Work specifically requested in specifications.
- .2 Construct in locations acceptable to Consultant.
- .3 Prepare mockups for Consultant's review with reasonable promptness and in orderly sequence, to not cause delays in Work.
- .4 Failure to prepare mockups in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .5 Mock-ups may remain as part of Work unless indicated otherwise.

1.11 Equipment and Systems

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

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 Installation and Removal

- .1 Provide temporary utilities and controls in order to execute work expeditiously.
- .2 Remove from site all such work after use.

1.3 Water Supply

- .1 Existing sources of water can be made available to the Contractor at no charge, subject to operational requirements. Arrange for connection and pay all costs for installation, maintenance and removal. Conversions or alterations to existing sources of water to meet construction requirements are the responsibility of the Contractor.
- .2 The points of delivery and limits on amount available will be determined on site by the Owner whose written permission must be obtained before any connection is made.

1.4 Temporary Heating and Ventilation

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be flameless type. Solid fuel salamanders are not permitted, unless prior approval is given by the Consultant.
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect Work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain temperatures of minimum 10° C in areas where construction is in progress.
- .5 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 Ventilate temporary sanitary facilities.
 - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .6 Permanent heating system of building may be used when available. Be responsible for damage to heating system if use is permitted.

- .7 On completion of Work for which permanent heating system is used, replace filters.
- .8 Ensure Date of Substantial Performance and warranties for heating system do not commence until entire system is in as near original condition as possible and is certified by Consultant.
- .9 Pay costs for maintaining temporary heat, when using permanent heating system. Owner will pay utility charges when temporary heat source is existing building equipment.
- .10 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Conform to applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct fired combustion units to outside.
- .11 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.5 Temporary Power and Light

- .1 Existing sources of electric power can be made available to the Contractor. Conversions or alterations to existing sources of electric power to meet construction requirements are the responsibility of the Contractor.
- .2 The points of delivery and limits on amount available will be determined on site by the Owner whose written permission must be obtained before any connection is made.
- .3 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of Consultant provided that guarantees are not affected.
- .4 Provide and maintain temporary lighting throughout project. Lighting levels shall be sufficient to complete work including inspections. Provide minimum lighting levels of 400 lux at work areas. Lighting levels at floors and stairs not within work areas shall be not less than 160 lux at all times during construction activity.
- .5 All equipment used shall be CSA approved.
- .6 Wiring and method of installation shall conform to local power requirements and shall be reviewed by a licensed inspector prior to use.

1.6 Temporary Communication Facilities

- .1 Provide and pay for temporary telephone, fax, cellular data, lines and all equipment necessary for Contractor's own use.

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 Construction aids.
- .2 Site storage.
- .3 Construction parking
- .4 Offices
- .5 Equipment, tool and material storage.
- .6 Sanitary facilities.
- .7 Signage.
- .8 Shoring

1.2 References

- .1 CSA Group (CSA)
 - .1 CAN/CSA Z321-96 (R2006) Signs and Symbols for the Workplace
 - .2 CAN/CSA Z797-18 Code of Practice for Access Scaffold

1.3 Installation and Removal

- .1 Provide construction facilities in order to execute work expeditiously.
- .2 Remove from site all such work after use.

1.4 Site Storage/Loading

- .1 Do not unreasonably encumber premises with products.
- .2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.

1.5 Construction Parking

- .1 Parking will be permitted on site at areas designated by the Owner provided it does not disrupt performance of Work or ongoing Owners operations.

1.6 Offices

- .1 General Contractor may provide their own offices as necessary and subject to site constraints. Direct location of these offices.

1.7 Equipment, Tool and Material Storage

- .1 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in a manner to cause least interference with work activities.

1.8 Sanitary Facilities

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.

- .2 Post notices and take such precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.9 Construction Signage

- .1 Direct requests for approval to erect a Contractor signboard to Consultant.
- .2 Signs and notices for safety and instruction shall be in English. Graphic symbols shall conform to CAN/CSA Z321.
- .3 Post "Construction Zone" signage outside barrier and entrance to all work areas.
- .4 Maintain approved signs and notices in good condition for duration of project and dispose of off-site on completion of project.
- .5 Install signage to direct site traffic and deliveries to the Construction work areas.

1.10 Shoring

- .1 Examine the site to determine the conditions under which work will be performed.
- .2 Contractor shall formulate his own conclusions as to the extent of the existing conditions and shoring required.
- .3 The method of shoring shall be according to the Contractor's and his Engineer's directions.
- .4 All existing loads must be shored prior to commencement of demolition and removal of load bearing elements.
- .5 All shoring and frame braces must be supplied with a safe load rating which must not be exceeded. Install in accordance with manufacturer's recommended procedures and safety guidelines. Ensure that the safe load conditions of the shoring are not exceeded by dead, live or construction loads.
- .6 All shoring shall be subject to the Consultant's review and approval prior to commencing demolition work.
- .7 Completely remove all shoring after new structure is installed and all concrete is set.
- .8 Submit shoring drawings and a proposed installation procedure stamped by a professional engineer registered in the Province of Ontario. Procedures shall follow the information provided on these drawings. The shoring design engineer shall be retained and paid for by the Contractor. The shoring engineer shall review all existing conditions on site prior to completing shoring design.
- .9 Removal of existing materials without proper engineered shoring is a safety hazard and will not be permitted.
- .10 Make good all damage to the existing structure and adjoining structures and bear full responsibility for failure to provide adequate shoring.
- .11 The failure or refusal of the Consultant to suggest the use of shoring, shall not in any way or to any extent relieve the Contractor of any responsibility concerning the condition of the work or of any of their obligations under the Contract, nor impose any liability on the Owner or their agents; nor shall

any delay, whether caused by any action or want of action on the part of the Contractor, or by any act of the Owner, or their agents, or employees, relieve the Contractor from necessity of properly and adequately protecting the existing structure from collapse or damage, nor from and of his obligations under the Contract relating to injury to persons or property, nor entitle him to any claims for extra compensation or an extension in schedule.

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 Product quality, availability, storage, handling, protection, and transportation.
- .2 Manufacturer's instructions.
- .3 Quality of Work, coordination and fastenings.
- .4 Dielectric Separation
- .5 Tolerances for Execution of Work.
- .6 Protection of Work in progress.
- .7 Existing Utilities

1.2 Definition – Basis of Design

- .1 Basis-of-Design Product Specification: A specification in which a single manufacturer's product is named and accompanied by the words "basis-of-design product," including make or model number or other designation. Published attributes and characteristics of basis-of-design product establish salient characteristics of products.
 - .1 Evaluation of Comparable Products: In addition to the basis-of-design product description, product attributes and characteristics may be listed to establish the significant qualities related to type, function, in-service performance and physical properties, weight, dimension, durability, visual characteristics, and other special features and requirements for purposes of evaluating comparable products of additional manufacturers named in the specification. Manufacturer's published attributes and characteristics of basis-of-design product also establish salient characteristics of products for purposes of evaluating comparable products.
- .2 Comparable Product Request Submittal: An action submittal requesting consideration of a comparable product, including the following information:
 - .1 Identification of basis-of-design product or fabrication or installation method to be replaced, including Specification Section number and title and Drawing numbers and titles.
- .3 Basis-of-Design Product Specification Submittal: An action submittal complying with requirements in Section 01 33 00 -Submittal Procedures.

1.3 Quality

- .1 Products, materials, equipment and articles 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.
- .2 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.
- .3 Should any dispute arise as to quality or fitness of products, decision rests strictly with Consultant based upon requirements of Contract Documents.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.4 Availability

- .1 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 right to substitute more readily available products of similar character, at no increase in Contract Price or Contract Time.

1.5 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 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials and lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of Consultant.
- .9 Touch up damaged factory finished surfaces to Consultant's satisfaction. Use touch up materials to match original. Do not paint over name plates.

1.6 Transportation

- .1 Pay costs of transportation of products required in performance of Work.
- .2 Transportation cost of products supplied by Owner will be paid for by Owner. Contractor shall be responsible for the unloading, handling and storage of such products.

1.7 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 re installation at no increase in Contract Price or Contract Time.

1.8 Quality of Work

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed.
- .2 Immediately notify Consultant if required Work is such as to make it impractical to produce required results.
- .3 Do not employ anyone unskilled in their required duties. Consultant reserves right to require dismissal from site, workers deemed incompetent or careless.
- .4 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Consultant, whose decision is final.

1.9 Coordination

- .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.

1.10 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.

1.11 Remedial Work

- .1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.12 Location of Fixtures

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform Consultant of conflicting installation. Install as directed.

1.13 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.

1.14 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.

1.15 Dielectric Separation

- .1 Ensure that a dielectric separator is provided in a permanent manner over entire contact surfaces to prevent electrolytic action (galvanic corrosion) between dissimilar materials. Similarly, prevent corrosion to aluminum in contact with alkaline materials such as contained in cementitious materials.

1.16 Tolerances for Execution of Work

- .1 Unless specifically indicated otherwise, Work shall be installed plumb, level, square and straight.
- .2 Unless acceptable tolerances are otherwise specified in specification sections, or are otherwise required for proper functioning of equipment, site services and mechanical and electrical systems:
 - .1 "Plumb and level" shall mean plumb or level within 1 mm in 1m.
 - .2 "Square" shall mean not in excess of 10 seconds lesser or greater than 90 degrees.
 - .3 "Straight" shall mean within 1 mm under a 1 m long straight edge.
 - .4 "Flush" shall mean within:
 - .1 6 mm for exterior concrete, masonry and paving materials.
 - .2 1 mm for interior concrete, masonry, tile and similar surfaces.
 - .3 0.5 mm for other interior surfaces.
- .3 Allowable tolerances shall not be cumulative

1.17 Protection of Work in Progress

- .1 Adequately protect Work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by Consultant, at no increase in Contract Price or Contract Time.
- .2 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 the Consultant.

1.18 Existing Utilities

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and/or building occupants and pedestrian and vehicular traffic.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

1.19 Hazardous Materials

- .1 Report any found or suspected hazardous materials to the Owner.

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 Safety Requirements
- .2 Fire Protection
- .3 Accident Reporting
- .4 Records on Site

1.2 References

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations.
- .2 Fire Commissioners of Canada, FC 301, Standard for Construction Operations.
- .3 National Fire Protection Agency (NFPA)
 - .1 NFPA 241 Standard for Safeguarding Construction, Alteration, and Demolition Operations
- .4 Occupational Health and Safety Act.
 - .1 R.R.O. 1990, Reg. 860: Workplace Hazardous Materials Information System (WHMIS)
 - .2 O. Reg. 632/05: Confined Spaces
- .5 Ontario Building Code.

1.3 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit to Owner and Consultant copies of the following documents, including updates issued:
 - .1 Notice of Project filed with Provincial Ministry of Labour or equivalent for Place of Work
 - .2 Site-specific Health and Safety Plan prior to commencement of work on the work site. Plan shall include but not be limited to the following:
 - .1 Name and contact info of Contractor's Health and Safety Representative for Work Site; including twenty-four (24) hour emergency contact phone numbers.
 - .2 Phone numbers of local fire, police, and ambulance outside of 911 services.
 - .3 Location of nearest medical facility and level of injury that each can service.
 - .3 Submit to the Owner, Consultant and Municipal Fire Department, for review, a "Fire Safety Plan" conforming to Section 2.14 of the National Fire Code of Canada. Maintain a copy of the "Fire Safety Plan" on site.
 - .4 Copies of certification for all employees on site of applicable safety training including, but not limited to:
 - .1 WHMIS.
 - .2 Fall arrest and protection.
 - .3 Suspended Access Equipment.
 - .4 Erection of Scaffolding.
 - .5 License for powder actuated devices.
 - .5 On-site Contingency and Emergency Response Plan addressing:
 - .1 Standard procedures to be implemented during emergency situations.
 - .2 Preventative planning and protocols to address possible emergency situations.
- .3 Guidelines for handling, storing, and disposing of hazardous materials that maybe encountered on site, including measures to prevent damage or injury in case of an accidental spill.
- .4 Incident and accident reports, promptly if and upon occurrence
 - .1 Reports or directions issued by authorities having jurisdiction, immediately upon issuance from that authority.
 - .2 Accident or Incident Reports, within 24 hours of occurrence.

- .5 Submit other data, information and documentation upon request by the Consultant as stipulated elsewhere in this section.

1.4 Compliance Requirements

- .1 Comply with the latest edition of the Ontario Occupational Health and Safety Act, and the Regulations made pursuant to the Act.

1.5 Constructor

- .1 Notify all regulatory bodies required for construction activities, (i.e., Notice of Project, employer notification, etc.). Notifications shall include, but not be limited to, the notification requirements laid out in OHSA Sec 51-53 and the requirements of Ontario Regulation 213/91 for Construction Projects, Sections 5, 6 and 7. For the purpose of this contract the Contractor shall be the "Constructor".
- .2 The "Constructor" will be solely responsible for the safety of all persons on the Site.

1.6 Safety Requirements

- .1 Observe and enforce all construction safety measures and comply with the latest edition and amending regulations of the following documents and in the event of any differences among those provisions, the most stringent shall apply:
 - .1 Occupational Health and Safety Act and Regulations for Construction Projects, August 1997, Ontario Regulation 213/91 including amendments.
 - .2 Hazardous Products Act and Canada Labour Code.
 - .3 The Workplace Safety and Insurance Board, O. Reg 454.
 - .4 Ontario Building Code Act, Ontario Regulation 332/12 including amendments.
 - .5 National Building Code of Canada, Part 8: Safety Measures on Construction and Demolition Sites.
 - .6 National Fire Code of Canada.
 - .7 NFPA 241 Standard for Safeguarding Construction, Alteration, and Demolition Operations, 2013 Edition
 - .8 Environmental Protection Act.
 - .9 The Power Commission Act.
 - .10 The Boiler and Pressure Vessels Act.
 - .11 The Elevators and Lifts Act.
 - .12 The Operating Engineer's Act.
 - .13 Municipal statutes.
- .2 Obey all Federal, Provincial and Municipal Laws, Acts, Statutes, Regulations, Ordinances and By-laws which could in any way, pertain to the work outlined in the Contract, or to any employees of the Contractor. Satisfy all statutory requirements imposed by the Occupational Health and Safety Act and Regulations made thereunder, on a Contractor, and Constructor and/or Employer with respect to or arising out of the performance of the Contractors obligations under this Contract.
- .3 Working at Heights: The supervisor of the project, will be responsible to ensure that his employees and subcontractors/suppliers have current Working at Heights and Fall Protection certification.
- .4 The supervisor of the project will be responsible for his employees and subcontractors/suppliers maintaining standard safety practices, as well as the specific safety rules listed below, while working on the Owner's property.

- .5 The Owner reserves the right to order individuals to leave the site if the individual is in violation of any safety requirement or any Act. Any expense incurred will be the responsibility of the Contractor.
- .6 Notify the Owner should any hazardous condition become apparent.
- .7 Enforce the use of CSA approved hard hats, reflective vests and safety boots for all persons entering or working at the construction site. Refuse admission to those refusing to conform to this requirement.
- .8 Provide safeguard and protection against accident, injury or damage to any person on the site, adjacent work areas and adjacent property.

1.7 Confined Space

- .1 Confined Space: Where applicable, provide the Consultant and all Regulatory Authorities with a copy of the Contractors' Confined Space Entry Procedure. In the event that defined procedures are not available, abide by the applicable requirements of the Occupational Health and Safety Act and all regulations made thereunder.
- .2 Persons intended to work in confined spaces, as defined by the Owner, must have formal training in performing work in confined spaces.
- .3 Provide proof of valid certificates of such training for all workers prior to entry of such workers into confined spaces.
- .4 Provide all necessary safety equipment for entry into confined spaces.
- .5 Where workers are required to enter a confined space, as defined by the OHSA, O. Reg. 632/05 Section 221.2, ensure that workers of the Contractor and all Subcontractors follow the requirements of the above legislation, including but not limited to:
 - .1 Having a method for recognizing each confined space to which the program applies
 - .2 Having a method for assessing the hazards to which workers may be exposed
 - .3 Having a method for the development of confined space entry plans (which include on-site rescue procedures)
 - .4 Having a method for training workers
 - .5 Having an entry-permit system.
 - .6 Supply the necessary tools and equipment to perform the confined space entry. These items include, but are not limited to, required documentation, gas detectors, breathing equipment, fall protection and rescue equipment.

1.8 Safety Meetings

- .1 Site toolbox safety meetings will be held weekly for all Contractor employees and all sub trade contractors.
- .2 Where a Joint Health and Safety Committee is required on a project, workers and supervisors, selected, as members of the committee must attend.

1.9 Workplace Hazardous Materials Information System (WHMIS)

- .1 Be familiar with WHMIS regulations and be responsible for compliance.

- .2 Provide to the Consultant a list of Designated Substances that will be brought to the site prior to commencing work. Safety Data Sheets (SDS) and the hazardous material inventory for each substance listed must be kept on the Project.
- .3 Be responsible for all other requirements of regulations as applicable to Employers.
- .4 All controlled products to be properly labelled and stored.
- .5 Immediately inform Owner and Consultant if any unforeseen or peculiar safety-related factor, hazard, or condition becomes evident during performance of Work.

1.10 Fire Protection

- .1 Provide and maintain safeguard and protection against fire in accordance with current fire codes and regulations.
- .2 Provide temporary fire protection throughout the course of construction. Particular attention shall be paid to the elimination of fire hazards.
- .3 Comply with the requirements of FCC No. 301 Standards for Construction Operations issued by the Fire Commissioner of Canada and the National Building Code.
- .4 Provide and maintain portable fire extinguishers during construction, in accordance with Part 6 of the National Fire Code of Canada 2015 and NFPA 241.
- .5 Maintain unobstructed access for firefighting at all areas in accordance with the National Building Code of Canada.

1.11 First Aid

- .1 Provide such equipment and medical facility as required by WSI Act to supply first aid services to anyone who may be injured at the place of Work. Report all accidents or injuries to the proper authorities and to the Owner and Consultant.

1.12 Accident Reporting

- .1 Investigate and report incidents and accidents as required by Occupational Safety and Health Act, and the Regulations made pursuant to the Act.

1.13 Records on Site

- .1 Maintain on site a copy of the safety documentation as specified in this section and any other safety related reports and documents issued to or received from the authorities having jurisdiction.
- .2 Upon request, make copies available to the Consultant.

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 Examination of Work and Site

- .1 Examine the existing building to be fully informed of their particulars as related to the Work.
- .2 Verify dimensions of completed Work in place before fabrication of Work to be incorporated with it. Ensure that all necessary job dimensions are taken for the proper execution of the work. Assume complete responsibility for the accuracy and completeness of such dimensions.
- .3 No claims for extra payment will be paid for extra work made necessary or for difficulties encountered due to conditions of the site which were visible or reasonably inferable from an examination of the site at the time prior to tender closing date and furthermore, failure of the Contractor to visit and examine the site shall be deemed a waiver of all claims for extra payment due to any condition of the site existing prior to tender closing date.
- .4 As-found damage: Record by photography and submit evidence to Consultant before commencing work, any found damaged surfaces or materials adjacent to new work, and not included under scope of this new work. Remedial work to any damage, not so recorded, shall be the responsibility of the Contractor.

1.2 Existing Services

- .1 Before commencing work, establish location and extent of service lines in area of Work and notify Consultant of findings. The Contractor is responsible for coordination of all utility locates.
- .2 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut off points as directed by Consultant.
- .3 Where Work involves breaking into or connecting to existing services, carry out work at times directed by authorities having jurisdiction, with minimum of disturbance to building occupants, pedestrian and vehicular traffic.
- .4 Where unknown services are encountered, immediately advise Consultant and confirm findings in writing.
- .5 Install temporary drain plugs to prevent construction debris from blocking pipes downstream of the work.
- .6 All existing concrete floor slabs shall be scanned prior to any cutting or breaking of concrete. Employ a qualified concrete scanning company or inspection and testing agency to scan and map floor slabs for reinforcing, plastic and metal conduit, piping, grounding cables, embedment and the like. Map all slabs and provide copies to the Owner and Consultant.

1.3 Location of Services, Equipment and Fixtures

- .1 Location of services, equipment, fixtures and outlets indicated on drawings or specified are to be considered as approximate.
- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance. Include existing equipment which affects or will be affected by the work.
- .3 Inform Consultant of impending installation and obtain approval for actual location.

- .4 Location of site services where required, is approximate and is based on information provided by the Owner. Undertake all locates to determine exact locations of existing services and lay out new services to avoid any conflicts with new building elements, including site improvements, building foundations and other new or existing services.
- .5 Submit field drawings and interference drawings to indicate relative position of various services and equipment. Refer to requirements for interference drawings specified elsewhere.
- .6 Prepare interference and equipment placing drawings to ensure that all components will be properly accommodated within the spaces provided.
- .7 Prepare drawings to indicate coordination and methods of installation of a system with other systems where their relationship is critical. Ensure that all details of equipment apparatus and connections are coordinated.
- .8 Ensure that clearances required by jurisdictional authorities and clearances for proper maintenance and access are indicated and maintained.
- .9 Submit interference drawings to Owner and Consultant in accordance with Section 01 33 00.
- .10 Unless specifically indicated by the Consultant, interference drawings will be received for information only and will not be reviewed.

1.4 Records

- .1 Record locations of maintained, re-routed and abandoned service lines.

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 Requirements and limitations for cutting and patching the Work.

1.2 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit written request and obtain Consultant's approval 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
- .3 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 Date and time work will be executed.

1.3 Materials

- .1 As specified and required for original installation.
- .2 Requests for change in materials shall include documentation indicating conformance to project requirements and intent.

1.4 Definitions

- .1 Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- .2 Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

PART 2 PRODUCTS

2.1 Materials

- .1 General: Comply with requirements specified in other Sections.
- .2 In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
- .3 If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Consultant for the visual and functional performance of in-place materials.

PART 3 EXECUTION

3.1 Preparation

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of Work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.
- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.

3.2 General

- .1 Carry out all cutting, fitting and patching required for the work of the Contract.
- .2 Repair all wall and floor surfaces where items have been removed.
- .3 Make good all finishes as required.
- .4 Repaint damaged wall surfaces.
- .5 Fit several parts together, to integrate with other Work.
- .6 Uncover Work to install ill-timed Work.
- .7 Remove and replace defective and non-conforming Work.
- .8 Provide cutting and patching of all openings in non-structural elements of Work as necessary to complete installation of mechanical and electrical Work. Include complete removal and replacement of such elements as necessary to provide construction access.
- .9 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .10 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .11 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools are not allowed on masonry work without prior approval.
- .12 Restore work with new products in accordance with requirements of Contract Documents.
- .13 Fit work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .14 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with "ULC approved firestopping material, full thickness of the construction element. Include any openings in existing building elements created by removal of existing services or equipment.

- .15 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.

3.3 Cutting and Patching

- .1 General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
- .2 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.
- .3 Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during installation or cutting and patching operations, by methods and with materials so as not to void existing warranties.
- .4 Temporary Support: Provide temporary support of work to be cut.
- .5 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.
- .6 Adjacent Occupied Areas: Where interference with use of adjoining areas or interruption of free passage to adjoining areas is unavoidable, coordinate cutting and patching according to requirements in Section 01 10 00 - Summary of Work.
- .7 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 to minimize interruption to occupied areas.
- .8 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. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.
 - .1 In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots neatly to minimum 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 and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
 - .4 Excavating and Backfilling: Comply with requirements in applicable Sections where required by cutting and patching operations.
 - .5 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.
 - .6 Proceed with patching after construction operations requiring cutting are complete.
- .9 Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other work. Patch with durable seams that are as invisible as practicable. Provide materials and comply with installation requirements specified in other Sections, where applicable.
 - .1 Inspection: Where feasible, test and inspect patched areas after completion to demonstrate physical 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 minimize evidence of patching and refinishing.
 - .1 Clean piping, conduit, and similar features before applying paint or other finishing materials.
 - .2 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, colour, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform colour and appearance.
 - .1 Where patching occurs in a painted surface, prepare substrate and apply primer and intermediate paint coats appropriate for substrate over the patch, and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
 - .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 and ensures thermal and moisture integrity of building enclosure.
- .10 Clean areas and spaces where cutting and patching are performed. Remove paint, mortar, oils, putty, and similar materials from adjacent finished surfaces.

3.4 Subfloor Levelling

- .1 Where existing flooring is to be removed from floor slabs to remain, including ceramic tile flooring, carefully remove all flooring, grout, adhesives, waterproofing membranes and the like down to the base slab. Clean, patch and repair slab where damaged with concrete or acceptable leveling compound in accordance with new flooring manufacturer's instructions and ASTM F710. Refer to original building drawings and remove and replace existing concrete floor toppings as necessary and where required.
- .2 Where new flooring is to be installed on new concrete slab or on framed floors, subfloor shall be levelled in accordance with flooring manufacturer's specifications and tolerances and with ASTM F710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.

3.5 Fire Barrier Seals

- .1 Ensure fire separations are maintained as indicated on the drawings. patch and firestop all penetrations accordingly.

End of Section

PART 1 GENERAL

1.1 Section Includes

- .1 Progressive Cleaning
- .2 Final Cleaning

1.2 References

- .1 National Fire Protection Association (NFPA)
 - .1 NFPA 241-22 Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.3 Project Cleanliness

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by the Owner. Do not burn waste materials on site.
- .3 Clear snow and ice from access to building, bank/pile snow in designated areas only.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide on-site containers for collection of waste materials and debris.
- .6 Provide and use clearly marked separate bins for recycling.
- .7 Clean interior areas prior to start of finishing work and maintain areas free of dust and other contaminants during finishing operations.
- .8 Store volatile waste in covered metal containers and remove from premises at end of each working day.
- .9 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .10 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

PART 2 PRODUCTS

2.1 Products

- .1 All cleaning materials and products shall be low VOC type. Submit list of cleaning products including SDS for approval prior to commencement of cleaning operations.
- .2 Use only cleaning materials recommended by manufacturer of surface to be cleaned and recommended by cleaning material manufacturer.

PART 3 EXECUTION

3.1 Final Cleaning

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

- .2 Remove waste products and debris other than that caused by others and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .5 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, floors and ceilings.
- .6 Clean lighting reflectors, lenses, and other lighting surfaces. Clean and/or replace lamps, light fixtures, grilles and lenses.
- .7 HEPA vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .8 Thoroughly vacuum clean interior of electrical equipment.
- .9 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .10 Clean and seal concrete floor surfaces with non-skid matte sealer.
- .11 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .12 Clean equipment and fixtures to a sanitary condition; clean or replace filters of mechanical equipment.
- .13 Broom clean and wash exterior paved areas, walks, steps and surfaces; rake clean other surfaces of grounds.
- .14 Remove dirt and other disfiguration from exterior surfaces.
- .15 Clean and sweep roofs. Clear all drains, scuppers, gutters and downspouts.
- .16 Remove debris and surplus materials from crawl spaces and other accessible concealed spaces.
- .17 Remove snow and ice from access to building.
- .18 Under direction of Consultant, aim adjustable luminaires.

3.2 Waste Management and Disposal

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

End of Section

PART 1 GENERAL

1.1 Section Includes

- .1 References.
- .2 Submittals.
- .3 Definitions.
- .4 Waste Management Goals for the Project.
- .5 Documents.
- .6 Waste Management Plan.
- .7 Materials Source Separation Program.
- .8 Disposal of Wastes.
- .9 Scheduling.
- .10 Storage, Handling and Protection.
- .11 Application.
- .12 Diversion of Materials.

1.2 References

- .1 O. Reg. 102/94 Waste Audits and Waste Reduction Work Plans.
- .2 O. Reg. 278/05 Occupational Health and Safety Act

1.3 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit a completed Waste Management Plan (WMP) prior to project start-up.

1.4 Definitions

- .1 Waste Management Plan (WMP): Contractor's approved overall strategy for waste management including waste reduction workplan and materials source separation program.
- .2 Materials Source Separation Program (MSSP): Consists of a series of ongoing activities to separate reusable and recyclable waste material into material categories from other types of waste at point of generation.
- .3 Separate Condition: Refers to waste sorted into individual types.

1.5 Waste Management Goals for the Project

- .1 The Owner has established that this Project shall generate the least amount of waste possible and that processes shall be employed that ensure the generation of as little waste as possible including prevention of damage due to mishandling, improper storage, contamination, inadequate protection or other factors as well as minimizing over packaging and poor quantity estimating.
- .2 Of the waste that is generated, the waste materials designated in this specification shall be salvaged for reuse and or recycling. Waste disposal in landfills or incinerators shall be minimized.

1.6 Waste Management Plan

- .1 Waste Management Plan: Submit a Waste Management Plan within 10 calendar days after receipt of Notice of Award of Contract, or prior to any waste removal, whichever occurs sooner. The Plan shall contain the following:
 - .1 Analysis of the proposed job site waste to be generated, including the types of recyclable and waste materials generated (by volume or weight). In the case of demolition, a list of each item proposed to be salvaged during the course of the project should also be prepared
 - .2 Alternatives to Land Filling: Contractor shall designate responsibility for preparing a list of each material proposed to be salvaged, reused, or recycled during the course of the Project.
- .2 Post WMP or summary where workers at site are able to review its content.

1.7 Materials Source Separation Program

- .1 The Waste Management Plan shall include a Source Separation Program for recyclable waste and shall be in accordance with the established policies currently in place at the local Municipality, and the requirements of O. Reg. 102/94.
- .2 Prepare MSSP and have ready for use prior to project start-up.
- .3 Implement MSSP for waste generated on project in compliance with approved methods and as approved by Consultant.
- .4 Provide on-site facilities for collection, handling, and storage of anticipated quantities of reusable and/or recyclable materials.
- .5 Provide containers to deposit reusable and/or recyclable materials.
- .6 Locate containers to facilitate deposit of materials without hindering daily operations.
- .7 Locate separated materials in areas which minimize material damage.
- .8 Collect, handle, store on-site, and transport off-site, salvaged materials in separate condition.

1.8 Disposal of Wastes

- .1 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .2 Provide appropriate on-site containers for collection of waste materials and debris. Containers for volatile wastes shall be closed containers and shall be removed from site daily.
- .3 Provide and use clearly marked separate bins for recycling.
- .4 Remove waste materials from site at regularly scheduled times or dispose of as directed by Consultant. Do not burn waste materials on site.
- .5 Remove waste material and debris from site and deposit in waste container at end of each working day.
- .6 Do not permit waste to accumulate onsite.

- .7 Burying of rubbish and waste materials is prohibited.
- .8 Disposal of waste into waterways, storm, or sanitary sewers is prohibited.

1.9 Scheduling

- .1 Coordinate work with other activities at site to ensure timely and orderly progress of the Work.

1.10 Storage, Handling and Protection

- .1 Store, materials to be reused, recycled and salvaged in locations as directed by Owner.
- .2 Materials from building demolition to be salvaged or re-used are to be removed and salvaged.
- .3 Unless specified otherwise, materials for removal become Contractor's property.

PART 2 PRODUCTS

2.1 Not Used

- .1 Not used

PART 3 EXECUTION

3.1 Application

- .1 Do work in compliance with Waste Management Plan.
- .2 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.
- .3 Source separate materials to be reused/recycled into specified sort areas.

3.2 Designated Substances

- .1 All designated substances abatement, removal and disposal shall be completed in accordance with O. Reg 278/05 and all other applicable legislation.

3.3 Diversion of Materials

- .1 Separate materials from general waste stream and stockpile in separate piles or containers, to approval of Owner, and consistent with applicable fire regulations. Mark containers or stockpile areas.
- .2 On-site sale of materials is not permitted.

End of Section

PART 1 GENERAL

1.1 Section Includes

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

1.2 References

- .1 Canadian Construction Documents Committee
 - .1 CCDC 2-2020 Stipulated Price Contract including Supplementary Conditions.
- .2 OAA/OGCA Document 100 - Recommended Procedures Regarding Substantial Performance of Construction Contracts and Completion Takeover of Projects.
- .3 The Construction Act.

1.3 Inspection and Declaration

- .1 Contractor's Inspection: The Contractor shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents. Submit duplicate copies of the deficiency list to the Owner and Consultant.
 - .1 Notify Consultant in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
 - .2 Request Consultant's review.
- .2 Consultant's Review: Consultant and Contractor will perform review of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.
- .3 Completion: submit written certificate that 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 Boiler Inspection Branch, Fire Commissioner, Utility companies, TSSA, ESA and other regulatory agencies have been submitted.
 - .5 Operation of systems have been demonstrated to Owner's personnel.
 - .6 Work is complete and ready for Final Review by the Consultant.
- .4 Final Inspection: when items noted above are completed, request final review of Work by Consultant, and Contractor. If Work is deemed incomplete by the Consultant, complete outstanding items and request re-review.
- .5 Declaration of Substantial Performance: when 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 GC 5.4 - Substantial Performance of Work and Payment of Holdback for specifics to application.
- .6 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.
- .7 Final Payment: When Consultant considers 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, General Conditions Article GC 5.5 – Final Payment for specifics to application.

- .8 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, General Conditions Article 5.4 - Substantial Performance of Work and Payment of Holdback.

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 As built, samples, and specifications.
- .2 Equipment and systems.
- .3 Product data, materials and finishes, and related information.
- .4 Operation and maintenance data.
- .5 Spare parts, special tools and maintenance materials.
- .6 Warranties and bonds.
- .7 Final site survey.

1.2 Submittals

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

1.3 Submission

- .1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .2 At least 2 weeks prior to commencement of scheduled commissioning activities, submit 2 copies of the draft Operating and Maintenance Manuals, for Consultants review and use during the commissioning activities. After the completion of the commissioning activities, the Consultant will return to the Contractor 1 draft copy, with review comments, for revision. Submit 1 copy of the revised Operating and Maintenance for approval prior to the production of final copies. Prior to the Issuance of the Final Certificate of Completion, and within 10 working days after Substantial Performance, submit 2 copies of the final Operating and Maintenance Manuals.
- .3 Building will not be deemed ready for use unless the draft copies of the Operating and Maintenance Manuals and the "As-built" Record Documents have been submitted and reviewed by the Consultant.
- .4 Building will not be deemed ready for use unless the completed and submitted Operating and Maintenance Manuals and "As-built" Record Documents have been accepted by the Consultant.
- .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.

1.4 Format

- .1 Organize data in the form as 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 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 1:1 scaled CAD files in .dwg format. Provide duplicate copies on memory stick

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 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.

1.6 As-Builts and Samples

- .1 In addition to requirements in General Conditions, maintain at the site for Consultant one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Consultant.

1.7 Recording Actual Site Conditions

- .1 Record information on set of drawings, provided by Consultant.
- .2 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .3 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 References to related shop drawings and modifications.
- .4 Submit following drawings:
 - .1 Record changes in red. Mark on one set of prints and at completion of project prior to final inspection, produce electronic "as-built" records on disk using latest version of AutoCad. Annotate "AS-BUILT RECORD" in each drawing title block.
 - .2 All changes shall be shown on a separate drawing layer named "as-built".
 - .3 At least 2 weeks prior to commencement of scheduled commissioning activities, submit one copy of the draft "As-built" Project Record Documents for Consultants review and use during the commissioning activities. After the completion of the commissioning activities, the Consultant will return to the Contractor the draft copy, with review comments, for revision. Prior to the Issuance of the Final Certificate of Completion, and within 10 working days after Substantial Performance, submit 2 copies of the final "As-built" Project Record Documents and disk of "as-built" record drawings.
- .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, required by individual specifications sections

1.8 Final Survey

- .1 Submit final site survey certificate in accordance with Section 01 71 00 - Examination and Preparation, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.9 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, shut-down, 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 co-ordination 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 01 45 00 - Quality Control
 - .15 Additional requirements: as specified in individual specification sections.
- 1.10 Materials and Finishes
- .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations.
 - .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
 - .3 Moisture-Protection and Weather-Exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
 - .4 Additional Requirements: as specified in individual specifications sections.
- 1.11 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 Spare parts as identified in individual sections are to be delivered to the Owner prior to the Contractor's application for Substantial Performance.
 - .4 Receive and catalogue items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit prior to final payment.

1.12 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 Maintenance materials are to be delivered to the Owner prior to the Contractor's application for Substantial Performance.
- .4 Receive and catalogue items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

1.13 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 Special tools are to be delivered to the Owner prior to the application for Substantial Performance.
- .4 Receive and catalogue items. Submit inventory listing to Consultant. Include approved listings in Maintenance Manual.

1.14 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.

1.15 Warranties and Guarantees

- .1 Separate each warranty or guarantee 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 guarantees, 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 guarantees until time specified for submittal.

1.16 Independent Specialty Engineers Sign-Off

- .1 Prior to Substantial Performance, provide copies of signed and stamped engineers review and sign-off letters stating that the work has been built in accordance with their drawings and designs. Conditional or vague letters of sign-off will not be accepted. All specialty design engineers for all sub-contractors and suppliers will be required to review the work in progress at appropriate intervals to ensure compliance with their designs and drawings and shall provide final sign-off letters. Provide copies of all field reports issued by specialty engineers. Carry all costs associated with full compliance with this requirement.

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 General

- .1 Conform to the requirements of Division 1.

1.2 References

- .1 The National Building Code of Canada 2020, Part 8-Safety Measures on Construction and Demolition Sites.
- .2 CSA Group (CSA)
 - .1 CSA S350-M1980 (R2003) Code of Practice for Safety in Demolition of Structures
- .3 ASTM International (ASTM)
 - .1 ASTM F710-22 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
- .4 Ontario Provincial Regulations
 - .1 Ontario Regulation 102/94 Waste Audits and Waste Reduction Work Plans.
 - .2 Ontario Regulation 103/94 Environmental Protection Act.
 - .3 Ontario Regulation 213/07 The Fire Code.
 - .4 Ontario Regulation 232/98 Landfilling Sites.
 - .5 Ontario Regulation 278/05 Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations.
 - .6 Ontario Regulation 347 Environmental Protection Act, General — Waste Management.
 - .7 Ontario Regulation 332/12 The Building Code.
- .5 The Workplace Health and Safety Act, and Regulations for Construction Projects.
- .6 The Contractors Health and Safety Policy.
- .7 Laws, rules and regulations of other authorities having jurisdiction.

1.3 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit detailed written schedule, methodology and proposed procedures for demolition, including a Safe Work Plan for review prior to commencement of demolition.
- .3 Where required by authorities having jurisdiction, submit for approval drawings, diagrams or details clearly showing sequence of disassembly work or supporting structures and underpinning.
- .4 Drawings for structural elements of the demolition process including shoring, underpinning and installation of new lintels or beams in existing load bearing walls, shall bear signature and stamp of qualified professional engineer registered in the Province of Ontario.
- .5 Submit proposed dust-control measures.
- .6 Submit proposed noise-control measures.
- .7 Submit schedule of demolition activities indicating the following:
 - .1 Detailed sequence of demolition and removal work, including start and end dates for each activity.
 - .2 Dates for shutoff, capping, and continuation of utility services.
- .8 If hazardous materials are encountered and disposed of, landfill records indicating receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

- .9 At Project Closeout: Submit record drawings in accordance with Section 01 78 00. Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions

1.4 Permits

- .1 Obtain and pay for all permits and comply with all laws, rules, ordinances, and regulations relating to Demolition of Building and preservation of Public Health and Safety.
- .2 The Consultant will complete General Review during demolition in accordance with the Ontario Building Code. All other engineering required for shoring design and for other structural elements of the demolition work will be completed by the Contractor's own engineer and paid for by the Contractor.

1.5 Waste Management Plan

- .1 All work of this section shall be completed in accordance with the contractors approved Waste Management Plan specified in Section 01 74 19.

1.6 Definitions

- .1 Chemical Waste: Includes petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals and inorganic wastes.
- .2 Demolition Waste: Building materials and solid waste resulting from construction, remodeling, repair, cleanup, or demolition operations that are not hazardous. This term includes, but is not limited to, asphalt concrete, Portland cement concrete, brick, lumber, gypsum wallboard, cardboard and other associated packaging, roofing material, ceramic tile, carpeting, plastic pipe, and steel. The materials may include rock, soil, tree stumps, and other vegetative matter resulting from land clearing and landscaping for construction or land development projects.
- .3 Environmental Pollution and Damage: The presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human or animal life; affect other species of importance to humanity; or degrade the utility of the environment for aesthetic, cultural or historical purposes.
- .4 Inert Fill: A permitted facility that accepts inert waste such as asphalt and concrete exclusively for the purpose of disposal.
- .5 Inert Solids/Inert Waste: Non-liquid solid waste including, but not limited to, soil and concrete that does not contain hazardous substances or soluble pollutants at concentrations in excess of water-quality standards established by a regional water board and does not contain significant quantities of decomposable solid waste.
- .6 Landfill: A landfill that accepts non-hazardous materials such as household, commercial, and industrial waste, resulting from construction, remodeling, repair, and demolition operations. A landfill must have a solid waste facilities permit from the Ministry of the Environment and be in conformance to O. Reg 232/98.
- .7 Recycling: The process of sorting, cleansing, treating and reconstituting materials for the purpose of using the altered form in the manufacture of a new product. Recycling does not include burning, incinerating or thermally destroying solid waste

- .8 Remove: Remove and legally dispose of items, except those identified for use in recycling, re-use, and salvage programs.
- .9 Reuse: The use, in the same or similar form as it was produced, of a material which might otherwise be discarded.
- .10 Solid Waste: All putrescible and non-putrescible solid, semisolid, and liquid wastes, including garbage, trash, refuse, paper, demolition and construction wastes, abandoned vehicles and parts thereof, discarded home and industrial appliances, dewatered, treated, or chemically fixed sewage sludge which is not hazardous waste, manure, vegetable or animal solid and semisolid wastes, and other discarded solid and semisolid wastes. "Solid waste" does not include hazardous waste, radioactive waste, or medical waste as defined or regulated by law.

1.7 Quality Assurance

- .1 Demolition Firm Qualifications: Demolition contractor shall be an experienced firm that has successfully completed demolition Work similar to that indicated for this Project.
- .2 Regulatory Requirements: Comply with governing regulations before starting demolition. Comply with hauling and disposal regulations of authorities having jurisdiction. Obtain and pay for all permits required.
- .3 Pre-demolition Conference: Conduct a conference at Project site.
 - .1 Review the environmental goals of this Project and make a proactive effort to increase awareness of these goals among all labor forces on site.
 - .2 Review schedule and scheduling procedures.
 - .3 Review health and safety procedures.
 - .4 Review of Project conditions including review of record photographs.

1.8 Project Conditions

- .1 Construct safety barriers, barricades, fencing and hoarding to separate public from work areas as described in Section 01 56 00.
- .2 The Owner assumes no responsibility for the actual condition of the structures to be demolished.
- .3 Conditions existing at the time of inspection for bidding purposes will be maintained by the Owner insofar as practicable. Variations within the structures may occur by the Owner's salvage operations prior to start of demolition.

PART 2 PRODUCTS

2.1 Materials

- .1 Provide all materials necessary for temporary shoring. On completion, remove temporary materials from site.
- .2 All building materials removed from the building shall become the property of the Contractor unless specified otherwise and shall be reused in new construction or removed from the Site.
- .3 All concrete, masonry, asphalt and similar materials shall be crushed prior to disposal.

2.2 Salvage

- .1 All items of salvageable value must be salvaged.
- .2 Provide a schedule of items to be salvaged and clearly indicate which items are to be retained by Owner. Clearly identify and tag each salvageable item.
- .3 Transport salvaged items from the site as they are removed.
- .4 Items of salvageable value to the Contractor may be removed from the structure as the work progresses, if such items are not claimed by the Owner.

2.3 Reuse

- .1 Salvage and reuse materials as indicated on the drawings.

2.4 Recycle

- .1 All materials from demolition and land clearing which can be recycled through local municipal programs and which is not scheduled for salvage shall be sorted and separated in accordance with Regional, Provincial and Municipal standards and regulations.
- .2 Provide recycling receptacles for the duration of construction activities at the building site.

PART 3 EXECUTION

3.1 Examination

- .1 Survey existing conditions and correlate with requirements indicated to determine extent of demolition, salvage and recycling required.
- .2 Verify that utilities have been disconnected and capped.
- .3 Survey condition of the building to determine whether removing any element might result in a structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during demolition.
- .4 Retain a licensed and qualified civil or structural engineer to provide analysis, including calculations, necessary to ensure the safe execution of the demolition work.
- .5 Perform surveys and tests as the Work progresses to detect hazards resulting from demolition activities.
- .6 Preliminary Survey:
 - .1 The Demolition Plans indicate the general extent of existing conditions based upon drawings provided by the Owner and existing site conditions. Review all areas of work to determine full extent of areas to be demolished, altered or renovated and become familiar with actual conditions and extent of work required.
 - .2 Before commencing demolition operations, examine Site and provide engineering survey to determine type of construction, condition of structure, and Site conditions. Assess strength and stability of damaged or deteriorated structures.
 - .3 Assess potential effect of removal of any part or parts on the remainder of structure before such part(s) are removed.

- .4 Assess effects of demolition at adjacent structures and consider need for underpinning, shoring and/or bracing.
- .5 Investigate for following conditions:
 - .1 load bearing walls and floors
 - .2 structure suspended from another
 - .3 effects of soils, water, lateral pressures on retaining or foundations walls
 - .4 presence of tanks and other piping systems
 - .5 presence of designated substances and hazardous materials.
- .7 After determining demolition methods, determine area of possible vibration. Carefully inspect beyond those adjacent areas. List potential damage areas and photograph each for record purposes before starting work.

3.2 Preparation

- .1 Erect and maintain dustproof and weatherproof partitions as required to prevent spread of dust, fumes and smoke to other parts of building. Maintain fire exits. On completion, remove partitions and make good surfaces to match adjacent surfaces of building.
- .2 Provide all shoring and bracing required for the execution of the work.
- .3 Before commencing demolition, verify that existing water, gas, electrical and other services in areas being demolished are cut off, capped diverted or removed as required. Post warning signs on electrical lines and equipment which must remain energized to serve adjacent areas during period of demolition.

3.3 Utilities

- .1 Contact authorities or utility companies for assistance in locating and marking services passing under, through, overhead or adjacent to structure to be demolished. Such services include:
 - .1 Electrical power lines
 - .2 Gas mains
 - .3 Communication cables
 - .4 Fibre optic cables
 - .5 Water lines.
 - .6 Drainage piping (storm and sanitary).
- .2 Before disconnecting, removing, plugging or abandoning any existing utilities serving the building:
 - .1 Notify the Owner, applicable utility companies, and local authorities having jurisdiction.
 - .2 Cut off and cap utilities at the mains on the property or in the street as required by the Owner and responsible utility company. Maintain fire protection to the existing buildings at all times.
 - .3 Remove, cut off and plug, or cap all utilities within the existing building areas to be demolished, except those designated to remain

3.4 Protection

- .1 Erect and maintain temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction. Maintain such areas free of snow, ice, water and debris. Lighting levels shall be equal to that prior to erection.
- .2 Provide safe access and egress from working areas using entrances, hallways, stairways or ladder runs, protected to safeguard personnel using them from falling debris.

- .3 Do not interfere with use and activities of adjacent buildings and site. Maintain free and safe passage to and from buildings.
- .4 Where demolition operations prevent normal access to adjacent properties, provide and maintain suitable alternative access.
- .5 Ensure that all necessary controls are in place at the beginning of each work period which will prevent the spread of contaminated material beyond the work area limits. Stop work immediately if there exists any possibility of the spread of contaminated materials.
- .6 Keep dust from entering existing facilities and areas of building not affected by the Work. Comply with Ministry of Health requirements regarding debris control.
- .7 Ensure scaffolds, ladders, equipment and other such equipment are not accessible to public. Protect with adequate fencing or remove and dismantle at end of each day or when no longer required.
- .8 Take precautions to guard against movement, settlement or collapse of adjacent structures, services or driveways. Be liable for such movement, settlement or collapse caused by failure to take necessary precautions. Repair promptly such damage when ordered.
- .9 If Owner considers additional bracing and shoring necessary to safeguard and prevent such movement or settlement, install bracing or shoring upon Owner's orders.
- .10 Particular attention shall be paid to prevention of fire and elimination of fire hazards which would endanger new work or existing premises.
- .11 Protect existing adjacent work against damages which might occur from falling debris or other causes due to work of this Section.
- .12 At all times protect the structure from overloading.
- .13 Provide protection around floor openings.
- .14 Protect from weather, parts of adjoining structures not previously exposed.
- .15 Protect interiors of building parts not to be demolished from exterior elements at all times.
- .16 At end of each day's work, leave work in safe condition so that no part is in danger of toppling or falling.

3.5 Temporary Ventilation

- .1 Provide all required temporary ventilation for demolition work.

3.6 Environmental Controls

- .1 Comply with provincial and municipal regulations pertaining to water, air, solid waste, recycling, chemical waste, sanitary waste, sediment and noise pollution.
- .2 Dust Control, Air Pollution, and Odour Control: Prevent creation of dust, air pollution and odors.

- .1 Use temporary enclosures and other appropriate methods to limit dust and dirt rising and scattering in air to lowest practical level.
- .2 Store volatile liquids, including fuels and solvents, in closed containers.
- .3 Properly maintain equipment to reduce gaseous pollutant emissions.
- .3 Noise Control: Perform demolition operations to minimize noise.
 - .1 Provide equipment, sound deadening devices, and take noise abatement measures that are necessary to comply with municipal regulations.
- .4 Salvage, Re-Use, and Recycling Procedures:
 - .1 Identify re-use, salvage, and recycling facilities.
 - .2 Develop and implement procedures to re-use, salvage, and recycle demolition materials.
 - .3 Identify materials that are feasible for salvage, determine requirements for site storage, and transportation of materials to a salvage facility.
 - .4 Source-separate clean and uncontaminated demolition materials including, but not limited to the following types:
 - .1 Concrete, Concrete Block, Concrete Masonry Units (CMU), Brick.
 - .2 Metal (ferrous and non-ferrous).
 - .3 Wood.
 - .4 Glass.
 - .5 Plastics and Insulation.
 - .6 Gypsum Board.
 - .7 Porcelain Plumbing Fixtures.
 - .8 Fluorescent Light Tubes.
 - .9 Paper: Bond, Newsprint, Cardboard, Paper, Packaging Materials.
 - .10 Other materials as appropriate.

3.7 Performance

- .1 Ensure demolition work is supervised by competent foreman at all times.
- .2 Demolition shall proceed safely in systematic manner. Work on each floor level shall be complete before commencing work on supporting structure and safety of its supports are impaired. Parts of building which would otherwise collapse prematurely shall be securely shored. Walls and piers shall not be undermined.
- .3 Until acceptance, maintain and preserve active utilities traversing premises.
- .4 Provide enclosed chutes for disposal of debris from heights more than 1 storey in accordance with CSA S350.

3.8 Demolition

- .1 Review demolition procedures to ensure no personnel or equipment are located or working without additional safe working platforms or working surface adequate to support the operations.
- .2 Any damage caused to the adjacent buildings or properties by the neglect of the Contractor or any of his forces shall be made good at the expense of the Contractor including all costs and charges which may be claimed by the Owner for damages suffered.
- .3 Demolish in a manner to minimize dusting. Keep dusty materials wetted at all times.

- .4 Demolition: Use methods required to complete Work within limitations of governing regulations and as follows:
 - .1 Locate demolition equipment throughout the building and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - .2 Demolish concrete and masonry in sizes that will be suitable for acceptance at recycling or disposal facilities.
 - .3 Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 - .4 Break up and remove concrete slabs on grade in small sizes, suitable for acceptance at recycling or disposal facilities, unless otherwise shown to remain.
 - .5 Remove all disconnected, abandoned utilities.
 - .6 Remove all finishes, fixtures, fitments and services as indicated
 - .7 Damages: Promptly repair damages to adjacent facilities caused by demolition operations.
 - .8 Prevent access to excavations by means of fences or hoardings.

3.9 Selective Demolition

- .1 Carefully dismantle and remove all items in as shown and as necessary to complete the work.
- .2 Salvage items scheduled for reuse or to be handed over to the Owner.
- .3 Particular attention shall be paid to prevention of fire and elimination of fire hazards which would endanger the existing buildings.
- .4 Where existing flooring is to be removed from floor slabs to remain, including ceramic tile flooring, carefully remove flooring, grout, adhesives, waterproofing membranes and the like down to the base slab. Patch and repair slab where damaged with concrete or acceptable leveling compound in accordance with new flooring manufacturer's instructions and ASTM F710. Refer to original building drawings and remove and replace existing concrete floor toppings as necessary and where required.
- .5 Return areas to condition existing prior to the start of the work unless indicated otherwise.
- .6 At interior bearing walls to be removed, include breaking out and removal of existing concrete foundations to a minimum of 200 mm below new finished floor level.

3.10 Handling of Demolished Materials

- .1 Conform to the approved Waste Management Plan.
- .2 Do not allow demolished materials to accumulate or be stored on-site for more than 5 days.
- .3 Do not burn, bury or otherwise dispose of rubbish and waste materials on project site.
- .4 Pallet and shrink-wrap materials scheduled for re-use and stockpile where directed on site.
- .5 Disposal: Transport demolished materials off Owner's property and legally reuse, salvage, recycle, or dispose of materials. Legally transport and dispose of materials that cannot be delivered to a source separated or mixed recycling facility to a transfer station or disposal facility that can legally accept the materials for the purpose of disposal.

- .6 Deliver to facilities that can legally accept new construction, excavation and demolition materials for purpose of re-use, recycling, composting, or disposal.

3.11 Cleaning

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Reinstate areas and existing works outside areas of demolition to conditions that existed prior to commencement of work.
- .3 Upon completion of demolition work, remove debris, trim surfaces and leave work site clean.

End of Section

PART 1 GENERAL

1.1 General

- .1 Conform to the requirements of Division 1.

1.2 Related Sections

- .1 Section 04 22 00 Concrete Unit Masonry

1.3 References

- .1 ASTM International (ASTM)
 - .1 ASTM A153/A153M-23 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- .2 CSA Group (CSA)
 - .1 CSA A23.1-14/A23.2-14 Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete.
 - .2 CSA S304-14 Design of Masonry Structures.
 - .3 CAN/CSA A371-14 Masonry Construction for Buildings.
 - .4 CSA G30.3-M1983 (R1998) Cold-Drawn Steel Wire for Concrete Reinforcement.
 - .5 CSA G30.18-09 (R2014) Carbon Steel Bars for Concrete Reinforcement
 - .6 CSA W186-M1990 (R2016) Welding of Reinforcing Bars in Reinforced Concrete Construction
- .3 American Concrete Institute (ACI)
 - .1 Detailing Manual
- .4 Reinforcing Steel Institute of Canada (RSIC)
 - .1 Reinforcing Steel Manual of Standard Practice

1.4 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data: Submit manufacturer's printed product literature, specifications and data sheets.
- .3 Shop Drawings:
 - .1 Submit shop drawings for all masonry reinforcing. Include placing drawings, bar lists and details. Indicate clearly reinforcing bar sizes, spacing, bending details, lap details, dowels to adjacent construction location and quantities of reinforcement and connectors.
 - .2 Prepare placing drawings and bar lists in accordance with the American Concrete Institute (ACI) Detailing Manual, and the Reinforcing Steel Institute of Canada (RSIC) Reinforcing Steel Manual of Standard Practice, the typical details included with Contract Documents.
 - .3 Prepare placing drawings to minimum scale of 1:50.
 - .4 Submit placing drawings and bar lists sufficiently detailed and dimensioned to permit correct placement of reinforcement and accessories without reference to architectural or structural Drawings.
 - .5 Show reinforcement, including dowels, in elevation on placing drawings for wall reinforcement.
 - .6 Show cover to reinforcement
 - .7 Show location of construction joints.

1.5 Shipping, Handling and Storage

- .1 Refer to Section 01 61 00 – Common Product Requirements.

- .2 Deliver, handle and store materials in accordance with manufacturer's printed instructions.

1.6 Waste Management and Disposal

- .1 Refer to Section 01 74 19 – Construction Waste Management and Disposal.

PART 2 PRODUCTS

2.1 Materials

- .1 All metal components: hot dipped zinc galvanized to CSA S304 unless otherwise indicated.
- .2 Bar Reinforcement: To CSA A371 and CSA G30.18, grade 400R, deformed billet steel bars.
- .3 Wire Reinforcement: To CSA A371 and CSA G30.3.
 - .1 Interior walls: hot dipped galvanized to CSA S304
 - .1 4.76 mm wire diameter hot dipped galvanized to CSA S304 for interior bearing walls.
 - .2 3.66 mm wire diameter bright wire finish, standard duty for interior non-bearing walls and partitions
 - .3 Truss Type: Blok-Trus BL-30 by Blok-Lok Ltd. for non-vertically reinforced walls
 - .4 Ladder Type: Blok-Trus BL-10 by Blok-Lok Ltd. for vertically reinforced walls
- .4 Equivalent products as manufactured by the following manufacturer's may be used subject to submission and acceptance by the Consultant of technical data:
 - .1 Hohmann and Barnard Inc.

2.2 Fabrication

- .1 Fabricate reinforcing in accordance with CSA A23.1 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Ontario.
- .2 Obtain Consultant's approval for locations of reinforcement splices other than shown on placing drawings.
- .3 Upon approval of Consultant, weld reinforcement in accordance with CSA W186.
- .4 Ship reinforcement clearly identified in accordance with drawings.

PART 3 EXECUTION

3.1 Installation

- .1 Install masonry reinforcement and anchors in accordance with CSA A370, CSA A371, CSA A23.1 and CSA S304 unless indicated otherwise.

3.2 Reinforcement

- .1 Unless otherwise noted, all masonry walls shall be reinforced with joint reinforcement.

- .2 Reinforcement shall be installed in the first and second bed joints, 200 mm apart immediately above lintels and below sill at openings, and in bed joints at 400 mm vertical intervals elsewhere. Reinforcement in the second bed joint above or below openings shall extend 600 mm beyond the jambs. All other reinforcement shall be continuous except that it shall not pass through vertical masonry control joints. Side rods shall be lapped at least 150 mm at splices.
- .3 Use prefabricated corner and tee sections for continuous reinforcement at corners and intersecting walls.
- .4 Vertical reinforcement shall have a minimum clearance of 13 mm from the masonry and not less than one bar diameter between bars.
- .5 All block cores containing vertical reinforcing and/or anchor bolts shall be solidly filled with non-shrink grout.
- .6 Place reinforcement and ties in grout spaces prior to grouting.
- .7 Cleanouts: Provide cleanouts in the bottom course of masonry for each grout pour when the grout pour height exceeds 1.5 m.
- .8 Construct cleanouts so that the space to be grouted can be cleaned and inspected. In solid grouted masonry, space cleanouts horizontally a maximum of 800 mm on center.
- .9 Construct cleanouts with an opening of sufficient size to permit removal of debris. The minimum opening dimension shall be 76 mm.
- .10 After cleaning, close cleanouts with closures braced to resist grout pressure.

3.3 Reinforced Lintels and Bond Beams

- .1 Reinforce masonry lintels and bond beams as indicated.
- .2 Place and grout reinforcement in accordance with CSA S304.

3.4 Lateral Support and Anchorage

- .1 Do lateral support and anchorage in accordance with CSA S304 and as indicated.

3.5 Control Joints

- .1 Terminate reinforcement 25 mm short of each side of control joints unless otherwise indicated.
- .2 Control joints shall be stepped to avoid cutting lintel beams. Under no circumstance shall the control joints be placed to compromise the bearing for the lintel.

3.6 Field Bending

- .1 Do not field bend reinforcement and connectors except where indicated or authorized by Consultant.
- .2 When field bending is authorized, bend without heat, applying a slow and steady pressure.

- .3 Replace bars and connectors which develop cracks or splits.

3.7 Field Touch Up

- .1 Touch up damaged and cut ends of galvanized reinforcement steel and connectors with compatible finish to provide continuous coating.

3.8 Cleaning

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.

End of Section

PART 1 GENERAL

1.1 General

- .1 Conform to the requirements of Division 1.

1.2 Related Sections

- .1 Section 04 05 19 Masonry Anchorage and Reinforcing
- .2 Section 06 10 00 Rough Carpentry
- .3 Section 07 92 00 Joint Sealants
- .4 Section 08 11 00 Metal Doors and Frames
- .5 Section 09 91 23 Interior Painting

1.3 References

- .1 ASTM International (ASTM)
 - .1 ASTM C90-22 Standard Specification for Loadbearing Concrete Masonry Units
 - .2 ASTM C129-22 Standard Specification for Nonloadbearing Concrete Masonry Units
 - .3 ASTM C150/C150M-22 Standard Specification for Portland Cement
 - .4 ASTM C207-18 Standard Specification for Hydrated Lime for Masonry Purposes.
 - .5 ASTM D2240-15(2021) Standard Test Method for Rubber Property—Durometer Hardness.
 - .6 ASTM D5249-10(2021) Standard Specification for Backer Material for Use with Cold and Hot Applied Joint Sealants in Portland Cement Concrete and Asphalt Joints.
- .2 CSA Group (CSA)
 - .1 CSA A23.1-14/A23.2:19 Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete.
 - .2 CSA A165 Series-14 (R2019) CSA Standards on Concrete Masonry Units.
 - .3 CSA A179-14 (R2019) Mortar and Grout for Unit Masonry
 - .4 CSA A370-14 (R2018) Connectors for Masonry.
 - .5 CSA A371-14 (R2019) Masonry Construction for Buildings.
 - .6 CSA S304-14 (R2019) Design of Masonry Structures.
- .3 Canadian Concrete Masonry Producers Association (CCMPA) Quality Assurance Program.

1.4 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Data: Submit manufacturer's printed product literature, specifications and data sheets
- .3 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Inspection Reports: Inspection and Testing Company shall submit reports of inspections and tests.
 - .1 Distribute inspection reports as follows:
 - .1 Consultant.
 - .2 Structural Engineer
 - .3 Contractor.

1.5 Quality Assurance

- .1 The masonry sub-contractor shall have a minimum of five years of continuous documented Canadian experience in work of the type and quality shown and specified. Proof of experience shall be submitted when requested by the Consultant and shall be subject to the approval of the Consultant.
- .2 Field Quality Control:
 - .1 Inspection and testing will be carried out by Testing Laboratory designated by Owner.
 - .2 Payment for specified Work performed by Inspection and Testing Company will be made from Cash Allowance.
 - .3 Inspection and Testing Company shall perform sampling, inspection and testing of masonry work at site, in accordance with referenced standards, including but not limited to the following:
 - .1 Masonry Placement Inspection
 - .2 Reinforcing Steel Placement
 - .3 Grout and Mortar Testing
 - .4 CMU Testing
 - .4 Review provided by Inspection and Testing Company does not relieve Contractor of his sole responsibility for quality control over Work. Performance or non-performance of Inspection and Testing Company shall not limit, reduce, or relieve Contractor of his responsibilities in complying with the requirements of the Specification.
 - .5 Provide access to Work for inspectors.

1.6 Shipping, Handling and Storage

- .1 Refer to Section 01 61 00 – Common Product Requirements.
- .2 Deliver, handle and store materials in accordance with manufacturer's printed instructions.
- .3 Materials shall be kept clean and dry.
- .4 Deliver cement, lime and mortar ingredients with manufacturer's seal and labels intact.
- .5 Cementitious material and aggregates shall be stored in accordance with the requirements of CSA A23.1.
- .6 Exposed units which become stained or chipped, surface marked or scratched, and materials which are affected by inadequate protection shall be replaced, at no additional expense to the Owner.

1.7 Project Conditions

- .1 Provide heat enclosures and heat as required.
- .2 Work to be undertaken shall be carried out according to CAN3-A371, Clause 5.15.2.
- .3 Maintain temperature of mortar between 5 ° C and 50 ° C until batch is used.
- .4 Keep masonry dry using secure waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven snow, rain and dirt, until masonry work is completed and protected by flashings or other permanent construction.

- .5 Protect masonry and other work from marking and other damage. Protect completed work from mortar droppings. Use non-staining coverings.

1.8 Waste Management and Disposal

- .1 Refer to Section 01 74 19 – Construction Waste Management and Disposal.

PART 2 PRODUCTS

2.1 Materials

- .1 Masonry Units: Concrete Block: Modular, conforming to CCMPA requirements and CSA A165.1.
 - .1 H/15/A/M concrete, masonry units, at all other locations unless noted otherwise.
 - .2 Special shapes: provide special shapes indicated or required including bullnose and corner blocks, base blocks, fillers, and the like as may be required. Provide purpose made shapes for lintels and bond beams.
 - .3 Exposed block shall all be made by one manufacturer and shall be uniform in colour, shade and texture.
- .2 Bar Reinforcement, wire reinforcement, connectors and ties: as specified in Section 04 05 19 - Masonry Anchorage and Reinforcing.
- .3 Control Joint Filler: to ASTM D5249-10, Type 1, Round, flexible, continuous-length, nonabsorbent, nongassing, nonstaining, and nonshrinking. Extruded from a cross-linked polyethylene. Flexible foam, heat-Resistant Backer Rod. 9.5 mm thick by width of wall.
- .4 Pre-manufactured Masonry Control Joint: Pre-manufactured polyvinylchloride control joints may be used in lieu of the specified built-up type of joint.
- .5 Mortar: Conforming to CSA A179.
 - .1 Use same brand of material and source of aggregate for entire project.
 - .2 Aggregate: CSA A179, fine grain aggregates.
 - .3 Cement: normal Portland to ASTM C150, Type 10.
 - .4 Water shall be clean, potable and free of deleterious amounts of acid, alkalies, or organic materials.
 - .5 Hydrated Lime: Type 'S' to ASTM C207.
 - .6 Type 'S' mortar shall be used for all concrete block masonry work.
 - .7 Proprietary Mortar Mixes: conform to mix requirements specified
 - .8 Mortar colour for concrete unit masonry work shall be grey.
 - .9 Admixtures of any kind are not allowed.
- .6 Grout: to CSA A179, Table 3: Premixed, non-shrink non-metallic grout.
- .7 Other materials not specifically described but required for a complete and proper installation of masonry, shall be as selected by the Contractor subject to approval by the Consultant

2.2 Mixes

- .1 Mixing: Prepare and mix mortar materials under strict supervision, and in small batches only for immediate use.

- .2 Mix proprietary mortars in strict accordance with manufacturer's instructions to produce the specified mortar types in accordance with CSA A179. Do not use re-tempered mortars.
- .3 Take representative samples for testing consistency of strength and colour according to CSA A179.

2.3 Accessories

- .1 Mechanical Fasteners: As recommended by manufacturer of material to be fastened, and in accordance with the reference standards, corrosion resistant.

PART 3 EXECUTION

3.1 Examination

- .1 Examine work of other trades for defects or discrepancies and report same in writing to Consultant.
- .2 Installation of any part of this work shall constitute acceptance of such surfaces as being satisfactory.

3.2 General

- .1 Do masonry work in accordance with CSA A371 except where specified otherwise.
- .2 A competent masonry foreman shall supervise and direct the work and only skilled masons shall execute the work of this Section.
- .3 Coordinate work of this Section with others such as, field welding of anchors to steel work, insulation application, and the like. Prepare all items for built-in as the work proceeds, either supplied and installed by other trades or installed under this Section.
- .4 Unless otherwise indicated on the drawings, all interior masonry partitions shall extend from floor level to the underside of floor or roof structures above.

3.3 Installation

- .1 Build masonry plumb, level, and true to line, with vertical joints in alignment.
- .2 Lay out coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.
- .3 Lay block with webs to align plumb over each other with thick ends of webs up. The top course of all partitions which do not pass through a ceiling or up to the underside of a roof deck shall have the open cells filled solid.
- .4 Cut exposed block with power driven abrasive cutting disc or diamond cutting wheel for flush mounted electrical outlets, grilles, pipes, conduits, leaving 3 mm maximum clearance.
- .5 Fill all vertical and bed joints, including plain end faces, through the entire wall thickness solidly with mortar.

- .6 Do not break bond of exposed walls where partitions intersect and if bond would show through on exposed face of walls. Bond these partitions to walls they intersect with prefabricated intersection masonry reinforcement in each course.
- .7 Bond intersecting block walls in alternate courses.
- .8 Terminate non load bearing walls within 20 mm of structure above unless indicated otherwise.
- .9 Where walls are pierced by structural members, ducts, pipes, fill voids with mortar to within 20 mm of such members.
- .10 Buttering corners of units, throwing mortar droppings into joints, deep or excessive furrowing of bed joints, is not permitted. Do not shift or tap units after mortar has taken initial set. Where adjustment must be made after mortar has started to set, remove mortar and replace with fresh supply.
- .11 Do not wet concrete masonry before or during laying in wall.
- .12 Bed and vertical joints shall be evenly and solidly filled with mortar.
- .13 Provide reinforced bond beams where indicated on structural drawings.
- .14 Provide vertical reinforcement as indicated on structural drawings. Fill all reinforced cores solid with grout as indicated. Provide cleanout port at bottom of each grouted core when required by Consultant.

3.4 Exposed Masonry

- .1 Do not use chipped, cracked or stained, and otherwise damaged units or unsatisfactory material in exposed and load bearing masonry walls.
- .2 Lay all joints 10 mm thick (uniform). All joints shall be full of mortar except where specifically designated to be left open.
- .3 All joints shall be slightly concave. Use sufficient force to press mortar tight against masonry units on both sides of joints. Remove excess material or burrs left after jointing by means of a trowel or rubbing with burlap bag.
- .4 Provide bullnose block at all exposed masonry corners.

3.5 Tolerances

- .1 Tolerances in notes to Clause 5.3 of CSA A371 apply.

3.6 Reinforcement

- .1 Refer to Section 04 05 19 - Masonry Anchorage and Reinforcing.

3.7 Concrete Masonry Lintels

- .1 Refer to Section 04 05 19 - Masonry Anchorage and Reinforcing.

- .2 Lintels in non-load-bearing walls shall be constructed with special bond or lintel block units unless shown otherwise on plans. Lintels shall bear 200 mm minimum and bearing shall be isolated with two layers of heavy asphalt coated paper.
- .3 Reinforcing steel in lintels shall be 2 x 20 M bars minimum specified under Section 04 05 19 - Masonry Anchorage and Reinforcing, or as noted on drawings.
- .4 Concrete fill for lintels shall be 25 MPa or as noted on the drawings. Concrete shall be as specified in Section 03 30 00.

3.8 Loose Steel Lintels

- .1 Install loose steel lintels. Centre over opening width.
- .2 Lintels supplied under Section 05 50 00 – Metal Fabrications.

3.9 Control Joints

- .1 Provide continuous joints as indicated and at spacing not to exceed 6000 mm c/c unless noted otherwise on drawings.
- .2 Break vertical mortar bond with extruded neoprene gasket or building paper.
- .3 Prime control joint to prevent drying out of caulking material.

3.10 Support of Loads

- .1 Use 25 MPa concrete unless specified otherwise on the Drawings, where concrete fill is used in lieu of solid units.
- .2 Use grout to CSA A179 where grout is used in lieu of solid units.
- .3 Install building paper below voids to be filled with grout. Keep paper 25 mm back from face of units.

3.11 Lateral Support and Anchorage

- .1 Do lateral support and anchorage of masonry in accordance with CSA S304.1 and as indicated.

3.12 Grouting

- .1 Grout masonry in accordance with CSA S304.1 and as indicated.

3.13 Temporary Wall Bracing

- .1 Design and provide all required temporary engineered wall bracing.
- .2 Brace masonry walls to resist wind pressure and other lateral loads during construction period.
- .3 Provide temporary bracing of masonry work during and after erection until mortar has cured and permanent lateral support is in place.

3.14 Built-ins

- .1 Build in items required to be built into masonry and provided by other Sections, including bearing plates, door frames, anchor bolts, sleeves and inserts. Build in items to present a neat, rigid, true and plumb installation. Leave wall openings required for ducts, grilles, pipes and other items.
- .2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.
- .3 Brace door jambs to maintain plumb. Fill voids between masonry and metal frames with masonry mortar or insulation, as indicated on drawings or as required to provide a neat, finished appearance.
- .4 Set wall plates on masonry in non-shrink grout in accordance with manufacturer's instructions.
- .5 Do all cutting, fitting, drilling, patching and making good for other trades in masonry work.

3.15 Protection

- .1 Protect masonry units from damage resulting from subsequent construction operations.
- .2 Use protection materials and methods which will not stain or damage masonry units.
- .3 Remove protection materials upon Substantial Performance, or when risk of damage is no longer present.

3.16 Cleaning

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Allow mortar droppings on unglazed concrete masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block and finally by brushing.
- .3 Remove mortar from concrete floor slabs and leave entire area vacuum clean.

End of Section

PART 1 GENERAL

1.1 General

- .1 Conform to the requirements of Division 1.

1.2 Related Sections

- .1 Section 04 22 00 Concrete Unit Masonry
- .2 Section 06 40 00 Architectural Woodwork
- .3 Section 08 11 00 Metal Doors and Frames
- .4 Section 09 21 16 Gypsum Board
- .5 Section 09 22 16 Non-Structural Metal Framing

1.3 References

- .1 ASTM International (ASTM)
 - .1 ASTM A123/A123M-17 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
 - .2 ASTM A653/A653M-23 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
 - .3 ASTM F1667-21a Standard Specification for Driven Fasteners: Nails, Spikes, and Staples
- .2 CSA Group (CSA)
 - .1 CSA A247- M86 (R1996) Insulating Fiberboard.
 - .2 CSA B111-1974(R2003) Wire Nails, Spikes and Staples.
 - .3 CSA G164-18 Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .4 CSA O141:23 Canadian Standard Lumber.
 - .5 CSA O151-17 Canadian Softwood Plywood
 - .6 CSA O437 Series-93 (R2011) Standards on OSB and Waferboard
 - .7 CSA Z809-08 Sustainable Forest Management
- .3 Underwriters Laboratories Canada (ULC)
 - .1 ULC 102-2018 Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .4 National Lumber Grading Authority (NGLA)
 - .1 Standard Grading Rules for Canadian Lumber, Latest Edition.
- .5 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001-2004 FSC Principle and Criteria for Forest Stewardship.
 - .2 FSC-STD-20-002-2004 Structure and Content of Forest Stewardship Standards V2-1
 - .3 FSC Accredited Certified Bodies.

1.4 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Certified Wood: Submit listing of wood products and materials used, produced from wood obtained from forests certified by FSC Accredited Certification Body in accordance with FSC-STD-01-001.

1.5 Quality Assurance

- .1 Sawn lumber shall be identified by the grade stamp of an association or independent grading agency certified by the Canadian Lumber Standards Accreditation Board.

1.6 Shipping, Handling and Storage

- .1 Protect materials, under cover, both in transit and on the site.
- .2 Store materials to prevent deterioration or the loss or impairment of their structural and other essential properties. Do not store materials in areas subject to high humidity and areas where masonry and concrete work are not completely dried out.
- .3 Store sheathing materials level and flat, in a dry location. Protect panel edges from moisture at all times.

1.7 Waste Management and Disposal

- .1 Refer to Section 01 74 19 – Construction Waste Management and Disposal.

PART 2 PRODUCTS

2.1 Materials

- .1 Timber Material shall be 'Grade Stamped'.
- .2 CSA Z809 or FSC Certified.
- .3 Construction Lumber: To CSA O141 Softwood Lumber graded to NLGA Standard Grading Rules for Canadian Lumber, published by the National Lumber Grades Authority. All lumber shall bear grade stamps. Moisture content of softwood lumber not to exceed 19% at time of installation.
 - .1 Framing lumber, plates, furring, blocking, No. 1 SPF.
 - .2 Nailing strips, furring and strapping: No. 4 S-P-F.
 - .3 Fitment framing: No. 1 S-P-F.
- .4 Canadian Softwood Plywood: to CSA O151-M, standard construction, good one or both sides as required, thickness as shown or specified.
- .5 Nails, Spikes and Staples: To ASTM F1667.
- .6 Proprietary Fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, recommended for purpose by manufacturer.
- .7 Adhesive: Contractors gun grade cartridge loaded wood adhesive, general purpose, to ASTM D2559.

PART 3 EXECUTION

3.1 Installation

- .1 Workmanship
 - .1 Execute work using skilled mechanics according to best practice, as specified here.
 - .2 Lay out work carefully and to accommodate work of other trades. Accurately cut and fit; erect in proper position true to dimensions; align, level, square, plumb, adequately brace, and secure permanently in place. Join work only over solid backing.
- .2 Rough Hardware: Include rough hardware such as nails, bolts, nuts, washers, screws, clips, hangers, connectors, strap iron, and operating hardware for temporary enclosures.

- .3 Provide wood nailers, blocking, cants, grounds, furring and similar members where shown and where required for screeding or attachment of other work and surface applied items. Attach to substrate as required to support applied loading.
- .4 Blocking: Provide solid wood backing to support millwork, cabinetwork, equipment, fixtures, railings and accessories and the like, as required. Coordinate with work of other Sections and install all required backing. Any such equipment mounted on gypsum wallboard assemblies or similar assemblies shall be adequately supported.
 - .1 Provide solid wood blocking in all partitions where wall stops are specified in the hardware schedule.
- .5 Coordinate installation of plywood backing in gypsum board partitions with Sections 09 21 16 and 09 22 16.

3.1 Cleaning

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.

End of Section

PART 1 GENERAL

1.1 General

- .1 Conform to the requirements of Division 1.

1.2 Related Sections

- .1 Section 06 10 00 Rough Carpentry
- .2 Section 07 92 00 Joint Sealants
- .3 Section 09 21 16 Gypsum Board
- .4 Section 09 91 23 Interior Painting

1.3 References

- .1 ASTM International (ASTM)
 - .1 ASTM F1667/F1667M-21a Standard Specification for Driven Fasteners: Nails, Spikes, and Staples
- .2 Architectural Woodwork Manufacturer's Association of Canada (AWMAC)
 - .1 Architectural Woodwork Standards Manual
- .3 American National Standards Institute (ANSI)
 - .1 ANSI A208.1-2009 Particleboard
 - .2 ANSI/NPA A208.2-2009 Medium Density Fibreboard (MDF)
 - .3 ANSI/NEMA LD 3-2005 High-Pressure Decorative Laminates (HPDL)
 - .4 ANSI/HPVA HP-1-2009 Standard for Hardwood and Decorative Plywood
- .4 CSA Group (CSA)
 - .1 CSA O112 SERIES-M1977 (R2006) Wood Adhesives
 - .2 CSA O121-08 (R2013) Douglas Fir Plywood
 - .3 CSA O151-17 (R2022) Canadian Softwood Plywood
 - .4 CSA O153:19 Poplar Plywood
 - .5 CSA Z809-08 Sustainable Forest Management
- .5 Canadian General Services Board (CGSB)
 - .1 CAN/CGSB-11.3-M, Hardboard
- .6 Forest Stewardship Council (FSC)
 - .1 FSC-STD-01-001-2004 FSC Principle and Criteria for Forest Stewardship.
 - .2 FSC-STD-20-002-2004 Structure and Content of Forest Stewardship Standards V2-1
 - .3 FSC Accredited Certified Bodies.

1.4 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit shop drawings conforming to AWMAC's STANDARDS (NAAWS).
 - .1 Show proposed assembly, connections, anchorage, materials, dimensions, thickness, and finishes.
 - .2 On casework and countertop elevations show location of backing required for attachment within walls.
- .3 Samples:
 - .1 Submit duplicate, 300 mm long samples of each type of solid wood and 300 x 300 mm samples of each type of plywood used in exposed work and scheduled to receive stained or natural finish, complete with specified finish, prior to fabrication of cabinetwork.

- .2 Veneer samples minimum 304 mm x 304 mm. Each sample set of three to represent range of colour and grain expected.
- .3 Submit full range of manufacturer's standard plastic laminates for selection by the Consultant.
- .4 Submit sample of each type of cabinet hardware component used.

1.5 Quality Assurance

- .1 Unless otherwise specified, carry out finish carpentry work in accordance with the requirements of "Millwork Standards" (latest issue) of Architectural Woodwork Manufacturers' Association of Canada (AWMAC), Custom Grade.
- .2 Woodwork Manufacturer Qualifications:
 - .1 Minimum 5 years of production experience similar to this project, whose qualifications indicate ability to comply with requirements of this Section.
- .3 Preinstallation Conference:
 - .1 Before framing completed hold a meeting with the contractor, casework manufacturer, casework installer, and framing sub-contractor.
 - .2 Review locations of backing required for casework installation as shown on casework shop drawings.
 - .3 Review method of attachment for backing to wall system as shown on architectural drawings.

1.6 Definition

- .1 "Exposed" when referred to in this Section, shall mean all parts which can be viewed and shall include interiors of cabinets, backs of doors, shelving and gables.

1.7 Shipping, Handling and Storage

- .1 Refer to Section 01 61 00 – Common Product Requirements.
- .2 Deliver, handle and store materials in accordance with manufacturer's printed instructions.
- .3 Protect against damage, including damage by excessive changes in moisture content, during delivery and storage. Maintain minimum storage temperature of 16 ° C, and relative humidity of 25% to 55%.
- .4 Cover plastic laminate faces at shop with heavy Kraft paper.
- .5 Do not deliver finish carpentry components to site before all wet trades are completed, the building is closed in and humidity conditions on site are acceptable. Do not deliver during rain or damp weather
- .6 Store materials on site in such a way as to prevent deterioration or loss or impairment of essential properties. Prevent excessive moisture gain of materials.

1.8 Protection

- .1 Provide coverings as necessary to protect finish carpentry components from damage of any kind during storage and after installation.

1.9 Waste Management and Disposal

- .1 Refer to Section 01 74 19 – Construction Waste Management and Disposal.

1.10 Warranty

- .1 Warrant the work of this Section against defects of workmanship and material, for a period of two years from the date of Substantial Performance and agree to make good promptly any defects which occur or become apparent within the warranty period.

PART 2 PRODUCTS

2.1 Materials

- .1 All materials CSA Z809 or FSC Certified.
- .2 Solid Wood:
 - .1 Unless otherwise indicated, provide AWMAC Custom Grade.
 - .2 All wood materials shall be new, straight and clean, free of sap, knots, pitch, and other defects, except as permitted by applicable grading rules.
 - .3 All wood shall be kiln dried to a maximum moisture content of 7%.
 - .4 Softwood: to CSA O141, dressed all sides used in concealed locations.
- .3 Veneers: As required by AWMAC's STANDARDS (NAAWS) for its use and Grade specified. Flat sliced birch veneers from architectural grade flitches to provide uniform grain pattern and colour throughout, free of dark streaks and blemishes. Sharp variation of grain patterns and colour between adjacent jointed pieces is not acceptable.
- .4 Plywood:
 - .1 Veneer core plywood: hardwood with a non-telegraphing grain manufactured with exterior glue. To ANSI/HPVA HP-1-09, minimum five (5) plies.
 - .2 Soft Plywood: to CSA O151-M Standard Grade, solid two sides. Use in concealed locations only, except as indicated.
 - .3 To ANSI/HPVA HP-1-09, Grade A face, book matched, flat cut birch face and No. 3 edge.
- .5 Particleboard: Meeting requirements of AWMAC's STANDARDS (NAAWS). To ANSI A208.1 , minimum density of 720kg/m3 Grade "R".
- .6 MDF: Medium Density Fiberboard meeting requirements of AWMAC's STANDARDS (NAAWS).
- .7 Edgeband
 - .1 For wood veneer casework: Veneer of same species and cut as exposed surfaces.
 - .2 For plastic laminate casework: High Pressure Decorative Laminate (HPDL).
- .8 Plastic laminate facing sheet: ANSI/NEMA LD 3 High-Pressure Decorative Laminates (HPDL) PF-S and GP-S:
 - .1 Backing sheet: BK Grade by manufacturer of facing sheet.
 - .2 Core: CAN3-0188.1M, Grade R.
 - .3 Laminating adhesive: CAN3-O112 Series M.
 - .4 Core sealer: clear water resistant synthetic resin sealer.
 - .5 Colours, pattern, gloss and texture will be selected by Consultant from full range of products by one of the following:
 - .1 Classroom Countertops: Formica Folkstone Celesta 692-58
 - .2 Kitchen Countertops: Formica Navy Grafix 7018-58

- .3 Control Panels: Formica White Matte 949-58.
- .9 Melamine Overlaid Panels:
 - .1 Melamine overlay, heat and pressure laminated with phenolic resin to 12.7 mm thick particle board.
 - .2 Overlay bonded to both faces where exposed two sides, and when panel material require surface on one side only, reverse side to be overlaid with a plain balancing sheet.
 - .3 Furniture finish: solid colour as selected by the Consultant.
 - .4 Edge Finishing: matching melamine and polyester overlay edge strip with self-adhesive.
- .10 Fasteners and Adhesive:
 - .1 Nails and staples: ASTM F1667, galvanized, spiral head nails.
 - .2 Screws: Zinc, cadmium or chrome plated steel.
 - .3 Splines: wood or metal, to suit application.
 - .4 Adhesive: Type 1 waterproof. To CSA O112-M, type as appropriate for the intended application. Complying with ANSI/WDMA I.S.-1 series. Contact bond not acceptable.
 - .5 Avoid the use of adhesives, preservatives, synthesizing agents and finish coatings that contain formaldehyde and high V.O.C. content.
- .11 Cabinet Hardware: Products listed are a standard of acceptance. Products by other manufacturers, of equal quality and similar appearance may also be accepted subject to review and approval by Consultant.
 - .1 Draw bolt fasteners: Knappe & Vogt KV 516
 - .2 Recessed Shelf Standard:
 - .1 Knappe & Vogt KV 255, Zinc, finish.
 - .2 Knappe & Vogt KV 256AL Series Aluminum Shelf Support Clip
 - .3 Hinges: Blum concealed hinges, 125° clip and 125° opening with self-closing spring. Soft close. Full or half overlay. Nickel plated steel.
 - .4 Cabinet Pulls: Richelieu D-Pull No: 30134-170, 96 mm c.c. brushed stainless steel.
 - .5 Cabinet Locks: CCL 0737 pin tumbler MK & KA by room.
 - .6 Catches: Type optional with manufacturer.
 - .7 Drawer Slides: Knappe & Vogt 8450FM Soft-Close Full-Extension Drawer Slide
 - .8 Door Bumpers: "Quietex" bumpers.
 - .9 Closet Rods: Commercial grade steel; long-lasting, corrosion resistant finish. Meets and/or exceeds ANSI/BHMA weight load requirements.
 - .1 Richeleau or Knappe and Vogt. round Closet Rod Tubing, Outside Diameter: 27 mm;
 - .2 2.7 mm wall thickness; inside diameter: 21 mm;
 - .3 Finish: Brilliant Chrome; premium double-plated finish, seamless, pit-free.
 - .4 Size as indicated on the drawings.
 - .5 Closet rod supports as recommended by manufacturer.
 - .10 Coat Hooks: Richeleau Rev-A-Shelf sidelines single coat hook. Chrome finish.
 - .11 Provide other hardware and hardware accessories as detailed or required.
 - .12 All exposed hardware to have Platinum (Mica) finish by Teknion or equivalent unless noted otherwise.

2.2 Fabrication

- .1 Materials and methods of construction to meet requirements of AWMAC's STANDARDS (NAAWS) for grade or grades specified.
 - .1 If there is conflict between plans and/or specifications and AWMAC's STANDARDS (NAAWS), plans and specifications shall govern.
- .2 Wood Casework: AWMAC Standard Custom Grade.

- .3 Construction Type: Frameless
- .4 Cabinet and door interface: Flush overlay.
- .5 Exposed joints and edges:
 - .1 Uniformly space exposed joints unless otherwise indicated.
 - .2 No edge grain shall be visible; mitre external corners, house internal fasteners. Glue mitred corners.
 - .3 All exposed edges of plywood and particle board shall have solid wood edging, pressure glued. AWMAC No. 3 edge.
 - .4 Ease edges of solid lumber components to 1.6 mm radius.
- .6 Mechanical Fasteners:
 - .1 Inconspicuously locate mechanical fasteners. Wherever possible, conceal fastenings.
 - .2 Countersink nail heads.
 - .3 Where exposed to view, countersink screw and bolt heads and fill holes with matching wood plugs.
 - .4 Cutting and fitting: make cut-outs in work of this Section as required to accommodate work of other Sections.
 - .5 Make provisions in cabinetwork to accept built-in appliances, provided by others.

2.3 Wood Casework

- .1 Materials and methods of construction to meet requirements of AWMAC's STANDARDS (NAAWS) for grade or grades specified.
- .2 If there is conflict between plans and/or specifications and AWMAC's STANDARDS (NAAWS), plans and specifications shall govern.
- .3 Wood Casework:
 - .1 Grade: AWMAC's STANDARDS (NAAWS) Custom Grade
- .4 Exposed Surfaces [[species], [cut]], [[book][slip] matched] [material suitable for opaque finish]] meeting requirements of AWMAC's STANDARDS (NAAWS) for Grade specified.
- .5 Exposed interior surfaces: Veneer of same species and cut [and grade] as exposed exterior surfaces.

2.4 Plastic Laminate Casework

- .1 Construct cabinetwork components as indicated and in accordance with AWMAC Custom grade.
- .2 Tenon, dado, dowel, or rabbet interior construction with all parts well glued. Shoulder mitre all exposed corners. Open ends or skeleton frames against walls are not permitted. Unless otherwise permitted by Consultant, use unitized construction system for all components.
- .3 Exposed Surfaces: Factory finished birch veneer meeting requirements of AWMAC's Standards (NAAWS) for Grade specified.
- .4 Exposed Surfaces: High Pressure Decorative Laminate (HPDL), meeting requirements of AWMAC's Standards (NAAWS) for Grade specified.
- .5 Semi-exposed surfaces: LPDL

- .6 Apply self-edged minimum 1.0 mm thick plastic laminate to exposed ends of countertops.
- .7 Rout gables for pilaster strips where adjustable shelving is required.
- .8 Construct shelving with edge moulding to match. Shelving to cabinetwork to be adjustable unless otherwise noted.
- .9 Apply moisture repellent sealer to concealed backs of cabinetwork.
- .10 Install cabinet hardware in accord with hardware manufacturer's directions. Unless otherwise indicated, provide each door with pull and with minimum two hinges. Provide locks where indicated.

2.5 Laminated Plastic Countertops

- .1 Core material: exterior grade hardwood plywood with a non-telegraphing grain.
- .2 Use largest practicable plastic laminate sheet size.
- .3 Back splashes: as indicated, 100 mm high.
- .4 Front edges: As indicated
- .5 Provide joints symmetrically; provide joints as corners and at changes in superficial areas; provide concealed draw bolt anchors and joints. All butt joints shall have a blind spine.

2.6 Finishes

- .1 Plastic laminate as indicated. Colours selected by the Consultant.
- .2 Wood Finish: 3 coats clear polyurethane finish on all sides. Factory finish.
- .3 All exposed interior surfaces: melamine unless indicated otherwise.
- .4 Cabinet and case backs unexposed to view shall be back primed with one coat of moisture repellent sealer.
- .5 Apply finishes in accordance with the AWMAC Manual.

2.7 Factory Finishing

- .1 Grade: AWMAC's STANDARDS (NAAWS) Match grade of product to be finished.

PART 3 EXECUTION

3.1 Examination

- .1 Verify mechanical, electrical, plumbing, HVAC and other building components, affecting work in this Section are in place and ready.
- .2 Verify HVAC controls and systems are operating properly.

- .3 Verify adequacy of backing and support framing. Advise Contractor of areas and surfaces requiring further modifications for plumb, level, even or square fitting.

3.2 Installation

- .1 Install work in accordance with AWMAC Installation Manual, Custom grade.
- .2 Secure all work in place, square, plumb, and level.
- .3 Accurately scribe and closely fit components to irregularities of adjacent surfaces.
- .4 Accurately fit joints in true plane, locate joints over bearing or supporting surfaces.
- .5 Countersink mechanical fasteners used at exposed and semi-exposed surfaces, excluding installation attachment screws and those securing cabinets end to end.
- .6 Where permitted, nail with small headed finishing nails. Countersink nail heads with nail setter.
- .7 Install plastic laminate components using concealed fastening devices.
- .8 Where components are fastened with screws or bolts, countersink screw and bolt heads and provide wood plugs matching surrounding wood.
- .9 Where cabinetwork abuts other building elements, provide wood trim matching cabinetwork except where otherwise detailed.
- .2 Cut equipment cutouts shown on plans using templates provided.
 - .1 Radius internal corners at least 3 mm and chamfer edges.
 - .2 Where core edge is to remain exposed, cover with plastic laminate edging.
 - .3 Where core edge is to be concealed, seal with sealer.
- .10 Where access is required to valves and other mechanical and electrical components, located behind cabinetwork, provide removable plywood access panels of size required and secure with four brass screws.
- .11 Provide for wiring and cable management systems wiring grommets as indicated on the drawings.
- .12 Apply mildew resistant silicone sealant to perimeter of all countertops as specified in Section 07 92 00.

3.3 Adjustment

- .1 Adjust all moving and operating parts to function smoothly and correctly.
- .2 Fill and retouch all nicks, chips and scratches. Replace all un-repairable damaged items.
- .3 Replace damaged components which, in the opinion of the Consultant, cannot be satisfactorily repaired.

3.4 Cleaning

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Upon completion of installation, clean installed items of pencil and ink marks and broom clean the area of operation.

End of Section

PART 1 GENERAL

1.1 General

- .1 Conform to the requirements of Division 1.

1.2 Related Sections

- .1 Section 04 22 00 Concrete Unit Masonry
- .2 Section 06 10 00 Rough Carpentry
- .3 Section 06 40 00 Architectural Woodwork
- .4 Section 08 11 00 Metal Doors and Frames

1.3 References

- .1 ASTM International (ASTM)
 - .1 ASTM C679-15(2022) Standard Test Method for Tack-Free Time of Elastomeric Sealants
 - .2 ASTM C719-22 Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle)
 - .3 ASTM C794-18(2022) Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants
 - .4 ASTM C834-17 Standard Specification for Latex Sealants
 - .5 ASTM C919-22 Standard Practice for Use of Sealants in Acoustical Applications
 - .6 ASTM C920-18 Standard Specification for Elastomeric Joint Sealants
 - .7 ASTM C1087-23 Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems
 - .8 ASTM C1183/C1183M-13(2018) Standard Test Method for Extrusion Rate of Elastomeric Sealants
 - .9 ASTM C1193-16 Standard Guide for Use of Joint Sealants
 - .10 ASTM C1246-17(2022) Standard Test Method for Effects of Heat Aging on Weight Loss, Cracking, and Chalking of Elastomeric Sealants After Cure
 - .11 ASTM C1330-23 Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
 - .12 ASTM E90-09(2016) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
- .2 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .3 South Coast Air Quality Management District (SCAQMD) California State
 - .1 SCAQMD Rule 1168-03: Adhesives and Sealants.

1.4 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit product data for all sealant materials and accessories including:
 - .1 Preparation instructions and recommendations.
 - .2 Standard drawings illustrating manufacturer's recommended sealant joint profiles and dimensions applicable to Project.
- .3 Joint Sealant Schedule: Indicate joint sealant location, joint sealant type, manufacturer and product name, and colour, for each application. Utilize joint sealant designations included in this Section.
- .4 Samples:
 - .1 Samples for Colour Selection: For each joint sealant type.

.2 Samples for Verification: For each joint sealant product, for each colour selected.

.5 Greenguard Certificates: For each sealant and accessory product specified to meet volatile organic emissions standards of the Greenguard Children and Schools Certification.

1.5 Quality Assurance

.1 Installer Qualifications: Company with minimum of three years of experience specializing in work of this section, employing applicators trained for application of joint sealants required for this project, with record of successful completion of projects of similar scope, and approved by manufacturer.

.2 Single Source Responsibility: Provide joint sealants by a single manufacturer responsible for testing of Project substrates to verify compatibility and adhesion of joint sealants.

.3 Caulking work shall be carried out in strict accordance with manufacturer's printed directions.

.4 Preconstruction Manufacturer Laboratory Compatibility, Staining, and Adhesion Testing: Submit samples of each substrate or adjacent material that will be in contact with or affect joint sealants. Current manufacturer test data of products on matching substrates will be acceptable.

.5 Adhesion: Use ASTM C719 and ASTM C794 to determine requirements for joint preparation, including cleaning and priming.

.6 Compatibility: Use ASTM C1087 to determine materials forming joints and adjacent materials do not adversely affect sealant materials and do not affect sealant colour.

1.6 Shipping, Handling and Storage

.1 Refer to Section 01 61 00 – Common Product Requirements.

.2 Deliver, handle and store materials in accordance with manufacturer's printed instructions.

1.7 Project Conditions

.1 Conform to manufacturer's recommended temperatures, relative humidity, and substrate moisture content for application and curing of sealants including special conditions governing use.

.2 Ventilate area of work by use of approved portable supply and exhaust fans.

1.8 Scheduling

.1 Ensure sealants are cured before covering with other materials.

1.9 Waste Management and Disposal

.1 Refer to Section 01 74 19 – Construction Waste Management and Disposal.

PART 2 PRODUCTS

2.1 Manufacturer

.1 Basis-of-Design Products: Provide joint sealant products manufactured by Tremco, Inc., Commercial Sealants and Waterproofing, 220 Wicksteed Avenue, Toronto, www.tremcosealants.com, or comparable products of other manufacturer approved by Consultant.

2.2 Materials, General

- .1 VOC Content for Interior Applications: Provide sealants and sealant primers complying with the following VOC content limits per 40 CFR 59, Subpart D (EPA Method 24):
 - .1 Architectural Sealants: 250 g/L.
 - .2 Sealant Primers for Nonporous Substrates: 250 g/L.
 - .3 Sealant Primers for Porous Substrates: 775 g/L.
- .2 Low-Emitting Sealants for Interior Applications: Provide sealants and sealant primers complying with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- .3 Compatibility: Provide joint sealants and accessory materials that are compatible with one another, and with adjacent materials, as demonstrated by sealant manufacturer using ASTM C1087 testing and related experience.

2.3 Silicone Joint Sealants

- .1 SJS#1: Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - .1 Basis of Design Product: Tremco Tremsil 200 Sanitary.
 - .2 Volatile Organic Compound (VOC) Content: 1 g/L maximum.
 - .3 Volatile Organic Emissions (VOE): Not greater than Greenguard Children & Schools Certification emissions levels.
 - .4 Colour: White and Clear.

2.4 Urethane Joint Sealants

- .1 UJS#1: Single-Component, Nonsag, Moisture-Cure, Polyurethane Hybrid Joint Sealant: ASTM C920, Type S, Grade NS, Class 35, Use NT; Greenguard certified.
 - .1 Basis of Design Product: Tremco Dymonic FC.
 - .2 Extrusion Rate ASTM C1183: 93.1 mL/min
 - .3 Weight Loss ASTM C1246: Pass
 - .4 Tack Free Time ASTM C679: 3 to 4 hours.
 - .5 Volatile Organic Compound (VOC) Content: 10 g/L maximum.
 - .6 Volatile Organic Emissions (VOE): Not greater than Greenguard Children & Schools Certification emissions levels.
 - .7 Colour: As selected by Consultant from manufacturer's standard line.
- .2 UJS#2: Immersible, Single-Component, Pourable, Traffic Grade Polyurethane Joint Sealant: ASTM C920, Type S, Grade P, Class 50, Use T and I.
 - .1 Basis of Design Product: Tremco Vulkem 45 SSL.
 - .2 Volatile Organic Compound (VOC) Content: 110 g/L maximum.
 - .3 Volatile Organic Emissions (VOE): Not greater than Greenguard Children & Schools Certification emissions levels.
 - .4 Colour: As selected by Consultant from manufacturer's standard line.

2.5 Latex Joint Sealants

- .1 LJS#1: Latex Joint Sealant: Siliconized acrylic latex, ASTM C834, Type OP, Grade NF.
 - .1 Basis of Design Product: Tremco Tremflex 834.
 - .2 Volatile Organic Compound (VOC) Content: 35 g/L maximum.

- .3 Volatile Organic Emissions (VOE): Not greater than Greenguard Children & Schools Certification emissions levels.
- .4 Colour: White, paintable.

2.6 Acoustical Sealants

- .1 AJS#1: Acoustical/Curtainwall Sealant: Single-component, non-hardening, non-sag, paintable synthetic rubber-tested to reduce airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing of similar assemblies according to ASTM E90.
 - .1 Basis of Design Product: Tremco Acoustical/Curtainwall Sealant.
 - .2 Volatile Organic Compound (VOC) Content: 160 g/L maximum.
 - .3 Colour: White, paintable.

2.7 Joint Sealant Accessories

- .1 Cylindrical Sealant Backing: ASTM C1330, Type B non-absorbent, bi-cellular material with surface skin, or Type O open-cell polyurethane, as recommended by sealant manufacturer for application.
- .2 Bond Breaker Tape: Polymer tape compatible with joint sealant and adjacent materials and recommended by sealant manufacturer.
- .3 Joint Substrate Primers: Substrate primer recommended by sealant manufacturer for application.
- .4 Cleaners: Chemical cleaners acceptable to joint sealant manufacturer.
- .5 Masking tape: Non-staining, non-absorbent tape product compatible with joint sealants and adjacent joint surfaces.

PART 3 EXECUTION

3.1 Examination

- .1 Examine joint profiles and surfaces to determine if work is ready to receive joint sealants. Verify joint dimensions are adequate for development of sealant movement capability. Verify joint surfaces are clean, dry, and adequately cured. Proceed with joint sealant work once conditions meet sealant manufacturer's written recommendations.

3.2 Preparation

- .1 Joint Surface Cleaning: Clean joints prior to installing joint sealants using materials and methods recommended by sealant manufacturer. Comply with ASTM C1193.
 - .1 Remove curing compounds, laitance, form-release agents, dust, and other contaminants.
 - .2 Clean nonporous and porous surfaces utilizing chemical cleaners acceptable to sealant manufacturer.
 - .3 Protect elements surrounding the Work of this section from damage or disfiguration. Apply masking tape to adjacent surfaces when required to prevent damage to finishes from sealant installation.

3.3 Application

- .1 Sealant and Primer Installation Standard: Comply with ASTM C1193 and manufacturer's written instructions.

- .2 Joint Backing: Select joint backing materials recommended by sealant manufacturer as compatible with sealant and adjacent materials. Install backing material at depth required to produce profile of joint sealant allowing optimal sealant movement.
 - .1 Install joint backing to maintain the following joint ratios:
 - .1 Joints up to 13 mm wide: 1:1 width to depth ratio.
 - .2 Joints greater than 13 mm wide: 2:1 width to depth ratio; maximum 13 mm joint depth.
 - .2 Install bond breaker tape over substrates when sealant backings are not used.
 - .3 Masking: Mask adjacent surfaces to prevent staining or damage by contact with sealant or primer.
 - .4 Joint Priming: Prime joint substrates when recommended by sealant manufacturer or when indicated by preconstruction testing or experience. Apply recommended primer using sealant manufacturer's recommended application techniques.
 - .5 Liquid Sealant Application: Install sealants using methods recommended by sealant manufacturer, in depths recommended for application. Apply in continuous operation from bottom to top of joint vertically and horizontally in a single direction. Apply using adequate pressure to fill and seal joint width.
 - .1 Tool sealants immediately with appropriately shaped tool to force sealants against joint backing and joint substrates, eliminating voids and ensuring full contact.
 - .2 Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
 - .3 Tool exposed joint surface concave using tooling agents approved by sealant manufacturer for application.
 - .6 Cleaning: Remove excess sealant using materials and methods approved by sealant manufacturer that will not damage joint substrate materials.
 - .1 Remove masking tape immediately after tooling joint without disturbing seal.
 - .2 Remove excess sealant from surfaces while still uncured.
 - .7 Installation of Acoustical Sealant: At sound-rated assemblies and elsewhere as indicated, seal construction at perimeters, behind control joints, and at openings and penetrations on both sides of assemblies with a continuous bead of acoustical sealant. Comply with ASTM C919 and with manufacturer's written recommendations.
- 3.4 Field Quality Control
- .1 Field-Adhesion Testing: Perform adhesion tests in accordance with manufacturer's instructions and with ASTM C1193, Method A.
 - .1 Perform 5 tests for the first 300 m of joint length for each kind of sealant and joint substrate, and one test for each 300 m of joint length thereafter or 1 test per each floor per building elevation, minimum.
 - .2 For sealant applied between dissimilar materials, test both sides of joint.
 - .2 Remove sealants failing adhesion test, clean substrates, reapply sealants, and re-test. Test adjacent sealants to failed sealants.
 - .3 Submit report of field adhesion testing to Consultant indicating tests, locations, dates, results, and remedial actions taken.
- 3.5 Interior Joint Sealant Schedule
- .1 Interior vertical movement joints in interior unit masonry.
 - .1 UJS#1: Single-component non-sag urethane sealant.

- .2 Interior perimeter joints of interior frames.
 - .1 UJS#1: Single-component non-sag urethane sealant.
- .3 Interior sanitary joints between plumbing fixtures, food preparation fixtures, and casework and adjacent walls, floors, and counters.
 - .1 SJS#1: Mildew-Resistant, Single-Component, nonsag, acid-curing silicone joint sealant.
- .4 Interior traffic joints in floor and between floor and wall construction.
 - .1 UJS#2: Single-component pourable urethane sealant.
- .5 Interior non-moving joints between interior painted surfaces and adjacent materials.
 - .1 LJS#1: Siliconized acrylic latex
 - .2 Joint-Sealant Colour: Paintable.
- .6 Interior exposed and non-exposed acoustical applications.
 - .1 AJS#1: Acoustical joint sealant.

3.6 Cleaning

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.

End of Section

PART 1 GENERAL

1.1 General

- .1 Conform to the requirements of Division 1.

1.2 Related Sections

- .1 Section 04 22 00 Concrete Unit Masonry
- .2 Section 07 92 00 Joint Sealants
- .3 Section 08 14 16 Flush Wood Doors
- .4 Section 08 71 10 Door Hardware
- .5 Section 09 21 16 Gypsum Board
- .6 Section 09 22 16 Non-Structural Metal Framing
- .7 Section 09 91 23 Interior Painting

1.3 References

- .1 ASTM International (ASTM)
 - .1 ASTM A653/A653M-23 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .2 ASTM C177-19e1 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus
 - .3 ASTM C518-21 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
 - .4 ASTM D6386-22 Standard Practice for Preparation of Zinc (Hot-Dip Galvanized) Coated Iron and Steel Product and Hardware Surfaces for Painting
 - .5 ASTM D7396-14(2020) Standard Guide for Preparation of New, Continuous Zinc-Coated (Galvanized) Steel Surfaces for Painting
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99 Ready-Mixed Organic Zinc-Rich Coating.
- .3 CSA Group (CSA)
 - .1 CSA-G40.20-13/G40.21-13 General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA W59-18 Welded Steel Construction (Metal Arc Welding).
- .4 Canadian Steel Door Manufacturers' Association (CSDMA)
 - .1 CSDMA Recommended Dimensional Standards for Commercial Steel Doors and Frames, 2000
 - .2 CSDMA Recommended Specifications for Commercial Steel Doors and Frames, 2006.
 - .3 CSDMA Selection and Usage Guide for Commercial Steel Door and Frame Products, 2009.
- .5 American National Standards Institute (ANSI)
 - .1 ANSI 250.4-2018 Test Procedure and Acceptance Criteria for — Physical Endurance for Steel Doors, Frames and Frame Anchors
 - .2 ANSI 250.10-2011 Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames

1.4 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Provide shop drawings
 - .1 Indicate each type of frame, steel and construction.

- .2 Indicate material thicknesses, mortises, reinforcements, anchorages, location of exposed fasteners, openings, arrangement of hardware, and finishes.
- .3 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.

1.5 System Description

- .1 Design exterior frame assembly to accommodate expansion and contraction when subjected to minimum and maximum surface temperature of -35° C to 35° C.

1.6 Defining Opening Sizes

- .1 Width - Widths of openings shall be measured from inside to inside of frame jamb rabbets. (Referred to as "frame rabbet width" or "nominal door width")
- .2 Height - Heights of openings shall be measured from the finished floor (exclusive of floor coverings) to the head rabbet of the frame. (Referred to as "frame rabbet height" or "nominal door height")
- .3 Door Sizes - Doors shall be sized so as to fit the above openings and allow a 3 mm nominal clearance at jambs and head of frame. A clearance of 13 mm maximum shall be allowed between the bottom of the door and the finished floor (exclusive of floor coverings).
- .4 Tolerances - Doors and frame product shall be manufactured and installed in accordance with the CSDMA's, "Recommended Dimensional Standards for Commercial Steel Doors and Frames".

1.7 Shipping, Handling and Storage

- .1 Refer to Section 01 61 00 – Common Product Requirements.
- .2 Deliver, handle and store materials in accordance with manufacturer's printed instructions.

1.8 Testing and Performance

- .1 Product quality shall meet the standards established by the Canadian Steel Door Manufacturer's Association.

1.9 Waste Management and Disposal

- .1 Refer to Section 01 74 19 – Construction Waste Management and Disposal.

PART 2 PRODUCTS

2.1 Materials

- .1 Acceptable Materials
 - .1 Steel frame product manufactured in accordance with this Specification by CSDMA members, are eligible for use on this project.
- .2 Steel: Commercial grade steel to ASTM A653, CS, Type B, Coating Designation ZF75 (A25) minimum. Minimum steel thicknesses shall be in accordance with Appendix 1 of the CSDMA, Recommended Specifications for Commercial Steel Door and Frame Products unless noted otherwise.

- .3 Reinforcement channel: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653, ZF75.
- .4 Primers:
 - .1 Touch-up prime CAN/CGSB-1.181, organic zinc rich, rust inhibitive.
 - .1 Maximum VOC limit 50 g/L to GC-03.

2.2 Accessories

- .1 Door silencers: single stud rubber/neoprene type.
- .2 Fiberglass: to ULC 702, loose batt type, minimum density of 24 kg/m³.
- .3 Metallic paste filler: to manufacturer's standard.
- .4 Sealant: As specified in Section 07 92 00.

2.3 Fabrication - Frame Products

- .1 General
 - .1 Fabricate frames in accordance with CSDMA specifications.
 - .2 Fabricate frames to profiles and maximum face sizes as indicated.
 - .3 Exterior frame product shall be 1.60 mm welded type construction, thermally broken.
 - .4 Interior frame product shall be 1.60 mm. Interior frames, transoms, sidelights and window assemblies shall be welded type construction.
 - .5 Blank, reinforce, drill and tap frames for templated hardware and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.
 - .6 Prepare frames to receive electrical conduit for door operators where indicated and required.
 - .7 Protect mortised cutouts with steel guard boxes.
 - .8 Provide anchorage appropriate to floor, wall and frame construction. Each wall anchor shall be located immediately above or below each hinge reinforcement on the hinge jamb and directly opposite on the strike jamb. For rebate opening heights up to and including 1520 mm provide two (2) anchors, and an additional anchor for each additional 760 mm of height or fraction thereof, except as indicated below. Frames in previously placed concrete, masonry or structural steel shall be provided with anchors located not more than 150 mm from the top and bottom of each jamb, and intermediate anchors at 660 mm on centre maximum. Fasteners for such anchors shall be provided by others.
 - .9 Minimum reinforcing, anchor and other component thickness shall be in accordance with Table 1 of the CSDMA, "Recommended Specifications for Commercial Steel Door and Frame Products".
 - .10 Each interior door opening shall be prepared for single stud rubber door silencers, three (3) for single door openings, two for double door openings, except on gasketed frame product.
 - .11 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
 - .12 Fire-rated frame products shall be provided for those openings requiring fire protection as determined and scheduled by the Consultant. Frames, transom and sidelight assemblies shall be listed for conformance with ULC 104. Window assemblies shall be listed for conformance with ULC 106. All fire-rated frame products shall bear the label of and be listed by a nationally recognized testing agency having a factory inspection service. Labeling shall be in accordance with NFPA 80, the listing authority's policies and label materials, and shall identify the manufacturer. Fire-rated frame products shall be constructed as listed for labeling in the

Follow-Up Service Procedures/Factory Inspection Manuals issued by the listing agency to individual manufacturers.

.2 Welded Type

- .1 Welding in accordance with CSA W59.
- .2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.
- .3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.
- .4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.
- .5 Where frame product is to be installed prior to the adjacent partition, a floor anchor shall be securely attached to the inside of each jamb profile. Each floor anchor shall be provided with two holes for securing to the floor. For conditions that do not permit the use of a floor anchor, an additional wall anchor, located within 150 mm of the base of the jamb, shall be substituted.
- .6 Weld in two temporary jamb spreaders per door opening to maintain proper alignment during shipment and handling, which shall not be used for installation.
- .7 Glazing stops shall be formed steel channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.
- .8 When required due to site access, when advised by the contractor responsible for coordination or installation, as specified on the drawings or due to shipping limitations, frame product for large openings shall be fabricated in sections as designated on the approved submittal drawings, with splice joints for field assembly and welding by others.
- .9 Prior to shipment, mark each frame product with an identification number as shown on the approved submittal drawings.
- .10 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
- .11 Manufacturer's nameplates on frames and screens are not permitted

2.4 Finishes

- .1 Doors and frames shall wipe coat zinc, ready for painting.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

- .1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and data sheets.

3.2 Installation

- .1 Install frames to CSDMA Installation Guide, NAAMM-HMMA 840, Installation Guide for Commercial Steel Doors and Frames.
- .2 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 10 - Door Hardware. Coordinate with Section 08 71 10 for preparation and installation of automatic door operators.
- .3 Adjust operable parts for correct clearances and function.
- .4 Install door silencers.
- .5 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows:

- .1 Hinge side: 1.0 mm.
- .2 Latch side and head: 1.5 mm.
- .3 Finished floor and thresholds: 13 mm.

.6 Caulk perimeter of frames. Refer to Section 07 92 00 – Joint Sealants.

3.3 Finish Repairs

- .1 Touch up with primer finishes damaged during installation.
- .2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.4 Cleaning

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.

End of Section

PART 1 GENERAL

1.1 General

- .1 Conform to the requirements of Division 1.

1.2 Related Sections

- .1 Section 06 20 00 Finish Carpentry
- .2 Section 08 11 00 Metal Doors and Frames
- .3 Section 08 14 16 Flush Wood Doors

1.3 References

- .1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
 - .1 ANSI/DHI A115.1G-1994 Installation Guide for Doors and Hardware
 - .2 ANSI/ICC A117.1-2017 Accessible and Usable Buildings and Facilities
 - .3 ANSI/BHMA A156.1-2013 American National Standard for Butts and Hinges.
 - .4 ANSI/BHMA A156.2-2011 Bored and Preassembled Locks and Latches.
 - .5 ANSI/BHMA A156.3-2014 Exit Devices.
 - .6 ANSI/BHMA A156.4-2013 Door Controls - Closers.
 - .7 ANSI/BHMA A156.5-2014 Auxiliary Locks and Associated Products.
 - .8 ANSI/BHMA A156.6-2010 Architectural Door Trim.
 - .9 ANSI/BHMA A156.8-2010 Door Controls - Overhead Stops and Holders.
 - .10 ANSI/BHMA A156.10-2011 Power Operated Pedestrian Doors.
 - .11 ANSI/BHMA A156.12-2013 Interconnected Locks and Latches.
 - .12 ANSI/BHMA A156.13-2012 Mortise Locks and Latches Series 1000.
 - .13 ANSI/BHMA A156.15-2011 Release Devices - Closer Holder, Electromagnetic and Electromechanical.
 - .14 ANSI/BHMA A156.16-2013 Auxiliary Hardware.
 - .15 ANSI/BHMA A156.18-2012 Materials and Finishes.
 - .16 ANSI/BHMA A156.19-2013 Power Assist and Low Energy Power - Operated Doors.
 - .17 ANSI/BHMA A156.21-2014 Thresholds.
 - .18 ANSI/BMHA A156.22-2012 Door Gasketing and Edge Seal Systems
- .2 Canadian Steel Door Manufacturers' Association (CSDMA)
 - .1 CSDMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction): Standard Hardware Location Dimensions.
- .3 National Wood Window and Door Association (NWWDA)
- .4 Door Hardware Institute (DHI)
- .5 Accessibility for Ontarians with Disabilities Act (AODA)

1.4 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data: Submit manufacturer's printed product literature, specifications and data sheets.
- .3 Samples:
 - .1 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
 - .2 After approval samples will be returned for incorporation in the Work.

- .4 Hardware List:
 - .1 Submit contract hardware list.
 - .2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.
- .5 Manufacturer's Instructions: Submit manufacturer's installation instructions.
- .6 Provide operation and maintenance data for door closers, locksets, door holders, electrified hardware and fire exit hardware for incorporation into Operations and Maintenance Manuals specified in Section 01 78 00 - Closeout Submittals.

1.5 Quality Assurance

- .1 Regulatory Requirements:
 - .1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.
 - .2 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
 - .3 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .2 Pre-installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.6 Shipping, Handling and Storage

- .1 Refer to Section 01 61 00 – Common Product Requirements.
- .2 Deliver, handle and store materials in accordance with manufacturer's printed instructions.
- .3 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .4 Receive the delivery of the Finishing Hardware and identify all items against the Finishing Hardware Schedule. Ensure each hardware item is accompanied by the correct template, installation instructions, special tools, fastening devices and other loose items. Advise the finish hardware supplier and Consultant in writing of errors or omissions.
- .5 Storage and Protection: Store finishing hardware in locked, clean and dry area.
- .6 Remove all hardware from doors and frames prior to painting. After painting is complete and dry, reinstall all hardware to manufacturer's recommendations.

1.7 Waste Management and Disposal

- .1 Refer to Section 01 74 19 – Construction Waste Management and Disposal.

1.8 Warranty

- .1 Warrant all hardware against defects of workmanship and material, for a period of one year, except for door closers which shall be warranted for ten years from the date of Substantial Performance and agree to make good promptly any defects which occur or become apparent within the warranty period.

PART 2 PRODUCTS

2.1 Materials

- .1 All hardware shall be supplied as specified in the Finishing Hardware Schedule.**
- .2 All finishes shall be as indicated in the Finishing Hardware Schedule by international codes.
- .3 All door handles shall be lever type meeting requirements of the referenced accessibility standards and the Ontario Building Code.
- .4 Power Door Operators and controls shall be CSA approved and shall meet the requirements of the Ontario Building Code and the Accessibility for Ontarians with Disabilities Act (AODA).

2.2 Fastenings

- .1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.
- .2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.
- .3 Exposed fastening devices to match finish of hardware.
- .4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.
- .5 Use fasteners compatible with material through which they pass.

2.3 Electrified Devices

- .1 Electrified exit devices shall conform to all traditional exit device standards as specified above. All power requirements for exit devices used must utilize a continuous circuit electric hinge for clean design and no visible means of interrupting power to device.
- .2 All exit devices with electric latch retraction shall provide for a remote means of unlocking for momentary or maintained periods of time.
- .3 Exit devices with electrified trim shall be fail-secure unless otherwise specified.

2.4 Keying

- .1 Keying: All permanent cylinders to be grandmaster-keyed as directed by the Owner. The factory shall key all locks and cylinders and maintain keying records. The factory shall establish a System Information Document (SID) to designate primary system administrators and require a separate letter of authorization for all future shipments of keyed products.
- .2 Remove all construction cores and install all permanent cores. Unless otherwise directed by the Owner.
- .3 Construction master/change keys are to be delivered by the contractor directly to The Owner.

- .4 Ship all permanent cylinders and keys separately. Identify door number and keyset symbol on each envelope for direct factory delivery to the owner.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Furnish metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .3 Furnish manufacturers' instructions for proper installation of each hardware component.

3.2 Examination

- .1 Before installing any hardware, carefully check all architectural drawings of the work requiring hardware, verify door swings, door and frame materials and operating conditions, and assure that all hardware will fit the work to which it is to be attached.
- .2 Check all shop drawings and frame and door lists affecting hardware type and installation, and certify to the correctness thereof, or advise the hardware supplier and Consultant in writing of required revisions.

3.3 Templates

- .1 Check the hardware schedule, drawings and specifications, and furnish promptly to the applicable trades any patterns, templates, template information and manufacturer's literature required for the proper preparation for and application of hardware, in ample time to facilitate the progress of the work.

3.4 Installation

- .1 Installation of hardware shall be in accordance with ANSI A115.1G, manufacturer's templates and instructions.
- .2 Install each item of mechanical and electromechanical hardware and access control equipment to comply with the manufacturer's written instructions and according to specifications. All items to be installed with fasteners identified by manufacturer's installation instructions unless otherwise noted.
- .3 Mounting Heights: Install door hardware at heights indicated in the following applicable publications unless; specifically indicated or required by local governing regulations, requirements to match for special templates, necessary coordination with door elevations, and or to ensure consistency with pairs of doors.
 - .1 DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames"
 - .2 DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors"
 - .3 ANSI/ICC A117.1 Accessibility Guidelines for Buildings and Facilities
 - .4 NWWDA
 - .5 AODA

- .4 Power door operator products and accessories are required to be installed by an AAADM certified technician as approved by the manufacturer. Adjust for proper opening and closing operation after final balancing of HVAC system.
- .5 Coordinate installation of electric door strikes, keypad locks, card readers, washroom duress systems, and other electronic door control and security devices with Electrical contractor including supply and installation of wiring and all terminations.
- .6 All hardware shall be installed by carpenters, skilled in the application of architectural hardware and satisfactory to the hardware supplier. Refer to Section 06 20 00 - Finish Carpentry. Instruction sheets, details and templates shall be read and understood before installation.
- .7 Install all materials as listed in the Finishing Hardware Schedule on the doors and frames listed. Interchanging of hardware will not be allowed.
- .8 Use only manufacturer's supplied fasteners. Failure to comply may void manufacturer's warranties and applicable licensed labels. Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .9 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .10 Remove construction cores when directed by Owner's Representative.
- .11 After installation, templates, installation instructions and details shall be put in a file and turned over to the Owner, when building is Substantially Performed.

3.5 Field Quality Control

- .1 Conduct periodic inspections to ensure that door frames are installed plumb, level and square with verification by installer prior to installation of doors and door hardware.
- .2 Hardware supplier to attend site meetings as required to ensure proper execution of the guidelines set forth herein.
- .3 Hardware supplier will perform final field inspection of installed door hardware after final adjustment of all products and will document and report any deficiencies or omissions for correction and written acceptance by the Contractor.

3.6 Adjusting

- .1 Adjust door hardware, operators, closers and controls for optimum, smooth operating condition, safety and for weather tight closure.
- .2 Lubricate hardware, operating equipment and other moving parts.
- .3 Adjust door hardware to provide tight fit at contact points with frames.

3.7 Demonstration

- .1 Instruct Owner's maintenance personnel in the proper adjustment, operation and maintenance of mechanical and electromechanical door hardware, electronic devices and maintenance of finishes.

3.8 Cleaning

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .3 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacturer's instructions.
- .4 Remove protective material from hardware items where present.

End of Section

PART 1 GENERAL

1.1 General

- .1 Conform to the requirements of Division 1.

1.2 Related Sections

- .1 Section 07 92 00 Joint Sealants
- .2 Section 08 11 00 Metal Doors and Frames

1.3 References

- .1 ASTM International (ASTM)
 - .1 ASTM C162-05 (2015) Standard Terminology of Glass and Glass Products.
 - .2 ASTM C542-05(2017) Standard Specification for Lock-Strip Gaskets
 - .3 ASTM C1048-18 Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass
 - .4 ASTM D2240-15e1 Standard Test Method for Rubber Property—Durometer Hardness
 - .5 ASTM E84-23c Standard Test Method for Surface Burning Characteristics of Building Materials
- .2 American National Standards Institute (ANSI).
 - .1 ANSI Z97.1 American National Standard for Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test.
- .3 American Architectural Manufacturer's Association (AAMA)
- .4 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-12.1-17 Safety Glazing
- .5 Consumer Product Safety Commission
 - .1 CPSC 16 CFR 1201 Safety Standard for Architectural Glazing Materials.
- .6 Environmental Choice Program (ECP).
 - .1 CCD-045-95 Sealants and Caulking.
- .7 Flat Glass Manufacturers Association (FGMA).
 - .1 FGMA Glazing Manual - 1997.
- .8 Glass Association of North America (GANA)
 - .1 GANA Glazing Manual 50th Anniversary Edition-2008.
 - .2 GANA Sealant Manual-2008.
 - .3 GANA/PGC International Protective Glazing Manual (2010).
- .9 South Coast Air Quality Management District, California State (SCAQMD)
 - .1 SCAQMD Rule 1168-03, Adhesives and Sealants Applications.

1.4 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data: Submit manufacturer's printed product literature, specifications and data sheets.
- .3 Provide maintenance data for glazing for incorporation into Operation and Maintenance Manual specified in Section 01 78 00 – Closeout Submittals.

1.5 Quality Assurance

- .1 Perform work in accordance with FGMA Glazing Manual and Laminators Safety Glass Association Standards Manual for glazing installation methods.
- .2 Installer: Company specializing in the installation of structural glazing with five years proven experience and approved by the manufacturer for installation of their products.

- .3 Safety glass products shall comply with the testing requirements of CAN/CGSB-12.1, Type 1 for Laminated Glass and Type 2 for Tempered Glass.
- .4 Provide safety glass permanently marked with the company name or logo and CAN/CGSB-12.1 if the product meets categories 1 and 2, or mark as CAN/CGSB 12.1M-1 if the product meets the requirements of Category 1 only.
- .5 Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this section or referenced standards.
 - .1 GANA Publications
 - .2 AAMA Publications
 - .3 IGMA/IGMAC Publications

1.6 Design Requirements

- .1 Design glass, glazing channels, connections, attachments and glazing accessories to withstand loads designated by the Ontario Building Code and to accommodate all building deflections.
- .2 Size glass to withstand wind loads, dead loads and positive and negative live loads acting normal to plane of glass to a design pressure of 1.2 kPa as measured in accordance with ANSI/ASTM E330.
- .3 Limit glass deflection to 1/200 with full recovery of glazing materials.
- .4 Glass thicknesses indicated are minimum and are for detailing only. Confirm glass thickness by analyzing project conditions, including in-service conditions and loads.

1.7 Project Conditions

- .1 Install glazing when ambient temperature is 10 ° C minimum. Maintain ventilated environment for 24 hours after application.
- .2 Maintain minimum ambient temperature before, during and for 24 hours after installation of glazing compounds.

1.8 Shipping, Handling and Storage

- .1 Refer to Section 01 61 00 – Common Product Requirements.
- .2 Deliver, handle and store materials in accordance with manufacturer's printed instructions.
- .3 Provide glass units with interleaving protection between lites. Keep glass and interleaving dry and store cases in clean, cool, dry areas with temperatures above the dew point. Circulation of cool, dry air in storage areas is essential. Open cases and inspect units periodically for moisture accumulation.
- .4 Do not store glass in direct sunlight without an opaque protective covering over same.

1.9 Waste Management and Disposal

- .1 Refer to Section 01 74 19 – Construction Waste Management and Disposal.

PART 2 PRODUCTS

2.1 Materials-Flat Glass

- .1 Tempered Safety Glass: To CAN/CGSB-12.1, transparent, 10 mm thick unless indicated otherwise. Type 2-tempered.
 - .1 Class B-float.
 - .2 Category 1
 - .3 Edge treatment: ground, bevel edge.

2.1 Glazing Products

- .1 Select appropriate glazing sealants, tapes, gaskets and other glazing materials of proven compatibility with other materials that they contact. These include glass products, insulating glass unit seals and glazing channel substrates under installation and service conditions, as demonstrated by testing and field experience.
- .2 Setting blocks: Neoprene 80-90 Shore A durometer hardness to ASTM D2240, to suit glazing method, glass light weight and area.
- .3 Spacer shims: Neoprene 50-60 Shore A durometer hardness to ASTM D2240, 75 mm long x one half height of glazing stop x thickness to suit application. Self-adhesive on one face.
- .4 Glazing tape:
 - .1 Preformed butyl compound with integral resilient tube spacing device, 10-15 Shore A durometer hardness to ASTM D 2240; coiled on release paper; black colour.
 - .2 Closed cell polyvinyl chloride foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume 2%, designed for compression of 25%, to effect an air and vapour seal.
- .5 Glazing splines: resilient polyvinyl chloride, extruded shape to suit glazing channel retaining slot, colour as selected.
- .6 Glazing Gaskets: To ASTM C864.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

- .1 Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 Examination

- .1 Verify that openings for glazing are correctly sized and within tolerance.
- .2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.3 Preparation

- .1 Clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.

- .3 Prime surfaces scheduled to receive sealant.

3.4 Installation – General

- .1 Perform work in accordance with GANA Glazing Manual for glazing installation methods.

3.5 Installation: Interior - Dry Method

- .1 Fill gap between glazing and stop with sealant to depth equal to bite of frame on glazing, maximum 9 mm below sight line.
- .2 Apply cap bead of sealant along void between stop and glazing, to uniform line, flush with sight line. Tool or wipe sealant surface smooth.
- .3 Cut glazing tape to length and set against permanent stops, projecting 1.6 mm above sight line.
- .4 Place setting blocks at 1/4 points, with edge block maximum 150 mm from corners.
- .5 Rest glazing on setting blocks and push against tape for full contact at perimeter of light or unit.
- .6 Place glazing tape on free perimeter of glazing.
- .7 Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- .8 Knife trim protruding tape.
- .9 Glaze hollow metal doors and pressed steel screens. Glass type as indicated.

3.6 Cleaning

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Perform cleaning to remove construction and accumulated environmental dirt.
- .3 Remove traces of primer, caulking.
- .4 Remove glazing materials from finish surfaces.
- .5 Remove labels after work is complete.
- .6 Clean glass using approved non-abrasive cleaner in accordance with manufacturer's instructions.
- .7 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.7 Protection of Finished Work

- .1 After installation, mark light with an "X" by using removable plastic tape.

End of Section

PART 1 GENERAL

1.1 General

- .1 Conform to the requirements of Division 1.

1.2 Related Sections

- .1 Section 06 10 00 Rough Carpentry
- .2 Section 07 92 00 Joint Sealants
- .3 Section 09 22 16 Non-Structural Metal Framing
- .4 Section 09 91 23 Interior Painting

1.3 References

- .1 ASTM International (ASTM)
 - .1 ASTM C840-20 Standard Specification for Application and Finishing of Gypsum Board
 - .2 ASTM C954-22 Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness
 - .3 ASTM C1002-22 Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
 - .4 ASTM C1047-19 Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base
 - .5 ASTM C1396/C1396M-17 Standard Specification for Gypsum Board
- .2 American National Standards Institute (ANSI)
 - .1 ANSI A118.9-1992 Test Methods and Specifications for Cementitious Backer Units.
 - .2 ULC List of Equipment and Material, Volume III, Fire Resistance Ratings.
- .3 Gypsum Association (GA)
 - .1 GA-214-2022 Recommended Levels of Gypsum Board Finish.
 - .2 GA-216-2021 Application and Finishing of Gypsum Board.
 - .3 GA-253-2021 Application of Gypsum Sheathing
- .4 Wall and Ceiling Bureau
 - .1 Technical Bulletin Control Joint Placement in Gypsum Board Assemblies

1.4 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for gypsum board assemblies and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 Quality Assurance

- .1 Dry wall installers: minimum 5 years proven experience.
- .2 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .3 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 Shipping, Handling and Storage

- .1 Refer to Section 01 61 00 – Common Product Requirements.
- .2 Deliver, handle and store materials in accordance with manufacturer's printed instructions.
- .3 Protect gypsum board materials before, during and after installation and to protect the installed work and materials of other trades affected by this work. Store materials in a dry area inside the building. Do not remove wrapping until ready for use. Prevent damage to all edges and surfaces.

1.7 Project Conditions

- .1 Maintain temperature minimum 10 ° C, maximum 21 ° 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.

1.8 Waste Management and Disposal

- .1 Refer to Section 01 74 19 – Construction Waste Management and Disposal.

PART 2 PRODUCTS

2.1 Gypsum Board

- .1 To ASTM C1396/C1396M. Standard for non-rated applications, Type X for rated applications, 1220 mm wide x maximum practical length, ends square cut, edges tapered with round edge, 12.7 mm thick or to thickness indicated on drawings. All fire rated board shall be minimum 16 mm thickness.
- .2 Water and Moisture Resistant Board: to ASTM C1396, 12.7 mm thick, 1220 mm wide with tapered edges.

2.2 Fastening and Adhesives

- .1 Drywall Screws: To ASTM C954 or ASTM C1002 self-drilling, self-tapping, case hardened, length to suit board thickness and provide minimum 12 mm penetration into support.
- .2 Joint Tape: To ASTM C475, 50 mm perforated with preformed seam, mould and mildew resistant.
 - .1 Joint tape for abuse resistant gypsum board: CGC Mould Resistant Fiberglass Drywall Tape.
- .3 Joint Filler and Topping: To ASTM C475 vinyl or latex base, slow setting.

2.3 Accessories

- .1 Casing beads, 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.
- .2 Sealants: as specified in Section 07 92 00 - Joint Sealants.

PART 3 EXECUTION

3.1 Gypsum Board Application

- .1 Coordinate installation of plywood backing with Section 06 10 00.
- .2 Do application and finishing of gypsum board in accordance with ASTM C840 and/or GA-216 except where specified otherwise.
- .3 Do not apply gypsum board until bucks, anchors, blocking, electrical, and mechanical work are approved.
- .4 Apply gypsum board at right angles to framing members or furring using screw fasteners. Maximum spacing of screws 300 mm o.c.
- .5 Apply water or moisture resistant gypsum wallboard where indicated. Apply water resistant sealant to edges, ends and cut outs which expose gypsum core.
- .6 Carry gypsum board from floor to underside of floor or roof structure above. Furr out and carry gypsum board around any structural members as may be required. Neatly cope gypsum board to fill deck flutes where gypsum board abuts floor or roof deck.

3.2 Accessories

- .1 Erect accessories straight, plumb or level, rigid and at proper plane. Use full length pieces where practical. Make joints tight, accurately aligned and rigidly secured. Mitre and fit corners accurately, free from rough edges.
- .2 Install casing beads where gypsum board butts against surfaces having no trim concealing junction and where indicated.
- .3 Install insulating strips continuously at edges of gypsum board or casing beads abutting exterior door or window frames, to provide thermal break.
- .4 Install continuous bead of acoustic sealant at all penetrations through sound control partitions.
- .5 Provide control joints in gypsum board facing. Construct control joints in accordance with ASTM C840 and as described in Wall and Ceiling Bureau Technical Bulletin "Control Joint Placement in Gypsum Board Assemblies". Place control joints consistent with lines of building spaces as indicated. Where not indicated install as directed at maximum 6.0 m spacing. Control joints shall be supported with metal studs or furring channels on both sides of the joint Construct joints using back-to-back casing beads filled with a low modulus sealant capable of flexible joint movement. Maintain fire-resistance rating of wall assemblies. Control joints shall be provided:
 - .1 At abutting structural elements, steel columns.
 - .2 At expansion or control joints in the substrate.
 - .3 At each door jamb.

3.3 Access Doors

- .1 Install access doors to electrical and mechanical fixtures specified in respective Sections.
- .2 Rigidly secure frames to furring or framing systems, to satisfy fire rating requirements.

3.4 Taping and Filling

- .1 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. Finish to GA-214 Level 5.
- .2 Finish corner beads, control joints and trims as required with two coats of joint compound and one coat of taping compound, feathered out onto panel faces.
- .3 Fill screw head depressions with joint and taping compounds to bring flush with adjacent surface of gypsum board so as to be invisible after painting is completed.
- .4 Sand lightly to remove burred edges and other imperfections. Avoid sanding adjacent surface of board.
- .5 Completed installation to be smooth, level or plumb, free from waves and other defects and ready for painting.

3.5 Cleaning

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.

End of Section

PART 1 GENERAL

1.1 General

- .1 Conform to the requirements of Division 1.

1.2 Related Sections

- .1 Section 05 41 00 Structural Metal Stud Framing
- .2 Section 09 21 16 Gypsum Board

1.3 References

- .1 ASTM International (ASTM).
 - .1 ASTM A653/A653M-23 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .2 ASTM C645-18 Standard Specification for Nonstructural Steel Framing Members
 - .3 ASTM C754-20 Standard Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
 - .4 ASTM C841-03(2018) Standard Specification for Installation of Interior Lathing and Furring.
 - .5 ASTM C1002-22 Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs
 - .6 ASTM E90-09(2016) Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
 - .7 ASTM E814-13a(2017) Standard Test Method for Fire Tests of Penetration Firestop Systems
 - .8 ASTM E1966-15(2019) Standard Test Method for Fire-Resistive Joint Systems
- .2 Canadian General Services Board (CGSB).
 - .1 CAN/CGSB-1.40-97 Primer, Structural Steel, Oil Alkyd Type.
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 ULC List of Equipment and Material, Volume III, Fire Resistance Ratings.
- .4 CSSBI Lightweight Steel Framing Manual

1.4 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for metal framing and include product characteristics, performance criteria, physical size, finish and limitations.

1.5 Quality Assurance

- .1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.6 Shipping, Handling and Storage

- .1 Refer to Section 01 61 00 – Common Product Requirements.
- .2 Deliver, handle and store materials in accordance with manufacturer's printed instructions.

1.7 Waste Management and Disposal

- .1 Refer to Section 01 74 19 – Construction Waste Management and Disposal.

PART 2 PRODUCTS

2.1 Metal Stud Framing Systems

- .1 Non-load bearing channel stud framing: to ASTM C645, stud size as indicated, roll formed from 0.53 mm thickness hot dipped galvanized steel sheet, for screw attachment of gypsum board. Knock-out service holes at 460 mm centres.
 - .1 Thickness of materials to conform to referenced standards unless noted otherwise.
 - .2 Thickness of materials shall be selected from manufacturer's standard span tables to suit total height requirements.
- .2 Floor and ceiling tracks: to ASTM C645, in widths to suit stud sizes, 32 mm flange height.
- .3 Metal channel stiffener: 1.4 mm thick cold rolled steel, coated with rust inhibitive coating.
- .4 Tie Wire: 0.90 mm, galvanized, soft annealed, steel wire or clip as recommended by the manufacturer of furring channels.

2.2 Metal Furring and Suspension Systems

- .1 Channel framing: to ASTM C645, stud size as indicated, roll formed from 0.53 mm thickness hot dipped galvanized steel sheet, for screw attachment of gypsum board.
 - .1 Thickness of materials to conform to referenced standards unless noted otherwise.
- .1 Metal Furring Runners, Hangers, Tie Wires, Inserts, Anchors: to ASTM C645 , electro-zinc coated steel.
- .2 Runner Channels: 38 x 19 x 0.59 mm and 38 x 9.5 x 0.45 mm, hot dip or electro-galvanized sheet steel. Use of various sizes governed by applied loads and applicable spans.
- .3 Drywall Furring Channel: Channel shaped furring member for screw attachment of drywall with knurled face. For interior use. Furring masonry or concrete surfaces. Cross furring under steel joist or suspended metal channels in suspended ceiling systems: 70 x 22 x 0.9 mm with knurled face, hot dip or electro-galvanized sheet steel. Bailey D-1001.
- .4 Deflection Track: Bailey Multi-Slot Track MST 250, size to suit studs, and top deflection clips TDC 350 and TDC 587.
- .5 Horizontal Flange attachment: Bailey Horizontal Flange Attachment Clip (HFA Clip)
- .6 Hangers: minimum 4.1 mm diameter (or as required by ULC fire rating design requirements) mild steel rods.

2.2 Fasteners

- .1 Powder activated fasteners: to suit structural conditions and fastening requirements and in accordance with manufacturer's recommendations: Ramset; Hilti; or approved equivalent.
- .2 Sheet Metal Screws: To ASTM C1002, self-drilling, self-tapping, case hardened, length to suit board thickness and provide minimum 12 mm penetration into support.

2.3 Accessories

- .1 Acoustic sealant: As specified in Section 07 92 00.
- .2 Insulating strip: rubberized, moisture resistant 3 mm thick foam strip, 12 mm wide, with self-sticking adhesive on one face, lengths as required.
- .3 Zinc Rich Paint: to CGSB 1-GP-181M. Low VOC type.

PART 3 EXECUTION

3.1 Examination

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for non-structural metal framing application in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied [and after receipt of written approval to proceed from Consultant.

3.2 Erection

- .1 Comply with ASTM C754.
- .2 All gypsum board shall be supported with steel framing whether indicated or not.
- .3 Unless otherwise indicated on the drawings, all gypsum board partitions shall extend from floor level to the underside of floor or roof structures above.
- .4 Align partition tracks at floor and ceiling and secure at 600 mm on centre maximum. Provide top deflection tracks where indicated or as required to permit structural deflection. Install top deflection clips as necessary to increase load capacity.
- .5 Place studs vertically at 400 mm on centre unless noted otherwise and not more than 50 mm from abutting walls, and at each side of openings and corners. Position studs in tracks at floor and ceiling. Cross brace steel studs as required to provide rigid installation to manufacturer's instructions.
- .6 Erect metal studding to tolerance of 1:1000.
- .7 Attach studs to bottom and ceiling track using screws.
- .8 Co-ordinate simultaneous erection of studs with installation of service lines. When erecting studs ensure web openings are aligned.

- .9 Co-ordinate erection of studs with installation of door/window frames and special supports or anchorage for work specified in other Sections.
- .10 Provide two studs extending from floor to ceiling at each side of openings wider than stud centres specified. Secure studs together, 50 mm apart using column clips or other approved means of fastening placed alongside frame anchor clips.
- .11 Install heavy thickness single jamb studs at openings.
- .12 Erect track at head of door/window openings and sills of window openings to accommodate intermediate studs. Secure track to studs at each end, in accordance with manufacturer's instructions. Install intermediate studs above and below openings in same manner and spacing as wall studs.
- .13 Frame openings and around built-in equipment, cabinets, access panels, on four sides. Extend framing into reveals. Check clearances with equipment suppliers.
- .14 Provide 40 mm stud or furring channel secured between studs for attachment of fixtures behind lavatory basins, toilet and bathroom accessories, and other fixtures including grab bars and towel rails, attached to steel stud partitions.
- .15 Install steel studs or furring channel between studs for attaching electrical and other boxes.
- .16 Maintain clearance under beams and structural slabs to avoid transmission of structural loads to studs. Use 50 mm leg ceiling tracks.
- .17 Install two continuous beads of acoustical sealant under studs and tracks around perimeter of sound control partitions.

3.3 Wall Furring

- .1 Install wall furring for gypsum board wall finishes in accordance ASTM C754 and ASTM C841 except where specified otherwise and indicated on drawings.
- .2 Frame openings and around built-in equipment, cabinets, access panels, etc., on four sides. Extend furring into reveals. Check clearances with equipment suppliers.
- .3 Furr duct shafts, beams, columns, pipes and exposed services where indicated.

3.4 Suspended and Furred Ceilings and Bulkheads

- .1 Erect hanger and runner channels for suspended gypsum board ceilings and bulkheads in accordance with ASTM C754 and ASTM C841 except where specified otherwise and indicated on drawings.
- .2 Securely anchor hanger to structural supports 1220 mm o.c. maximum along runner channels and not more than 150 mm from ends. Under no circumstances shall hanger wires be secured to or supported from mechanical or electrical materials or equipment or penetrate mechanical ductwork.
- .3 Space runner or furring channels as shown on drawings and not more than 610 mm o.c. maximum nor 150 mm from walls. Run channels in long direction of board. Bend hanger sharply under bottom flange of runner and securely wire in place with a saddle tie. Provide channels below mechanical or electrical equipment and mechanical ductwork to maintain maximum spacing.

- .4 Install furring channels transversely across runner channels in short direction of wallboard at 610 mm o.c. maximum or 150 mm from walls and interruptions in ceiling continuity. Secure channels to support with furring clips or wire. Where splicing is necessary lap minimum 200 mm and wire tie each end with double loops of 0.90 mm galvanized tie wire, 25 mm from each end of overlap.
- .5 Support light fixtures by providing additional ceiling suspension hangers within 150 mm of each corner and at maximum 610 mm around perimeter of fixture. Coordinate with Electrical.
- .6 Install work level to tolerance of 1:1200.
- .7 Frame with furring channels, perimeter of openings for access panels, light fixtures, diffusers, grilles, etc.
- .8 Install furring channels parallel to, and at exact locations of steel stud partition header track.
- .9 Furr for gypsum board faced vertical bulkheads within or at termination of ceilings.

3.5 Gypsum Board

- .1 Installation of gypsum board is specified in Section 09 21 16

3.6 Cleaning

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

End of Section

PART 1 GENERAL

1.1 General

- .1 Conform to the requirements of Division 1.

1.2 Related Sections

- .1 Section 09 21 16 Gypsum Board
- .2 Section 09 53 00 Acoustical Suspension

1.3 References

- .1 ASTM International (ASTM)
 - .1 ASTM C423-23 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
 - .2 ASTM E84-23c Standard Test Method for Surface Burning Characteristics of Building Materials
 - .3 ASTM E1264-22 Standard Classification for Acoustical Ceiling Products
 - .4 ASTM E1414/E1414M-21a Standard Test Method for Airborne Sound Attenuation Between Rooms Sharing a Common Ceiling Plenum
 - .5 ASTM E1477-98a(2022) Standard Test Method for Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 ULC 102-2018 Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.4 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.
 - .1 Acoustical Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. For acoustical performance, each carton of material must carry an approved independent laboratory classification of NRC, CAC, and AC.
- .3 Submit duplicate 300 x 300 mm samples of each type of acoustical unit.
- .4 Provide maintenance data for acoustic panel ceilings for incorporation into Operation and Maintenance Manual specified in Section 01 78 00 – Closeout Submittals.

1.5 Quality Assurance

- .1 Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.
 - .1 Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
 - .2 Surface Burning Characteristics: As follows, tested per ASTM E84 and complying with ASTM E1264 Classification.
 - .3 Fire Resistance: As follows tested per ASTM E119 and listed in the appropriate floor or roof design in the Underwriters Laboratories Fire Resistance Directory

- .2 Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.6 Project Conditions

- .1 Permit wet work to dry before beginning to install.
- .2 Maintain uniform minimum temperature of 15° C and humidity of 20-40% before and during installation.
- .3 Store materials in work area 48 hours prior to installation.
- .4 Building areas to receive ceilings shall be free of construction dust and debris.

1.7 Performance Requirements

- .1 Surface-Burning Characteristics: Conform to ULC S102 or ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
- .2 Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to applicable code.

1.8 Shipping, Handling and Storage

- .1 Refer to Section 01 61 00 – Common Product Requirements.
- .2 Deliver, handle and store materials in accordance with manufacturer's printed instructions.
- .3 Protect on site stored or installed absorptive material from moisture damage.

1.9 Waste Management and Disposal

- .1 Refer to Section 01 74 19 – Construction Waste Management and Disposal.

1.10 Extra Materials

- .1 Provide extra materials of acoustic units in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Provide acoustical units amounting to 5% of gross ceiling area for each pattern and type required for project.
- .3 Ensure extra materials are from same production run as installed materials.

PART 2 PRODUCTS

2.1 Materials

- .1 Acoustic units for suspended ceiling system: to ASTM E1264
- .2 Panel Type 1: Armstrong Fine Fissured #1729.
 - .1 Class A.
 - .2 Composition: Mineral Fiber
 - .3 Pattern: Fine fissured.

- .4 Texture: medium.
 - .5 Flame spread: ASTM E1264, Class A (U.L.C.), 25 or less.
 - .6 Smoke developed 50 or less in accordance with ULC 102.
 - .7 Noise Reduction Coefficient (NRC): ASTM C423; Classified with UL label, 0.55
 - .8 Ceiling Attenuation Class (CAC): ASTM C1414; Classified with UL label, 35
 - .9 Light Reflectance (LR) range of 0.82 to ASTM E1477.
 - .10 Dimensional Stability: Standard
 - .11 Edge Profile: Square Lay-In
 - .12 Colour: White.
 - .13 Size 610 x 1219 x 16 mm thick.
 - .14 Shape flat.
 - .15 Surface coverings: Factory applied latex paint.
- .3 Alternate manufacturer: Products as manufactured by the following are acceptable, subject to Consultants approval of style, finish, performance characteristics and texture:
- .1 CGC
 - .2 Certainteed
- .4 Ceiling Suspension System: as specified in Section 09 53 00.

PART 3 EXECUTION

3.1 Examination

- .1 Do not install acoustical panels until work above ceiling has been inspected by Consultant.

3.2 Installation

- .1 Co-ordinate with Section 09 53 00 - Acoustical Suspension.
- .2 Coordinate layout and installation of ceilings with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, and fire-suppression system.
- .3 Install acoustical panels and tiles in ceiling suspension system.
- .4 Install acoustical units parallel to building lines with edge unit not less than 50% of unit width, with directional pattern running in same direction. Refer to reflected ceiling plan.
- .5 Scribe acoustic units to fit adjacent work. Butt joints tight, terminate edges with moulding.

3.3 Cleaning

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.

End of Section

PART 1 GENERAL

1.1 General

- .1 Conform to the requirements of Division 1.

1.2 Related Sections

- .1 Section 09 21 16 Gypsum Board
- .2 Section 09 51 13 Acoustic Panel Ceilings

1.3 References

- .1 ASTM International (ASTM)
 - .1 ASTM A307-21 Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
 - .2 ASTM A641/A641M-19 Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - .3 ASTM A653 / A653M – 23 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 - .4 ASTM A1011/A1011M-23 Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength
 - .5 ASTM C635/C635M-22 Standard Specification for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay in Panel Ceilings.
 - .6 ASTM C636/C636M-19 Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
 - .7 ASTM E84-23c Standard Test Method for Surface Burning Characteristics of Building Materials
 - .8 ASTM E119-22 Standard Test Methods for Fire Tests of Building Construction and Materials
 - .9 ASTM E1264-22 Standard Classification for Acoustical Ceiling Products

1.4 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data: Submit manufacturer's technical data for each type of acoustical ceiling unit and suspension system required.
- .3 Acoustical Certifications: Manufacturer's certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards.
- .4 Submit one representative model of each type of ceiling suspension system.
 - .1 Ceiling system to show basic construction and assembly, treatment at walls, recessed fixtures, splicing, interlocking, finishes, acoustical unit installation.

1.5 Design Requirements

- .1 Determine the superimposed loads that will be applied to suspension systems by components of the building other than the ceiling and ensure that adequate hangers are installed to support the additional loads in conjunction with the normal loads of the system.

- .2 Design supplemental suspension members and hangers where width of ducts and other construction within ceiling plenum produces hanger spacing that interferes with location of hangers at required spacing to support standard suspension system members:
 - .1 Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- .3 Rigidly secure acoustic ceiling system including integral mechanical and electrical components with maximum deflection of L/360 to ASTM C635 deflection test.

1.6 Performance Requirements

- .1 Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to applicable code.

1.7 Quality Assurance

- .1 Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.
- .2 Fire Performance Characteristics: Identify acoustical ceiling components with appropriate markings of applicable testing and inspecting organization.
 - .1 Surface Burning Characteristics: Tested per ASTM E84 and complying with ASTM E1264 Classification.
 - .2 Fire Resistance: Tested per ASTM E119 and listed in the appropriate floor or roof design in the Underwriters Laboratories Fire Resistance Directory
- .3 Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.
- .4 Where required, provide fire-resistance rated suspension system: certified by a Canadian Certification Organization accredited by Standards Council of Canada.
- .5 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and as described in Section 09 51 13.

1.8 Shipping, Handling and Storage

- .1 Refer to Section 01 61 00 – Common Product Requirements.
- .2 Deliver, handle and store materials in accordance with manufacturer's printed instructions.

1.9 Waste Management and Disposal

- .1 Refer to Section 01 74 19 – Construction Waste Management and Disposal.

PART 2 PRODUCTS

2.1 Materials

- .1 Components: All main beams and cross tees, base metal and end detail shall be commercial quality hot-dipped galvanized steel as per ASTM C635. Main beams and cross tees shall be double-web steel construction with type exposed flange design. Exposed surfaces chemically

cleansed, capping pre-finished galvanized steel in baked polyester paint. Main beams and cross tees shall have rotary stitching.

- .2 Face width: 22 mm
- .3 Edge Moldings and Trim: Hemmed angle moulding to match main beams and cross tees.
- .4 Structural Classification: Intermediate Duty System, ASTM C635.
- .5 Colour: White and match the actual colour of the specified ceiling tile.
- .6 Standard of Acceptance:
 - .1 Armstrong Prelude XL
 - .2 Donn DXT
 - .3 Certainteed Classic Environmental Stab.
- .7 Attachment Devices: Size for five times design load indicated in ASTM C635, Table 1, Direct Hung unless otherwise indicated or required.
- .8 Threaded Rod: to ASTM A397. Galvanized or zinc plated.
- .9 Wire for Hangers and Ties: ASTM A641, Class 1 zinc coating, soft annealed, with a yield stress load of at least three times design load, but not less than 2.06 mm thick.
- .10 Channel Framing and Fittings: Strut type metal framing and components to ASTM A1011 or ASTM A653. Unistrut P1000SL or equivalent. Galvanized.

PART 3 EXECUTION

3.1 Manufacturer's Instructions

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.2 Examination

- .1 Do not proceed with installation until all wet work such as concrete, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer's printed recommendations.

3.3 Preparation

- .1 Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid use of less than half width units at borders and comply with reflected ceiling plans. Coordinate panel layout with mechanical and electrical fixtures.
- .2 Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.
 - .1 Furnish concrete inserts and similar devices to other trades for installation well in advance of time needed for coordination of other work.

3.4 Installation

- .1 Install suspension system and panels in compliance with ASTM C636; CISCA Seismic Guidelines and in accordance with the manufacturer's installation instructions.
- .2 Install wall moldings at intersection of suspended ceiling and vertical surfaces.
- .3 Do not erect ceiling suspension system until work above ceiling has been inspected by Consultant.
- .4 Secure hangers to overhead structure using attachment methods as indicated by manufacturer. Do not suspend ceiling systems from building services including plumbing lines, conduit, cable trays or duct work.
- .5 Hanger and bracing wires shall not attach to or bend around obstructions including but not limited to: piping, ductwork, conduit and equipment. Provide trapeze or other supplementary support members at obstructions to allow typical hanger spacing. Brace assemblies must be configured and/or located in order to avoid obstructions in addition to maintaining the required brace assembly spacing.
- .6 Install hangers spaced at maximum 1219 mm centres and within 152 mm from ends of main tees. Install hanger wires plumb and straight.
- .7 Lay out centre line of ceiling both ways, to provide balanced borders at room perimeter with border units not less than 50% of standard unit width.
- .8 Ensure suspension system is coordinated with location of related components.
- .9 Completed suspension system to support super-imposed loads, such as lighting fixtures, diffusers, grilles, and speakers.
- .10 Support at light fixtures and diffusers with additional ceiling suspension hangers within 150 mm of each corner and at maximum 610 mm around perimeter of fixture.
- .11 Interlock cross member to main runner to provide rigid assembly.
- .12 Frame at openings for light fixtures, air diffusers, speakers and at changes in ceiling heights.
- .13 Install access splines to provide ceiling access.
- .14 Finished ceiling system to be square with adjoining walls and level within 1:1000

3.5 Cleaning

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Touch up scratches, abrasions, voids and other defects in painted surfaces.

End of Section

PART 1 GENERAL

1.1 General

- .1 Conform to the requirements of Division 1.

1.2 References

- .1 ASTM International (ASTM)
 - .1 ASTM E84-23c Standard Test Method for Surface Burning Characteristics of Building Materials
 - .2 ASTM F710-21 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring
 - .3 ASTM F1066-04(2018) Standard Specification for Vinyl Composition Floor Tile
 - .4 ASTM F1344-21a Standard Specification for Rubber Floor Tile
 - .5 ASTM F1861-21 Standard Specification for Resilient Wall Base
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 ULC 102.2-2018 Method of Test for Surface Burning Characteristics of Flooring, Floor Coverings, and Miscellaneous Materials and Assemblies

1.3 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit duplicate samples of manufacturer's full range of colours for specified products for selection of colours by the Consultant.
- .3 Submit a complete list of all materials proposed to be furnished and installed under this portion of the Work, stating manufacturer's name and catalogue number for each item, and product samples in colours specified.
 - .1 Submit two copies of the manufacturer's current recommended method of installation for each item.
- .4 Provide maintenance data for resilient flooring for incorporation into Operation and Maintenance Manual specified in Section 01 78 00 – Closeout Submittals.

1.4 Shipping, Handling and Storage

- .1 Refer to Section 01 61 00 – Common Product Requirements.
- .2 Deliver, handle and store materials in accordance with manufacturer's printed instructions.
- .3 Use all means necessary to protect resilient flooring materials before, during and after installation and to protect the installed work and materials of all other trades.

1.5 Maintenance Materials

- .1 Provide extra stock materials of resilient flooring, base and adhesives in accordance with Section 01 78 00 – Closeout Submittals.
 - .1 Provide one carton of each colour, pattern and type flooring material required for this project for maintenance use.
 - .2 Provide one container of adhesive.
 - .3 Clearly identify each container of floor tile and each container of adhesive.

- .2 Extra materials to be from same production run as installed materials.

1.6 Environmental Requirements

- .1 Maintain air temperature and structural base temperature at floor installation area above 20° C for 48 hours before, during and after installation.

1.7 Waste Management and Disposal

- .1 Refer to Section 01 74 19 – Construction Waste Management and Disposal.

1.8 Warranty

- .1 Warrant the work of this Section against defects of workmanship and material, for a period of ten years from the date of Substantial Performance and agree to make good promptly any defects which occur or become apparent within the warranty period.

PART 2 PRODUCTS

2.1 Materials

- .1 Luxury Vinyl Tile: to CSA A126.1 or ASTM F1066, 305 x 305 x 3.0 mm thick, non-asbestos, Class 2 through pattern tile with static load of not less than 517 kPa and U.L.C. flame spread rating of 75 or less.
 - .1 Interface Stargazing Scorpio Electric Blue A01708
 - .2 Interface Stargazing Scorpio Silverlight A01716
- .2 Resilient Base: To ASTM F1861, thermoplastic rubber, not less than 3.0 mm thickness with preformed internal and external corners. Base at resilient tile shall have standard toe.
 - .1 Tarkett Traditional 4 ½" with toe, Black
- .3 Primers, Adhesives and Caulking: non-flammable, solvent free, waterproof, recommended by flooring manufacturer for specific material on applicable substrate, above, at or below grade.
- .4 Sub-floor filler and leveler shall be white premixed latex compatible with flooring products and adhesive as recommended by flooring manufacturer for specific flooring types.
- .5 Metal edge strips: aluminum extruded, smooth, mill finish with lip to extend under floor finish, shoulder flush with top of adjacent floor finish.
- .6 Transition strips, mouldings and adaptors shall be rubber or vinyl, manufactured by Johnsonite, Roppe or Burke Mercer with lip to extend under floor tile with tapered edge, colour matched to flooring.
- .7 Sealer: water based, type recommended by flooring manufacturer.
- .8 Wax: type recommended by flooring manufacturer.
- .9 All colours and patterns shall be as selected by the Consultant from the complete range of manufacturer's colours and patterns.

PART 3 EXECUTION

3.1 Surface Conditions

- .1 Conform to requirements of ASTM F710.
- .2 Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
- .3 Confirm that resilient flooring and base may be installed in accordance with the original design and the manufacturer's recommendations.
- .4 Ensure concrete floors are dry, by using test methods recommended by tile manufacturer. Concrete must be cured a minimum of 35 days prior to commencement of resilient flooring application.
- .5 In the event of discrepancy, immediately notify the Consultant. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.
- .6 Perform subfloor moisture testing in accordance with ASTM F1869 and Bond Tests as described in manufacturer's installation guidelines to determine if surfaces are dry; free of curing and hardening compounds, old adhesive, and other coatings; and ready to receive flooring. Relative humidity shall not exceed 80%. MVER shall not exceed 5 lbs./1000 sq. ft./24 hrs. On installations where both the Percent Relative Humidity and the Moisture Vapor Emission Rate tests are conducted, results for both tests shall comply with the allowable limits listed above. Do not proceed with flooring installation until results of moisture tests are acceptable. All test results shall be documented and retained.

3.2 Sub Floor Treatment

- .1 Remove sub-floor ridges and bumps. Fill low spots, cracks, joints, holes and other defects with sub-floor filler.
- .2 Install sub floor and levelling compound to manufacturer's recommended standard limits and deviations. Levelling compound shall be applied to all subfloors and shall meet flatness requirements of flooring manufacturer and in accordance with ASTM F710.
- .3 Remove all substance and materials affecting adhesive bond.
- .4 Vacuum clean floors.
- .5 Clean floor and apply filler; trowel and float to leave smooth, flat hard surface. Prohibit traffic until filler is cured and dry.
- .6 Prime or seal substrates to flooring and adhesive manufacturer's instructions.
- .7 Allow for excessive leveling of existing slabs.

3.3 Application

- .1 Provide a high ventilation rate, with maximum outside air, during installation, and for 48 hours after installation. Whenever possible, ventilate directly to outside. Do not allow contaminated air to re-circulate through the building ventilation system.

- .2 Install all resilient flooring in strict accordance with the manufacturer's printed instructions and recommendations.
- .3 Do not lay floor coverings and base until all trades, except painter, have completed their work and just prior to completion of the building.
- .4 Apply adhesive uniformly with recommended trowels, at coverage as recommended by the manufacturer. Do not spread more adhesive than can be covered before initial set takes place.
- .5 Lay flooring with joints parallel to building lines unless otherwise indicated, to produce symmetrical tile pattern. Patterns shall be as directed by the consultant. Allow for one field tile and one accent tile in each room or space. Border tiles shall be minimum $\frac{1}{2}$ tile width.
- .6 Install flooring to square grid pattern with all joints aligned unless otherwise indicated.
- .7 As installation progresses, and after installation, roll flooring in 2 directions with a 45 kg roller to ensure full adhesion.
- .8 Cut and fit tile neatly around fixed objects.
- .9 Install feature strips or feature tiles where directed. Fit joints tightly.
- .10 Continue flooring throughout areas to receive movable type partitions or fitments without interrupting floor pattern.
- .11 Install flooring full depth of closets, toe spaces, and recesses.
- .12 Terminate flooring at centre line of door in openings where adjacent floor finish or colour is dissimilar.
- .13 Install transition strips at unprotected or exposed edges where flooring terminates. Locate transition strip at centre line of door where a door occurs.

3.4 Base Application

- .1 Lay out base to keep number of joints to a minimum. Locate joints at maximum available spacing or at internal or pre moulded corners.
- .2 Clean substrate and prime with one coat of adhesive.
- .3 Apply adhesive to back of base.
- .4 Set base against wall and floor surfaces tightly by using a 3 kg hand roller.
- .5 Install straight and level to variation of 1:1000.
- .6 Scribe and fit to door frames and other obstructions. Use pre-moulded end pieces at flush door frames.
- .7 Cope internal corners. Use pre moulded corner units for right angle external corners. Use formed straight base materials for external corners of other angles, minimum 300 mm each leg.

- .8 Provide rubber base at all locations specified, regardless of floor finish.

3.5 Cleaning

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Remove excess adhesive from resilient floor coverings, base and adjacent finished surfaces as the work progresses.
- .3 Clean, seal and wax floor and base surfaces to manufacturer's instructions. In carpeted areas, clean base before installation of carpet.

3.6 Protection

- .1 Protect new floors until time of final inspection.
- .2 Prohibit traffic on floors for 48 hours after installation.
- .3 Immediately prior to final inspection, remove protection, clean, dry or damp mop resilient flooring and apply one additional coat of wax.

End of Section

PART 1 GENERAL

1.1 General

- .1 Conform to the requirements of Division 1.

1.2 Related Sections

- .1 Section 08 11 00 Metal Doors and Frames
- .2 Section 08 14 16 Flush Wood Doors
- .3 Section 09 21 16 Gypsum Board

1.3 References

- .1 ASTM International (ASTM)
 - .1 ASTM A780/A780M-20 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- .2 Environmental Protection Agency (EPA)
 - .1 Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 (for Surface Coatings).
- .3 Master Painters Institute (MPI)
 - .1 MPI Architectural Painting Specifications Manual, 2018
 - .2 MPI Standard GPS-1-12 and GPS-2-12 MPI Green Performance Standard for Painting and Coatings.
- .4 Society for Protective Coatings (SSPC)
 - .1 Systems and Specifications, SSPC Painting Manual 2009
- .5 Underwriters Laboratories of Canada (ULC)
 - .1 ULC 102-18 Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies
- .6 South Coast Air Quality Management District, California State (SCAQMD)
 - .1 SCAQMD Rule 1113-96, Architectural Coatings.
- .7 Green Seal GS-11 Green Seal Environmental Standard for Paints and Coatings, January 1997.
- .8 National Fire Code of Canada

1.4 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Samples:
 - .1 Submit full range colour sample chips.
 - .2 Submit duplicate 200 x 300 mm sample panels of each paint, stain, clear coating and special finish with specified paint or coating in colours, gloss/sheen and textures required to MPI Architectural Painting Specification Manual standards.
 - .3 Retain reviewed samples on-site to demonstrate acceptable standard of quality for appropriate on-site surface.
- .4 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties and SCAQMD Rule 1113-96.
- .5 Provide maintenance data for paint products for incorporation into Operating and Maintenance Manuals specified in Section 01 78 00- Closeout Submittals. Include following:

- .1 Product name, number, type and use.
- .2 Colour numbers.
- .3 MPI Environmentally Friendly classification system rating.

1.5 Quality Assurance

- .1 Qualifications:
 - .1 Contractor: to have a minimum of five years proven satisfactory experience.
 - .2 Qualified journeypersons as defined by local jurisdiction to be engaged in painting work.
 - .3 Apprentices: may be employed provided they work under direct supervision of qualified journeyperson in accordance with trade regulations.
- .2 Conform to latest MPI requirements for painting work including preparation and priming.
- .3 Materials: in accordance with MPI Painting Specification Manual "Approved Product" listing and from a single manufacturer for each system used.
- .4 Paint materials to be highest quality product of an approved manufacturer listed in MPI Painting Specification Manual and to be compatible with other coating materials as required.
- .5 Retain purchase orders, invoices and documents to prove conformance with noted MPI requirements when requested by Consultant.
- .6 Provide mock-up in accordance with Section 01 45 00 - Quality Control.
 - .1 Prepare and paint designated surface, area, room or item (in each colour scheme) to specified requirements, with specified paint or coating showing selected colours, gloss/sheen and textures. Locate where directed.
 - .2 Mock-up will be used to judge workmanship, substrate preparation, operation of equipment and material application and workmanship to MPI Architectural Painting Specification Manual standards.
 - .3 Allow 24 hours for inspection of mock-up before proceeding with work.
 - .4 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work.

1.6 Shipping, Handling and Storage

- .1 Refer to Section 01 61 00 – Common Product Requirements.
- .2 Deliver and store materials in original containers, sealed, with labels intact. Labels to indicate:
 - .1 Manufacturer's name and address.
 - .2 Type of paint or coating.
 - .3 Compliance with applicable standard.
 - .4 Colour number in accordance with established colour schedule.
- .3 Provide and maintain dry, temperature controlled, secure storage. Store materials and equipment in well-ventilated area with temperature range 7 ° C to 30 ° C. Store materials and supplies away from heat generating devices.
- .4 Observe manufacturer's recommendations for storage and handling.
- .5 Keep areas used for storage, cleaning and preparation, clean and orderly. After completion of operations, return areas to clean condition.
- .6 Remove paint materials from storage only in quantities required for same day use.

- .7 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.
- .8 Remove damaged, opened and rejected materials from site.

1.7 Fire Safety Requirements

- .1 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.
- .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
- .3 Handle, store, use and dispose of flammable and combustible materials in accordance with National Fire Code of Canada requirements.

1.8 Waste Management and Disposal

- .1 Refer to Section 01 74 19 – Construction Waste Management and Disposal.
- .2 Place materials defined as hazardous or toxic in designated containers. Handle and dispose of hazardous materials in accordance with Municipal regulations.
- .3 Unused materials must be disposed of at official hazardous material collections site.
- .4 Paint and related materials are regarded as hazardous products and are subject to regulations for disposal. Information on these controls can be obtained from the Ministry of the Environment.
- .5 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.
- .6 Place materials defined as hazardous or toxic waste in containers or areas designated for hazardous waste.

1.9 Maintenance

- .1 Extra Materials:
 - .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
 - .2 Quantity: provide one four litre can of each type and colour of finish coating. Identify colour and paint type in relation to established colour schedule and finish system.
 - .3 Deliver to Owner and store where directed.

1.10 Ambient Conditions

- .1 Heating, Ventilation and Lighting:
 - .1 Ventilate enclosed spaces in accordance with Section 01 51 00 – Temporary Utilities.
 - .2 Provide heating facilities to maintain ambient air and substrate temperatures above 10 ° C for 24 hours before, during and after paint application until paint has cured sufficiently.
 - .3 Provide continuous ventilation for seven days after completion of application of paint.
 - .4 Provide temporary ventilating and heating equipment where permanent facilities are not available or supplemental ventilating and heating equipment if ventilation and heating from existing system is inadequate to meet minimum requirements.
 - .5 Provide minimum lighting level of 323 Lux on surfaces to be painted.

- .2 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Unless pre-approved in writing by Consultant and product manufacturer, perform no painting when:
 - .1 Ambient air and substrate temperatures are below 10 ° C.
 - .2 Substrate temperature is above 32 ° C unless paint is specifically formulated for application at high temperatures.
 - .3 Substrate and ambient air temperatures are not expected to fall within MPI or paint manufacturer's prescribed limits.
 - .4 The relative humidity is under 85% or when the dew point is more than 3 ° C variance between the air/surface temperature. Paint should not be applied if the dew point is less than 3 ° C below the ambient or surface temperature. Use sling psychrometer to establish the relative humidity before beginning paint work.
 - .2 Ensure that conditions are within specified limits during drying or curing process, until newly applied coating can itself withstand 'normal' adverse environmental factors.
 - .3 Perform painting work when maximum moisture content of the substrate is below:
 - .1 Allow new concrete to cure minimum of 28 days.
 - .2 15% for wood.
 - .3 12% for plaster and gypsum board.
 - .4 Test for moisture using calibrated electronic Moisture Meter. Test concrete floors for moisture using "cover patch test".
 - .5 Test concrete and plaster surfaces for alkalinity as required.
- .3 Surface and Environmental Conditions:
 - .1 Apply paint finish in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .2 Apply paint to adequately prepared surfaces and to surfaces within moisture limits.
 - .3 Apply paint when previous coat of paint is dry or adequately cured.

PART 2 PRODUCTS

2.1 Materials

- .1 Provide paint materials for paint systems from single manufacturer.
- .2 Products to meet requirements of GS-11 or SCAQMD Rule 1113-96
- .3 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.
- .4 Only qualified products with E2 or E3 "Environmentally Friendly" rating are acceptable for use.
- .5 Linseed oil, shellac, and turpentine: highest quality product from approved manufacturer listed in MPI Architectural Painting Specification Manual, compatible with other coating materials as required.
- .6 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids:
 - .1 Non-flammable, biodegradable.
 - .2 Manufactured without compounds which contribute to ozone depletion in the upper atmosphere.
 - .3 Manufactured without compounds which contribute to smog in the lower atmosphere.
 - .4 Do not contain methylene chloride, chlorinated hydrocarbons or toxic metal pigments.
 - .5 Recycled content of 15% post-consumer and ½ post-industrial waste.

- .7 Formulate and manufacture water-borne surface coatings with no aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- .8 Flash point: 61 °C or greater for water-borne surface coatings and recycled water-borne surface coatings.

2.2 Colours

- .1 Consultant will provide Colour Schedule.
- .2 Colour schedule will be based upon selection of eight base colours and six deep tint accent colours.
- .3 Selection of colours will be from manufacturer's full range of colours.
- .4 Where specific products are available in restricted range of colours, selection will be based on limited range.
- .5 Second coat in three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.

2.3 Mixing and Tinting

- .1 Perform colour tinting operations prior to delivery of paint to site.
- .2 Use and add thinner in accordance with paint manufacturer's recommendations. Do not use kerosene or similar organic solvents to thin water-based paints.
- .3 Thin paint for spraying in accordance with paint manufacturer's instructions.
- .4 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 Gloss/Sheen Ratings

- .1 Paint gloss: defined as sheen rating of applied paint, in accordance with following values:

Gloss Level Category/	Units @ 60 Degrees	Units @ 85 Degrees
G1 – matte finish	0 to 5	Max. 10
G2 – velvet finish	0 to 10	10 to 35
G3 – eggshell finish	10 to 25	10 to 35
G4 – satin finish	20 to 35	Min. 35
G5 – semi-gloss finish	35 to 70	
G6 – gloss finish	70 to 85	
G7 – high gloss finish	> 85	

- .2 Gloss level ratings of painted surfaces as specified and as noted on Finish Schedule.

2.5 Interior Painting Systems

- .1 Galvanized Metal: interior doors, frames:
 - .1 INT 5.3A Latex G5 semi-gloss finish

- .2 Concrete Masonry:
 - .1 INT 4.2D High performance architectural latex G5 semi-gloss finish.
- .3 Wood Clear Polyurethane Finish:
 - .1 INT 6.3K Polyurethane varnish G6 gloss finish.
- .4 Gypsum Board: Walls:
 - .1 INT 9.2A Latex G3 eggshell finish over latex sealer.
- .5 Gypsum Board: Ceilings and Bulkheads:
 - .1 INT 9.2A Latex G2 velvet finish over latex sealer.
- .6 All other surfaces not noted above: high performance finish suitable for commercial and institutional environment and in accordance with MPI painting manual.

PART 3 EXECUTION

3.1 General

- .1 Perform preparation and operations for interior painting in accordance with MPI Architectural Painting Specifications Manual except where specified otherwise.
- .2 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and application instructions, and data sheets.

3.2 Examination

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report damages, defects, unsatisfactory or unfavourable conditions to Consultant before proceeding with work.

3.3 Preparation

- .1 Protection:
 - .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage by suitable non-staining covers or masking and in accordance with paint manufacturers and MPI recommendations. If damaged, clean and restore surfaces as directed by Consultant.
 - .2 Protect items that are permanently attached such as Fire Labels on doors and frames.
 - .3 Protect factory finished products and equipment.
- .2 Surface Preparation:
 - .1 Move and cover furniture and portable equipment as necessary to carry out painting operations. Replace as painting operations progress.
 - .2 Place "WET PAINT" signs in occupied areas as painting operations progress.
- .3 Clean and prepare surfaces in accordance with MPI Architectural Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:
 - .1 Remove dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths, or compressed air.
 - .2 Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
 - .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
 - .4 Allow surfaces to drain completely and allow to dry thoroughly.

- .5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
- .6 Use trigger operated spray nozzles for water hoses.
- .7 Many water-based paints cannot be removed with water once dried. Minimize use of mineral spirits or organic solvents to clean up water-based paints.
- .4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
- .5 Where possible, prime non-exposed surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
 - .1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
 - .2 Apply wood filler to nail holes and cracks.
 - .3 Tint filler to match stains for stained woodwork.
- .6 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements and SSPC-SP 6. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes blowing with clean dry compressed air or vacuum cleaning.
- .7 Touch up of shop primers with primer as specified.
- .8 Do not apply paint until prepared surfaces have been accepted by Consultant.

3.4 Application

- .1 Apply paint materials in accordance with paint manufacturer's written application instructions.
- .2 Brush and Roller Application:
 - .1 Apply paint in uniform layer using brush and/or roller type suitable for application.
 - .2 Work paint into cracks, crevices and corners.
 - .3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
 - .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces free of roller tracking and heavy stipple.
 - .5 Remove runs, sags and brush marks from finished work and repaint.
- .3 Spray application:
 - .1 Provide and maintain equipment that is suitable for intended purpose, capable of atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
 - .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
 - .3 Apply paint in uniform layer, overlapping at edges of spray pattern. Back roll first coat application.
 - .4 Brush out immediately all runs and sags.
 - .5 Use brushes and rollers to work paint into cracks, crevices and places which are not adequately painted by spray.
- .4 Apply coats of paint continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

- .5 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .6 Sand and dust between coats to remove visible defects.
- .7 Finish surfaces both above and below sight lines as specified for surrounding surfaces.
- .8 Finish alcoves as specified for adjoining rooms.
- .9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.5 Mechanical/Electrical Equipment

- .1 Paint finished area exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces.
- .2 Mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.
- .3 Other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
- .4 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.
- .5 Do not paint over nameplates.
- .6 Keep sprinkler heads free of paint.
- .7 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.
- .8 Paint fire protection piping red.
- .9 Paint natural gas piping yellow.
- .10 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.
- .11 Do not paint interior transformers and substation equipment.

3.6 Field Quality Control

- .1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .2 Standard of Acceptance:
 - .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
 - .2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.
 - .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.7 Cleaning and Restoration

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.
- .2 Remove protective coverings and warning signs as soon as practical after operations cease.
- .3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.
- .4 Protect freshly completed surfaces from paint droppings and dust to approval of Consultant. Avoid scuffing newly applied paint.
- .5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Consultant.

End of Section

PART 1 GENERAL

1.1 General

- .1 Conform to the requirements of Division 1.

1.2 Related Sections

- .1 Section 06 10 00 Rough Carpentry
- .2 Section 06 20 00 Finish Carpentry

1.3 Reference Standards

- .1 Aluminum Association (AA)
 - .1 Aluminum Association Designation System for Aluminum Finishes

1.4 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit manufacturer's preprinted technical literature for pre-manufactured products.
- .3 Submit samples of metal finishes when requested by the Consultant.
- .4 Submit operating and maintenance instructions for all manufactured products and specialties, for inclusion in the Operations and Maintenance Manuals specified in Section 01 78 00-Closeout Submittals.

1.5 Shipping, Handling and Storage

- .1 Refer to Section 01 61 00 – Common Product Requirements.
- .2 Deliver, handle and store materials in accordance with manufacturer's printed instructions.
- .3 Protect finished surfaces during shipment and installation.

1.6 Waste Management and Disposal

- .1 Refer to Section 01 74 19 – Construction Waste Management and Disposal.

PART 2 PRODUCTS

2.1 Materials

- .1 Items specified herein shall be standard manufactured items, modified if required and as specified to suit conditions of this project.
- .2 Fabricate work true to dimensions, square and plumb, to suit site conditions.
- .3 Thickness of metals shall be adequate for the various conditions with requirements specified as a minimum.
- .4 Finished work shall be free from warping, open seams, weld marks, rattles and other defects. Drilling shall be reamed and exposed edges finished smooth.

- .5 Provide all fastenings, anchorage and accessories as required to complete the work and as recommended by the manufacturer.
- .6 Fastenings shall be concealed or theft-proof type where possible. Exposed fastenings shall be neatly executed and shall be of the same material and finish as the base metal on which they occur.

2.2 Products

- .1 **Idea boards:** Rite-On, Wipe Off, Series 3000 writing boards, white porcelain enamel on steel, factory pre-framed in clear anodized aluminum trim with chalk rail by Architectural School Products Ltd. Sizes as indicated. Provide one package of companion writing pens (3 each red, blue, green and black) for each whiteboard.
- .2 **Tackboards:** Deluxe Series 4000, fine grain natural cork, light textured, brown with satin finished anodized aluminum frame and concealed fasteners, as manufactured by Architectural School Products Ltd. Sizes as indicated.
- .3 **Coat Rod and Shelf:** ASI Model STL1001. Shelf to consist of four 19 mm square 1.311 mm steel tubes closed and protected with plastic end caps. Coat rod to be 25 mm diameter chromium plated heavy duty steel hanger bar. Mounting brackets to be two piece heavy duty die cast aluminum designed with an integral backplate to provide positive fastening. Shelf and brackets to be finished in manufacturer's standard Duracron finish. Colour to be selected by the Consultant.

PART 3 EXECUTION

3.1 Installation - General

- .1 Install manufactured items in accordance with manufacturer's printed instructions and recommendations.

3.2 Cleaning

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.

End of Section

PART 1 GENERAL

1.1 General

- .1 Conform to the requirements of Division 1.

1.2 Related Sections

- .1 Section 06 10 00 Rough Carpentry

1.3 References

- .1 ASTM International (ASTM)
 - .1 ASTM D5116-17 Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products
 - .2 ASTM D6670-18 Standard Practice for Full-Scale Chamber Determination of Volatile Organic Emissions from Indoor Materials/Products
- .2 Underwriters Laboratories of Canada (ULC)
 - .1 ULC 109-14 Flame Tests of Flame Resistant Fabrics and Films
- .3 National Fire Protection Association (NFPA)
 - .1 NFPA 701 Standard Methods of Fire Tests for Flame Propagation of Textiles and Films
- .4 Canadian Electrical Code.

1.4 Submittals

- .1 Make submittals in accordance with Section 01 33 00 – Submittal Procedures.
- .2 Submit shop drawings. Clearly indicate, by large scale details, anchorage, assembly, materials, components, finishes, and perimeter construction conditions.
- .3 Submit duplicate 300 mm x 300 mm samples of fabrics in selected colours.
- .4 Submit manufacturer's maintenance data in the form of printed instructions for cleaning and maintaining roller shades, for inclusion in Operation and Maintenance Manuals specified in section 01 78 00 – Closeout Submittals

1.5 Quality Assurance

- .1 Work of this Section shall be by forces in the direct employ or under control of the system manufacturer, skilled, trained and experienced in work of similar scope and complexity.
- .2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section, with a minimum of ten years of experience.
- .3 Mock-Ups: Erect one full size mock-up of each roller shade type for review. Completed and accepted mock-up shall act as the standard to which the balance of the work will be judged.

1.6 Shipping, Handling and Storage

- .1 Refer to Section 01 61 00 – Common Product Requirements.
- .2 Test all operable components prior to shipping.

- .3 Deliver, handle and store materials in accordance with manufacturer's printed instructions.

1.7 Waste Management and Disposal

- .1 Refer to Section 01 74 19 – Construction Waste Management and Disposal.

1.8 Warranty

- .1 Warrant the work of this Section against defects of workmanship and material, for a period of two years from the date of Substantial Performance and agree to make good promptly any defects which occur or become apparent within the warranty period.
- .2 Manufacturer's Warranty: Submit manufacturer's standard 10 year product warranty executed by an authorized company official.

PART 2 PRODUCTS

2.1 Roller Shades

- .1 Roller Shade System to be Manually Operated Roller Shade system with fabric shadecloth.
- .2 Specification is based on Moduline Lite-lift chain operated roller shade system as manufactured by Sun Project Inc. System will be single shade system, as indicated.
- .3 Alternative products are acceptable, subject to approval of Consultant.
- .4 System to be complete, including frame, header assembly, hembar, shade fabric.
- .5 Shadecloth to be Ecofriendly shadecloth to meet indoor air quality guidelines of ASTM D5116/D6670.
 - .1 Fabric: SunProject SC2000 fine weave fiberglass and polyester sunscreen fabric. Openness factor: 3%; thickness: 0.48 mm; flame retardant; fade resistant. Colour to be selected by Consultant.
 - .2 Performance: fabric shall hang flat, without buckling or distortion. Edge, where trimmed, shall hang true and straight, without shifting sideways more than 3 mm in either direction due to warp distortion or weave design.
 - .3 Fabric shall be certified by an independent laboratory to pass the small scale vertical burn requirements test ULC S109 and NFPA 701.
- .6 Framing system to be factory finished aluminum framing, jambs, and header assembly. Colour to be selected by Consultant.
- .7 Provide continuous lightseal hembar.

2.2 Hardware – Manually Controlled Shades

- .1 Chain Operated with infinite positioning. Left or right hand operation and banding as applicable to project conditions.
 - .1 Drive assembly:
 - .1 Must allow fingertip control and include a built-in shock absorber system to prevent chain breakage under normal operating conditions.
 - .2 Factory set for size and travel of shades.
 - .3 Capable of being field adjusted from the exterior of the shade unit without having to disassemble the hardware.

- .4 Drive Chain: No. 10 stainless steel bead chain formed in a continuous loop. The chain shall have passed a 40kg load test. Chain may be positioned at either, or both ends of the shade without disassembly of the shade unit.
 - .1 Supply and install child safe chain retainers.
- .5 Supply and install counter balancing mechanism designed to offset the weight of the shade and give fingertip control.

2.3 Assembly

- .1 Supply and install fully factory assembled shade units consisting of 2 shade brackets, shade tube, extruded aluminum fascia, hembar and fabric as specified.
- .2 Factory modify housings where necessary to bypass columns and other obstructions.
- .3 End Brackets: 2 piece molded ABS construction with nylon drive sprocket. Bracket colour coordinated with fascia colour.
- .4 Shade tube; Minimum 1.52 mm thick extruded aluminum with 3 equally spaced continuous stiffening fins, non-sag design, maximum deflection under full load of fabric L/700.
- .5 Fascia: One piece extruded aluminum 1.7 mm thickness complete with three continuous screw flutes. Anodized. Colour as selected by the Consultant. Extruded aluminum snap lock fascia which continuously fits on the end and center brackets as a one-piece section.
- .6 Hembar: extruded aluminum with matching plastic end finials.

2.4 Shade Mounting System

- .1 Extruded aluminum bracket designed to accept preassembled shade system.
 - .1 Brackets shall be used to facilitate the alignment with shade opening.
- .2 Modular Construction: shades must be removable as a complete modular unit without any component disassembly required.

2.5 Aluminum Finish

- .1 Exposed aluminum: Baked enamel, colour to be selected by the Consultant.
- .2 Unexposed aluminum: mill finish.

2.6 Fabrication

- .1 Finished assemblies shall be square, true to size and free from distortion, twist or other defects that could affect their strength, operation or appearance.
- .2 Factory applied finish shall be uniform, smooth and without blemishes.
- .3 The fabric shall be colour fast, retain its shape, not be affected by moisture or heat, and shall be non-flammable. Cut fabric to eliminate glare and reflection from shining surfaces while maintaining exterior view. The top of the fabric shall be retained in the recessed spline of the shade roller and the bottom of the fabric shall be retained by the hem bar.

PART 3 EXECUTION

3.1 Installation

- .1 Install shading devices in accordance with manufacturer's instructions.
- .2 Take field measurements prior to fabrication to ensure fit.
- .3 Fabric shall be premeasured and manufactured off-site.
- .4 Install square, plumb, true to line, adequately anchored, maintaining uniform clearances, accurate alignment levels and parallel with the window plane. Fabric shall not travel more than 3 mm in either direction within channels after installation.
- .5 Adjust operable parts for correct function.
- .6 Secure with non-corrosive fasteners, concealed in final assembly.
- .7 Fabric shall hang flat, without buckling or distortion. The edge, when trimmed, shall hang straight without raveling. An unguided roller shade cloth shall roll true and straight, without shifting sideways more than + 3 mm in either direction due to warp distortion, or weave design.
- .8 Black out shades shall be installed to eliminate passage of light from exterior.
- .9 Electrical wiring, hook-up, switches, motorized shades: in accordance with Division 26 requirements.
- .10 Adjust to provide for operation without binding.
- .11 Refinish damaged or defective work so that no variation in surface appearance is discernable.

3.2 Demonstration

- .1 Prior to acceptance of system, arrange for demonstration of equipment with authorized representatives of the Owner, to be performed by representative of shade manufacturer to assure proper function, operation and explanation.
- .2 Conduct comprehensive demonstration for Owner's staff on operation and care of interior window treatments.

3.3 Cleaning

- .1 Proceed in accordance with Section 01 74 11 – Cleaning.

End of Section

Division 20 Common Requirements for Mechanical

20 00 01	Mechanical Specification Index
	Common Contract Requirements for Mechanical
20 02 51	Mechanical Contract General Requirements
	Common Work Results for Mechanical
20 05 11	Mechanical Work Requirements
20 05 21	Demolition and Renovation
20 05 32	Thermometers and Pressure Gauges
20 05 34	Bases, Hangers and Supports (Indoor)
20 05 49	Vibration Control Measures
20 05 53	Identification of Mechanical Services
	Testing, Adjusting, and Balancing
20 06 11	Testing, Adjusting, and Balancing (TAB) of Mechanical Systems
	Commissioning for Mechanical
20 08 11	Mechanical Contractor Commissioning Requirements

Division 22 Plumbing

	Plumbing Insulation
22 07 19	Plumbing Piping Insulation
	Facility Water Distribution
22 11 16	Domestic Water Piping - Copper
22 11 31	Potable Water Auxiliary Equipment
	Facility Sanitary Sewerage
22 13 13	Sanitary Drains
22 13 16	Sanitary Waste and Vent Piping – Cast Iron and Copper
22 13 17	Sanitary Waste and Vent Piping – Plastic
	Plumbing Auxiliary Equipment
22 36 13	Plumbing Auxiliary Equipment
	Fire Extinguishers
22 37 13	Portable Fire Extinguishers
	Plumbing Fixtures Combined With Drawing Schedule
22 44 13	Plumbing Fixtures Combined With Drawing Schedule

Division 23 Heating, Ventilating, and Air Conditioning (HVAC)

Common Work Results for HVAC

23 05 81 Pipe Welding

HVAC Insulation

23 07 13 Duct Insulation

23 07 19 HVAC Piping Insulation

Hydronic Piping and Pumps

23 21 13 Hydronic Piping - Screwed/Welded

HVAC Water Treatment

23 25 13 Water Treatment for Closed-Loop Hydronic Systems

HVAC Ducts and Casings

23 31 13 Metal Ducts

Air Duct Accessories

23 33 13 Duct Accessories

23 33 13.13 Volume-Control Dampers

23 33 16 Fire Dampers

23 33 17 Smoke Control Dampers

23 33 46 Flexible Ducts

23 33 53 Duct Liners

HVAC Fans

23 34 23 Packaged Exhausters

Air Outlets and Inlets

23 37 13 Diffusers, Registers, and Grilles

23 37 23 Louvres and Vents for Intake and Exhaust

Convection Heating and Cooling Units

23 82 16 Water to Air Coils

23 82 29 Radiators, Convectors, and Cabinet Heaters

Division 25 Integrated Automation

Building Automation System

25 20 11 Building Automation System

END OF SECTION

Part 1 General

1.1 GENERAL PROVISIONS

- .1 This section covers items common to all sections of Mechanical Division.
- .2 Conform to Division 1 General Conditions.
- .3 Furnish labour, materials, and equipment necessary for completion of work as described in contract documents.
- .4 Unless specifically indicated, all materials and equipment provided under this contract shall be new and shall be manufactured in the project year.

1.2 INTENT

- .1 Mention herein or indication on Drawings of articles, materials, operations or methods requires: supply of each item mentioned or indicated, of quality, or subject to qualifications noted; installation according to conditions stated: and, performance of each operation prescribed with furnishing of necessary labour, equipment, and incidentals for mechanical work.
- .2 Where used, words "Section" and "Division" shall also include other Subcontractors engaged on site to perform work to make building and site complete in all respects.
- .3 Where used, word "supply" shall mean furnishing to site in location required or directed complete with accessory parts.
- .4 Where used, word "install" shall mean secured in place and connected up for operation as noted or directed.
- .5 Where used, word "provide" shall mean supply and install as each is described above.

1.3 TENDERS AND BONDING

- .1 Submit tender based on specified described equipment or Alternates listed.
- .2 State in Tender, names of all Subcontractors proposed for work under this Division.

1.4 REGULATIONS, PERMITS, AND FEES

- .1 All materials and quality of work shall meet all current and latest Provincial, Municipal and Fire Marshall requirements, regulations, codes, and by-laws in force in the area of the project.
- .2 Each contractor shall give all necessary notices, obtain all necessary permits, and pay all fees in order that the work shown or specified may be carried out. Each contractor shall furnish any certificates necessary as evidence that the work installed conforms with the laws and regulations of all authorities having jurisdiction.
- .3 In the event that changes or alterations are required on completed work by authorized inspectors, these changes shall be made at the contractor's expense.
- .4 Special equipment which does not have a standard CSA label shall be inspected by the local electrical authority having jurisdiction and the Approval Certificate shall be submitted to the Consultant as soon as possible. All costs and fees for inspections shall be borne by this contractor.

1.5 DRAWINGS

- .1 Mechanical Drawings do not show structural and related details. Take information involving accurate measurement of building from building drawings, or at building. Make, without additional charge, any necessary changes, or additions to runs of piping, conduits, and ducts to accommodate structural conditions. Location of pipes, ducts, conduits and other equipment may be altered by Consultant without extra charge provided change is made before installation and does not necessitate major additional material.
- .2 As work progresses and before installing piping, ductwork, heating units, registers, diffusers, fixtures and any other fittings and equipment which may interfere with interior treatment and use of building, provide detail drawings, or obtain directions for exact location of such equipment and fittings.
- .3 Mechanical Drawings indicate general location and route of pipes, ducts and conduits which are to be installed. Where required work is not shown or only shown diagrammatically, install same at maximum height in space to conserve head room (minimum 2200 mm (88") clear) and interfere as little as possible with free use of space through which they can pass. Follow building lines, conceal piping, conduits and ducts in furred spaces, ceilings and walls unless specifically shown otherwise. Install work close to structure so furring will be small as practical.
- .4 Install piping and ductwork to clear structural members and any fireproofing. Locate mechanical work to permit installation of specified insulation. Do not remove or damage structural fireproofing. Leave space to permit fireproofing and insulation to be inspected and repaired.
- .5 Before commencing work, check and verify all sizes, locations, grade and invert elevations, levels, and dimensions to ensure proper and correct installation. Verify existing/municipal services.
- .6 Locate all mechanical and electrical equipment in such a manner as to facilitate easy and safe access to and maintenance and replacement of any part.
- .7 In every place where there is indicated space reserved for future or other equipment, leave such space clear, and install piping and other work so that necessary installation and connections can be made for any such apparatus. Obtain instructions whenever necessary for this purpose.
- .8 Relocate equipment and/or material installed but not co-ordinated with work of other Sections and/or installed incorrectly as directed, without extra charge.
- .9 Where drawings are done in metric and product not available in metric, the corresponding imperial trade size shall be utilized.

1.6 INTERFERENCE AND COORDINATION DRAWINGS

- .1 Prepare interference and equipment placing drawings to ensure that all components will be properly accommodated within the constructed spaces provided.
- .2 Prepare drawings to indicate co-ordination and methods of installation of a system with other systems where their relationship is critical. Ensure that all details of equipment apparatus, and connections are coordinated.

- .3 Ensure that clearances required by jurisdictional authorities and clearances for proper maintenance are indicated on drawings.
- .4 Upon consultant's request submit copies of interference drawings to consultant.
- .5 Due to the nature of the building and the complexity of the building systems provide the following:
 - .1 Interference drawings, showing coordination of architectural, structural, mechanical, and electrical systems for the consultant's review prior to fabrication.
 - .2 Detailed layout drawings, clearly showing fasteners and hangers.
- .6 Provide CAD drawings (minimum file version AutoCAD 2013) in addition to hard copies.

1.7 QUALITY ASSURANCE

- .1 Perform work in accordance with applicable provisions of local Plumbing Code, Gas Ordinances, and adoptions thereof for all mechanical systems. Provide materials and labor necessary to comply with rules, regulations, and ordinances.
- .2 In case of differences between building codes, provincial laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Promptly notify Consultant in writing of such differences.

1.8 ALTERNATES AND SUBSTITUTIONS

- .1 Throughout Mechanical Division are lists of "Alternate Equipment" manufacturers acceptable to Consultant if their product meets characteristics of specified described equipment. Submitted Bids shall be based on the supply of named articles and or products as specified in the Bid Documents.
- .2 Each bidder may elect to use "Alternate Equipment" from lists of Alternates where listed. Include for any additional costs including all costs for revisions to electrical contract to suit Alternate used. Prices are not required in Tender for Alternates listed except where specifically noted as "Separate Price". Complete the Supplementary Tender Form.
- .3 When two or more suppliers/manufacturers are named in the Bid Documents, only one supplier/manufacturer of the products named will be acceptable; however, it is the responsibility of this Division to ensure "Alternate Equipment" fits space allocated and gives performance specified. If an "Alternate Equipment" nor "equal" specified product unit is proposed and does not fit space allotted in Consultant's opinion, supply of specified described equipment will be required without change in Contract amount. Should electrical characteristics for "alternate" or "equal" equipment differ from equipment specified it shall be the responsibility of the equipment manufacturer to pay all costs associated with the revisions to the electrical contract. Only manufacturers listed will be accepted for their product listing. All other manufacturers shall be quoted as substitution stating conditions and credit amount.
- .4 If item of material specified is unobtainable, state in Tender proposed substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after Contract has been awarded.
- .5 If pipe or item, of size or weight indicated, is unobtainable, supply next larger size or heavier weight without additional charge.

1.9 EXAMINATION

- .1 Site Reviews
 - .1 Examine premises to understand conditions, which may affect performance of work of this Division before submitting proposals for this work.
 - .2 No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.
- .2 Drawings:
 - .1 Mechanical Drawings show general arrangement of piping, ductwork, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
 - .2 Consider Architectural and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over Plumbing, Mechanical, and Fire Protection Drawings.
 - .3 Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
- .3 Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.

1.10 SEQUENCING SCHEDULING AND COORDINATION

- .1 It is understood that while Drawings are to be followed as closely as circumstances permit, this Division will be held responsible for installation of systems according to the true intent and meaning of Contract Documents. Anything not clear or in conflict will be explained by making application to Consultant. Should conditions arise where certain changes would be advisable, secure Consultant's approval of these changes before proceeding with work.
- .2 Coordinate work of various trades in installing interrelated work. Before installation of mechanical items, make proper provision to avoid interferences in a manner approved by Consultant. Each Contractor shall refer to all sections of the specification for their responsibilities with other trades. Changes required in work specified in Mechanical Division caused by neglect to do so shall be made at no cost to Owner.
- .3 Arrange pipes, ducts, and equipment to permit ready access to valves, unions, traps, starters, motors, control components, and to clear openings of doors and access panels.
- .4 Furnish and install inserts and supports required by Mechanical Division unless otherwise noted. Furnish sleeves, inserts, supports, and equipment that are an integral part of other Divisions of the Work to Sections involved in sufficient time to be built into construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location or installation of items above shall be borne by Mechanical Division.

- .5 Be responsible for required excavation, backfilling, cutting, and patching incident to work of this Division and make required repairs afterwards to satisfaction of Consultant. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns, or trusses.
 - .1 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.
 - .2 Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
 - .3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.
- .6 Adjust locations of pipes, ducts, equipment, fixtures, etc, to accommodate work from interferences anticipated and encountered. Determine exact route and location of each pipe and duct prior to fabrication.
 - .1 Make offsets, transitions, and changes in direction of pipes, ducts, and electrical raceways as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
 - .2 Furnish and install traps, air vents, sanitary vents, pull boxes, etc, as required to effect these offsets, transitions, and changes in direction.
- .7 Slots and openings through floors, walls, ceilings, and roofs shall be provided by this contractor but performed by a trade specializing in this type of work. This Division shall see that they are properly located and do any cutting and patching caused by its neglect to do so.

1.11 REQUEST FOR INFORMATION (RFI) PROCEDURES

- .1 RFIs shall be submitted to the consultant minimum two (2) weeks prior to answer being required. Failure to submit an RFI in a timely manner will forfeit delay claims and schedule extension requests by the contractor.
- .2 All RFIs will be submitted with the following information:
 - .1 RFI number
 - .2 Name of project
 - .3 Date of initiation
 - .4 Date response required by (minimum two (2) weeks)
 - .5 Subject
 - .6 Submitter's name
 - .7 Drawing/specification reference
 - .8 Photograph of the issue (if applicable)
 - .9 Description of the issue
 - .10 Contractor's proposed resolution

1.12 CONTRACT BREAKDOWN

- .1 Provide breakdown of contract exclusive of HST to acceptance of consultants prior to first draw submission.
- .2 Provide labour and material cost for each item.
- .3 Breakdown shall indicate total contract amount.
- .4 Contract breakdown shall be as follows as a minimum.
 - Mobilization and shop drawings (max. \$2000.00)
 - Demolition
 - Inside buried plumbing and drainage
 - Above grade rough-in plumbing and drainage
 - Plumbing Fixtures
 - Reheat coils
 - Heating piping
 - Piping Insulation
 - Ductwork
 - Duct Insulation
 - Grilles & Diffusers
 - Fire Stopping
 - Fans & Equipment
 - Building Automation Systems
 - Testing Adjusting and Balancing
 - Mechanical contractor closeout requirements (min. of 3% for the first \$500,000.00, 1% from \$500,000.00 to \$5,000,000.00, and 0.5% beyond. Shall not be less than \$5,000.00)
- .5 Progress claims, when submitted are to be itemized against each item of the contract breakdown, this shall be done in table form showing contract amount, work complete to date, previous draw, amount this draw and balance.
- .6 **Mobilization amount may only be drawn when all required shop drawings have been reviewed by the consultant.**

1.13 COMMISSIONING CONTRACT BREAKDOWN

- .1 This contractor shall work with the HVAC system commissioning contractor as specified elsewhere. The following commissioning breakdown shall be indicated on the contract breakdown draw.

1.14 SHOP DRAWINGS AND PRODUCT DATA

- .1 Furnish complete catalog data for manufactured items of equipment to be used in the Work to Consultant for review within 14 days after award of Contract.
- .2 Upon receipt of reviewed shop drawing, product is to be ordered immediately.
- .3 Provide a complete list of shop drawings to be submitted prior to first submission.
- .4 Before submitting to the Consultant, review all shop drawings to verify that the products illustrated therein conform to the Contract Documents. By this review, the Contractor agrees that it has determined and verified all field dimensions, field construction criteria, materials, catalogue numbers, and similar data and that it has checked and coordinated each shop drawing with the requirements of the work and of the Contract Documents. The Contractor's review of each shop drawings shall be indicated by stamp, date and signature of a qualified and responsible person possessing by the appropriate authorization.
- .5 If material or equipment is not as specified or submittal is not complete, it will be rejected by Consultant.
- .6 Additional shop drawings required by the contractor for maintenance manuals, site copies etc., shall be photocopies of the "reviewed" shop drawings. All costs to provide additional copies of shop drawings shall be borne by the contractor.
- .7 Catalog data or shop drawings for equipment, which are noted as being reviewed by Consultant or their Engineer shall not supersede Contract Documents.
- .8 Review comments of Consultant shall not relieve this Division from responsibility for deviations from Contract Documents unless Consultant's attention has been called to such deviations in writing at time of submission, nor shall they relieve this Division from responsibility for errors in items submitted.
- .9 Check work described by catalog data with Contract Documents for deviations and errors.
- .10 Shop drawings and product data shall show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances. e.g., access door swing spaces.
- .11 Shop drawings and product data shall be accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Acoustical sound power data, where applicable.
 - .3 Points of operation on performance curves.
 - .4 Manufacturer to certify as to current model production.
 - .5 Certification of compliance to applicable codes.
- .12 State sizes, capacities, brand names, motor HP, accessories, materials, gauges, dimensions, and other pertinent information. List on catalog covers page numbers of submitted items. Underline applicable data.

- .13 Shop drawings shall be submitted electronically as per the following directions:
 - .1 Electronic Submissions:
 - .1 Electronically submitted shop drawings shall be prepared as follows:
 - .1 Use latest software to generate PDF files of submission sheets.
 - .2 Scanned legible PDF sheets are acceptable. Image files are not acceptable.
 - .3 PDF format shall be of sufficient resolution to clearly show the finest detail.
 - .4 PDF page size shall be standardized for printing to letter size (8.5"x11"), portrait with no additional formatting required by the consultant. Submissions requiring larger detail sheets shall not exceed 11"x17".
 - .5 Submissions shall contain multiple files according to section names as they appear in Specification.
 - .6 File names shall include consultant project number and description of shop drawing section submitted.
 - .7 Each submission shall contain an index sheet listing the products submitted, indexed in the same order as they appear in the Specification. Include associated PDF file name for each section.
 - .8 On the shop drawing use an "electronic mark" to indicate what is being provided.
 - .9 **Each file shall bear an electronic representation of the "company stamp" of the contractor. If not stamped the file submission will not be reviewed.**
 - .2 Email submissions shall include subject line to clearly identify the consultants project number and the description of the shop drawings submitted.
 - .3 Electronic attachments via email shall not exceed 10MB. For submissions larger than 10MB, multiple email messages shall be used. Denote related email messages by indicating "1 of 2" and "2 of 2" in email subject line for the case of two messages.
 - .4 Electronic attachments via web links (URL) shall directly reference PDF files. Provide necessary access credentials within link or as username/password clearly identified within body of email message.
 - .5 On site provide one copy of the "reviewed" shop drawings in a binder as noted above.
 - .6 Contractor to print copies of "reviewed" shop drawings and compile into maintenance manuals in accordance with requirements detailed in this section.

1.15 OPERATION AND MAINTENANCE MANUAL

- .1 Provide operation and maintenance data for incorporation into manual as in submittals' requirements.
- .2 Operation and maintenance manual to be approved by, and final copies deposited with, Consultant before final inspection.
 - .1 Submit 1 copy of Operation and Maintenance Manual to Consultant for approval. Submission of individual data will not be accepted unless so directed by Consultant.
 - .1 Manual(s) shall be in a three ring binder (minimum 50 mm (2") ring) labelled:
 - .1 Operation and Maintenance Manual.
 - .2 Project Name.
 - .3 Location.
 - .2 Make changes as required and re-submit as directed by Consultant.
- .3 Operation data to include:
 - .1 Control schematics for each system including environmental controls.
 - .2 Description of each system and its controls.
 - .3 Description of operation of each system at various loads together with reset schedules and seasonal variances.
 - .4 Operation instruction for each system and each component.
 - .5 Description of actions to be taken in event of equipment failure.
 - .6 Valves schedule and flow diagram.
 - .7 Colour coding chart.
 - .8 Spare parts equipment list.
 - .9 Manufacturers standard or extended warranty information.
- .4 Maintenance data shall include:
 - .1 Servicing, maintenance, operation, and trouble-shooting instructions for each item of equipment.
 - .2 Data to include schedules of tasks, frequency, tools required and task time.
- .5 Performance data to include:
 - .1 Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
 - .2 Equipment performance verification test results.
 - .3 Special performance data as specified elsewhere.
 - .4 Testing, adjusting and balancing reports as specified in Testing, Adjusting and Balancing Section.
 - .5 Copy of all substantial performance final certificates.

- .6 Miscellaneous data to include:
 - .1 Letter of contractor's warranty and guarantee.
 - .2 Index sheet.
 - .3 Tabbed format for each section.
 - .4 Manufacturers approved shop drawings.
 - .5 Spare parts list and source.
 - .6 List of Manufacturers and suppliers address for each piece of equipment.
- .7 Final Submittals:
 - .1 Upon acceptance of Operation and Maintenance Manual by the Consultant provide the following:
 - .1 Provide two (2) copies of final operation maintenance manuals, as well as a PDF file of the entire approved manual on a USB stick. Only one USB stick is to be provided containing both the approved manual and as-built drawings.

1.16 AS-BUILT DRAWINGS

- .1 Site records:
 - .1 Contractor shall provide 2 sets of reproducible mechanical drawings. Provide sets of white prints as required for each phase of the work. Mark thereon all changes as work progresses and as changes occur. This shall include changes to existing mechanical systems, control systems and low voltage control wiring.
 - .2 On a weekly basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection at all times.
- .2 As-Built drawings:
 - .1 Prior to start of Testing, Adjusting and Balancing (TAB), finalize production of as-built drawings.
 - .2 Identify each drawing in lower right hand corner in letters at least 3 mm (1/8") high as follows: - "AS-BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
 - .3 TAB to be performed using as-built drawings.
 - .1 Submit hard copy to Consultant for approval. When returned, make corrections as directed.
 - .2 Once approved, submit completed reproducible paper as-built drawings as well as a scanned pdf file copy on USB stick with Operating and Maintenance Manuals.

1.17 WARRANTIES

- .1 In addition to guarantee specified in General Conditions, guarantee heating, cooling, and plumbing systems to be free from noise in operation that may develop from failure to construct system in accordance with Contract Documents.
- .2 Provide certificates of warranty for each piece of equipment made out in favor of Owner. Clearly record "start-up" date of each piece of equipment on certificate. Include certificates as part of Operation & Maintenance Manual.
- .3 If mechanical sub-contractor with offices located more than 80 km (50 miles) from Project site is used, provide service/warranty work agreement for warranty period with local mechanical sub-contractor approved by Consultant. Include copy of service/warranty agreement in warranty section of Operation & Maintenance Manual.
- .4 Warranty period shall start from date of ready for takeover.

1.18 READY FOR TAKEOVER

- .1 Complete the following to the satisfaction of the consultant prior to request for ready for takeover.
 - .1 As-Built Drawings.
 - .2 Maintenance Manuals
 - .3 System Start up
 - .4 TAB Reports
 - .5 Instructions to Owners
 - .6 Final Certificates (required prior to consultant's release of conformance letter).
 - .1 Potable Water Test (Refer to domestic water piping – Copper section – Part 3)

1.19 OCCUPANCY REQUIREMENTS

- .1 The contractor shall provide the following documentation to the consultant prior to receiving occupancy. Failure to provide the proper documentation will result in the occupancy not being granted. List of required documentation:
 - .1 Final Certificates (required prior to consultant's release of conformance letter).
 - .1 Potable Water Test (Refer to domestic water piping – Copper section – Part 3).

1.20 REVISION TO CONTRACT

- .1 Provide the following:
 - .1 Itemized list of material with associated costs.
 - .2 Labour rate and itemized list of labour for each item.
 - .3 Copy of manufacturers/supplier's invoice if requested.

1.21 DELIVERY, STORAGE, AND HANDLING

- .1 Follow Manufacturer's directions in delivery, storage, and protection, of equipment and materials. Contractor to include all costs associated with delivery storage and handling in tender price.
- .2 Deliver equipment and material to site and tightly cover and protect against dirt, water, and chemical or mechanical injury but have readily accessible for inspection. Store items subject to moisture damage (such as controls) in dry, heated space.

1.22 DESIGNATED SUBSTANCES AND HAZARDOUS MATERIALS

- .1 **If designated substances and/or hazardous materials are suspected or identified cease all work in the immediate area in accordance with OHSA and notify consultant.**
- .2 **Each contractor and on site employee of the contractor shall have “asbestos awareness training”.**
- .3 The Contractor shall ensure that employees who may come into contact with designated substances and/or hazardous materials due to the nature of the work that they perform, have received training that enables them to recognize designated substances and/or hazardous materials and that enables them to react in accordance with the Occupational Health and Safety Act and regulations thereto should contact with designated substances and/or hazardous materials occur during the course of their work.
- .4 **It is the responsibility of the contractor to review the designated substances and/or hazardous materials book in the building prior to starting any work.**
- .5 **Existing occupied buildings (depending upon their age) may contain designated substances and/or hazardous materials in thermal insulating materials and some manufactured products, such as vinyl asbestos floor tile. Any insulating materials, on pipes, fittings, boilers, tanks, ductwork, etc. may contain designated substances and/or hazardous materials and shall not be disturbed.**
- .6 **A survey of each building documenting the location and condition of designated substances and/or hazardous materials -containing materials is available for your mandatory review prior to commencing any work on premises.**

1.23 CONFINED SPACES

- .1 Certain areas of the building may be defined as a “Confined Space”. Any personnel working in these areas must have confined space training, appropriate equipment and undertake all work in conformance with appropriate codes and standards.
- .2 Refer to building documentation for any spaces deemed “Confined Space”.

1.24 ENERGY EFFICIENCY

- .1 The mechanical systems of this building must achieve the energy efficiency levels by conforming to ANSI/ASHRAE/IESNA 90.1 "Energy Standard for Buildings Except Low-Rise Residential Buildings" and Chapter 2 of Division 3 of SB-10 prescriptive method from the Ontario Building Code.
- .2 All equipment, products, and installations must conform to the Codes and Standards.

END OF SECTION

Part 1 General

1.1 TESTS

- .1 Give 48 hours written notice of date for tests.
- .2 Insulate or conceal work only after testing and approval by Consultant.
- .3 Conduct tests in presence of Consultant.
- .4 Bear costs including retesting and making good.
- .5 Piping:
 - .1 General: maintain test pressure without loss for 4 h unless otherwise specified.
 - .2 Hydraulically test steam and hydronic piping systems at 1-1/2 times system operating pressure or minimum 860 kPa, whichever is greater.
 - .3 Test drainage, waste and vent piping to Ontario Building Code and authorities having jurisdiction.
 - .4 Test domestic hot, cold and recirculation water piping at 1-1/2 times system operating pressure or minimum 860 kPa (124.8 psi), whichever is greater.
- .6 Equipment: test as specified in relevant sections.
- .7 Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

1.2 SYSTEM START UP

- .1 **Provide adjusting testing and start up of all equipment prior to testing and balancing (TAB) specified elsewhere.**
- .2 **Provide consultant with written notice verifying all equipment operation and installation is complete.**
- .3 **Start up shall be in presence of the following: owner or representative, contractor, building automation systems (BAS) contractor, and manufacturer's representative. Each person shall witness and sign off each piece of equipment. Consultant's attendance will be determined by consultant.**
- .4 Simulate system start up and shut down and verify operation of each piece of equipment.
- .5 Arrange with all parties and provide 72 hours notice for start up procedure.
- .6 Arrange with building automation systems contractor to sequence all components and ensure system operation.

1.3 COMMISSIONING

- .1** Coordinate and direct each step of the commissioning process and recommend acceptance or non-acceptance to the Owner/Owner's Representative.
- .2** Prepare, in writing, documentation of any deficiencies discovered during the commissioning process. Submit to consultant and Owner/Owner's Representative.
- .3** The Commissioning Process is detailed in *ASHRAE Guideline 1-1996 HVAC Commissioning Process*. The commissioning plan may be modified to reflect the actual construction schedule and design.
- .4** Provide a pre-functional test of all HVAC mechanical system and sub-system elements, including control devices, shall be checked for the following:
 - .1** Verify that each element has been properly installed, properly identified, and that all connections (including electrical) have been made correctly.
 - .2** Verify that each element has been checked for proper lubrication, drive rotation, belt tension, control sequence, flow direction, or other conditions which may cause damage or reduce system performance.
 - .3** Verify that tests, meter readings, and specific mechanical/electrical performance characteristics agree with those required by equipment or system manufacturer.
 - .4** Controls calibration to be completed in accordance with the specification.
 - .5** The TAB shall be done in accordance with the specifications.
- .5** Reports:
 - .1** The contractor shall be responsible for recording, documenting, and maintaining detailed inspection and testing data on the test documentation reports. The data record shall be comprehensive and concise.
 - .2** All data must be recorded as soon as possible during the course of the inspection and testing.
 - .3** All documentation shall have the date, time, and names of persons participating in the inspection and testing.
 - .4** All test instruments shall be documented for valid calibration.
 - .5** The recording work sheets, inspection check lists, and Performance Testing plans must all be approved by the Engineer and the owner's representative prior to the start of the testing.
 - .6** Include all commissioning documentation in the maintenance manuals.
- .6** Mechanical System Execution:
 - .1** Operate equipment and systems shall be tested in the presence of the owner's representative and the consultant to demonstrate compliance with specified requirements. To minimize the time of Commissioning Team members, testing shall be done in four seasonal single blocks of time insofar as possible.
 - .2** Notify the consultant, in writing, fourteen (14) days prior to tests scheduled under requirements of this Section.
 - .3** Testing shall be conducted under specified design operating conditions as recommended or approved by the consultant.

- .4 All elements of systems shall be tested to demonstrate that total systems satisfy all requirements of these Specifications. Testing shall be accomplished on hierarchical basis. Test each piece of equipment for proper operation, followed by each sub-system, followed by entire system, followed by any inter-ties of other major systems.
- .5 All special testing materials and equipment shall be provided by the appropriate contractor.
- .6 Provide three copies of all test reports and records to the consultant.
- .7 The verification testing procedures shall address all operating characteristics of all mechanical equipment and systems, including:

Equipment Checklist

Exhaust Fans

Controllers/Valves/Dampers

Relays/Sensors/Transducers

1.4 DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTION

- .1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .2 Mechanical contractor to schedule and coordinate the demonstration all on the same day, starting at a pre-approved time and continuing consequently until complete.
- .3 Where specified elsewhere in Mechanical Division, qualified manufacturers' representatives who are knowledgeable about the project to provide demonstrations and instructions.
- .4 Use operation and maintenance manual, as-built drawings, audio visual aids, etc. as part of instruction materials.
- .5 Instruction duration time requirements as specified in appropriate sections.
- .6 Where deemed necessary, Consultants may record these demonstrations on video tape for future reference.

1.5 TRIAL USAGE

- .1 Consultant or owner may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.
- .2 Trial usage to apply to following equipment and systems:
 - .1 HVAC
 - .2 Exhaust air
 - .3 Domestic water
 - .4 Plumbing and drainage.

1.6 DEFICIENCIES

- .1 During the course of construction, the consultants will monitor construction and provide written reports of work progress, discussions, and instruction to correct work.
- .2 Instruction to correct work shall be done within the work period before the next review.
- .3 The contractor shall not conceal any work until inspected.
- .4 The contractor shall expedite 100% complete rough-in work and have inspected prior to concealing services and equipment especially above ceiling.
- .5 Upon completion of the project the consultant will do a final review. Upon receiving the final inspection report, the contractor must correct and sign back the inspection report indicating the deficiencies are completed. A re-inspection will only be done once consultant receives this in writing.

1.7 EQUIPMENT INSTALLATIONS

- .1 Unions or flanges: provide for ease of maintenance and disassembly.
- .2 Space for servicing, disassembly and removal of equipment and components: provide as recommended by manufacturer or as indicated.
- .3 Equipment drains: pipe to floor drains.
- .4 Install equipment, rectangular cleanouts and similar items parallel to or perpendicular to building lines.

1.8 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to equipment unless specified or indicated otherwise. Coordinate with block coursing (if applicable).
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install mechanical equipment at following heights unless indicated otherwise.
 - .1 Fire extinguisher 1350 (4' – 0") to hanger
 - .2 Fire extinguisher cabinets 1500 (5' – 0") to top of cabinet
 - .3 **Hydronic heating elements 200 mm (8") to bottom of cabinet**
 - .4 Thermostats: Barrier Free (operable) 1200 mm (47.25")
Non Barrier Free 1500 mm (59")

Also follow direction of architectural drawings and where discrepancies occur clarify prior to rough-in.

1.9 ANCHOR BOLTS AND TEMPLATES

- .1 Supply anchor bolts and templates for installation by other divisions.

1.10 PROTECTION OF OPENINGS

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

1.11 ELECTRICAL

- .1 Electrical work to conform to Electrical Division including the following:
 - .1 Supplier and installer responsibility and related mechanical responsibility is indicated in Equipment Schedule on mechanical and/or electrical drawings
 - .2 Power wiring and conduit is specified in Electrical Division except for conduit, wiring and connections below 50 V which are related to control systems specified in Mechanical Division. Follow Electrical Division for quality of materials and workmanship.
 - .3 Electrically operated equipment shall be C.S.A. approved label. Special Inspection Label of Provincial Authority having jurisdiction will be accepted in lieu of C.S.A. approval. Each motor shall have an approved starter. Starter will be supplied and installed by Electrical Division unless otherwise indicated.

1.12 CONTROL WIRING

- .1 Furnish and install all components, devices, and control wiring for all plumbing, fire protection, HVAC equipment, HVAC systems, lighting, and other electrical loads to make all equipment operable to satisfaction of owner and consultant and to manufacturer's requirements and recommendations.
- .2 All electrical wiring, mechanical wiring and installations shall comply with local and national electrical and mechanical codes.
- .3 Supply and install wiring as required for all devices and systems. Install wiring in EMT conduit and otherwise comply with all requirements of the Electrical Division. Approved plenum wire may be used for sensor and network communication wiring where it complies with appropriate building codes and regulatory authorities.
- .4 All wiring concealed in walls and chases, and all exposed wiring shall be run in conduit.
- .5 Provide recessed conduit and backer boxes where controls are wall mounted. Surface mounted boxes and conduit are acceptable in mechanical or service rooms.
- .6 Free-run plenum rated cable shall be run in cable hangers where provided by electrical division or tied neatly to pipe and duct hangers in the ceiling. Avoid wiring that droops. Follow building lines and do not run wiring "as the crow flies".

1.13 MOTORS

- .1 Provide high efficiency motors for mechanical equipment as specified.
- .2 If delivery of specified motor will delay delivery or installation of any equipment, install motor approved by Consultant for temporary use. Final acceptance of equipment will not occur until specified motor is installed.
- .3 Motors under 373 W, (1/2 hp): speed as indicated, continuous duty, built-in overload protection, resilient mount, single phase, voltage as indicated.
- .4 Motors 373 W, (1/2 hp) and larger: EEMAC Class B, squirrel cage induction, speed as indicated, continuous duty, drip proof, ball bearing, maximum temperature rise 40°C (72°F), 3 phase, voltage as indicated.

1.14 BELT DRIVES

- .1 Fit reinforced belts in sheave matched to drive. Multiple belts to be matched sets.
- .2 Use cast iron or steel sheaves secured to shafts with removable keys unless otherwise specified.
- .3 For motors under 7.5 kW 10 hp: standard adjustable pitch drive sheaves, having plus or minus 10% range. Use mid-position of range for specified r/min.
- .4 For motors 7.5 kW 10 hp and over: sheave with split tapered bushing and keyway having fixed pitch unless specifically required for item concerned. Provide sheave of correct size to suit balancing.
- .5 Minimum drive rating: 1.5 times nameplate rating on motor. Keep overhung loads within manufacturer's design requirements on prime mover shafts.
- .6 Motor slide rail adjustment plates to allow for centre line adjustment.
- .7 Provide sheave changes as required for final air balancing.

1.15 GUARDS

- .1 Provide guards for unprotected devices.
- .2 Guards for belt drives:
 - .1 Expanded metal screen welded to steel frame.
 - .2 Minimum 1.2 mm (18 gauge) thick sheet metal tops and bottoms.
 - .3 40 mm (1 1/2") diameter holes on both shaft centres for insertion of tachometer.
 - .4 Removable for servicing.
- .3 Provide means to permit lubrication and use of test instruments with guards in place.
- .4 Install belt guards to allow movement of motors for adjusting belt tension.
- .5 Guard for flexible coupling:
 - .1 "U" shaped, minimum 1.6 mm (16 gauge) thick galvanized mild steel.
 - .2 Securely fasten in place.
 - .3 Removable for servicing.

- .6 Unprotected fan inlets or outlets:
 - .1 Wire or expanded metal screen, galvanized, 20 mm (3/4") mesh.
 - .2 Net free area of guard: not less than 80% of fan openings.
 - .3 Securely fasten in place.
 - .4 Removable for servicing.
- .7 Duct Openings in Floor
 - .1 Provide reinforced expanded mesh grating, style 3 (3 lbs/sq.ft.) cover on accessible unprotected duct openings over 300 mm (12") wide and as indicated. This includes all ductwork terminating in air handling units and plenums.
 - .2 Securely Fasten in place.
 - .3 Removable for servicing.

1.16 PIPING AND EQUIPMENT SUPPORTS

- .1 Equipment supports supplied by equipment manufacturer: specified elsewhere in Mechanical Division.
- .2 Piping and equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of - Structural Steel Section. Submit structural calculations with shop drawings.
- .3 Mount base mounted equipment on chamfered edge housekeeping pads, minimum of 100 mm (4") high and 150 mm (6") larger than equipment dimensions all around. Concrete specified elsewhere.
- .4 Where housekeeping pads incorporate existing pads provide 10 mm dowels into existing pads. New pad height shall match existing.

1.17 SLEEVES

- .1 Pipe sleeves: at points where pipes pass through masonry, concrete or fire rated assemblies and as indicated. Grout sleeves in place.
- .2 Schedule 40 steel pipe.
- .3 Sleeves with annular fin continuously welded at midpoint:
 - .1 Through foundation walls.
 - .2 Where sleeve extends above finished floor.
 - .3 Through fire rated walls and floors.
- .4 Sizes: minimum 6 mm (1/4") clearance all around, between sleeve and uninsulated pipe or between sleeve and insulation.
- .5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25 mm (1") above other floors.

- .6 Fill voids around pipes:
 - .1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof fire retardant non-hardening mastic.
 - .2 Where sleeves pass through walls or floors, provide space for firestopping. Where pipes/ducts pass through fire rated walls, floors and partitions, maintain fire rating integrity.
 - .3 Ensure no contact between copper tube or pipe and ferrous sleeve.
 - .4 Fill future-use sleeves with lime plaster or other easily removable filler.
 - .5 Coat exposed exterior surfaces of ferrous sleeves with heavy application of zinc rich paint to CGSB 1-GP-181M+Amdt-Mar-78.
- .7 Provide minimum 20 gauge duct sleeves where ducts pass through masonry concrete or fire rated assemblies. Maintain minimum 25 mm clearance all around or to the requirements of the authority having jurisdiction. Seal at wall as indicated.

1.18 FIRE STOPPING

- .1 This contractor shall work with all other contractors on the project in providing one common method of fire stopping all penetrations made in fire rated assemblies.
- .2 Approved fire stopping and smoke seal material in all fire separations and fire ratings within annular space between pipes, ducts, insulation and adjacent fire separation and/or fire rating.
- .3 Do not use cementitious or rigid seals around penetrations for pipe, ductwork, or other mechanical items.
- .4 Insulated pipes and ducts: ensure integrity of insulation and vapour barrier at fire separation.
- .5 Provide materials and systems capable of maintaining effective barrier against flame, smoke and gases. Ensure continuity and integrity of fire separation.
- .6 Comply with the requirements of CAN4-S115-M35, and do not exceed opening sized for which they have been tested.
- .7 Systems to have an F or FT rating (as applicable) not less than the fire protection rating required for closures in a fire separation. Provide "fire wrap" blanket around services penetrating fire walls. Extent of blanket must correspond to ULC recommendations.
- .8 The fire stopping materials are not to shrink, slump or sag and to be free of asbestos, halogens and volatile solvents.
- .9 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.
- .10 Fire stop materials are to be capable of receiving finish materials in those areas which are exposed and scheduled to receive finishes. Exposed surfaces are to be acceptable to consultant prior to application of finish.
- .11 Firestopping shall be inspected and approved by local authority prior to concealment or enclosure.

- .12 Install material and components in accordance with ULC certification, manufacturers instructions and local authority.
- .13 Submit product literature and installation material on fire stopping in shop drawing and product data manual. Maintain copies of these on site for viewing by installers and consultant.
- .14 Manufacturer of product shall provide certification of installation. Submit letter to the consultant.
- .15 Acceptable Alternate Manufacturers to approval of local authority:
Minnesota Mining and Manufacturing
- .16 Fyresleeve Industries Inc.
General Electric Pensil Firestop Systems
International Protective Coatings Corp.
Rectorseal Corporation (Metacaulk)
Proset Systems
3M
AD Systems
Hilti
- .17 Ensure firestop manufacturer representative performs on site inspections and certifies installation. Submit inspection reports/certification at time of substantial completion.

1.19 ESCUTCHEONS

- .1 On pipes and ductwork passing through walls, partitions, floors and ceilings in exposed finished areas and on water and drain pipes inside millwork and cabinets.
- .2 Chrome or nickel plated brass or Type 302 stainless steel, one piece type with set screws.
- .3 Outside diameter to cover opening or sleeve.
- .4 Inside diameter to fit around finished pipe.

1.20 PAINTING

- .1 Refer to Section Interior Painting and specified elsewhere.
- .2 Apply at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.
- .3 Apply two coats of paint to exposed piping service in mechanical room, base colour as specified in Mechanical Identification Section.
- .4 Prime and touch up marred finished paintwork to match original.
- .5 Restore to new condition, or replace equipment at discretion of consultant, finishes which have been damaged too extensively to be merely primed and touched up.

1.21 SPARE PARTS

- .1 Furnish spare parts in accordance with general requirements and as follows:
 - .1 One glass for each gauge glass.
 - .2 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.
- .2 Provide list of equipment in maintenance manuals indicating corresponding spare parts required. List of spare parts to be signed off by receiving personnel.

1.22 SPECIAL TOOLS

- .1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Maintenance Materials Special Tools and Spare Parts.

1.23 ACCESS DOORS

- .1 Provide access doors to concealed mechanical equipment for operating, inspecting, adjusting and servicing.
- .2 Flush mounted 600 x 600 mm (24" x 24") for body entry and 300 x 300 mm (12" x 12") for hand entry unless otherwise noted. Doors to open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.
- .3 Material:
 - .1 Special areas such as tiled or marble surfaces: use stainless steel with brushed satin or polished finish as directed by Consultant.
 - .2 Remaining areas: use prime coated steel.
 - .3 Fire rated areas: provide ULC listed access doors.
 - .4 Washrooms or high moisture area ceilings: Aluminum with mill finish suitable for painting.
- .4 Installation:
 - .1 Locate so that concealed items are accessible.
 - .2 Locate so that hand or body entry (as applicable) is achieved.
- .5 Acceptable materials:
 - Le Hage
 - Zurn
 - Acudor
 - Nailor Industries Inc.

1.24 DIELECTRIC COUPLINGS

- .1 General:
 - .1 To be compatible with and to suit pressure rating of piping system.
 - .2 Where pipes of dissimilar metals are joined.
- .2 Pipes NPS 50 mm (2") and under: isolating unions.
- .3 Pipes NPS 65 mm (2 1/2") and over: isolating flanges.

1.25 DRAIN VALVES

- .1 Locate at low points and at section isolating valves unless otherwise specified.
- .2 Minimum NPS 20 mm (3/4") unless otherwise specified: bronze, with hose end male thread and complete with cap and chain.
- .3 Drain valves on potable water systems shall be complete with vacuum breaker.

1.26 REPAIRS, CUTTING, AND RESTORATION

- .1 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.
- .2 Each Section of this Division shall bear expense of cutting, patching, and repairing to install their work and/or replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
- .3 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.
- .4 All patching, painting and making good of the existing walls, floors, ceilings, partitions and roof will be at the expense of this Contractor, but performed by the Contractor specializing in the type of work involved unless otherwise noted.

1.27 EXISTING SYSTEMS

- .1 Connections into existing systems to be made at time approved by Consultant. Request written approval of time when connections can be made.
- .2 Be responsible for damage to existing plant by this work.

1.28 CLEANING

- .1 Clean interior and exterior of all systems including strainers. Vacuum interior of ductwork and air handling units prior to turn over to owner.
- .2 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition including replacement of all filters in all air and piping systems.

1.29 DISCONNECTION AND REMOVAL

- .1 Disconnect and/or remove equipment, piping, ductwork, etc. as indicated.
- .2 Cap and conceal all redundant and obsolete connections.
- .3 Provide a list of equipment to be removed to the owner, for his acceptance of same. Remove all equipment from site, which the owner does not retain.
- .4 Store equipment to be retained by owner on site where directed by consultant.

1.30 OWNER SUPPLIED EQUIPMENT

- .1 Connect to equipment supplied by the owner and make operable.

1.31 DEMOLITION

- .1 **The general requirements are indicated on the drawings and on the outline specification in Division 1.**
- .2 **The general execution of the demolition is to be carried out in a clean and efficient manner.**
- .3 **Demolition of existing ceiling, walls etc., to facilitate removal of existing services or equipment or installation of new to be kept to a minimum and then restored to match existing.**
- .4 All openings or holes created by removal of existing mechanical systems which are not being reused are to be patched with the same material surrounding surfaces.
- .5 All new holes and openings to facilitate mechanical systems are to be patched to match surrounding surfaces.
- .6 Protect all existing furnishings materials and equipment. Any damage occurring as a result of the work of this Division shall be repaired or replaced at the expense of this Division.
- .7 Where work involves breaking into or connecting to existing services, carry out work at times directed by the Owners in an expedient manner with minimum disruption to the facility and systems downtime.
- .8 Where unknown services are encountered, immediately advise Consultant and confirm findings in writing.
- .9 Where the location of any services has been shown on the plans, such information is not guaranteed. It is this Division's responsibility to verify locations, invert elevations, etc., immediately after moving on site. Should for any reason the information obtained necessitates changes in procedure or design, advise the Consultant at once. If verification of existing conditions is not done at the outset and any problems arise, the responsibility for same is entirely this Division's.

1.32 LOCATION OF EXISTING UNDERGROUND SERVICES

- .1 This contractor shall locate existing services prior to starting any work in the affected area.
- .2 This contractor shall use a video camera for the existing storm and/or sanitary drainage at the indicated connection point to confirm location, size and invert of the existing piping.

1.33 EXISTING CONCRETE SLAB X-RAY/SCANNING

- .1 This contractor shall retain the services of a qualified company to provide and X-ray and/or scan of the existing buried services in wall and/or floors prior to starting any work in the affected area.
- .2 Failure to locate existing piping, conduit rebar etc., shall not relieve this contractor of repair of same prior to installing his service.
- .3 This contractor shall be responsible for all repairs and/or replacement of existing services caused by cutting the existing concrete slabs and/or walls.

1.34 EXCAVATING AND BACKFILLING

- .1 Provide all excavating and backfilling inside and outside the building for plumbing pipes, drains and equipment. All backfilling shall be new clean granular 'A' fill brought in specifically for the purpose of backfilling to the underside of floor slab. All backfilling shall be compacted at intervals not more than 150 mm (6") layer to the satisfaction of the Consultant.
- .2 Provide excavating and backfilling outside the building with granular A brought in specifically for backfilling to a minimum of 450 mm (18") over the pipe. Backfilling outside building over and above the 450 mm (18") backfill as previously specified herein shall be by the Mechanical Contractor as specified under Division 2. Where backfilling outside the building is not specified under Division 2 the mechanical contractor shall provide new clean granular 'A' fill to grade level.
- .3 Bottoms of trenches shall be excavated so that the pipe will be supported on a 150 mm (6") compacted bed of clean granular 'A' fill. Provide all necessary pumping to maintain excavation free of water.
- .4 Should water be encountered during excavation, the mechanical contractor shall provide all labour and material, including all equipment required for dewatering the excavation. After the water has been removed, this Contractor shall install a 300 mm (12") base of compacted 50 mm (2") clear stone covered with filter cloth before installing backfill as detailed and/or as specified.
- .5 Be responsible for all weather protection required to install piping and/or equipment to the satisfaction of the Consultant.
- .6 Be responsible for providing all clear stone or granular 'A' material suitable for application to replace existing soil not suitable for backfilling above the 450 mm (18") bedding material.

1.35 CONFINED SPACES

- .1 Certain areas of the building may be defined as a “Confined Space”. Any personnel working in these areas must have confined space training, appropriate equipment and undertake all work in conformance with appropriate codes and standards.
- .2 Refer to building documentation for any spaces deemed “Confined Space”.

1.36 INTEGRATED LIFE SAFETY SYSTEMS TESTING

- .1 Mechanical systems in this building, including but not limited to smoke control dampers, smoke control fans, high speed low velocity ceiling fans, makeup air units, heat tracing for fire protection systems and fire protection system components may be subject to Integrated Life Safety Systems testing.
- .2 The Mechanical Contractor shall co-ordinate with the Integrated Life Safety Systems Testing Agent as follows:
 - .1 Confirm which mechanical systems are to be included as part of the testing process.
 - .2 Verify in writing to the Integrated Life Safety Systems Testing Agent that mechanical commissioning of the affected systems/devices is complete prior to the scheduled testing date(s).
 - .3 Participate in the Integrated Life Safety Systems Testing to confirm proper operation of all associated systems.
 - .4 This contractor shall work with the Integrated Life Safety Systems Testing Agent to reset all systems back to normal operating mode after the testing is complete.
- .3 Include all costs associated with Integrated Life Safety System Testing in the tender value.
- .4 Refer to Division 1/Division 26 Integrated Life Safety Systems Testing specifications for additional information/requirements.

END OF SECTION

Part 1 General

1.1 GENERAL PROVISIONS

- .1 Conform to the General Provisions of General Requirements Section.
- .2 This project is one of a retrofit nature in part, and which will require some demolition.
- .3 Allow for all remedial work in areas indicated on the drawings and as generally defined in the relevant sections of the specifications.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- .1 Electrical Division.

1.3 SCOPE OF WORK

- .1 The scope of work is essentially the selected disconnection and/or removal of services and/or equipment, piping ductwork etc. as indicated or required to complete the work.

Part 2 Products

2.1 GENERAL

- .1 This Division is to liaise with the Owners or Consultant for equipment being removed that may be suitable for reuse to that specified or handed over to the owner.
- .2 This Division to take full responsibility for any special tools or equipment required to disassemble or remove material from building.

Part 3 Execution

3.1 GENERAL

- .1 The general requirements are indicated on the drawings and on the outline specification in Division 1.
- .2 The general execution of the demolition is to be carried out in a clean and efficient manner.
- .3 Demolition of existing ceiling, walls etc., to facilitate removal of existing services or equipment or installation of new to be kept to a minimum and then restored to match existing.
- .4 All openings or holes created by removal of existing mechanical systems which are not being reused are to be patched with the same material surrounding surfaces.
- .5 All new holes and openings to facilitate mechanical systems are to be patched to match surrounding surfaces.

- .6 Protect all existing furnishings materials and equipment. Any damage occurring as a result of the work of this Division shall be repaired or replaced at the expense of this Division.
- .7 Where work involves breaking into or connecting to existing services, carry out work at times directed by the Owners in an expedient manner with minimum disruption to the facility and systems downtime.
- .8 Where unknown services are encountered, immediately advise Consultant and confirm findings in writing.
- .9 Where the location of any services has been shown on the plans, such information is not guaranteed. It is this Division's responsibility to verify locations, invert elevations, etc., immediately after moving on site. Should for any reason the information obtained necessitates changes in procedure or design, advise the Consultant at once. If verification of existing conditions is not done at the outset and any problems arise, the responsibility for same is entirely this Division's.
- .10 Disconnect and/or remove equipment piping, ductwork, etc. as indicated.
- .11 Cap and conceal all redundant and obsolete connections.
- .12 Provide a list of equipment to be removed to the owner, for his acceptance of same. Remove all equipment from site which the owner does not retain.
- .13 Maintain equipment to be retained by owner on site where directed by consultant.
- .14 Demolition of all parts of the work must be completed within the confines of the work area and in such a way as the dust produced and risk to injury of will not adversely affect the building users.
- .15 Demolished areas of the existing building will remain in their current use in some cases. Demolition in these areas must be kept to the minimum required to complete the work.
- .16 Demolition shall take place within areas isolated from all other areas with appropriate hoarding, scaffolding, netting, fencing or other means of security between building users and the work.
- .17 Co-ordinate making safe electrical devices, capping plumbing and removal of fixtures prior to commencement of demolition.
- .18 All piping and equipment to be removed and/or abandoned shall be drained prior to capping and/or abandoning. Disposal of all liquids shall be to the approval of authority of having jurisdiction and/or provincial regulations.

3.2 EXISTING SYSTEM DRAINAGE

- .1 Drain all existing piping and drainage systems including all related equipment as required to facilitate system renovations.
- .2 Disposal of existing system shall be to the requirements of the local and/or provincial regulations.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ANSI/ASME B40.100, Pressure Gauges and Gauge Attachments.
- .3 CAN/CGSB-14.4, Thermometers, Liquid-in-Glass, Self Indicating, Commercial/Industrial Type.
- .4 CAN/CGSB-14.5, Thermometers, Bimetallic, Self-Indicating, Commercial/Industrial Type.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 Submit manufacturer's product data for following items:
 - .1 Thermometers.
 - .2 Pressure gauges.
 - .3 Stop cocks.
 - .4 Syphons.
 - .5 Wells.

Part 2 Products

2.1 GENERAL

- .1 Design point to be at mid point of scale or range.
- .2 Ranges: suitable for application.

2.2 DIRECT READING THERMOMETERS

- .1 Industrial, variable angle type, liquid filled, 225 mm (9") scale length: to CAN/CGSB 14.4.
 - .1 Acceptable materials:
 - .1 Trerice
 - .2 Winters 91T
 - .3 Wiess

2.3 REMOTE READING THERMOMETERS

- .1 100 mm (4") diameter liquid filled activated dial type: to CAN/CGSB-14.5, accuracy within one scale division, brass movement, stainless steel capillary, stainless steel spiral armour, stainless steel bulb and polished stainless steel case for wall mounting.
 - .1 Acceptable materials:
 - .1 Trerice
 - .2 Winters Contractor

2.4 THERMOMETER WELLS

- .1 Copper pipe: copper or bronze.
- .2 Steel pipe: brass or stainless steel.

2.5 PRESSURE GAUGES

- .1 115 mm (4 1/2"), dial type: to ANSI/ASME B40.100, Grade 2A, stainless steel phosphor bronze bourdon tube having 0.5% accuracy full scale unless otherwise specified.
 - .1 Acceptable materials:
 - .1 Winters
 - .2 Trerice
 - .3 Wiess
 - .2 Provide:
 - .1 Siphon for steam service.
 - .2 Snubber for pulsating operation.
 - .3 Diaphragm assembly for corrosive service.
 - .4 Gasketed pressure relief back with solid front.
 - .5 Bronze stop cock.

Part 3 Execution

3.1 GENERAL

- .1 Install so they can be easily read from floor or platform. If this cannot be accomplished, install remote reading units.
- .2 Install between equipment and first fitting or valve.

3.2 THERMOMETERS

- .1 Install in wells on all piping. Provide heat conductive material inside well.
- .2 Install in locations as indicated and on inlet and outlet of:
 - .1 Water heating and cooling coils.
 - .2 In other locations indicated.
- .3 Install wells as indicated only for balancing purposes.
- .4 Use extensions where thermometers are installed through insulation.

3.3 PRESSURE GAUGES

- .1 Install in following locations:
 - .1 Upstream and downstream of control valves.
 - .2 Inlet and outlet of coils.
 - .3 In other locations as indicated.
- .2 Install gauge cocks for balancing purposes, elsewhere as indicated.
- .3 Use extensions where pressure gauges are installed through insulation.

3.4 NAMEPLATES

- .1 Install engraved lamicoid nameplates as specified elsewhere identifying medium.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 American National Standards Institute/ American Society of Mechanical Engineers (ANSI/ASME)
 - .1 ANSI/ASME B31.1, Power Piping, (SI Edition).
- .3 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 125, Specification for Steel Springs, Helical, Heat-Treated.
 - .2 ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A 563, Specification for Carbon and Alloy Steel Nuts.
- .4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS)
 - .1 MSS SP-58, Pipe Hangers and Supports - Materials, Design, Manufacture Selection, Application, and Installation.

1.2 DESIGN REQUIREMENTS

- .1 Construct pipe hanger and support to manufacturer's recommendations utilizing manufacturer's regular production components, parts and assemblies.
- .2 Base maximum load ratings on allowable stresses prescribed by ASME B31.1 or MSS SP-58.
- .3 Ensure that supports, guides, anchors do not transmit excessive quantities of heat to building structure.
- .4 Design hangers and supports to support systems under all conditions of operation, allow free expansion and contraction, prevent excessive stresses from being introduced into pipework or connected equipment.
- .5 Provide for vertical adjustments after erection and during commissioning. Amount of adjustment to be in accordance with MSS SP-58.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 Submit shop drawings and product data for following items:
 - .1 All bases, hangers and supports.
 - .2 Connections to equipment and structure.
 - .3 Structural assemblies.

1.4 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

Part 2 Products

2.1 GENERAL

- .1 Fabricate hangers, supports and sway braces in accordance with ANSI B31.1 and MSS-SP-58.
- .2 Use components for intended design purpose only. Do not use for rigging or erection purposes.

2.2 PIPE HANGERS

- .1 Finishes:
 - .1 Pipe hangers and supports: to ANSI & ULC requirements
 - .2 Ensure steel hangers in contact with copper piping are copper plated.
- .2 Upper attachment structural: Suspension from upper flange of I-Beam or joist.
 - .1 Cold piping NPS 50 mm (2") maximum: Ductile iron C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip.
 - .1 Rod: 10 mm (3/8") UL listed
 - .2 Cold piping NPS 65 mm (2 1/2") or greater, all hot piping: Malleable iron beam clamp, eye rod, jaws and extension with carbon steel retaining clip, tie rod, nuts and washers, UL listed & FM approved.
- .3 Upper attachment structural: Suspension from upper flange of I-Beam.
 - .1 Cold piping NPS 50 mm (2") maximum: Ductile iron top-of-beam C-clamp with hardened steel cup point setscrew, locknut and carbon steel retaining clip, UL listed.
 - .2 Cold piping NPS 65 mm (2 1/2") or greater, all hot piping: Malleable iron top-of-beam jaw-clamp with hooked rod, spring washer, plain washer and nuts.
- .4 Upper attachment to concrete.
 - .1 Ceiling: Carbon steel welded eye rod, clevis plate, clevis pin and cotters with weldless forged steel eye nut. Ensure eye 6 mm (1/4") minimum greater than rod diameter.
 - .2 Concrete inserts: wedge shaped body with knockout protector plate ULC listed. Note: Rapidex and Siporex are not considered concrete. Should one of these systems be encountered, piping/ductwork and/or equipment shall be supported from adjacent walls or from supplemental steel provided by this contractor attached to the adjacent walls/structure.
- .5 Shop and field-fabricated assemblies.
 - .1 Trapeze hanger assemblies: ASME B31.1.
 - .2 Steel brackets: ASME B31.1.
- .6 Hanger rods: threaded rod material to MSS SP-58.
 - .1 Ensure that hanger rods are subject to tensile loading only.
 - .2 Provide linkages where lateral or axial movement of pipework is anticipated.

- .7 Pipe attachments: material to MSS SP-58.
 - .1 Attachments for steel piping: carbon steel.
 - .2 Attachments for copper piping: copper plated black steel.
 - .3 Use insulation shields for all piping.
 - .4 Oversize pipe hangers and supports to accommodate thermal insulation. Provide 1.5 mm (16 gauge) saddles.
- .8 Adjustable clevis: material to MSS SP-58 UL listed, clevis bolt with nipple spacer and vertical adjustment nuts above and below clevis.
 - .1 Ensure "U" has hole in bottom for rivetting to insulation shields.

2.3 RISER CLAMPS

- .1 Steel or cast iron pipe: black carbon steel to MSS-SP-58, type 42, UL listed.
- .2 Copper pipe: carbon steel copper plated to MSS-SP-58, type 42.
- .3 Bolts: to ASTM A 307.
- .4 Nuts: to ASTM A 563.

2.4 INSULATION PROTECTION SHIELDS

- .1 Insulated cold piping:
 - .1 64 kg/m² (13.12 lbs/ft²) density insulation plus insulation protection shield to: MSS SP-69, galvanized sheet carbon steel. Length designed for maximum 3 m (10') span.
- .2 Insulated hot piping:
 - .1 Curved plate 300 mm (12") long, with edges turned up, welded-in centre plate for pipe sizes NPS 300 mm (12") and over, carbon steel to comply with MSS SP-58.

2.5 CONSTANT SUPPORT SPRING HANGERS

- .1 Springs: alloy steel to ASTM A 125, shot peened, magnetic particle inspected, with +/- 5% spring rate tolerance, tested for free height, spring rate, loaded height and provided with CMTR.
- .2 Load adjustability: [10]% minimum adjustability each side of calibrated load. Adjustment without special tools. Adjustments not to affect travel capabilities.
- .3 Provide upper and lower factory set travel stops.
- .4 Provide load adjustment scale for field adjustments.
- .5 Total travel to be actual travel + 20%. Difference between total travel and actual travel 25 mm (1") minimum.
- .6 Individually calibrated scales on each side of support calibrated prior to shipment, complete with calibration record.

2.6 EQUIPMENT SUPPORTS

- .1 Fabricate equipment supports not provided by equipment manufacturer from structural grade steel meeting requirements of miscellaneous metals, specified herein. Submit calculations with shop drawings.

2.7 EQUIPMENT ANCHOR BOLTS AND TEMPLATES

- .1 Provide templates to ensure accurate location of anchor bolts.

2.8 OTHER EQUIPMENT SUPPORTS

- .1 From structural grade steel meeting requirements of structural steel section specified herein.
- .2 Submit structural calculations with shop drawings.

2.9 MANUFACTURER

- .1 Acceptable materials:
 - .1 Grinnell
 - .2 Anvil
 - .3 Myatt
 - .4 Taylor

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with:
 - .1 Manufacturer's instructions and recommendations.
- .2 Vibration Control Devices:
 - .1 Install on piping systems at pumps, boilers, chillers, cooling towers, elsewhere as indicated.
- .3 Clamps on riser piping:
 - .1 Support independent of connected horizontal pipework using riser clamps and riser clamp lugs welded to riser.
 - .2 Bolt-tightening torques to be to industry standards.
 - .3 Steel pipes: Install below coupling or shear lugs welded to pipe.
 - .4 Cast iron pipes: Install below joint.
- .4 Clevis plates:
 - .1 Attach to concrete with 4 minimum concrete inserts at each corner.
- .5 Provide supplementary structural steelwork where structural bearings do not exist or where concrete inserts are not in correct locations.

3.2 HANGER SPACING

- .1 Plumbing piping: most stringent requirements of Canadian Plumbing Code, Provincial Code, or authority having jurisdiction.
- .2 Fire protection: to applicable fire code.
- .3 Copper piping: up to NPS 15 mm (1/2"): every 1.5 m (5').
- .4 Within 300 mm (12") of each elbow and:

3.3 HANGER INSTALLATION

- .1 Install hanger so that rod is vertical under operating conditions.
- .2 Adjust hangers to equalize load.
- .3 Support from structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary structural steel members.
- .4 Do "NOT" support piping, ductwork and equipment from roof deck, on bottom chord of floor and/or roof joist and/or from OWSJ bridging. Provide structural member between joist.

3.4 HORIZONTAL MOVEMENT

- .1 Angularity of rod hanger resulting from horizontal movement of pipework from cold to hot position not to exceed 4mm (5/32") from vertical.
- .2 Where horizontal pipe movement is less than 15 mm (1/2"), offset pipe hanger and support so that rod hanger is vertical in the hot position.

3.5 FINAL ADJUSTMENT

- .1 Adjust hangers and supports:
 - .1 Ensure that rod is vertical under operating conditions.
 - .2 Equalize loads.
- .2 Adjustable clevis:
 - .1 Tighten hanger load nut securely to ensure proper hanger performance.
 - .2 Tighten upper nut after adjustment.
- .3 C-clamps:
 - .1 Follow manufacturer's recommended written instructions and torque values when tightening C-clamps to bottom flange of beam.
- .4 Beam clamps:
 - .1 Hammer jaw firmly against underside of beam.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with general requirements.
- .2 Provide separate shop drawings for each isolated system complete with performance and product data.

Part 2 Products

2.1 GENERAL

- .1 Size and shape of bases type and performance of vibration isolation to be as indicated.
- .2 To be of the same manufacturer for all isolation.
- .3 Acceptable materials:
 Korfund
 Vibro-Acoustics
 Vibron

2.2 ELASTOMERIC PADS

- .1 Type EP1 - neoprene waffle or ribbed; 10 mm (3/8") minimum thick; 50 durometer; maximum loading 350 kPa (50.8 psi).
- .2 Type EP2 - rubber waffle or ribbed; 10 mm (3/8") minimum thick; 30 durometer natural rubber; maximum loading 415 kPa (60.2 psi).
- .3 Type EP3 - neoprene-steel-neoprene; 10 mm (3/8") minimum thick neoprene bonded to 1.5 mm (16 gauge) steel plate; 50 durometer neoprene, waffle or ribbed; holes sleeved with isolation washers; maximum loading 350 kPa (50.8 psi).
- .4 Type EP4 - rubber-steel-rubber; 10 mm (3/8") minimum thick rubber bonded to 1.5 mm (16 gauge) steel plate; 30 durometer natural rubber, waffle or ribbed; holes sleeved with isolation washers; maximum loading 415 kPa (60.2 psi).
- .5 Acceptable materials:
 Korfund
 IAC Acoustics
 Vibro-Acoustics
 Vibron

2.3 ELASTOMERIC MOUNTS

- .1 Type M1 - colour coded; neoprene in shear; maximum durometer of [60]; threaded insert and two bolt-down holes; ribbed top and bottom surfaces.

Acceptable materials:

Vibro-Acoustics

Korfund

IAC Acoustics

Vibron

2.4 SPRINGS

- .1 Design stable springs so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times the ratio of static deflection to working height. Select for 50% travel beyond rated load. Units to be complete with levelling devices.
- .2 Ratio of height when loaded to diameter of spring to be between 0.8 to 1.0.
- .3 Cadmium plate for all installations.
- .4 Colour code springs.

2.5 SPRING MOUNT

- .1 Zinc or cadmium plated hardware; housings coated with rust resistant paint.
- .2 Type M2 - stable open spring: support on bonded 6 mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad.
- .3 Type M3 - stable open spring: 6 mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad, bonded under isolator and on isolator top plate; leveling bolt for rigidly mounting to equipment.
- .4 Type M4 - restrained stable open spring: supported on bonded 6 mm (1/4") minimum thick ribbed neoprene or rubber friction and acoustic pad; built-in resilient limit stops, removable spacer plates.
- .5 Type M5 - enclosed spring mounts with snubbers for isolation up to 950 kg (2100 lbs) maximum.
- .6 Performance: as indicated.
- .7 Acceptable materials:
 - Korfund
 - IAC Acoustics
 - Vibron
 - Vibro-Acoustics

2.6 HANGERS

- .1 Colour coded springs, rust resistant, painted box type hangers. Arrange to permit hanger box or rod to move through a 30° arc without metal to metal contact.
- .2 Type H1 - neoprene - in-shear, molded with rod isolation bushing, which passes through hanger box.
- .3 Type H2 - stable spring, elastomeric washer, cup with molded isolation bushing which passes through hanger box.
- .4 Type H3 - stable spring, elastomeric element with pre-compression washer and nut [with deflection indicator].
- .5 Performance as indicated.
- .6 Acceptable materials:
Vibron
IAC Acoustics
Korfund
Vibro-Acoustics

2.7 ACOUSTIC BARRIERS FOR ANCHORS AND GUIDES

- .1 Acoustic barriers: between pipe and support, consisting of 25 mm (1") minimum thick heavy-duty duct and neoprene isolation material.
- .2 Acceptable materials:
Vibron
IAC Acoustics
Vibro-Acoustics

2.8 HORIZONTAL THRUST RESTRAINT

- .1 Spring and elastomeric element housed in box frame; assembly complete with rods and angle brackets for equipment and ductwork attachment; provision for adjustment to limit maximum start and stop movement to 10 mm (3/8").
- .2 Arrange restraints symmetrically on either side of unit and attach at centerline of thrust.
- .3 Acceptable materials:
Korfund
IAC Acoustics
Vibron
Vibro-Acoustics

2.9 STRUCTURAL BASES

- .1 Type B1 - Prefabricated steel base: integrally welded on sizes up to 2400 mm (96") on smallest dimension, split for field welding on sizes over 2400 mm (96") on smallest dimension and reinforced for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; pre-drilled holes to receive equipment anchor bolts; and complete with adjustable built-in motor slide rail where indicated.
- .2 Type B2 - Steel rail base: structural steel, positioned for alignment of drive and driven equipment; without supplementary hold down devices; complete with isolation element attached to base brackets arranged to minimize height; and pre-drilled holes to receive equipment anchor bolts.
- .3 Bases to clear housekeeping pads by 25 mm (1") minimum.
- .4 Acceptable materials:
 - Korfund
 - IAC Acoustics
 - Vibron
 - Vibro-Acoustics

Part 3 Execution

3.1 INSTALLATION

- .1 Install vibration isolation equipment in accordance with manufacturers instructions and adjust mountings to level equipment.
- .2 Ensure piping, ducting and electrical connections to isolated equipment do not reduce system flexibility and that piping, conduit and ducting passage through walls and floors do not transmit vibrations.
- .3 Unless indicated otherwise, support piping connected to isolated equipment with spring mounts or spring hangers with 25 mm (1") minimum static deflection as follows:
 - .1 Up to NPS 100 mm (4"): first 3 points of support. NPS 125 mm (5") to NPS 200 mm (8"): first 4 points of support. NPS 250 mm (10") and Over: first 6 points of support.
 - .2 First point of support shall have a static deflection of twice deflection of isolated equipment, but not more than 50 mm (2").
- .4 Where isolation is bolted to floor use vibration isolation rubber washers.
- .5 Block and shim level bases so that ductwork and piping connections can be made to a rigid system at the operating level, before isolator adjustment is made. Ensure that there is no physical contact between isolated equipment and building structure.

3.2 SITE VISIT

- .1 Manufacturer to visit site and provide written certification that installation is in accordance with manufacturer's instructions and submit report to Consultant.
- .2 Provide Consultant with notice 24 h in advance of visit.
- .3 Make adjustments and corrections in accordance with written report.

3.3 TESTING

- .1 Experienced and competent sound and vibration testing professional engineer to take vibration measurement for HVAC systems after start up and TAB of systems to Testing Adjusting and Balancing Section.
- .2 Vibration measurements shall be taken for equipment-listed below:
- .3 Provide Consultant with notice 48 h in advance of commencement of tests.
- .4 Establish adequacy of equipment isolation and acceptability of noise levels in occupied areas and where appropriate, remedial recommendations including sound curves.
- .5 Submit complete report of test results including sound curves.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-1.60, Interior Alkyd Gloss Enamel.
 - .2 CAN/CGSB-24.3, Identification of Piping Systems.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with General Requirements.
- .2 Product data to include paint colour chips, all other products specified in this section.

1.3 PRODUCT LITERATURE

- .1 Submit product literature in accordance with General Requirements.
- .2 Product literature to include nameplates, labels, tags, lists of proposed legends.

Part 2 Products

2.1 MANUFACTURER'S EQUIPMENT NAMEPLATES

- .1 Metal or plastic lamicoid nameplate mechanically fastened to each piece of equipment by manufacturer.
- .2 Lettering and numbers to be raised or recessed.
- .3 Information to include, as appropriate:
 - .1 Equipment: Manufacturer's name, model, size, serial number, capacity.
 - .2 Motor: voltage, Hz, phase, power factor, duty, frame size.

2.2 SYSTEM NAMEPLATES

- .1 Colours:
 - .1 Hazardous: red letters, white background.
 - .2 Elsewhere: black letters, white background (except where required otherwise by applicable codes).
- .2 Construction:
 - .1 3 mm (1/8") thick laminated plastic, matte finish, with square corners, letters accurately aligned and machine engraved into core.

.3 Sizes:

.1 Conform to following table:

Size	No. of Sizes mm (")	Height of Line mm (")	Letters mm (")
1	10 x 50 (3/8" x 2")	1 (3/64")	3 (1/8")
2	15 x 75 (1/2" x 3")	1 (3/64")	6 (1/4")
3	15 x 75 (1/2" x 3")	2 (5/64")	3 (1/8")
4	20 x 100 (3/4" x 4")	1 (3/64")	10 (3/8")
5	20 x 100 (3/4" x 4")	2 (6/64")	6 (1/4")
6	20 x 200 (3/4" x 8")	1 (3/64")	10 (3/8")
7	25 x 125 (1" x 5")	1 (3/64")	15 (1/2")
8	25 x 125 (1" x 5")	2 (5/64")	10 (3/8")
9	32 x 200 (1¼" x 8")	1 (3/64")	20 (3/4")

.2 Use maximum of 25 letters/numbers per line.

.4 Locations:

- .1 Terminal cabinets, control panels: Use size #5.
- .2 Equipment in Mechanical Rooms: Use size #9.
- .3 Roof top equipment: use size #9.
- .4 Equipment above ceiling: use size #1 riveted to ceiling suspension system.

2.3 FIRE DAMPER/FIRE STOP FLAP NAMEPLATES/FIRE SMOKE DAMPER

.1 Colours:

- .1 Black letters, yellow background.

.2 Construction:

- .1 Self adhesive 50 mm x 25 mm, matte finish, with round corners.

.3 Locations:

- .1 Install on adjacent ceiling grid. Where fire stop flap is installed in gypsum ceiling install on diffuser/grille frame. Where fire damper is installed above gypsum ceiling install on adjacent wall.

2.4 EXISTING IDENTIFICATION SYSTEMS

- .1 Apply existing identification system to new work.
- .2 Where existing identification system does not cover for new work, use identification system specified this section.
- .3 Before starting work, obtain written approval of identification system from Consultant.

- .4 Upon completion of this project all references to room names and numbering shall be to the Owner's requirements which may or may not be the numbering system used on the drawings. Each contractor shall verify the proper numbering scheme to be used prior to project completion.
- .5 All equipment shall be identified in sequence from the existing equipment and "NOT" duplicate numbering of equipment.

2.5 IDENTIFICATION OF PIPING SYSTEMS

- .1 Identify contents by background colour marking, pictogram (as necessary), legend; direction of flow by arrows. To CAN/CGSB 24.3 except where specified otherwise.
- .2 Legend:
 - .1 Block capitals to sizes and colours listed in CAN/CGSB-24.3.
- .3 Arrows showing direction of flow:
 - .1 Outside diameter of pipe or insulation less than 75 mm (3"): 100 mm (4") long x 50 mm (2") high.
 - .2 Outside diameter of pipe or insulation 75 mm (3") and greater: 150 mm (6") long x 50 mm (2") high.
 - .3 Use double-headed arrows where flow is reversible.
- .4 Extent of background colour marking:
 - .1 To full circumference of pipe or insulation.
 - .2 Length to accommodate pictogram, full length of legend and arrows.
- .5 Materials for background colour marking, legend, arrows:
 - .1 Pipes and tubing 20 mm (3/4") and smaller: Waterproof and heat-resistant pressure sensitive plastic marker tags.
 - .2 All other pipes: Pressure sensitive vinyl with protective overcoating, waterproof contact adhesive undercoating, suitable for ambient of 100% RH and continuous operating temperature of 150°C (300°F) and intermittent temperature of 200°C (395°F).
- .6 Colours and Legends:
 - .1 Where not listed, obtain direction from Consultant.
 - .2 Colours for legends, arrows: To following table:

Background colour:	Legend:	Arrows:
Yellow	White	Black
Green	White	Black
Red	White	Black
- .7 Pictograms:
 - .1 Where required, to Workplace Hazardous Materials Information System (WHMIS) regulations.

- .8 Background colour marking and legends for piping systems:

CONTENTS	BACKGROUND COLOUR MARKING	LEGEND
Hot water heating supply	Yellow	HEATING SUPPLY
Hot water heating return	Yellow	HEATING RETURN
Domestic hot water supply	Green	DOM. HW SUPPLY
Dom. HW recirculation	Green	DOM. HW CIRC
Domestic cold water supply	Green	DOM. CWS
Domestic tempered supply	Green	DOM. TEMPERED
Trap Primer	Green	TRAP PRIMER
Sanitary	Green	SAN
Plumbing vent	Green	SAN. VENT
Condensate	Green	CONDENSATE
Instrument air	Green	INSTRUMENT AIR
Control air tubing	White	CONTROL AIR
Conduit for low voltage		
Control wiring	White	CONTROL WIRING___VOLTS

2.6 IDENTIFICATION DUCTWORK SYSTEMS

- .1 50 mm (2") high stencilled letters and directional arrows 150 mm (6") long x 50 mm (2") high.
- .2 Colours: Black, or co-ordinated with base colour to ensure strong contrast.

2.7 VALVES, CONTROLLERS

- .1 Brass tags with 15 mm (1/2") stamped identification data filled with black paint.
- .2 Include flow diagrams for each system, of approved size, showing charts and schedules with identification of each tagged item, valve type, service, function, normal position, location of tagged item.
- .3 Provide adhesive coloured tab (max. size 15 mm) indication on ceiling to locate valves/equipment above. Same applies to grid. Colour to be approved by consultant.

2.8 CONTROLS COMPONENTS IDENTIFICATION

- .1 Identify all systems, equipment, components, controls, sensors with system nameplates specified in this section.
- .2 Inscriptions to include function and (where appropriate) fail-safe position.
- .3 Provide equipment identification and/or indication on ceiling to locate devices/equipment above ceiling. Install identification on grid. Colours to be approved by consultant.

2.9 LANGUAGE

- .1 Identification to be in English.

Part 3 Execution

3.1 TIMING

- .1 Provide identification only after all painting specified has been completed.

3.2 INSTALLATION

- .1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.
- .2 Provide ULC and/or CSA registration plates as required by respective agency.

3.3 NAMEPLATES

- .1 Locations:
 - .1 In conspicuous location to facilitate easy reading and identification from operating floor.
- .2 Standoffs:
 - .1 Provide for nameplates on hot and/or insulated surfaces.
- .3 Protection
 - .1 Do not paint, insulate or cover in any way.

3.4 LOCATION OF IDENTIFICATION ON PIPING AND DUCTWORK SYSTEMS

- .1 On long straight runs in open areas in boiler rooms, equipment rooms, galleries, tunnels not more than 1.7 m (5'-8") intervals and more frequently if required to ensure that at least one is visible from any one viewpoint in operating areas and walking aisles.
- .2 Adjacent to each change in direction.
- .3 At least once in each small room through which piping or ductwork passes.
- .4 On both sides of visual obstruction or where run is difficult to follow.
- .5 On both sides of separations such as walls, floors, partitions.
- .6 Where system is installed in pipe chases, ceiling spaces, galleries, other confined spaces, at entry and exit points, and at each access opening.
- .7 At beginning and end points of each run and at each piece of equipment in run.
- .8 At point immediately upstream of major manually operated or automatically controlled valves, dampers, etc. Where this is not possible, place identification as close as possible, preferably on upstream side.

- .9 Identification to be easily and accurately readable from usual operating areas and from access points.
 - .1 Position of identification to be approximately at right angles to most convenient line of sight, considering operating positions, lighting conditions, risk of physical damage or injury and reduced visibility over time due to dust and dirt.

3.5 VALVES, CONTROLLERS

- .1 Valves and operating controllers, except at plumbing fixtures, radiation, or where in plain sight of equipment they serve: Secure tags with non-ferrous chains or closed "S" hooks.
- .2 Install one copy of flow diagrams, valve schedules mounted in frame behind non-glare glass where directed by Consultant. Provide one copy (reduced in size if required) in each operating and maintenance manual.
- .3 Number valves in each system consecutively. Where existing numbering system is installed start new numbering system at 100.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 TAB means to test, adjust and balance to perform in accordance with requirements of Contract Documents and to do all other work as specified in this section including all air handling systems and equipment, all plumbing systems and equipment and all temperature controls system, building automation systems and equipment.
- .2 This contractor must co-ordinate their work with that of the TAB contractor.

1.2 QUALIFICATIONS OF TAB AGENCIES

- .1 Names of all personnel it is proposed to perform TAB to be submitted to and approved by Consultant within 30 days of start of work.
- .2 Provide documentation confirming qualifications, successful experience.
- .3 Only the following NEBB (National Environmental Balancing Bureau) TAB contractors may quote:
 - .1 Air Audit Inc.
110 Turnbull Court, Unit 11
Cambridge, Ontario
N1T 1K6
(519) 740-0871
 - .2 Air Velocities Control Ltd.
100 Premium Way
Mississauga, Ontario
L5B 1A2
(905) 279-4433
 - .3 Flowset Balancing Ltd.
431 Willis Dr.
Oakville, Ontario
L6L 4V6
(416) 410-9793
 - .4 Air Adjustments & Balancing Inc.
P.O. Box 176,
Schomberg, Ontario
L0G 1T0
(416) 254-3004
 - .5 **VPG Associates**
2062 King Road
King City, Ontario
L7B 1K9
(905) 833-4334

1.3 PURPOSE OF TAB

- .1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average (95% design) and low (75% of design) loads using actual or simulated loads. TAB contractor to perform equipment evaluation upon start up and once during each season in the first year of operation.
- .2 Adjust and regulate equipment and systems so as to meet specified performance requirements and to achieve specified interaction with all other related systems under all normal and emergency loads and operating conditions. Confirm all equipment interlocks and functions of associated systems.
- .3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges and temperatures. Refer to BAS for system operating functions.

1.4 EXCEPTIONS

- .1 TAB of systems and equipment regulated by codes, standards to be to satisfaction of authority having jurisdiction.

1.5 CO-ORDINATION

- .1 Schedule time required for TAB (including repairs, re-testing) into project construction and completion schedule so as to ensure completion before acceptance of project.
- .2 Do TAB of each system independently and subsequently, where interlocked with other systems, in unison with those systems. Co-ordinate with other trades to ensure all systems are interlocked as indicated elsewhere prior to TAB.

1.6 PRE-TAB REVIEW

- .1 Review contract documents before project construction is started and confirm in writing to Consultant adequacy of provisions for TAB and all other aspects of design and installation pertinent to success of TAB.
- .2 Review specified standards and report to Consultant in writing all proposed procedures which vary from standard.
- .3 During construction, co-ordinate location and installation of all TAB devices, equipment, accessories, measurement ports and fittings.
- .4 During construction indicate all tolerances of piping, ductwork etc conforms to specifications.

1.7 START-UP

- .1 Follow start-up procedures as recommended by equipment manufacturer unless specified otherwise.
- .2 Follow special start-up procedures specified elsewhere in the Mechanical Division.

March 2024

1.8 OPERATION OF SYSTEMS DURING TAB

- .1 Operate systems for length of time required for TAB and as required by Consultant for verification of TAB reports.

1.9 START OF TAB

- .1 Notify Consultant in writing 3 days prior to start of TAB.
- .2 Start TAB only when building is essentially completed, including:
 - .1 Installation of ceilings, doors, windows, other construction affecting TAB.
 - .2 Application of weather-stripping, sealing, caulking.
 - .3 All pressure, leakage, other tests specified elsewhere in the Mechanical Division.
 - .4 All provisions for TAB installed and operational.
 - .5 Start-up, verification for proper, normal and safe operation of all mechanical and associated electrical and control systems affecting TAB including but not limited to:
 - .1 Proper thermal overload protection in place for electrical equipment.
 - .2 Air systems:
 - .1 Filters in place, clean.
 - .2 Duct systems clean.
 - .3 Ducts, air shafts, ceiling plenums are airtight to within specified tolerances.
 - .4 Correct fan rotation.
 - .5 Fire, smoke, volume control dampers installed and open.
 - .6 Coil fins combed, clean.
 - .7 Access doors, installed, closed.
 - .8 All outlets installed, volume control dampers open.
 - .3 Liquid systems:
 - .1 Flushed, filled, vented.
 - .2 Correct pump rotation.
 - .3 Strainers in place, baskets clean.
 - .4 Isolating and balancing valves installed, open.
 - .5 Calibrated balancing valves installed, at factory settings.
 - .6 Chemical treatment systems complete, operational.
 - .7 Control valves are properly piped.
 - .8 Coils and radiation are properly piped.
 - .9 BAS in operation.

1.10 APPLICATION TOLERANCES

- .1 Do TAB to following tolerances of design values:
 - .1 HVAC systems: plus 10%, minus 5%.
 - .2 Hydronic systems: plus or minus 10%.

1.11 ACCURACY TOLERANCES

- .1 Measured values to be accurate to within plus or minus 2% of actual values.

1.12 INSTRUMENTS

- .1 Prior to TAB, submit to Consultant list of instruments to be used together with serial numbers.
- .2 Calibrate in accordance with requirements of most stringent of referenced standard for either applicable system or HVAC system.
- .3 Calibrate within 3 months of TAB. Provide certificate of calibration to Consultant.

1.13 SUBMITTALS

- .1 Submit, prior to commencement of TAB:
 - .1 Proposed methodology and procedures for performing TAB if different from referenced standard.

1.14 PRELIMINARY TAB REPORT

- .1 Submit for checking and approval of Consultant, prior to submission of formal TAB report, sample of rough TAB sheets. Include:
 - .1 Details of instruments used.
 - .2 Details of TAB procedures employed.
 - .3 Calculations procedures.
 - .4 Summaries.

1.15 TAB REPORT

- .1 Format to be in accordance with NEBB, AABC, or SMACNA.
- .2 The following additional information shall be provided for all air systems:
 - .1 Minimum damper position (MAD/Economizer) and the corresponding BAS signal and the voltage to the actuator to meet the full ASHRAE occupied ventilation requirements.
 - .2 Minimum damper position (MAD/Economizer) and the corresponding BAS signal and the voltage to the actuator to meet the full ASHRAE unoccupied ventilation requirements.
 - .3 Static pressure reading for each HVAC/AHU unit with VAV/VVT boxes open to 80% of design airflow and bypass damper closed to 0%. Provide reading at normal MAD/economizer damper position, dampers fully closed and dampers fully open.

March 2024

.3 TAB report to show all results in SI or imperial units as indicated on plans and to include:

- .1 Project as-built drawings.
- .2 System schematics.

1.16 VERIFICATION

- .1 All reported results subject to verification by Consultant.
- .2 Provide manpower and instrumentation to verify up to 30% of all reported results.
- .3 Number and location of verified results to be at discretion of Consultant.
- .4 Bear costs to repeat TAB as required to satisfaction of Consultant.

1.17 SETTINGS

- .1 After TAB is completed to satisfaction of Consultant, replace drive guards, close all access doors, lock all devices in set positions, ensure sensors are at required settings. Replace all ceiling tile etc.
- .2 Permanently mark all settings to allow restoration at any time during life of facility. Markings not to be eradicated or covered in any way.

1.18 COMPLETION OF TAB

- .1 TAB to be considered complete only when final TAB Report received and approved by Consultant.

1.19 AIR SYSTEMS

- .1 Standard: TAB to be to most stringent of TAB standards of NEBB, AABC, SMACNA, ASHRAE.
- .2 Do TAB of all systems, equipment, components, controls specified in the Mechanical Division including but not limited to following:
 - .1 Air handling systems and equipment
 - .2 Duct testing to SMACNA standards.
- .3 Qualifications: personnel performing TAB to be current member in good standing of NEBB.
- .4 Quality assurance: Perform TAB under direction of qualified supervisor.
- .5 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: air velocity, static pressure, flow rate, pressure drop (or loss), temperatures (dry bulb, wet bulb, dewpoint), duct cross-sectional area, RPM, electrical power, voltage, noise, vibration.

March 2024

- .6 Locations of equipment measurements: To include, but not be limited to, following as appropriate:
 - .1 Inlet and outlet of each damper, filter, coil, humidifier, fan, and other equipment causing changes in conditions.
 - .2 At each controller, controlled device.
- .7 Locations of systems measurements to include, but not be limited to, following as appropriate: Each main duct, main branch, sub-branch, grille, register or diffuser.

1.20 HYDRONIC SYSTEMS

- .1 Definitions: for purposes of this section, to include low pressure hot water heating.
- .2 Standard: TAB to be the most stringent of TAB standards of NEBB, AABC, SMACNA, ASHRAE.
- .3 Do TAB of all systems, equipment, components, controls specified in Mechanical Division including but not limited to hydronic equipment testing.
- .4 Qualifications: personnel performing TAB to be current member in good standing of NEBB.
- .5 Quality assurance: perform TAB under direction of qualified supervisor.
- .6 Measurements: to include, but not limited to, following as appropriate for systems, equipment, components, controls: Flow rate, static pressure, pressure drop (or loss), temperature, specific gravity, density, RPM, electrical power voltage, noise, vibration.
- .7 Locations of equipment measurement: To include, but not be limited to, following as appropriate:
 - .1 Inlet and outlet of each heat exchanger (primary and secondary sides), boiler, chiller, coil, humidifier, cooling tower, condenser, pump, PRV, control valve, other equipment causing changes in conditions.
 - .2 At each controller, controlled device.
- .8 Locations of systems measurements to include, but not be limited to, following as appropriate: Supply and return of each primary and secondary loop (main, main branch, branch, sub-branch of all hydronic systems, inlet connection of make-up water.

1.21 DUCT LEAKAGE TESTING

- .1 Co-ordinate leakage testing with the sheet metal contractor. TAB contractor will be responsible for all duct testing.
- .2 Duct to be tested in accordance with SMACNA HVAC Duct Leakage Test Manual and as indicated.

March 2024

1.22 DOMESTIC HWC SYSTEMS

- .1 Meet all requirements as specified for hydronic systems.
- .2 Locations of equipment measurements: To include, but not be limited to, following as appropriate: Inlet and outlet of each heater, tank, pump, circulator, at each controller, controlled device.
- .3 Locations of systems measurements to include, but not be limited to, following as appropriate: main, main branch, branch, sub-branch.

1.23 OTHER SYSTEMS

- .1 Plumbing systems:
 - .1 TAB procedures:
- .2 Recirculating Systems pump flows, pressures

1.24 OTHER TAB REQUIREMENTS

- .1 General requirements applicable to all work specified this paragraph:
 - .1 Qualifications of TAB personnel: as for air systems specified this section.
- .2 Quality assurance: as for air systems specified this section.
- .3 Building pressure conditions:
 - .1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions at all times.
 - .2 TAB procedures:

<u>Positive</u>	<u>Negative</u>
Corridors	Washrooms
Cafeteria	Cafeteria Kitchen (Kitchen maximum -0.02 inches w.c.)
Corridors	Industrial Areas
- .4 Zone pressure differences:
 - .1 Adjust HVAC systems, equipment, controls to establish air pressure differentials, with all systems in all possible combinations of normal operating modes.
- .5 Smoke management systems:
 - .1 Test for proper operation of all smoke and fire dampers installed as component parts of air systems specified.
- .6 Provide duct testing as specified.
- .7 Provide plenum testing as specified.
- .8 Changing of air handling equipment sheave and belts as required for specified air flow sheaves and belts supplied by unit manufacturer. Retest equipment after sheave change.

END OF SECTION

Part 1 General

1.1 GENERAL

- .1 The Mechanical Contractor shall provide the labour and material to conduct the closeout process as outlined in this specification section.
- .2 The mechanical contractor shall perform the closeout requirements specified in conjunction with the independent commissioning consultant (CC) retained by the owner.

Part 2 Products

2.1 GENERAL

- .1 The mechanical contractor and manufacturers shall provide all instrumentation and equipment necessary to conduct the tests specified. The Mechanical Contractor shall advise the Mechanical Consultant of instrumentation to be used and the dates the instruments were calibrated.

Part 3 Execution

3.1 THE CONTRACT CLOSE OUT PROCESS

- .1 The mechanical contractor close out process shall consist of:
 - Shop Drawings and As-built Drawings
 - Installation inspection and equipment verification
 - Plumbing and drainage system testing
 - Testing of piping systems
 - Independent contractor balancing of water systems
 - Testing of air systems
 - Independent contractor balancing of air systems
 - Testing of equipment and systems
 - BAS Commissioning
 - Commissioning meetings
 - Operating and maintenance manuals
 - Training
 - Systems Demonstration and turnover
 - Testing forms
 - Warranties
 - Contractor to provide list of equipment maintenance including schedule of maintenance parts, quantities, and model fixtures, etc.

3.2 SHOP DRAWINGS AND AS-BUILT DRAWINGS

- .1 Conform to General Requirements Section for shop drawings and as-built drawings requirements.

3.3 INSTALLATION INSPECTION AND EQUIPMENT VERIFICATION

- .1 The Mechanical Contractor shall co-ordinate with the Consultant who will inspect the mechanical installation.
- .2 The Mechanical Contractor shall complete the equipment verification forms for each piece of equipment. The forms shall be included in the operating and maintenance manual. The equipment data shall include:
 - Manufacturers name, address and telephone number
 - Distributors name, address and telephone number
 - Make, model number and serial number
 - Fans - belt type and size, shive type and size
 - Electrical - volts, amps, fuse size, overload size
 - Any other special characteristics.

3.4 PLUMBING AND DRAINAGE SYSTEM TESTING

- .1 The plumbing and drainage system shall be tested in accordance with the Plumbing Code under the Ontario Water Resources Act and the specification.
- .2 The Mechanical Contractor shall notify the Building Inspector when systems are available for testing. The Mechanical Contractor shall document all tests performed and shall arrange for the Building Inspector to sign for tests completed. The forms shall be forwarded to the Consultant.

3.5 THE CONTRACTOR'S TESTING OF PIPING SYSTEMS

- .1 Test all piping systems in accordance with all applicable plumbing codes and General Requirements section.
- .2 All tests for the systems shall be performed in the presence of the Consultant or Commissioning Consultant. Complete the testing forms and forward to the Consultant.

3.6 THE INDEPENDENT CONTRACTORS TESTING AND BALANCING OF WATER SYSTEMS

- .1 Conform with the specification section, Testing, Adjusting and Balancing.
- .2 The Independent Contractor shall be hired by The Mechanical Contractor.

3.7 THE CONTRACTORS TESTING OF AIR SYSTEMS

- .1 Conform with the specification section, Testing, Adjusting and Balancing.
- .2 All tests shall be performed in the presence of the Mechanical Consultant or the Commissioning Consultant. Complete the testing forms and forward to the Consultant.

3.8 THE INDEPENDENT CONTRACTORS TESTING AND BALANCING OF AIR SYSTEMS

- .1 Conform with specification section, Testing, Adjusting and Balancing.
- .2 The Independent Contractor shall be hired by The Mechanical Contractor and shall report to the Commissioning Consultant.

3.9 TESTING OF EQUIPMENT AND SYSTEMS

- .1 General:
 - .1 The Mechanical Contractor shall hire the services of the manufacturers technicians to test the equipment and associated systems. The technician shall record the results of the tests on the testing forms. The tests shall be witnessed by the Consultant or Owners representative. When the tests have been completed satisfactorily the technician and witnessing authority shall sign the forms. A copy of the forms shall be forwarded to the Consultant. The original shall be inserted into the operating and maintenance manual.
 - .2 Should equipment or systems fail a test, the test shall be repeated after repairs or adjustments have been made. The additional tests shall be witnessed.
 - .3 Tests which have not been witnessed shall not be accepted and shall be repeated.
 - .4 The equipment and systems to be tested shall include:
 - Life Safety and Fire Protection Systems
 - Water Treatment Systems
 - Building Automation Systems (BAS)
- .2 BAS Testing:
 - .1 The BAS Contractor shall test the system as described in General Requirements and/or Controls Sections.
 - .2 Co-ordinate with the Consultant and submit completed test forms monthly.
 - .3 Demonstrate to the Owner and Consultant the operation of the BAS when all tests have been completed.

3.10 CLOSEOUT SCHEDULE

- .1 The Mechanical Contractor shall include the schedule for all tests and equipment start-up tests in the construction schedule.
- .2 All testing forms and reports associated with the mechanical systems shall be directed to the Consultant with copies to the Owner and Consultant.
- .3 The forms and reports to be issued shall include:
 - Shop drawings, issued and accepted
 - Equipment verification forms
 - Testing forms
 - Reports resulting from tests
 - Testing schedule
 - Equipment Start-up Forms

3.11 OPERATION AND MAINTENANCE MANUAL

- .1 Conform to General Requirements section for the Operating and Maintenance Manual requirements.

3.12 OPERATOR TRAINING

- .1 Conform to General Requirements section for requirements for Instruction to Operating Staff.
- .2 The training shall be conducted in a classroom and at the equipment or system.
- .3 Training will begin when the operating and maintenance manuals have been delivered to The Owner and approved by the Consultant.
- .4 Each training session shall be structured to cover:
The operating and maintenance manual
 - Operating procedures
 - Maintenance procedures
 - Trouble-shooting procedures
 - Spare parts required
 - Submit a course outline to the Mechanical Consultant before training commences.
 - Provide course documentation for up to eight people.
- .5 The training sessions shall be scheduled and co-ordinated by the Mechanical Contractor.
- .6 Training shall be provided for the following systems:

<u>System</u>	<u>Minimum Training Times</u>
Water Treatment Systems	2 hours
The Mechanical System	8 hours
Life Safety & Fire Protection	½ hour
- .7 The minimum training for the BAS shall be 16 hours. The training shall include:
 - A walk through of the installation for the Building Owner to review the installation and equipment
 - Operation of the central computer
 - Operation of portable terminals
 - Control sequences
 - Report set-up and generation
 - Managing the system
 - Maintenance requirementsRefer to Controls specification section for further information.
- .8 The training requirement for the mechanical system shall include a walk-through of the building by the Mechanical Contractor. During the walk through the Mechanical Contractor shall:
 - Identify equipment
 - Identify starters associated with equipment
 - Identify valves and balancing dampers
 - Identify access doors
 - Review general maintenance of equipment
 - Review drain points in pipework systems
 - Identify maintenance items
- .9 When each training session has been completed The Owner shall sign the associated form to verify completion.

3.13 MECHANICAL SYSTEM DEMONSTRATION AND TURNOVER

- .1 Refer to General Requirements section, Mechanical Project Completion.
- .2 The system demonstration and turnover to The Owner shall occur when:
 - The installation is complete
 - The acceptance test conducted by the Mechanical Consultant has been completed successfully
 - The Commissioning Consultant system performance testing has been completed successfully
 - Training has been completed
 - Operating and Maintenance Manuals have been accepted
 - Shop-drawings have been updated
 - As-built drawings have been completed
- .3 The systems demonstration shall be conducted by the Mechanical Contractor and the manufacturers. The demonstration shall cover a demonstration of equipment installation and operation.

3.14 TESTING FORMS

- .1 The Mechanical Contractor and manufacturers shall provide forms for testing. The forms must be approved by the Consultant and The Owner before they are used.

3.15 WARRANTIES

- .1 Equipment and system warranties shall not begin until the system demonstration and turnover has been conducted successfully and accepted by The Owner.
- .2 The Mechanical Contractor shall fill out the warranty form listing the equipment and systems and the start and finishing dates for warranty.
- .3 Refer to the general conditions specification section for the requirements during the warranty period.

3.16 CLOSEOUT PROCESS ALLOCATION

- .1 The mechanical contractor closeout process shall be as follows:
 - .1 3% for the first \$500,000 of contract value.
 - .2 1% of the contract value for value between \$500,000 to \$5,000,000.
 - .3 0.5% of contract value for the value in excess of \$5,000,000.
 - .4 Minimum Allocation for Close Out Documents is \$5,000.
- .2 The Mechanical Contractor shall submit all test and verification forms. The Consultant will use these forms to calculate percentage complete.
- .3 The monies shall not be paid out until the performance testing, O & M manuals, systems demonstration, and training including all required paperwork have been completed to the satisfaction of the consultant. Refer to General Requirements section for contract breakdown.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian General Standards Board (CGSB)
 - .1 ASTM C553, Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .2 CGSB 51-GP-52Ma, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
 - .3 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulating Pipes, Vessels and Round Ducts.
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .4 American Society for Testing and Materials (ASTM)
 - .1 ASTM C547, Type I and IV, Standard Specifications for Mineral Fibre Pipe Insulation.
 - .2 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .3 ASTM C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot-Plate Apparatus.
 - .4 ASTM C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - .5 ASTM C 921, Practice for Determining the Properties Jacketing Materials for Thermal Insulation.
 - .6 ASTM C1695, Standard Specification for Fabrication of Flexible, Removable, and Reusable Blanket Insulation for Hot Service.
 - .7 ASTM C1729 Standard Specification for Aluminium Jacketing for Insulation.
- .5 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
 - .1 ASHRAE Standard 90.1.
- .6 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC), North American Commercial and Industrial Insulation Standards.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with general requirements.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves, and jointing recommendations.
- .3 Submit properly completed detail plates from the North American Commercial and Industrial Insulation Standards manual, applicable to installation types required by this specific section.

1.3 INSTALLATION INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with general requirements.
- .2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.4 QUALIFICATIONS

- .1 Installer to have successfully completed apprenticeship program.
- .2 Installer to be specialist in performing work of this section and have at least three (3) years successful experience in this size and type of project, qualified to standards of TIAC.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Protect from weather, construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions required by manufacturer.

1.6 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.

Part 2 Products

2.1 MATERIAL LIMITATIONS

- .1 Products shall not contain formaldehyde, asbestos, lead, mercury or mercury compounds or PBDE fire retardants.

2.2 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.3 INSULATION

- .1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C (75°F) mean temperature when tested in accordance with ASTM C335, ASTM C177 or ASTM C518.
- .3 Type A-1: Rigid moulded or wound mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: to ASTM C547 Type I and IV.
 - .2 Jacket: to ASTM C1136, Type I, II, III, IV, X.
 - .3 Maximum "k" factor: to ASTM C547.
- .4 Materials:
 - .1 All materials must be supplied by the same manufacturer.
 - .2 Acceptable Materials:
 - .1 Johns Manville
 - .2 Knauf
 - .3 Manson
 - .4 Owens Corning

2.4 INSULATION SECUREMENT

- .1 Tape: Self-adhesive, aluminum, reinforced, 50 mm (2") wide minimum.
- .2 Contact adhesive: Quick setting.
- .3 Canvas adhesive: Washable.

2.5 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 Hydraulic setting or Air drying on mineral wool, to ASTM C 449M.

2.6 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

2.7 INDOOR VAPOUR RETARDER FINISH

- .1 Compatible with insulation.

2.8 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 Minimum thickness: 20 mm (0.020")
 - .2 One-piece moulded type [and sheet] to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .3 Colours: white.
 - .4 Minimum service temperatures: -29°C (-20°F).
 - .5 Maximum service temperature: 65°C (150°F).
 - .6 Moisture vapour transmission: 0.05 perm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks are not to be used below ambient temperature (cold) operating systems.
 - .3 Pressure sensitive vinyl tape of matching colour.

2.9 CAULKING FOR JACKETS

- .1 Caulking: Silicone clear caulking.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENT

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed, and certified.
- .2 Surfaces to be clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with TIAC, North American Commercial and Industrial Insulation Standards.
- .2 Apply materials in accordance with manufacturers' instructions and this specification.
- .3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
- .4 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.

- .5 Below ambient/chilled water installation:
 - .1 All pipes, valves, strainers, flanges, unions, and other pipe system components and spec must be properly insulated with correctly completed vapor retarder applied.
 - .2 All insulation material must have properly installed and sealed vapor retarding jacket, including circumferential and longitudinal seams.
 - .3 All penetrations, tears, and punctures must be repaired and sealed with a vapor retarding material with a 0.02 or lower perm rating.
 - .4 Vapor stops must be installed at 18' intervals at all pipe insulation termination points including fittings, flanges, and other changes in direction or other types of piping specialties.
 - .5 All fitting insulation must be of the same type, thickness, and density of the pipe insulation, be premoulded insulation covers or fabricate from the same material as the pipe insulation. Full thickness must be maintained over all fitting surfaces. Blanket insulation with a factory applied vapor retarder facing is unacceptable.
 - .6 A complete vapor retarder must be installed on insulation over fittings before applying final finish. Vapor retarder must extend onto and be sealed to the vapor retarder of the pipe insulation.
 - .7 Additional fitting covers, PVC, or metal must have a vapor retarder seal applied to all longitudinal and circumferential seams in addition to the vapor retarder applied to the fitting insulation.
 - .8 Additional field applied to jackets must not use staples, screws, tacks, or rivets for attachment to avoid puncturing vapor retarder underneath.
 - .9 Insulating support inserts are to be high compressive strength insulation with a rigid shield. No calcium silicate is to be used for insulation on below-ambient operation piping.

3.3 REMOVABLE, PRE-FABRICATED, INSULATION AND ENCLOSURES

- .1 Application: At expansion joints, valves, primary flow measuring elements, flanges, and unions at equipment.
- .2 Flexible removable blanket insulation covers are not acceptable for below-ambient (cold) operation piping systems. Rigid removable insulation jackets that are vapor retarder exterior material, that can be vapor sealed at the seams, are acceptable on below-ambient (cold) operation piping systems.
- .3 Design: To permit movement of expansion joint and to permit periodic removal and replacement without damage to adjacent insulation.
- .4 Insulation:
 - .1 Insulation, fastenings and finishes: same as system.
 - .2 Jacket: As per adjacent insulation.

3.4 INSTALLATION OF ELASTOMERIC INSULATION

- .1 Insulation to remain dry at all times. Overlaps to manufacturers instructions. Ensure tight joints.
- .2 Provide vapour retarder as recommended by manufacturer.

3.5 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges, and fittings unless otherwise specified.
- .2 Install insulator and jackets to applicable TIAC codes.
- .3 Insulate ends of capped piping with type and thickness indicated for capped service.
- .4 Thickness of insulation to be as listed in following table:
 - .1 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.
 - .2 All storm piping including all vertical and horizontal piping shall be insulated.

Application	Type	Pipe sizes through (NPS) and insulation thickness mm (")				
		to 25 (1")	32 (1¼") 40 (1½")	50 (2") 80 (3")	105 (4") 150 (6")	200 (8") & over
Domestic Water Piping	A-1	25 (1")	25 (1")	40 (1½")	40 (1½")	40 (1½")
Exhaust system						
Horizontal Cast Iron	A-1	N/A	N/A	25 (1")	25 (1")	25 (1")
Sanitary Piping						
Trap Primer Piping	A-1	15 (½")	15 (½")	25 (1")		

- .5 Finishes: Conform to the following table:

<u>Application</u>	<u>Piping</u>	<u>Valves & Fittings</u>
Exposed indoors	PVC	PVC
Exposed in mech. rooms	PVC	PVC
Concealed indoors	N/A	PVC

- .6 Connection: To appropriate TIAC code.
- .7 Finish attachments: SS bands, @ 150 mm (6") oc. seals: closed.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ANSI/ASME B16.15, Cast Copper Alloy Threaded Fittings, Classes 125 and 250.
- .3 ANSI B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.
- .4 ANSI/ASME B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.
- .5 ANSI B16.24, Cast Copper Alloy, Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500.
- .6 ASTM B88M, Specification for Seamless Copper Water Tube (Metric).
- .7 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
- .8 MSS-SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
- .9 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.

1.2 SHOP DRAWINGS

- .1 Submit shop drawing data in accordance with general requirements.

1.3 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

Part 2 Products

2.1 PIPING

- .1 Domestic hot, cold and recirculation systems, within building.
 - .1 Above ground: copper tube, hard drawn, type L: to ASTM B88M.

2.2 FITTINGS

- .1 Bronze pipe flanges and flanged fittings, Class 150 and 300: to ANSI B16.24.
- .2 Cast bronze threaded fittings, Class 125 and 250: to ANSI/ASME B16.15.
- .3 Cast copper, solder type: to ANSI B16.18.
- .4 Wrought copper and copper alloy, solder type: to ANSI/ASME B16.22.
- .5 Tee drill NPS 25 mm (1") and larger.
- .6 **NPS 80 mm (3") and larger: roll grooved to CSA B242.**

2.3 JOINTS

- .1 Solder: 95/5.
- .2 Teflon tape: for threaded joints.
- .3 Dielectric connections between dissimilar metals: dielectric fitting to ASTM F1545, complete with thermoplastic liner.
- .4 Tee drill fittings shall be brazed with silver solder, 45% Ag - 15% Cu or copper phosphorous, 95% Cu, 5% P and non-corrosive flux.
- .5 **Rubber gaskets, 1.5 mm (16 gauge) thick: to ANSI/AWWA C111/A21.11.**
- .6 **Bolts, nuts, hex head and washers: to ASTM A307, heavy series.**
- .7 **Grooved couplings: designed with angle bolt pads to provide rigid joint, complete with EPDM flush seal gasket.**

2.4 VALVES

- .1 All valves shall be of commercial grade and of same manufacturer, Lead-Free.
- .2 Acceptable materials:
Milwaukee
Crane
Kitz

2.5 BALL VALVES

- .1 All valves shall be of commercial grade and of same manufacturer.
- .2 NPS 80 mm (3") and under, soldered:
 - .1 To ANSI B16.18, Class 150.
 - .2 Bronze body, full port stainless steel ball, PTFE Teflon adjustable packing, brass gland and PTFE Teflon seat, steel lever handle, with NPT to copper adaptors.

2.6 GATE VALVES

- .1 NPS 50 mm (2") and under, soldered:
 - .1 Rising stem: to MSS SP-80, Class 125, 860 kPa (125 psi), bronze body, screw-in bonnet, solid wedge disc.
- .2 NPS 50 mm (2") and under, screwed:
 - .1 Rising stem: to MSS SP-80, Class 125, 860 kPa (125 psi), bronze body, screw-in bonnet, solid wedge disc.
- .3 NPS 65 mm (2-1/2") and over, in mechanical rooms, flanged:
 - .1 Rising stem: to MSS SP-70, Class 125, 860 kPa (125 psi), flat flange faces, cast-iron body, OS&Y bronze trim.
- .4 NPS 65 mm (2-1/2") and over, other than mechanical rooms, flanged:
 - .1 Non-rising stem: to MSS SP-70, Class 125, 860 kPa (125 psi), flat flange faces, cast-iron body, bronze trim, bolted bonnet.

2.7 GLOBE VALVES

- .1 NPS 50 mm (2") and under, soldered:
 - .1 To MSS SP-80, Class 125, 860 kPa (125 psi), bronze body, renewable composition disc, screwed over bonnet.
 - .2 Lockshield handles: as indicated.
- .2 NPS 50 mm (2") and under, screwed:
 - .1 To MSS SP-80, Class 150, 1.03 MPa (150 psi), bronze body, screwed over bonnet, renewable composition disc.
 - .2 Lockshield handles: as indicated.

2.8 SWING CHECK VALVES

- .1 NPS 50 mm (2") and under, soldered:
 - .1 To MSS SP-80, Class 125, 860 kPa (125 psi), bronze body, bronze swing disc, screw in cap, regrindable seat.
- .2 NPS 50 mm (2") and under, screwed:
 - .1 To MSS SP-80, Class 125, 860 kPa (125 psi), bronze body, bronze swing disc, screw in cap, regrindable seat.
- .3 NPS 65 mm (2 1/2") and over, flanged:
 - .1 To MSS SP-71, Class 125, 860 kPa (125 psi), cast iron body, flat flange faces, [regrind] [renewable] seat, bronze disc, bolted cap.

2.9 BUTTERFLY VALVES

- .1 Provide copper tubing grooved valves where indicated.
- .2 NPS 100 mm (4") and over:
 - .1 Bronze body per CDA-836.
 - .2 EPDM/Bronze disk and trim.
 - .3 Two position handle.
- .3 Acceptable material:
Victaulic Series 608

2.10 BALANCING VALVES

- .1 Provide brass balancing valves suitable for potable water.
- .2 Brass body, EDPM O-Ring, Polytetrafluoroethylene slip washer and stainless steel spring.
- .3 Connect with dielectric connections.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.
- .2 Cut square, ream and clean tubing and tube ends, clean recesses of fittings and assemble without binding.
- .3 Assemble all piping using fittings manufactured to ANSI standards.
- .4 Install tubing close to building structure to minimize furring, conserve headroom and space. Group exposed piping and run parallel to walls.
- .5 Install CWS piping below and away from HWS and HWC and all other hot piping so as to maintain temperature of cold water as low as possible.
- .6 Connect to fixtures and equipment in accordance with manufacturers instructions unless otherwise indicated.
- .7 Bent tubing is not acceptable.

3.2 VALVES

- .1 Isolate equipment, fixtures and branches with ball valves.
- .2 Balance recirculation system using lockshield globe valves. Mark settings and record on as-built drawings on completion.

3.3 PRESSURE TESTS

- .1 Conform to requirements of general requirements.
- .2 Test pressure: greater of 1½ times maximum system operating pressure or 860 kPa (125 psi).

3.4 FLUSHING AND DISINFECTING

- .1 Maintain testable RP backflow preventor between municipal water and new plumbing system.
- .2 Ensure a minimum of 90% of plumbing fixtures are installed.
- .3 Flush water mains through available outlets with a sufficient flow of potable water to produce a velocity of 1.5 m/s, within pipe for 10 min, or until foreign materials have been removed and flushed water is clear with backflow protection.
- .4 Provide connections and pumps for flushing as required.
- .5 Open and close valves, and operate fixtures to ensure thorough flushing.
- .6 When flushing has been complete to satisfaction of Consultant introduce a strong solution of Chlorine into water system and ensure that it is distributed throughout entire system.
- .7 Rate of chlorine application to be proportional to rate of water entering pipe.

- .8 Chlorine injection to be close to point of filling water main or at building water service and to occur simultaneously.
- .9 Confirm adequate chlorine residual not less than 50 ppm has been obtained, leave system charged with chlorine solution for 24 h. After 24 h, further samples shall be taken to ensure that there is still not less than 10 ppm of chlorine residual remaining throughout system.
- .10 Upon 10 ppm confirmation and 24 hr elapsed time flush line to remove chlorine solution.
- .11 Measure chlorine residuals at extreme end of pipe-line being tested.
- .12 Perform bacteriological tests on water main, after chlorine solution has been flushed out. Take samples daily for minimum of two days. Should contamination remain or reoccur during this period, repeat disinfecting procedure. Specialist contractor shall submit certified copy of test results.
- .13 Take water samples at remote fixtures and service connections.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
- .3 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
- .4 PDI-WH201, Water Hammer Arresters.
- .5 CAN/CSA-B64 Series, Backflow Preventers and Vacuum Breakers.

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 For shop drawings, indicate dimensions, construction details and materials.
- .3 For product data, indicate dimensions, construction details and materials for all items specified herein.

1.3 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in general requirements.
- .2 Data to include:
 - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year and capacity.
 - .2 Details of operation, servicing and maintenance.
 - .3 Recommended spare parts list.

Part 2 Products

2.1 INTERIOR HOSE BIBB

- .1 20 mm (3/4") diameter brass construction, 200 psi, 180°F pressure and temperature limits, complete with hose connection, and wheel handle straight/angle pattern to suit.
- .2 Provide vacuum breaker complete with hose connection.
- .3 Acceptable manufacturers:
 - Exposed on wall; Watts BD series
 - Surface mounted (piping in wall); Watts SC-3 series
 - Delta
 - Waltec
 - Wilkins
 - Emco

2.2 WATER HAMMER ARRESTORS

- .1 Copper construction, bellows type: to PDI-WH 201.
- .2 Acceptable material:
Zurn Z-1700
Mifab MWH-100
Ancon No. 15

2.3 BACK FLOW PREVENTORS

- .1 The backflow preventor shall prevent backflow by either backpressure or backsiphonage from a cross-connection between potable water lines and substances that are objectionable.
- .2 To CAN/CSA-B64.
- .3 Application: as indicated.
- .4 Reduced pressure principle type up to 50 mm (2") (RP):
Rated to 180°F and supplied with full port ball valves. The main body and access covers shall be bronze (ASTM B584), the seat ring and all internal polymers shall be NSF® Listed Noryl™ and the seat disc elastomers shall be SILICONE. The first and second check shall be orientated at a 45° angle up-wards and accessible for maintenance without removing the relief valve. Supplied with an air gap adapter.
 - .1 Acceptable materials:
Watts 009 ½" - 2"
Wilkins 975 XL ½" - 2"
Conbraco 40-200 Series
- .5 Reduced pressure principle type from 65 mm (2½") to 250 mm (10") (RP):
The reduced pressure principle backflow preventer shall be ASSE 1013 approved, and supplied with full port gate valves. The main body and access covers shall be epoxy coated cast iron (ASTM A126 Class B), the seat ring and check valve shall be cast bronze (ASTM B584), the stem shall be stainless steel (ASTM A276) and the seat disc elastomers shall be EPDM. The first and second checks shall be accessible for maintenance without removing the relief valve or the entire device from the line.
If installed indoors, the installation shall be supplied with an air gap adapter, strainer, and integral monitor switch.
 - .1 Acceptable materials:
Watts 909 2½" - 10"
Wilkins 975 2½"- 10" or 375 4"- 6"
Conbraco 40-200 Series

- .6 Double check valve assembly (DCVA):
The double check type backflow preventer shall be ASSE 1015 approved, and supplied with full port ball valves. The main body and access covers shall be bronze (ASTM B584), the seat rings and all internal polymers shall be NSF® Listed Noryl™ and the seat disc elastomers shall be silicone. The first and second checks shall be accessible for maintenance without removing the device from the line.
 - .1 Acceptable materials:
Watts 007 ½" - 2"
Wilkins 950XL ¾" - 2"
Conbraco 40-100 Series
- .7 Double check valve assembly (DCVA)
The double check backflow preventer shall be ASSE 1015 approved, and supplied with full port gate valves. The main body and access covers shall be epoxy coated cast iron (ASTM A126 Class B), the seat ring and check valve shall be cast bronze (ASTM B584), the stem shall be stainless steel (ASTM A276) and the seat disc elastomers shall be EPDM. The checks shall be accessible for maintenance without removing the device from the line.
 - .1 Acceptable materials:
Watts 709 2½" - 10"
Wilkins 950 2" - 10", 350 4" - 6"
Conbraco 40-100 Series
- .8 Back flow preventor with intermediate atmospheric vent:
 - .1 Acceptable material:
Watts Series 9D
Wilkins 750
Conbraco 40-4A Series

2.4 VACUUM BREAKERS

- .1 To CAN/CSA-B64 Series.
- .2 Atmospheric vacuum breaker (A-VB):
 - .1 Acceptable materials:
Watts 288A
Conbraco 38-103 Series
Wilkins 35
- .3 Hose connection vacuum breaker (HCVB):
 - .1 Acceptable materials:
Watts Series 8
Conbraco 38-304-AS
Wilkins BFP-8
- .4 Laboratory faucet intermediate vacuum breaker (LFVB):
 - .1 Acceptable materials:
Watts N-LF9
Conbraco 38-502-01

2.5 HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Bronze construction complete with integral back flow preventer, hose thread spout, replaceable composition disc, and chrome plated in finished areas.
 - .1 Acceptable materials:
 - Watts BD series
 - Emco
 - Chicago
 - Zurn

2.6 STRAINERS

- .1 860 kPa (125 psi), Y type with 20 mm (3/4") mesh, bronze or stainless steel removable screen.
- .2 NPS 50 mm (2") and under, bronze body, screwed ends, with brass cap.
 - .1 Acceptable materials:
 - Watts Series 777SI
 - Crane/Powers
 - Colton 125 YTB
 - Wilkins S Series
- .3 NPS 65 mm (2½") and over, cast iron body, flanged ends, with bolted cap.
 - .1 Acceptable materials:
 - Watts 77F-D (77F-D-FDA for water service)
 - Crane/Powers
 - Colton 125 YTB
 - Wilkins FS Series

2.7 SOLENOID VALVES

- .1 Two (2) way normally closed all bronze construction.
- .2 Voltage shall be suitable for controlling function.
- .3 Acceptable material:
 - Asco

2.8 OWNER SUPPLIED EQUIPMENT

- .1 The mechanical contractor shall supply and install all water, gas, condensate and sanitary piping to the owner supplied equipment. Connection to equipment shall be by this contractor.
- .2 Provide flexible riser stops to all sinks and ball valves to all other equipment.
- .3 Provide backflow preventors on equipment required by the local plumbing inspector.
- .4 Provide flexible gas piping to all gas equipment.

- .5 All equipment in store equipment schedule will be supplied and set in place by Mechanical Contractor unless otherwise noted.
- .6 Coordinate all rough-ins and connection with the supplier on site.
- .7 Owner supplied equipment includes existing relocated equipment.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with provincial codes, and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.2 WATER HAMMER ARRESTORS

- .1 Install on branch supplies to each fixture or group of fixtures and where indicated.

3.3 BACK FLOW PREVENTORS

- .1 Install in accordance with CAN/CSA-B64 Series, where indicated and elsewhere as required by code.
- .2 Pipe discharge to terminate over nearest drain and or service sink.
- .3 Provide test results in manual and leave tag with test results on device.

3.4 HOSE BIBBS AND SEDIMENT FAUCETS

- .1 Install at bottom of all risers, at low points to drain systems, and as indicated.

3.5 STRAINERS

- .1 Install with sufficient room to remove basket.
- .2 Strainer size to match pipe size.

3.6 COMMISSIONING

- .1 In context of this paragraph, "verify" to include "demonstrate" to Consultant.
- .2 Timing: commission only after start-up deficiencies rectified.
- .3 Access doors: verify size and location relative to items to be services.
- .4 Adjust to suit site conditions, including, but not necessarily limited to, following:
 - .1 Water hammer arrestors:
 - .1 Verify accessibility.
 - .2 Backflow preventors, vacuum breakers:
 - .1 Verify installation of correct type to suit application.
 - .2 Adjust as necessary to ensure proper operation.
 - .3 Verify visibility of discharge.

- .3 Pressure regulators:
 - .1 Adjust settings to suit installed locations, required flow rates.
- .4 Hose bibbs, sediment faucets:
 - .1 Verify operation.
- .5 Water make-up assembly:
 - .1 Verify operation.
- .6 Water meters:
 - .1 Verify operation.
- .7 Pipeline strainers:
 - .1 Verify accessibility of basket.
 - .2 Clean out during commissioning until system clean.
- .5 Commissioning reports:
 - .1 Record all results on approved report forms.
 - .2 Include signature of tester and supervisor.
 - .3 To be countersigned by Consultant.
- .6 Verification:
 - .1 Notify Consultant 48 h before commencing tests.
 - .2 All tests and procedures to be witnessed by Consultant.
 - .3 All reported results subject to verification by consultant.
- .7 Training:
 - .1 Train O&M personnel in start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
- .8 Demonstrations:
 - .1 Demonstrate full compliance with Design Criteria.
 - .2 Demonstrations also to show completeness of O&M personnel training.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ASTM A126, Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings.
- .3 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
- .4 CAN/CSA-B79, Commercial and Residential Drains and Cleanouts.

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 For shop drawings, indicate dimensions, construction details and materials.
- .3 For product data, indicate dimensions, construction details and materials for all items specified herein.

1.3 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in general requirements.
- .2 Data to include:
 - .1 Description of plumbing specialties and accessories, giving manufacturers name, type, model, year, and capacity.
 - .2 Details of operation, servicing, and maintenance.
 - .3 Recommended spare parts list.

Part 2 Products

2.1 FLOOR DRAINS

- .1 Floor drains and trench drains: to CAN/CSA-B79.
- .2 Provide floor drains as per schedule on drawings.

2.2 CLEANOUTS

- .1 Cleanout plugs: heavy cast iron male ferrule with brass screws and threaded brass or bronze plug. Sealing-caulked lead seat or neoprene gasket.
- .2 Wall access: face or wall type, stainless steel round cover with flush head securing screws, bevelled edge frame complete with anchoring lugs.
 - .1 Acceptable material:
Zurn ZSS-1469
Mifab C1400-RD
Watts CO-480-RD-3
Jay R. Smith 4710

- .3 Floor access: rectangular, round, as indicated, cast iron body and frame with adjustable secured 15 mm ($\frac{1}{2}$ ") thick flush mounted heavy duty nickel bronze top and:
Plugs: bolted bronze with neoprene gasket.
 - .1 Cover for unfinished concrete floors: nickel bronze round, gasket, vandal-proof screws.
 - .1 Acceptable material:
Zurn ZN-1400 – HD or Zurn ZNX-1612
Mifab C1100-XR-6
Watts CO-200-RX-1-6
Jay R. Smith SQ-4-1753-XNBCO-SP-U
 - .2 Cover for terrazzo finish: round polished nickel bronze with recessed cover for filling with terrazzo, vandal-proof locking screws.
 - .1 Acceptable materials:
Zurn ZN-1400-Z
Mifab C1100-UR-6
Watts CO-200-U-1-6
Jay R. Smith SQ-4-1753-NBRT-SP-U
 - .3 Cover for VCT tile and linoleum floors: square polished nickel bronze with 15 mm ($\frac{1}{2}$ ") thick flush mounted heavy duty nickel bronze cover, complete with vandal-proof locking screws.
 - .1 Acceptable materials:
Zurn ZN-1400-T – HD
Mifab C1100-TS-6
Watts CO-200-TS-1-6
Jay R. Smith 4200-U
 - .4 Cover for ceramic tile floors: 15 mm ($\frac{1}{2}$ ") thick heavy duty nickel bronze square, cover complete with gasket, vandal-proof screws, for flush finish.
 - .1 Acceptable material:
Zurn ZN-1400 – T-HD or Zurn ZNX-1612
Mifab C1100-S-6
Watts CO-200-S-1-6
Jay R. Smith SQ-4-1753-NBCO-SP-U-Y
 - .5 Cover for carpeted floors: round polished nickel bronze with flush cover, complete with stainless steel carpet marker, vandal-proof locking screws.
 - .1 Acceptable materials:
Zurn ZN-1400-HD-CM or ZN-1612-CM
Mifab C1100C-S-1-6
Ancon CO-200-RC-1-6
Smith
Contour C3000RMNB

2.3 TRAP SEAL PRIMER STATIONS

- .1 Provide trap primer stations where indicated complete with solenoid valve, backflow preventor, vacuum breaker, NPS 15 mm (1/2") solder ends, NPS 15 mm (1/2") drip line connections.
- .2 Solenoid valve electric characteristics shall be suitable for controlling function.
- .3 Coordinate location and number of trap primer stations with Building Automation System (BAS) contractor.

2.4 SOLENOID VALVES (HEADER TRAP SEAL PRIMER)

- .1 Two (2) way normal closed all bronze construction.
- .2 With integral adjustable cycle time clock control. Timer control to have two dial functions, time between cycles and time held in "open position".
- .3 Suitable for 120V.
- .4 Acceptable material:
Asco

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with provincial codes, and local authority having jurisdiction.
- .2 Install in accordance with manufacturer's instructions and as specified.

3.2 CLEANOUTS

- .1 In addition to those required by code, and as indicated, install at base of all soil and waste stacks.
- .2 Bring cleanouts to wall or finished floor unless serviceable from below floor.
- .3 Building drain cleanout and stack base cleanouts: line size to maximum NPS 100 mm (4").

3.3 TRAP SEAL PRIMER STATIONS

- .1 Provide primer stations where indicated.
- .2 Install for all floor drains and elsewhere, as indicated.
- .3 Install copper piping to floor drains above grade. Install polypropylene piping to floor drains on grade.

3.4 COMMISSIONING

- .1 In context of this paragraph, "verify" to include "demonstrate" to Consultant.
- .2 Timing: commission only after start-up deficiencies rectified.
- .3 Access doors: verify size and location relative to items to be services.

- .4 Adjust to suit site conditions, including, but not necessarily limited to, following:
 - .1 Floor, hub and trench drains:
 - .1 Verify proper operation of trap primer, flushing features.
 - .2 Verify security and removability of strainers.
 - .2 Cleanouts:
 - .1 Verify covers are gastight, secure and easily removable.
 - .2 Verify that cleanout rods can probe as far as next cleanout.
 - .3 Trap seal primers:
 - .1 Verify operation.
 - .2 Adjust flow rate to suit site conditions.
 - .4 Acid dilution devices:
 - .1 Verify operation.
- .5 Commissioning reports:
 - .1 Record all results on approved report forms.
 - .2 Include signature of tester and supervisor.
 - .3 To be countersigned by Consultant.
- .6 Verification:
 - .1 Notify Consultant 48 h before commencing tests.
 - .2 All tests and procedures to be witnessed by Consultant.
 - .3 All reported results subject to verification by consultant.
- .7 Training:
 - .1 Train O&M personnel in start-up, operation, monitoring, servicing, maintenance and shut-down procedures.
- .8 Demonstrations:
 - .1 Demonstrate full compliance with Design Criteria.
 - .2 Demonstrations also to show completeness of O&M personnel training.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ASTM B32, Specification for Solder Metal.
- .3 ASTM B306, Specification for Copper Drainage Tube (DWV).
- .4 ASTM C564, Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.
- .5 CAN/CSA-B70, Cast Iron Soil Pipe, Fittings and Means of Joining.
- .6 CAN/CSA-B125.3, Plumbing Fittings.

Part 2 Products

2.1 COPPER TUBE AND FITTINGS

- .1 Above ground sanitary, and vent, maximum 65 mm (2½") Type DWV copper to: ASTM B306.
 - .1 Fittings.
 - .1 Cast brass: to CAN/CSA B125.3.
 - .2 Wrought copper: to CAN/CSA B125.3.
 - .2 Solder: tin-lead, 50:50, to ASTM B32, type 50A.

2.2 CAST IRON PIPING AND FITTINGS

- .1 Above ground sanitary, and vent, minimum NPS 80 mm (3"), cast iron to: CAN/CSA-B70.
 - .1 Mechanical joints (vents)
 - .1 Neoprene or butyl rubber compression gaskets: to ASTM C564 or CAN/CSA-B70.
 - .2 Stainless steel clamps (2 band).
 - .2 Mechanical joints (sanitary)
 - .1 Heavy duty neoprene or butyl rubber compression gaskets to: ASTM C1540.
 - .2 Stainless steel clamps (4 band min).

2.3 VENT FLASHINGS

- .1 Thaler or equal spun aluminum complete with insulation, cap, and rubber gasket.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction.
- .2 Install above ground piping parallel and close to walls and ceilings to conserve headroom and space, and to grade as indicated.
- .3 Place Cleanouts
 - .1 Where shown on Drawings and near bottom of each stack and riser.
 - .2 At every 90 degree change of direction for horizontal lines.
 - .3 Every 15 m (50') of horizontal run.
 - .4 Extend clean out to accessible surface. Do not place cleanouts in carpeted floors. In such locations, use wall type cleanouts.
- .4 Each fixture and appliance discharging water into sanitary sewer or building sewer lines shall have a seal trap in connection with a complete venting system so gases pass freely to atmosphere with no pressure or syphon condition on water seal.
- .5 Vent entire waste system to atmosphere.
 - .1 Discharge 500 mm (20") above roof. Join lines together in fewest practicable number before projecting above roof.
 - .2 Set back vent lines so they will not pierce roof near an edge or valley.
 - .3 Venting shall be 7.5 m (25'-0") from any outdoor air intakes.
 - .4 Provide copper vent piping through roof as per detail.
- .6 Use torque wrench to obtain proper tension in cinch bands when using hubless cast iron pipe. Butt ends of pipe against centering flange of coupling.
- .7 Flash pipes passing through roof with 453 g (16 oz) sheet copper flashing fitted snugly around pipes and caulk between flashing and pipe with flexible waterproof compound.
 - .1 Flashing base shall be at least 600 mm (24") square.
 - .2 Flashing may be a 24 kg/m² (5 lb/ft²) lead flashing fitted around pipes and turned down into pipe 15 mm (½") with turned edge hammered against pipe wall.
- .8 Before piping is covered, conduct tests in presence of Consultant and correct leaks or defective work. Conduct test prior to placing floor slab but after backfill is placed.
 - .1 Do not caulk threaded work.
 - .2 Fill waste and vent system to roof level [a minimum of 3,100 mm - (10')] with water and show no leaks for 2 hours.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ASTM D2235, Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
- .3 ASTM D2564, Specification for Solvent Cements for Poly (Vinyl-Chloride) (PVC) Plastic Piping Systems.
- .4 CAN/CSA-B181.1, ABS Drain, Waste and Vent Pipe and Pipe Fittings.
- .5 CAN/CSA-B181.2, PVC and CPVC Drain, Waste and Vent Pipe and Pipe Fittings.
- .6 CAN/CSA-B182.1, Plastic Drain and Sewer Pipe and Pipe Fittings.

Part 2 Products

2.1 PIPING AND FITTINGS

- .1 Buried sanitary, and vent piping to:
 - .1 80 mm (3") and smaller: ABS drain waste and vent pipe to CAN/CSA-B181.1.
 - .2 100 mm (4") and larger: SDR-35 PVC drain waste and vent pipe to CAN/CSA-B181.2.
 - .3 Vent piping: any size, PVC-DWV plastic drain and sewer pipe and fittings CAN/CSA-B181.2.
- .2 Above grade sanitary and vent piping:
 - .1 80 mm (3") and smaller: IPEX: PVC-XFR drain waste and vent pipe to CAN/CSA-B181.2.
 - .2 100 mm (4") and larger: IPEX: PVC-XFR drain waste and vent pipe to CAN/CSA-B181.2.
 - .3 Vent piping: any size, IPEX: PVC-XFR plastic drain and sewer pipe and fittings CAN/CSA-B181.2.
- .3 Use plastic XFR – DWV in pipe chase for urinal piping to 1.5 M (5' –0") above finished floor.
- .4 Where piping pierces a fire separation an approved fire stop system to the approval of authority having jurisdiction shall be used.

2.2 JOINTS

- .1 Solvent weld for PVC: to ASTM D2564.
- .2 Solvent weld for ABS: to ASTM D2235.

2.3 EXPANSION

- .1 Provide solvent welded expansion joints as required by manufacturer's recommendations.

2.4 VENT FLASHINGS

- .1 Thaler Stack Jack spun aluminum complete with insulation, cap, and rubber gasket.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with Provincial Plumbing Code and local authority having jurisdiction. Install in accordance with manufacturer's instructions.
- .2 Installation of underground pipe
 - .1 Provide all excavation, bedding, backfill, and compaction.
 - .2 Install materials in accordance with Manufacturer's instructions.
 - .3 Use jacks to make-up gasketed joints.
 - .4 Stabilize unstable trench bottoms.
 - .5 Bed pipe true to line and grade with continuous support from firm base.
 - .1 Bedding depth - 100 mm to 150 mm (4" to 6").
 - .2 Material and compaction to meet ASTM standard noted above.
 - .6 Excavate bell holes into bedding material so pipe is uniformly supported along its entire length. Blocking to grade pipe is forbidden.
 - .7 Trench width at top of pipe -
 - .1 Minimum 450 mm (18") or diameter of pipe plus 300 mm (12"), whichever is greater.
 - .2 Maximum - Outside diameter of pipe plus 600 mm (24").
 - .8 Piping and joints shall be clean and installed according to manufacturer's recommendations. Break down contaminated joints, clean seats and gaskets and reinstall.
 - .9 Do not use back hoe or power equipment to assemble pipe.
 - .10 Initial backfill shall be 300 mm (12") above top of pipe with material specified in referenced ASTM standard.
- .3 Place Cleanouts
 - .1 Where shown on Drawings and near bottom of each stack and riser.
 - .2 At every 90 degree change of direction for horizontal lines.
 - .3 Every 15 m (50 ft) of horizontal run.
 - .4 Extend clean out to accessible surface. Do not place cleanouts in carpeted floors. In such locations, use wall type cleanouts

- .4 Each fixture and appliance discharging water into sanitary sewer or building sewer lines shall have a seal trap in connection with a complete venting system so gases pass freely to atmosphere with no pressure or syphon condition on water seal.
- .5 Before piping is covered, conduct tests in presence of Consultant and correct leaks or defective work. Conduct test prior to placing floor slab but after backfill is placed.
 - .1 Fill waste and vent system a minimum of 1.8 m (6 ft) above finished floor with water and show no leaks for 2 hours.
 - .2 Conduct ball test in presence of consultant to ensure proper grade and clear of obstructions.
- .6 Install solvent welded expansion joints as per manufacturer's recommendation. Care is to taken to accommodate ambient temperatures at time of install.
- .7 **Vent entire waste system to atmosphere.**
 - .1 **Discharge 350 mm (14") above roof. Join lines together in fewest practicable number before projecting above roof.**
 - .2 **Set back vent lines so they will not pierce roof near an edge or valley.**
 - .3 **Venting shall be 7.5 m (25'-0") from any outdoor air intakes.**
- .8 **Flash pipes passing through roof with Thaler insulated Stack Jack flashing.**
 - .1 **Flashing base shall be at least 600 mm (24") square.**
- .9 **Install above ground piping parallel and close to walls and ceilings to conserve headroom and space, and to grade as indicated.**

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with general requirements.
- .2 Indicate:
 - .1 Equipment, including connections, fittings, control assemblies and ancillaries, identifying factory and field assembled.
 - .2 Wiring and schematic diagrams.
 - .3 Dimensions and recommended installation.
 - .4 Pump performance and efficiency curves.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance and engineering data for incorporation into manual specified in general requirements
- .2 Data to include:
 - .1 Manufacturer's name, type, model year, capacity, and serial number.
 - .2 Details of operation, servicing, and maintenance.
- .3 Recommended spare parts list with names and addresses.

Part 2 Products

2.1 THERMOSTATIC WATER CONTROLLER (3 Port)

- .1 3/4" inlets 1" outlets thermostatic controller with swivel action check stops, removable cartridge with strainer, stainless steel piston and liquid fill thermal motor with bellows mounted out of water. Volume control shut off valve, bimetal dial thermometer (3" face, range 20° – 240°F), brass pipe, fittings and unions. Standard valve and piping finish is rough bronze.
- .2 Acceptable materials:
Symmons 7-400A-ASB-W
Powers

2.2 ANCHOR BOLTS AND TEMPLATES

- .1 Supply for installation by other Divisions.

END OF SECTION

Part 1 General

1.1 GENERAL REQUIREMENTS

- .1 Conform to Sections of Division 1 and to General Mechanical Requirements Section.

1.2 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Perform work in accordance with the recommendations of and the requirements of:
 - .1 Local and district bylaws and regulations.
 - .2 N.F.P.A.14 "Installation of Standpipe and Hose Systems".
 - .3 The Ontario Building Code.
 - .4 U.L.C. or Factory Mutual approval for hose, valve and extinguisher requirements.
 - .5 N.F.P.A.10 "Standard for Portable Fire Extinguishers".
 - .6 The Ontario Fire Code.

1.3 SUBMITTALS

- .1 Submit shop drawings and maintenance data in accordance with general requirements.

1.4 COORDINATION

- .1 Confirm fire extinguisher cabinet locations and quantities from both architectural and mechanical drawings and report any discrepancies to consultant prior to bid close.
- .2 Coordinate location of cabinet with other trades and provide protection against damage during construction.

Part 2 Products

2.1 MULTI-PURPOSE DRY CHEMICAL EXTINGUISHERS (CLASS ABC)

- .1 Stored pressure rechargeable type with hose and shut off nozzle, ULC labelled for A, B and C class protection as indicated. Size of extinguishers shall be as follows:
 - .1 Kitchen Type 'K' 10 lb 20BC rating
 - .2 Servery Areas Type 'K' 10 lb 20 BC rating
 - .3 Mechanical Rooms 10 lb ABC rating
 - .4 Storage Rooms 10 lb ABC rating
 - .5 Corridor/Gym/Finished Areas 5 lb ABC rating complete with cabinet
 - .6 Acceptable materials:
 - .1 Wilson & Cousins
 - .2 National

2.2 CABINETS

- .1 Recessed mounted type of a size sufficient to contain all necessary components. Tub to be constructed of 1.5 mm (16 gauge) steel and finished with Wilco "Pro-Tech" Premier white painted finish. Adjustable frame comprising of 180° opening door and trim to be separate assembly adaptable to any type of finished wall. Trim to have 6 mm (1/4") return on outer edges with full length semi-concealed piano hinge, and Corbin style latching device.
- .2 Doors and trim to be 1.5 mm (16 gauge) white painted finish. Door glass to be 6 mm (1/4") Duo Lite Safety Glass.
- .3 Cabinet to maintain fire resistive rating of construction in which they occur.
- .4 Do not provide cabinets for mechanical room and service area fire extinguishers unless indicated.
- .5 Acceptable material:
 - .1 Wilson & Cousins Model IE - 105R (5 and 10 lb. Class)
 - .2 National

2.3 IDENTIFICATION

- .1 Identify extinguishers in accordance with recommendations of NFPA 10.
- .2 Attach tag or label to extinguishers indicating month and year of installation and provide space for the addition of recording service dates.

Part 3 Execution

3.1 INSTALLATION

- .1 Provide portable fire extinguisher cabinets and mount in wall during construction. Cabinet to be surface or recessed mounted as indicated on the drawings. Install cabinets so that the door will not obstruct normal traffic when open.
- .2 Hang extinguishers in cabinets with wall mounting bracket.
- .3 Prior to installing the extinguisher cabinets, confirm the mounting height and exact location with the Consultant. Mount extinguisher so top of unit is not more than 1.5 m (5').
- .4 Install wall mounted fire extinguishers complete with wall mounting bracket where indicated and/or directed on site by consultant.
- .5 Caulk perimeter of fire extinguisher cabinets after acceptance.

3.2 TESTS

- .1 Fire protection equipment shall be tested to the requirements of NFPA10, NFPA13, NFPA14 and comply with the requirements of the authorities having jurisdiction.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 CAN/CSA B45S1, Supplement #1 to CAN/CSA B-45 Series Plumbing Fixtures.
- .3 CAN/CSA-B45 Series, CSA Standards on Plumbing Fixtures.
- .4 CAN/CSA-B125.3, Plumbing Fittings.
- .5 CAN/CSA-B651, Accessible Design for the Built Environment.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 Indicate, for all fixtures and trim:
 - .1 Dimensions, construction details, roughing-in dimensions.
 - .2 Factory-set water consumption per flush at recommended pressure.
 - .3 For water closets, urinals: minimum pressure required for flushing.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data including monitoring requirements for incorporation into manual specified in general requirements.
- .2 Include:
 - .1 Description of fixtures and trim, giving manufacturer's name, type, model, year, capacity.
 - .2 Details of operation, servicing, maintenance.
 - .3 List of recommended spare parts.

1.4 PRODUCTS INSTALLED BUT NOT SUPPLIED UNDER THIS SECTION

- .1 Install rough-in for equipment supplied by others, complete with valves on hot and cold water supplies, waste and vent.
- .2 Equipment installed by others.
 - .1 Connect with unions.
- .3 Equipment not installed.
 - .1 Capped with valves for future connection by others.

Part 2 Products

2.1 MANUFACTURED UNITS

- .1 Fixtures: manufacture in accordance with CAN/CSA-B45 series.
- .2 Trim, fittings: manufacture in accordance with CAN/CSA-B125.3.
- .3 Exposed plumbing brass to be chrome plated.
- .4 Number, locations: Architectural drawings to govern.
- .5 Fixtures in any one location to be product of one manufacturer and of same type.
- .6 Trim in any one location to be product of one manufacturer and of same type.

2.2 FIXTURE CARRIERS

- .1 Provide factory manufactured floor-mounted carrier systems for all wall-mounted fixtures.
- .2 Acceptable materials:
 - .1 Zurn
 - .2 Smith
 - .3 Ancon

2.3 PLUMBING FIXTURES

- .1 Refer to plumbing fixture schedule on the drawings for fixture type, manufacturer, trim, drainage supply, and accessories.

2.4 FIXTURE PIPING

- .1 Hot and cold water supplies to each fixture/faucet:

Chrome plated flexible supply pipes each with screwdriver stop, reducers, escutcheon and chrome plated nipple.

 - .1 Acceptable materials:
 - .1 Delta 47T900 Series
 - .2 McGuire
- .2 Waste:

Open grid strainer, or pop up as indicated, offset open grid strainer on Barrier-Free fixtures, cast brass fittings with tubular piping, chrome plated, rubber gasket compression fitting, and overflow flange.

 - .1 Acceptable materials:
 - .1 Delta 33T200 Series
 - .2 McGuire

- .3 'P' Traps:
 - Cast brass P trap with cleanout on each fixture not having integral trap.
 - Chrome plated in all exposed places.
- .1 Acceptable materials:
 - .1 Delta 33T300 Series
 - .2 McQuire

Part 3 Execution

3.1 INSTALLATION

- .1 Mounting heights:
 - .1 Standard: to comply with manufacturer's recommendations unless otherwise indicated or specified. Confirm mounting height(s) with consultant prior to rough-in.
 - .2 Wall-hung fixtures: measured from finished floor.
 - .3 Physically Barrier-Free: to comply with most stringent of either NBCC or CAN/CSA B651.
- .2 Drinking fountains:
 - .1 In accordance with CAN/CSA B45S1.

3.2 ADJUSTING

- .1 Conform to water conservation requirements specified this section.
- .2 Adjustments.
 - .1 Adjust water flow rate to design flow rates.
 - .2 Adjust pressure to fixtures to ensure no splashing at maximum pressures.
 - .3 Adjust flush valves to suit actual site conditions.
 - .4 Adjust urinal flush timing mechanisms.
 - .5 Adjust water cooler, drinking fountain flow stream to ensure no spillage.
 - .6 Automatic flush valves for water closets and urinals: set controls to prevent unnecessary flush cycles during silent hours.
- .3 Checks.
 - .1 Water closets, urinals: flushing action.
 - .2 Aerators: operation, cleanliness.
 - .3 Vacuum breakers, backflow preventors: operation under all conditions.
 - .4 Wash fountains: operation of flow-actuating devices.
 - .5 Refrigerated water coolers: operation, temperature settings.

- .4 Thermostatic controls.
 - .1 Verify temperature settings, operation of control, limit and safety controls.
- .5 Floor and wall mounted fixtures: caulk to floor or wall using silicone caulking to make water tight, colour to match fixture.
- .6 Counter mounted fixtures: lay fixtures into bead of caulking to ensure excess moisture does not reach the cut edge of the countertop. Clean excess caulking off outside the sink.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ANSI/ASME B31.1, Power Piping.
- .3 ANSI/ASME Boiler and Pressure Vessel Code:
 - .1 Section 1: Power Boilers.
 - .2 Section V: Nondestructive Examination.
 - .3 Section IX: Welding and Brazing Qualifications.
- .4 CSA W47.2, Certification of Companies for Fusion Welding of Aluminum.
- .5 CSA W48, Filler Metals and Allied Metals for Arc Welding.
- .6 CSA B51, Boiler, Pressure Vessel and Pressure Piping Code.
- .7 CAN/CSA-W117.2, Safety in Welding, Cutting and Allied Processes.
- .8 CSA W178.1, Certification of Welding Inspection Organizations.
- .9 CSA W178.2, Certification of Welding Inspectors.
- .10 AWS B2.1, Specification for Welding Procedure and Performance Qualification.
- .11 AWS C1.1, Recommended Practices for Resistance Welding.
- .12 AWS W1, Welding Inspection.
- .13 ANSI/AWWA C206, Field Welding of Steel Water Pipe.

1.2 WELDERS QUALIFICATIONS

- .1 Welding qualifications to be in accordance with CSA B51.
- .2 Use qualified and licensed welders possessing certificate for each procedure to be performed from authority having jurisdiction.
- .3 Furnish welder's qualifications to Consultant.
- .4 Each welder to possess identification stamp issued by authority having jurisdiction.
- .5 Certification of companies for fusion welding of aluminum to be in accordance with CSA W47.2.

1.3 INSPECTORS QUALIFICATIONS

- .1 Inspectors to be qualified to CSA W178.2.

1.4 WELDING PROCEDURES

- .1 Registration of welding procedures in accordance with CSA B51.
- .2 Copy of welding procedures to be available for inspection at all times.
- .3 Safety in welding, cutting and allied processes to be in accordance with CAN/CSA-W117.2.

Part 2 Products

2.1 ELECTRODES

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

Part 3 Execution

3.1 WORKMANSHIP

- .1 Welding to be in accordance with ANSI/ASME B31.1, ANSI/ASME Boiler and Pressure Vessel Code, Sections I and IX and ANSI/AWWA C206, using procedures conforming to AWS B3.0, AWS C1.1, and applicable requirements of provincial authority having jurisdiction.
- .2 Protect all adjacent areas.

3.2 INSTALLATION REQUIREMENTS

- .1 Identify each weld with welder's identification stamp.
- .2 Backing rings:
 - .1 Where used, fit to minimize gaps between ring and pipe bore.
 - .2 Do not install at orifice flanges.
- .3 Fittings:
 - .1 NPS 50 mm (2") and smaller: install welding type sockets.
 - .2 Branch connections: install welding tees or forged branch outlet fittings.

3.3 INSPECTION AND TESTS - GENERAL REQUIREMENTS

- .1 Review all weld quality requirements and defect limits of applicable codes and standards with Consultant before any work is started.
- .2 Formulate "Inspection and Test Plan" in co-operation with Consultant.
- .3 Do not conceal welds until they have been inspected, tested and approved by inspector.
- .4 Provide for inspector to visually inspect all welds during early stages of welding procedures in accordance with AWS W1. Repair or replace all defects as required by codes and as specified herein.

3.4 SPECIALIST EXAMINATIONS AND TESTS

- .1 General.
 - .1 Perform examinations and tests by specialist qualified in accordance with CSA W178.1 and CSA W178.2 and approved by Consultant.
 - .2 To ANSI/ASME Boiler and Pressure Vessels Code, Section V, CSA B51 and requirements of authority having jurisdiction.
 - .3 Inspect and test 25% of welds in accordance with "Inspection and Test Plan" by non-destructive visual examination and magnetic particle (hereinafter referred to as "particle") tests and/or full gamma ray radiographic (hereinafter referred to as "radiography") tests as specified.
- .2 Hydrostatically test all welds to requirements of ANSI/ASME B31.1.
- .3 Visual examinations: include entire circumference of weld externally and (wherever possible) internally.
- .4 Failure of visual examinations:
 - .1 Upon failure of any weld by visual examination, perform additional testing as directed by Consultant of a total of up to 10% of all welds, selected at random by Consultant by radiographic tests.

3.5 DEFECTS CAUSING REJECTION

- .1 As described in ANSI/ASME B31.1 and ANSI/ASME Boiler and Pressure Vessels Code.
- .2 In addition, hydronic water systems:
 - .1 Undercutting greater than 0.8 mm (1/32") adjacent to cover bead on outside of pipe.
 - .2 Undercutting greater than 0.8 mm (1/32") adjacent to root bead on inside of pipe.
 - .3 Undercutting greater than 0.8 mm (1/32") at combination of internal surface and external surface.
 - .4 Incomplete penetration and incomplete fusion greater than total length of 40 mm (1 1/2") in any 1500 mm (60") length of weld depth of such defects being greater than 0.8 mm (1/32").
 - .5 Repair all cracks and defects in excess of 0.8 mm (1/32") in depth.
 - .6 Repair defects whose depth cannot be determined accurately on the basis of visual examination or particle tests.

3.6 REPAIR OF WELDS WHICH FAILED TESTS

- .1 Re-inspect and re-test repaired or re-worked welds at Contractor's expense.

3.7 CLAIMS AGAINST OWNER FOR DELAYS

- .1 Claims against Owner for delays in completion of project will not be entertained for reasons of failures of welds to pass examinations.

3.8 OCCUPIED AREAS

- .1 Do not do any "Hot Work" in occupied areas.
- .2 Obtain "Hot Work" permits for working in existing building.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian General Standards Board (CGSB)
 - .1 ASTM C553, Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .2 CAN/ULC-S702, Mineral Fiber Thermal Insulation for Buildings.
 - .3 ASTM C612, Mineral Fiber Block and Board Thermal Insulation.
 - .4 CGSB 51-GP-52Ma-[89], Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .3 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
- .4 American Society for Testing and Materials (ASTM).
 - .1 ASTM C177 Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Mean of the Guarded Hot-Plate Apparatus.
 - .2 ASTM C518 Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - .3 ASTM C 449M, Standard Specification for Mineral Fiber-Hydraulic-Setting Thermal Insulating and Finishing Cement.
 - .4 ASTM C1729 Standard Specification for Aluminum Jacketing for Insulation.
 - .5 ASTM C1290 Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
 - .6 ASTM C1393 Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes And Tanks.
- .5 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
 - .1 ASHRAE Standard 90.1.
- .6 Manufacturer's Trade Associations.
 - .1 Thermal Insulation Association of Canada (TIAC)
 - .2 North American Commercial and Industrial Insulation Standards.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with general requirements.
- .2 Submit for approval manufacturer's catalogue literature related to installation, fabrication for duct jointing recommendations.
- .3 Submit completed detail plates from the North American Commercial and Industrial Insulation Standards manual, applicable to installation types required by this specification section.

1.3 INSTALLATION INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with general requirements.
- .2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.4 QUALIFICATIONS

- .1 Installer to have successfully completed apprenticeship program.
- .2 Installer to be specialist in performing work of this section and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials to site in original factory packaging, labeled with manufacturer's name, address.
- .2 Protect from weather and construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions required by manufacturer.

1.6 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services and equipment in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.
- .2 Insulation systems - insulation material, fasteners, jackets, and other accessories.

1.7 QUALITY ASSURANCE

- .1 Products shall not contain formaldehyde, asbestos, lead, mercury or mercury compounds or PBDE fire retardants.
- .2 **Products shall be Certified UL GREENGUARD Gold or Indoor Advantage Gold and formaldehyde free.**

Part 2 Products

2.1 LIMITATION ON MATERIALS

- .1 Products shall not contain formaldehyde, asbestos, lead, mercury or mercury compounds or PBDE fire retardants.

2.2 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.3 INSULATION

- .1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C (75°F) mean temperature when tested in accordance with ASTM C177 or ASTM C518.
- .3 Type C-1: Rigid mineral fibre board to ASTM C612, with factory applied vapour retarder jacket meeting the requirement of ASTM C1136 Type II and IV (FSK):
 - .1 Jacket: to ASTM C1136 Type II and IV (FSK)
 - .2 Maximum "k" value: .033 W/M•°C (.23 BTU•IN/HR•FT²•°F)
- .4 Type C-2: Mineral fibre blanket to ASTM C553 Type I, II, and III, ASTM C1136 Type II and IV, and ASTM C1290 Type III:
 - .1 Jacket: to ASTM C1136, Type II and IV.
 - .2 Maximum "k" value: .042 W/M•°C (.29 BTU•IN/HR•FT²•°F)
- .9 Manufacturers:
 - .1 All materials must be supplied by the same manufacturer.
 - .2 Acceptable Materials:
 - .1 Johns Manville
 - .2 Fibreglass Canada
 - .3 Knauf
 - .4 Manson
 - .5 Roxul

2.4 JACKETS

- .1 Canvas:
 - .1 220 g/m² (6 oz/yd²) cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
 - .2 Lagging adhesive: Compatible with insulation.

2.5 ACCESSORIES

- .1 Vapour retarder lap adhesive:
 - .1 Water based, fire retardant type, compatible with insulation.
- .2 Indoor Vapour Retarder Finish:
 - .1 Compatible with insulation.
- .3 Insulating Cement: hydraulic setting on mineral wool, to ASTM C 449.
- .4 ULC Listed Canvas Jacket:
 - .1 220 g/m² (6oz/yd²) cotton, plain weave, treated with dilute fire retardant lagging adhesive to ASTM C 921.
- .5 Tape: self-adhesive, aluminum, reinforced, 75 mm (3") wide minimum.
- .6 Contact adhesive: quick-setting Childers CP-82 or equal.
- .7 Canvas adhesive: washable.
- .8 Tie wire: 1.5 mm (16 gauge) stainless steel.
- .9 Facing: 25 mm (1") stainless steel hexagonal wire mesh stitched on one face of insulation
- .10 Fasteners: weld pins, length to suit insulation, with 40 mm (1½") diameter clips.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENTS

- .1 Pressure testing of ductwork systems to be complete, witnessed, and certified.
- .2 Surfaces to be clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with North American Commercial and Industrial Insulation Standards.
- .2 Apply materials in accordance with manufacturers instructions and this specification.
- .3 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.

- .4 Supports, Hangers in accordance with general requirements.
 - .1 Apply high compressive strength insulation where insulation may be compressed by weight of ductwork.
- .5 Fasteners: At 300 mm (12") oc. in horizontal and vertical directions, minimum two rows each side.
- .6 Provide rigid insulation for exposed ductwork.

3.3 DUCTWORK INSULATION SCHEDULE

- .1 Insulation types and thicknesses conform to following table:

Application	Type	Thickness
Rectangular supply air ducts	C-1	25 mm (1")
Round supply air ducts	C-2	25 mm (1")
Supply, return and fan exhaust ducts exposed (visible) in space being served	none	
Exhaust plenums dampers and louvres	C-1	25 mm (1")
Interior acoustically lined ducts	none	
Last 1.5m of Exhaust duct	C-1	25 mm (1")

- .2 Finishes: Conform to following table:

Application	Rectangular	Round
Indoor, concealed	none	none
Indoor, exposed	Canvas	Canvas

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.53, Poly (Vinyl Chloride) Jacketing Sheet, for Insulating Pipes, Vessels, and Round Ducts.
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .4 American Society for Testing and Materials (ASTM)
 - .1 ASTM C547, Type I and IV Standard Specification for Mineral Fiber Pipe Insulation.
 - .2 ASTM C177, Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
 - .3 ASTM C518, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus to recognize the correct thermal insulation performance testing for blanket.
 - .4 ASTM C1393, Standard Specification for Perpendicularly Oriented Mineral Fiber Roll and Sheet Thermal Insulation for Pipes and Tanks
 - .5 ASTM C1695, Standard Specification for Fabrication of Flexible Removable and Reusable Blanket Insulation for Hot Service.
 - .6 ASTM C 335, Test Method for Steady State Heat Transfer Properties of Pipe Insulation.
 - .7 ASTM C 921, Practice for Determining the Properties Jacketing Materials for Thermal Insulation.
 - .8 ASTM C1729 Standard Specification for Aluminium Jacketing for Insulation.
 - .9 ASTM C553, Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .10 CGSB 51-GP-52Ma, Vapour Barrier Jacket and Facing Material for Pipe, Duct and Equipment Thermal Insulation.
- .5 American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE).
 - .1 ASHRAE Standard 90.1.
- .6 Manufacturer's Trade Associations
 - .1 Thermal Insulation Association of Canada (TIAC)
 - .2 North American Commercial and Industrial Insulation Standards

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with general requirements.
- .2 Submit properly completed detail plates from the North American Commercial and Industrial Insulation Standards manual, applicable to installation types required by this specific section.
- .3 Submit for approval manufacturer's catalogue literature related to installation, fabrication for pipe, fittings, valves, and jointing recommendations.

1.3 INSTALLATION INSTRUCTIONS

- .1 Submit manufacturer's installation instructions in accordance with general requirements.
- .2 Installation instructions to include procedures to be used, installation standards to be achieved.

1.4 QUALIFICATIONS

- .1 Installer to have successfully completed apprenticeship program.
- .2 Installer to be specialist in performing work of this section and have at least 3 years successful experience in this size and type of project, qualified to standards of TIAC.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Protect from weather, construction traffic.
- .3 Protect against damage from any source.
- .4 Store at temperatures and conditions required by manufacturer.

1.6 DEFINITIONS

- .1 For purposes of this section:
 - .1 "CONCEALED" - insulated mechanical services in suspended ceilings and non-accessible chases and furred-in spaces.
 - .2 "EXPOSED" - will mean "not concealed" as defined herein.
 - .3 "PVC" – Poly Vinyl Chloride – polymer used to manufacture a non-metallic final protective finish jacket over insulation systems.

1.7 QUALITY ASSURANCE

- .1 Products shall not contain formaldehyde, asbestos, lead, mercury or mercury compounds or PBDE fire retardants.
- .2 **Products shall be Certified UL GREENGUARD Gold or Indoor Advantage Gold and formaldehyde free.**

Part 2 Products

2.1 MATERIAL LIMITATIONS

- .1 Products shall not contain formaldehyde, asbestos, lead, mercury or mercury compounds or PBDE fire retardants.

2.2 FIRE AND SMOKE RATING

- .1 In accordance with CAN/ULC-S102:
 - .1 Maximum flame spread rating: 25.
 - .2 Maximum smoke developed rating: 50.

2.3 INSULATION

- .1 Mineral fibre as specified herein includes glass fibre, rock wool, slag wool.
- .2 Thermal conductivity ("k" factor) not to exceed specified values at 24°C (75°F) mean temperature when tested in accordance with ASTM C335, ASTM C177 or ASTM C518.
- .3 Type A-1: Rigid moulded or wound mineral fibre with factory applied vapour retarder jacket.
 - .1 Mineral fibre: to ASTM C547 Type I and IV.
 - .2 Jacket: to ASTM C1136, Type I, II, III, IV, X.
 - .3 Maximum "k" factor: to ASTM C547.
- .4 Type A-2: High temperature mineral fibre blanket:
 - .1 Mineral fibre: to ASTM C553, Type V, flexible, non-combustible.
 - .2 Jacket: to ASTM C1136, Type I, II, III, IV, X.
 - .3 Maximum "k" value: .040 W/M•°C@ 38C mean (.28 BTU•IN/HR•FT²•°F @ 100F mean)
- .5 Materials:
 - .1 All materials must be supplied by the same manufacturer.
 - .2 Acceptable Materials:
 - Knauf
 - Manson
 - Owens Corning

2.4 INSULATION SECUREMENT

- .1 Tape: Self-adhesive, aluminum, reinforced, 50 mm (2") wide minimum.
- .2 Contact adhesive: Quick setting.
- .3 Canvas adhesive: Washable.
- .4 Tie wire: 1.5mm (16 gauge) diameter stainless steel.
- .5 Bands: Stainless steel, 20 mm (3/4") wide, 0.5 mm (0.020") thick.

2.5 CEMENT

- .1 Thermal insulating and finishing cement:
 - .1 Air drying on mineral wool, to ASTM C 449M.
 - .2 Hydraulic setting on mineral wool, to ASTM C165

2.6 VAPOUR RETARDER LAP ADHESIVE

- .1 Water based, fire retardant type, compatible with insulation.

2.7 INDOOR VAPOUR RETARDER FINISH

- .1 Compatible with insulation.

2.8 OUTDOOR VAPOUR RETARDER FINISH

- .1 Compatible with insulation.
- .2 Reinforcing fabric: Open weave fibreglass fabric, with maximum weave of 10 x 10 squares per inch.

2.9 JACKETS

- .1 Polyvinyl Chloride (PVC):
 - .1 Minimum thickness: 20mil (0.020")
 - .2 One-piece moulded type [and sheet] to CAN/CGSB-51.53 with pre-formed shapes as required.
 - .3 Colours: white.
 - .4 Minimum service temperatures: -29°C (-20°F).
 - .5 Maximum service temperature: 65°C (150°F).
 - .6 Moisture vapour transmission: 0.05 perm.
 - .7 Fastenings:
 - .1 Use solvent weld adhesive compatible with insulation to seal laps and joints.
 - .2 Tacks (not to be used on below-ambient temperature systems)
 - .3 Pressure sensitive vinyl tape of matching colour.

2.10 CAULKING FOR JACKETS

- .1 Caulking: Silicone clear caulking.

Part 3 Execution

3.1 PRE-INSTALLATION REQUIREMENT

- .1 Pressure testing of piping systems and adjacent equipment to be complete, witnessed, and certified.
- .2 Surfaces to be clean, dry, free from foreign material.

3.2 INSTALLATION

- .1 Install in accordance with North American Commercial and Industrial Insulation Standards.
- .2 Provide continuous insulation for complete systems including all valves, air separators, fittings, and other equipment.
- .3 Apply materials in accordance with manufacturers' instructions and this specification.
- .4 Maintain uninterrupted continuity and integrity of vapour retarder jacket and finishes.
 - .1 Hangers, supports to be outside vapour retarder jacket.
- .5 Supports, Hangers:
 - .1 Apply high compressive strength insulation, suitable for service, at oversized saddles and shoes where insulation saddles have not been provided.
- .6 **Use two layers with staggered joints when required nominal wall thickness exceeds 75 mm (3").**
- .7 Below ambient/chilled water installation:
 - .1 All pipes, fittings, valves, strainers, flanges, unions, and other pipe system components and specialties must be properly insulated with correctly completed vapor retarded applied.
 - .2 All insulation material must have properly installed and sealed vapor retarding jacket, including circumferential and longitudinal seams.
 - .3 All penetrations, tears, and punctures must be repaired and sealed with a vapor retarding material with a .02 or lower perm rating.
 - .4 Vapor stops must be installed at 18' intervals, at all pipe insulation termination points, including fittings, flanges, and other changes in direction or other types of piping specialties.
 - .5 All fitting insulation must be of the same type, thickness, and density of the pipe insulation, be premoulded insulation covers or fabricated from the same material as the pipe insulation. Full thickness must be factory-applied, vapor-retarder facing is unacceptable.

- .6 A complete vapor retarder must be installed on insulation over fittings before applying final finish. Vapor retarder must extend onto and be sealed to the vapor retarder or pipe insulation.
- .7 Additional fitting covers, PVC or metal, must have a vapor retarder seal applied to all longitudinal and circumferential seams in addition to the vapor retarder applied to the fitting insulation.
- .8 Additional field applied jackets must not use staples, screws, tacks or rivets for attachment, to avoid puncturing vapor retarder underneath.
- .9 Insulating support inserts are to be high compressive strength insulation with a rigid shield. No calcium silicate is to be used for insulation on below-ambient operation piping.

3.3 REMOVABLE, PREFABRICATED, INSULATION, AND ENCLOSURES

- .1 Application: At expansion joints, valves, primary flow measuring elements, flanges, and unions at equipment.
- .2 Flexible removable insulation covers are not acceptable for below-ambient (cold) operation piping systems. Rigid removable insulation jackets that are vapor retarder exterior material that can be vapor sealed at the seams, are acceptable on below-ambient (cold) operation piping systems.
- .3 Insulation:
 - .1 Insulation, fastenings, and finishes: same as system.
 - .2 Jacket: As per adjacent insulation.

3.4 PIPING INSULATION SCHEDULES

- .1 Includes valves, valve bonnets, strainers, flanges, air separators, and fittings unless otherwise specified.
- .2 Install insulator and jackets to applicable TIAC codes.
- .3 Insulate ends of capped piping with type and thickness indicated for capped service.
- .4 Thickness of insulation to be as listed in following table.
 - .1 Do not insulate exposed runouts to plumbing fixtures, chrome plated piping, valves, fittings.

Application	Type	Pipe sizes through (NPS) and insulation thickness mm (")				
		to 25 (1")	32 (1¼") 40 (1½")	50 (2") 80 (3")	105 (4") 150 (6")	200 (8") & over
Condensate	A-1	40 (1½")	40 (1½")	50 (2")	50 (2")	50 (2")
Hot Water Heating	A-1	40 (1½")	50 (2")	50 (2")	50 (2")	50 (2")

.5 Finishes: Conform to the following table:

<u>Application</u>	<u>Piping</u>	<u>Valves & Fittings</u>
Exposed indoors	PVC	PVC
Exposed in mech. rooms	PVC	PVC
Concealed indoors	N/A	PVC

.6 Connection: To appropriate TIAC code.

.7 Finish attachments: SS bands, @ 150 mm (6") oc. seals: closed.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 Canadian Standards Association (CSA).
 - .1 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
- .3 American National Standards Institute (ANSI).
 - .1 ANSI/ASME B16.1, Gray Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250 and 800.
 - .2 ANSI/ASME B16.3, Malleable-Iron Threaded Fittings, Classes 150 and 300.
 - .3 **ANSI/ASME B16.5, Pipe Flanges and Flanged Fittings: NPS½ through NPS24 Metric/Inch.**
 - .4 **ANSI/ASME B16.9, Factory-Made Wrought Steel Buttwelding Fittings.**
 - .5 **ANSI B18.2.1, Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).**
 - .6 **ANSI/ASME B18.2.2, Nuts for General Applications: Machine Screw Nuts, Hex, Square, Hex Flange, and Coupling Nuts (Inch Series).**
- .4 American Society for Testing and Materials (ASTM).
 - .1 ASTM A47/A47M, Specification for Ferritic Malleable Iron Castings.
 - .2 ASTM A53/A53M, Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.
 - .3 ASTM A536, Specification for Ductile Iron Castings.
 - .4 ASTM B61, Specification for Steam or Valve Bronze Castings.
 - .5 ASTM B62, Specification for Composition Bronze or Ounce Metal Castings.
- .5 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS).
 - .1 MSS-SP-67, Butterfly Valves.
 - .2 MSS-SP-70, Cast Iron Gate Valves, Flanged and Threaded Ends.
 - .3 MSS-SP-71, Cast Iron Swing Check Valves, Flanged and Threaded Ends.
 - .4 MSS-SP-80, Bronze Gate, Globe, Angle and Check Valves.
 - .5 MSS-SP-85, Cast Iron Globe and Angle Valves, Flanged and Threaded Ends.

1.2 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with general requirements.
- .2 Indicate on manufacturers' catalogue literature the following:
 - .1 Piping
 - .2 Valves
 - .3 Accessories

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

Part 2 Products

2.1 STEEL PIPE

- .1 Steel pipe: to ASTM A53/A53M, Grade B, as follows:
 - .1 NPS 150 mm (6") and smaller: Schedule 40.
 - .2 **NPS 200 mm (8") and [over,] [10] Schedule 30.**
 - .3 **NPS 300 mm (12") and over, 10 mm (3/8") wall thickness.**
- .2 Final connection to copper heating elements.
 - .1 Type "L" copper with 95/5 solder joints and dielectric couplings. Maximum length 600 mm (24").
- .3 Pipe Joints
 - .1 NPS 50 mm (2") and under: screwed fittings with pulverized lead paste.
 - .2 NPS 65 mm (2½") and over: welding fittings and flanges to CSA W47.1.
 - .3 Flanges: plain or raised face, slip-on.
 - .4 Flange gaskets: suitable for hydronic heating up to 110°C (220°F).
 - .5 Pipe thread: taper.
 - .6 Bolts and nuts: to ANSI B18.2.1 and ANSI/ASME B18.2.2.
- .4 Fittings
 - .1 Screwed fittings: malleable iron, to ANSI/ASME B16.3, Class 150.
 - .2 Pipe flanges and flanged fittings:
 - .1 Cast iron: to ANSI/ASME B16.1, Class 125.
 - .2 Steel: to ANSI/ASME B16.5.
 - .3 Butt-welding fittings: steel, to ANSI/ASME B16.9.
 - .4 Unions: malleable iron, to ASTM A47/A47M and ANSI/ASME B16.3.

2.2 VALVES

- .1 Connections:
 - .1 NPS 32 mm (1 1/4") and smaller: screwed ends.
 - .2 NPS 50 mm (2") and smaller: screwed ends.
 - .3 NPS 65 mm (2 ½") and larger: flanged ends.
- .2 Gate valves: Application: Isolating equipment, control valves, pipelines:
 - .1 NPS 50 mm (2") and under:
 - .1 Mechanical Rooms: Class 125, rising stem, solid wedge disc.
 - .2 Elsewhere: Class 125, non-rising stem, solid wedge disc.

- .2 NPS 65 mm (2 1/2") and over:
 - .1 Mechanical Rooms:
 - .1 Rising stem, solid wedge disc, bronze trim.
 - .1 Operators: handwheel.
 - .2 Non-rising stem, solid wedge disc, bronze trim.
 - .1 Operators: handwheel.
- .3 Butterfly valves: Application: Isolating each cell or section of multiple component equipment and where indicated.
 - .1 NPS 32 mm (1 1/4") and smaller: screwed ends.
 - .2 NPS 50 mm (2") and smaller: screwed ends.
 - .3 NPS 65 mm (2 1/2") and over: Flanged ends.
- .4 Globe valves: Application: Throttling, flow control, emergency bypass:
 - .1 NPS 50 mm (2") and under:
 - .1 With PFTE disc, as specified. Bronze.
 - .2 NPS 65 mm (2 1/2") and over:
 - .1 With solid bronze disc, bronze trim, cast iron body.
- .5 Drain valves: Gate, Class 125, non-rising stem, solid wedge disc, with chain and cap.
- .6 Swing check valves:
 - .1 NPS 50 mm (2") and under:
 - .1 Class 150, swing, with PFTE disc, as specified. Bronze. Jenkins 4475TJ.
 - .2 NPS 65 mm (2 1/2") and over:
 - .1 Flanged or Grooved ends, Bronze trim, Cast Iron: Gate, Globe, Check.
- .7 Ball valves:
 - .1 NPS 80 mm (3") and under:
 - .1 Body and cap: cast high tensile bronze to ASTM B62.
 - .2 Pressure rating: Class 125, 860 kPa (125 psi) steam, WP = 1.4 MPa (203 psi) WOG.
 - .3 Connections:
 - .1 NPS 50 mm (2") and under screwed ends to ANSI B1.20.1 and with hex. shoulders
 - .2 NPS 65 mm (2 1/2") and over flanged or grooved ends.
 - .4 Stem: stainless steel tamperproof ball drive.
 - .5 Ball and seat: replaceable stainless steel solid ball and teflon seats.
 - .6 Operator: removable lever handle.
 - .7 Extended handles on chilled water valves.
 - .8 Full port.

.8 All valves shall be of commercial grade and of same manufacturer.

.9 Acceptable Manufacturers:

- .1 Newman Hattersley Canada Ltd.
- .2 Jenkins/Crane
- .3 Milwaukee
- .4 Toyo
- .5 Kitz

2.3 BALANCING VALVES

- .1 Size 15 mm (1/2") to 50mm (2"): Bronze body, brass ball, NPT connections and variable orifice.
- .2 Size 65 mm (2 1/2") to larger: Cast iron body, raised flange connections, glove style with brass plug.
- .3 Differential pressure readout ports with internal EPT inserts and check valves, 6 mm (1/4")NPT tapped drain/purge ports, memory stop and calibrated nameplate.
- .4 Acceptable materials:
 - .1 Bell & Gossett Circuit Setters
 - .2 Armstrong
 - .3 Taco
 - .4 Tour & Anderson
 - .5 Oventrop

2.4 TRIPLE DUTY VALVE

- .1 Straight pattern, combination check, throttling shut off and calibrated balancing valve, heavy duty cast iron construction with standard 125 psig ANSI flanged connections rated for maximum working pressure of 175 psig at 250°F.
- .2 Valve shall be fitted with a replaceable bronze disk with EPDM seat insert, stainless steel stem and chatter preventing spring. Valve design shall permit replacing under full system pressure.
- .3 Valve shall be equipped with brass readout valves (with integral check valves).
 - .1 Acceptable material
 - Bell & Gossett
 - Armstrong

2.5 AUTOMATIC AIR VENT

- .1 Industrial float vent: cast iron body and NPS 15 mm (1/2") connection and rated at 860 kpa (125 psi) working pressure.
- .2 Float: solid material suitable for 115°C (240°F) working temperature.
- .3 Plastic vents are not acceptable.
- .4 Acceptable materials:
 - .1 Maid-O-Mist No. 67
 - .2 Spirax Sarco

Part 3 Execution

3.1 PIPING INSTALLATION

- .1 Installation shall be by a licensed pipe fitter.
- .2 Connect to equipment in accordance with manufacturer's instruction unless otherwise indicated.
- .3 Install concealed pipes close to building structure to keep furring space to minimum. Install to conserve headroom and space. Run exposed piping parallel to walls. Group piping wherever practical.
- .4 Slope piping in direction of drainage and for positive venting.
- .5 Use eccentric reducers at pipe size change installed to provide positive drainage or positive venting.
- .6 Provide clearance for installation of insulation and access for maintenance of equipment, valves and fittings.
- .7 Ream pipes, clean scale and dirt, inside and outside, before and after assembly.
- .8 Assemble piping using fittings manufactured to ANSI standards.
- .9 Saddle type branch fittings may be used on mains if branch line is no larger than half the size of main. Hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding saddle.

3.2 VALVE INSTALLATION

- .1 Install rising stem valves in upright position with stem above horizontal.
- .2 Install butterfly valves on chilled water and condenser water lines only.
- .3 Install gate or ball valves at branch take-offs and to isolate each piece of equipment, and as indicated.
- .4 Install globe valves for balancing and in by-pass around control valves as indicated.
- .5 Provide silent check valves on discharge of pumps and in vertical pipes with downward flow and as indicated.

- .6 Provide swing check valves in horizontal lines as indicated.
- .7 Install chain operators on valves NPS 65 mm (2½") and over where installed more than 2400 mm (96") above floor in Boiler Rooms and Mechanical Equipment Rooms.
- .8 Provide ball valves for glycol service.

3.3 AIR VENTS

- .1 Install at high points of systems.
- .2 Install ball valve on automatic air vent inlet.
- .3 Extend vent lines in Mechanical Room with screwdriver stop at 1.8 m AFF.

3.4 CIRCUIT BALANCING VALVES

- .1 Install flow measuring stations and flow balancing valves as indicated.
 - .1 On return side of all heating devices (convectors, panels, force flows, radiation, coils, etc.).
 - .2 On return side of all water or glycol cooling coils.
 - .3 On return side of all reverse return piping loops and/or branch circuits.
- .2 Install to manufacturers requirements.
- .3 Minimum valve size shall be one pipe size smaller than piping or 20 mm (¾"), whichever is larger.
- .4 Refer to Testing Adjusting and Balancing Section for applicable procedures.

3.5 FILLING OF SYSTEM

- .1 Refill system with clean water adding water treatment as specified.
- .2 Co-ordinate filling of system with HVAC water treatment contractor.
- .3 **Refill glycol heating system with 40% propylene glycol solution as specified.**

3.6 TESTING

- .1 Test system in accordance with Mechanical General Requirements Section.
- .2 For glycol systems, retest with propylene glycol to ASTM E202, inhibited, for use in building system after cleaning. Repair any leaking joints, fittings or valves.

3.7 FLUSHING AND CLEANING

- .1 Scope:
 - .1 **Flush new piping only.**
- .2 Refer to Water Treatment Section

- .3 Procedure:
 - .1 Flushing and cleaning should only take place after successful piping pressure testing.
 - .2 Terminal device (reheat coils, heat pumps, perimeter radiation, etc.), air handling unit coils and their associated control and balancing valves should be bypassed during the preliminary flushing and cleaning process.
 - .3 Instruments such as flow meters, flow metering valves and orifice plates should only be installed after flushing and cleaning.
- .4 Timing:
 - .1 The overall construction schedule identifies piping flushing and cleaning with realistic time allotments.
 - .2 The mechanical contractor is required to provide a detailed report outlining the processes and procedures for flushing and cleaning per piping system at least 4 to 6 weeks in advance of work.
 - .3 As a minimum, at least one piping flushing and cleaning procedure shall be witnessed, by the consultant and/or commissioning agent.
- .5 The mechanical contractor shall to utilize a qualified water treatment specialist to supervise the flushing and cleaning process and provide the certified water analysis report certifying that the piping systems are clean.
- .6 Coordinate flushing and cleaning of mechanical systems with HVAC water treatment contractor and HVAC systems commissioning contractor.
- .7 Flush and clean new piping system in presence of Consultant.
- .8 Flush after pressure test for a minimum of 4 hrs.
- .9 Fill system with solution of water and non-foaming, phosphate-free detergent 3% solution by weight. Circulate for minimum of 8 hrs.
- .10 Thoroughly flush all new mechanical systems and equipment with approved cleaning chemicals designed to remove deposition from construction such as pipe dope, oils, loose mill scale and other extraneous materials. Chemicals to inhibit corrosion of various system materials and be safe to handle and use.
- .11 During circulation of cleaning solution, periodically examine and clean filters and screens and monitor changes in pressure drop across equipment.
- .12 Refill system with clean water. Circulate for at least 2 hours. Clean out strainer screens/baskets regularly. Then drain.
- .13 Drainage to include drain valves, dirt pockets, strainers, every low point in system.
- .14 Drain and flush systems until alkalinity of rinse water is equal to make-up water. Refill with clean water treated to prevent scale and corrosion during system operation.
- .15 Re-install strainer screens/baskets only after obtaining Consultant's approval and approval from HVAC water treatment contractor.

- .16 Repeat system drain and flush as often as necessary to have a clean system.
- .17 Disposal of cleaning solutions to be approved by authority having jurisdiction.
- .18 Isolate new piping system from existing system as required for system cleaning.
- .19 **After hydronic system is cleaned, refill with clean water and chemical as per chemical supplier treatment.**

3.8 EXISTING SYSTEM DISPOSAL

- .1 Disposal of existing system shall be to the requirements of the local and/or provincial regulations.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Plumbing Specialties and Accessories.
- .2 Hydronic Systems – Steel.

1.2 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 American Society of Mechanical Engineers (ASME).
- .3 ANSI/ASME Boiler and Pressure Vessel Code, Section VI.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with general requirements.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit operation and maintenance data for incorporation into manual specified in general requirements.
- .2 Include following:
 - .1 Log sheets as recommended by manufacturer.
 - .2 Test reports.

Part 2 Products

2.1 MANUFACTURER

- .1 Equipment, chemicals, service by one supplier.
- .2 Acceptable manufacturer:
 - .1 Rochester Midland Corporation, contact Chris Kilgour (298-314-0264)

2.2 POT FEEDER

- .1 Existing

2.3 WATER TREATMENT FOR HYDRONIC SYSTEMS

- .1 Hot water heating system: Existing pot feeder.
- .2 Micron filter for each pot feeder:
 - .1 Capacity 2% of pump recirculating rate at operating pressure.
 - .2 Six (6) sets of filter cartridges for each type, size of micron filter.
- .3 Balancing valve set for 2% pump capacity.

2.4 CHEMICALS

- .1 Provide 1 year's supply.

2.5 TEST EQUIPMENT

- .1 Provide one set of test equipment for each system to verify performance.
- .2 Complete with carrying case, reagents for chemicals, all specialized or supplementary equipment.

2.6 CLEANING CHEMICALS

- .1 Provide as required to make system clean.
- .2 Cleaner chemical: compatible and of the same manufacturer of the water treatment supplier.

2.7 RECORD MANAGEMENT

- .1 Provide cards and card holder mounted on wall adjacent to each pot feeder.

Part 3 Execution

3.1 INSTALLATION

- .1 Install HVAC water treatment systems in accordance with ASME Boiler Code Section VII, and requirements and standards of authorities having jurisdiction, except where specified otherwise.
- .2 Ensure adequate clearances to permit performance of servicing and maintenance of equipment.

3.2 CHEMICAL FEED PIPING

- .1 Install crosses at all changes in direction. Install plugs in all unused connections.

3.3 WATER TREATMENT SERVICES

- .1 After entire new and existing system is cleaned as specified elsewhere, provide monthly water treatment monitoring and consulting services for period of one year after system start-up. Provide written report to consultant after each visit. Service to include:
 - .1 Initial water analysis and treatment recommendations.
 - .2 System start-up assistance.
 - .3 On site system testing and recording of treated hydronic system.
 - .4 Operating staff training.
 - .5 Visit plant every 7 days during first month of operation and as required until system stabilizes, and advise consultant in writing on treatment system performance.

- .6 Provide monthly visits with reports after system has stabilized to the satisfaction of the owner.
- .7 Provide necessary monthly recording charts and log sheets for one year operation.
- .8 Provide necessary laboratory and technical assistance.
- .9 Instructions and advice to operating staff to be clear, concise and in writing.

3.4 START-UP

- .1 Start up water treatment systems in accordance with manufacturer's instructions.

3.5 SYSTEM COMMISSIONING AND TRAINING

- .1 Commissioning and training shall be provided by installing water treatment sub-contractor and water treatment supplier.
- .2 Timing:
 - .1 After start-up deficiencies rectified.
 - .2 After start-up and before TAB of connected systems.
- .3 Pre-commissioning Inspections:
 - .1 Verify:
 - .1 Presence of test equipment, reagents, chemicals, details of specific tests to be performed, operating instructions.
 - .2 Suitability of log book.
 - .3 Currency and accuracy of initial water analysis.
 - .4 Required quality of treated water.
- .4 Commissioning procedures - applicable to all Water Treatment Systems:
 - .1 Establish, adjust as necessary and record all automatic controls and chemical feed rates.
 - .2 Monitor performance continuously during commissioning of all connected systems and until acceptance of project.
 - .3 Establish test intervals, regeneration intervals.
 - .4 Record on approved report forms all commissioning procedures, test procedures, dates, times, quantities of chemicals added, raw water analysis, treated water analysis, test results, instrument readings, adjustments made, results obtained.
 - .5 Establish, monitor and adjust automatic controls and chemical feed rates as necessary.
 - .6 Visit project at monthly intervals after commissioning is satisfactorily completed to verify that performance remains as set during commissioning (more often as required until system stabilizes at required level of performance).
 - .7 Advise Engineer in writing on all matters regarding installed water treatment systems.

- .5 Training:
 - .1 Commission systems, perform tests in presence of, and using assistance of, assigned O&M personnel.
 - .2 Train O&M personnel in softener regeneration procedures.
- .6 Certificates:
 - .1 Upon completion, furnish certificates confirming satisfactory installation and performance.
- .7 Commissioning Reports:
 - .1 To include system schematics, test results, test certificates, raw and treated water analyses, design criteria, all other data required by Consultant.
- .8 Commissioning activities during Warranty Period:
 - .1 Check out water treatment systems on regular basis and submit written report to Consultant.

3.6 CLEANING OF MECHANICAL SYSTEM

- .1 Coordinate cleaning of mechanical systems with mechanical contractor.
- .2 Provide copy of recommended cleaning procedures and chemicals for approval by Consultant.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- .3 SMACNA HVAC Duct Leakage Test Manual.
- .4 ASTM A480/A480M, Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and Strip.
- .5 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process. (Metric).
- .6 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
- .7 ANSI/NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section general requirements.
- .2 Indicate following:
 - .1 Sealants
 - .2 Tape
 - .3 Proprietary Joints
 - .4 Fittings

1.3 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

Part 2 Products

2.1 DUCTWORK

- .1 Galvanized Steel:
 - .1 Galvanized steel with Z90 designation zinc coating lock forming quality: to ASTM A653/A653M.
 - .2 Thickness:

Size Type	Class A Gauge	Class B Gauge	Class C Gauge
Square and Rectangular			
Up to 600 mm (24")	22	24	24
625 mm to 1000 mm (25" to 40")	20	22	24
Round and Oval			
Up to 300 mm (12")	24	24	24
325 mm to 600 mm (13" to 24")	22	24	24

- .3 All ductwork between HVAC unit connections and 3.0 m (10'-0") downstream or to silencers shall be 1.4 mm (18 gauge).

2.2 DUCT CONSTRUCTION

- .1 Round and oval:
 - .1 Ducts: factory fabricated, spiral wound, with matching fittings and specials to SMACNA.
 - .2 Transverse joints up to 900 mm (36"): slip type with tape and sealants.
 - .3 Transverse joints over 900 mm (36"): Ductmate or Exanno Nexus Duct System.
- .2 Square and rectangular:
 - .1 Ducts: to SMACNA.
 - .2 Transverse joints, longest side:
 - up to and including 750 mm (30"): SMACNA proprietary duct joints.
- .3 Ducts with sides over 750 mm (30") to 1200 mm (48"), transverse duct joint system by Ductmate/25, Nexus, or WDCI (Lite) (SMACNA "E" or "G" Type connection). Weld all corners.
 - .1 Acceptable materials:
 - .1 Ductmate Canada Ltd.
 - .2 Nexus, Exanno Corp.
 - .3 WDCI

- .4 Ducts 1200 mm (48") and larger, Ductmate/35, Nexus, or WDCI (heavy) (SMACNA "J" Type connection). Weld all corners.

- .1 Acceptable materials:

- .1 Ductmate Canada Ltd.
 - .2 Nexus, Exanno Corp.
 - .3 WDCI.

2.3 FITTINGS

- .1 Fabrication: to SMACNA.
- .2 Radiused elbows:
 - .1 Rectangular: standard radius and or short radius with single thickness turning vanes Centreline radius: 1.5 times width of duct.
 - .2 Round:
 - .1 In exposed areas one-piece smooth radius, 1.5 times diameter.
 - .2 In concealed areas 3-piece adjustable, 1.5 times diameter.
- .3 Mitred elbows, rectangular:
 - .1 To 400 mm (16"): with double thickness turning vanes.
 - .2 Over 400 mm (16"): with double thickness turning vanes.
- .4 Branches:
 - .1 Rectangular main and branch: with 45° entry on branch.
 - .2 Round main and branch: enter main duct at 45° with conical connection.
 - .3 Provide volume control damper in branch duct near connection to main duct.
 - .4 Main duct branches: with splitter damper.
- .5 Diffuser connection to main:
 - .1 90° round spin in collars with balancing damper and locking quadrant.
- .6 Transitions:
 - .1 Diverging: 20° maximum included angle.
 - .2 Converging: 30° maximum included angle.
- .7 Offsets:
 - .1 Full short radiused elbows.
- .8 Obstruction deflectors: maintain full cross-sectional area.

2.4 SEAL CLASSIFICATION

- .1 Classification as follows:

Maximum Pressure Pa (" w.c.)	SMACNA Seal Class	Acceptable Leakage Classification (Rectangular)	Acceptable Leakage Classification (Round)
2500 (10")	A	4	2
1500 (6")	A	4	2
1000 (4")	A	4	2
750 (3")	A	8	4
500 (2")	B	16	8
250 (1")	B	16	8
125 (0.5")	C	16	8

- .2 Seal classification:

- .1 Class A: longitudinal seams, transverse joints, duct wall penetrations and connections made airtight with sealant and tape.
- .2 Class B: longitudinal seams, transverse joints and connections made airtight with sealant.
- .3 Class C: transverse joints and connections made air tight with gaskets, or sealant or combination thereof. Longitudinal seams sealed with foil tape or sealant.

2.5 SEALANT

- .1 Sealant: oil resistant, polymer type flame resistant duct sealant. Temperature range of -30°C (-22°F) to plus 93°C (199°F).
- .1 Acceptable materials:
- .1 Duro Dyne S-2
- .2 Foster

2.6 TAPE

- .1 Tape: polyvinyl treated, open weave fiberglass tape, 50 mm (2") wide.
- .1 Acceptable material:
- .1 Duro Dyne FT-2

2.7 DUCT LEAKAGE

- .1 In accordance with SMACNA HVAC Duct Leakage Test Manual.

2.8 FIRESTOPPING

- .1 40 mm x 40 mm x 3 mm (1½" x 1½" x 16ga) retaining angles all around duct, on both sides of fire separation.
- .2 Firestopping material and installation must not distort duct.
- .3 All ductwork passing through partition walls shall be firestopped.

2.9 HANGERS AND SUPPORTS

- .1 Band hangers: use on round and oval ducts only up to 500 mm (20") diameter, of same material as duct but next sheet metal thickness heavier than duct.
- .2 Trapeze hangers: ducts over 500 mm (20") diameter or longest side, to ASHRAE and SMACNA.
- .3 Hangers: galvanized steel angle with black steel rods to ASHRAE and SMACNA following table:

Duct Size mm (")	Angle Size mm (")	Rod Size mm (")
up to 750 (30)	25 x 25 x 3 (1 x 1 x 1/8)	6 (1/4)
>750 to 1050 (>30 to 42)	40 x 40 x 3 (1½ x 1½ x 1/8)	6 (1/4)
>1050 to 1500 (>42 to 60)	40 x 40 x 3 (1½ x 1½ x 1/8)	10 (3/8)
>1500 to 2100 (>60 x 84)	50 x 50 x 3 (2 x 2 x 1/8)	10 (3/8)
>2100 to 2400 (>84 x 96)	50 x 50 x 5 (2 x 2 x 1/8)	10 (3/8)
>2400 (96) and over	50 x 50 x 6 (2 x 2 x ¼)	10 (3/8)

- .4 Upper hanger attachments:
 - .1 For concrete: manufactured concrete inserts.
 - .1 Acceptable material:
 - .1 Myatt fig. 485
 - .2 For steel joist: manufactured joist clamp or steel plate washer.
 - .1 Acceptable material:
 - .1 Grinnell fig. 61 or 60
 - .3 For steel beams: manufactured beam clamps:
 - .1 Acceptable material:
 - .1 Grinnell Fig. 60

Part 3 Execution

3.1 GENERAL

- .1 The following systems shall conform to these requirements:

System	Class	Material
HVAC Supply and Return	B	Galvanized steel
General Exhaust	B	Galvanized steel

- .2 Do work in accordance with ASHRAE and SMACNA.
- .3 Do not break continuity of insulation vapour barrier with hangers or rods.
- .4 Support risers in accordance with ASHRAE and SMACNA.

- .5 Install breakaway joints in ductwork on each side of fire separation.
- .6 Install proprietary manufactured flanged duct joints in accordance with manufacturer's instructions.
- .7 Manufacture duct in lengths to accommodate installation of acoustic duct lining.

3.2 HANGERS

- .1 Strap hangers: install in accordance with SMACNA.
- .2 Angle hangers: complete with locking nuts and washers.
- .3 Hanger spacing: in accordance with ASHRAE, SMACNA and as follows:

Duct Size	Spacing
mm (")	mm (")
to 1500 (60")	3000 (120")
over 1500 (60")	2500 (100")

- .4 Do not support ductwork over 250 mm x 250 mm (10" x 10") from roof deck.

3.3 SEALING

- .1 Apply sealant to outside of joint to manufacturer's recommendations.
- .2 Bed tape in sealant and recoat with minimum of 1 coat of sealant to manufacturers recommendations.

3.4 LEAKAGE TESTS

- .1 Co-ordinate leakage testing with TAB contractor. TAB contractor will be responsible for all duct testing.
- .2 Duct to be tested in accordance with SMACNA HVAC Duct Leakage Test Manual.
- .3 Leakage tests to be done in sections.
- .4 Trial leakage tests to be performed as instructed to demonstrate workmanship.
- .5 Install no additional ductwork until trial test has been passed.
- .6 Test section to be minimum of 15 m (50'-0") long with not less than 3 branch takeoffs and two 90° elbows. Maximum test length and area to be determined by BAS testing equipment. Allow for twelve (12) tests.
- .7 Complete test before insulation or concealment.
- .8 Provide all necessary end caps and fittings as required for the TAB contractor. Remove same after successful completion of duct test.
- .9 Pressure test ductwork to 1½ times operating pressure (minimum pressure 500 Pa (2" wc) all systems).

3.5 CLEANING

- .1 Keep ducts clear from dust and debris
- .2 Keep duct liner clean from dust, debris, and moisture.
- .3 At completion of project vacuum ducts if dirt or dust is present.

- .4 Where new systems connect into existing systems the existing systems shall be cleaned and vacuumed prior to reconnection. **The extent of the cleaning shall be limited to the area immediately surrounding the new connection point.**
- .5 Ensure all systems are clean prior to start up.

3.6 INSTALLATION REQUIREMENTS

- .1 All ductwork is to be protected from the weather and precipitation. The top and sides of all ductwork are to be completely covered with 6mil poly to the satisfaction of the consultant. Maintain protection of the ductwork until the building is made watertight and hollow cores drained. Tape all joints.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- .3 ANSI/NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
- .4 CSA B228.1, Pipes, Ducts and Fittings for Residential Type Air Conditioning.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with general requirements.
- .2 Indicate the following:
 - .1 Flexible connections.
 - .2 Duct access doors.
 - .3 Turning vanes.
 - .4 Instrument test ports.

1.3 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

Part 2 Products

2.1 GENERAL

- .1 Manufacture in accordance with CSA B228.1.

2.2 FLEXIBLE CONNECTIONS

- .1 Frame: galvanized sheet metal frame with fabric clenched by means of double locked seams.
- .2 Material:
 - .1 Fire resistant, self extinguishing, neoprene coated glass fabric, temperature rated at -40°C (-40°F) to plus 90°C (194°F), density of 1.3 kg/m.

2.3 ACCESS DOORS IN DUCTS

- .1 Non-insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm (25 gauge) thick complete with sheet metal angle frame.
- .2 Insulated ducts: sandwich construction of same material as duct, one sheet metal thickness heavier, minimum 0.6 mm (24 gauge) thick complete with sheet metal angle frame and 25 mm (1") thick rigid glass fibre insulation.
- .3 Gaskets: neoprene
- .4 Hardware:
 - .1 Up to 300 mm (12"): 2 sash locks
 - .2 301 mm to 450 mm (13" to 18"): 4 sash locks Complete with safety chain.
 - .3 451 mm to 1000 mm (19" to 40"): piano hinge and minimum 2 sash locks.
 - .4 Doors over 1000 mm (40"): piano hinge and 2 handles operable from both sides.
 - .5 Hold open devices.
- .5 Acceptable materials:
Nailor
E. H. Price
Titus

2.4 TURNING VANES

- .1 Factory or shop fabricated double thickness, to recommendations of SMACNA and as indicated.
- .2 Acceptable materials:
Duro Dyne
Ductmate

2.5 INSTRUMENT TEST PORTS

- .1 1.6 mm (16 gauge) thick steel zinc plated after manufacture.
- .2 Cam lock handles with neoprene expansion plug and handle chain.
- .3 28 mm (1 1/8") minimum inside diameter. Length to suit insulation thickness.
- .4 Neoprene mounting gasket.
- .5 Acceptable material:
Duro Dyne IP1 or IP2
Duct mate

2.6 SPIN-IN COLLAR

- .1 Construction: galvanized straight or conical spin-in collar complete with spin-in bead and crimped collar connection.
- .2 Provide balancing damper where indicated.
- .3 Acceptable materials:
 - .1 Ecco Manufacturing
 - .2 Flex Master

Part 3 Execution

3.1 INSTALLATION

- .1 Flexible connections:
 - .1 Install in following locations:
 - .1 Inlets and outlets to supply air units and fans. (Unless internally isolated)
 - .2 Inlets and outlets of exhaust and return air fans.
 - .3 As indicated.
 - .2 Length of connection: 100 mm (4").
 - .3 Minimum distance between metal parts when system in operation: 75 mm (3").
 - .4 Install in accordance with recommendations of SMACNA.
 - .5 When fan is running:
 - .1 Ducting on each side of flexible connection to be in alignment.
 - .2 Ensure slack material in flexible connection.
- .2 Access doors and viewing panels:
 - .1 Size:
 - .1 600 mm x 600 mm (24" x 24") for person size entry.
 - .2 600 mm x 1000 mm (24" x 40") for servicing entry.
 - .3 300 mm x 300 mm (12" x 12") for viewing.
 - .4 As indicated.
 - .2 Location:
 - .1 At fire and smoke dampers.
 - .2 At control dampers.
 - .3 At devices requiring maintenance.
 - .4 At locations required by code.
 - .5 At inlet and outlet of reheat coils.
 - .6 Elsewhere as indicated.
 - .7 Inlet and outlet of duct mounted coils.

- .3 Instrument test ports.
 - .1 General:
 - .1 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
 - .2 Locate to permit easy manipulation of instruments
 - .3 Install insulation port extensions as required.
 - .4 Locations.
 - .1 For traverse readings:
 - .1 At ducted inlets to roof and wall exhausters.
 - .2 At inlets and outlets of other fan systems.
 - .3 At main and sub-main ducts.
 - .4 And as indicated.
 - .2 For temperature readings:
 - .1 At outside air intakes.
 - .2 In mixed air applications in locations as approved by Consultant.
 - .3 At inlet and outlet of coils.
 - .4 Downstream of junctions of two converging air streams of different temperatures.
 - .5 And as indicated.
- .4 Turning vanes:
 - .1 Install in accordance with recommendations of SMACNA and as indicated.
 - .2 Install on supply ducts only.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 SMACNA HVAC Duct Construction Standards, Metal and Flexible.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with general requirements.
- .2 Indicate the following: performance data.

Part 2 Products

2.1 GENERAL

- .1 Manufacture to SMACNA standards.

2.2 SINGLE BLADE DAMPERS

- .1 Of same material as duct, but one sheet metal thickness heavier. V-groove stiffened, minimum 1.6 mm (16 gauge).
- .2 Size and configuration to recommendations of SMACNA, except maximum height 100 mm (4").
- .3 Shaft extension to accommodate insulation thickness and locking quadrant.
- .4 Inside and outside nylon end bearings.
- .5 Channel frame of same material as adjacent duct, complete with angle stop.

2.3 MULTI-BLADED DAMPERS

- .1 Factory manufactured of material compatible with duct.
- .2 Opposed blade: configuration, metal thickness and construction to recommendations of SMACNA.
- .3 Maximum blade height:
 - .1 50 mm (2") up to 375 mm (15") high duct.
 - .2 100 mm (4") max 400 mm (16") high duct and over.
- .4 Bearings: self-lubricating nylon.

- .5 Linkage: shaft extension with locking quadrant.
- .6 Channel frame of same material as adjacent duct, complete with angle stop.
- .7 Shaft extension to accommodate insulation thickness and locking quadrants.**
- .8 Acceptable materials:
 - .1 Duro Dyne
 - .2 E.H. Price
 - .3 Nailor
 - .4 T.A. Morrison
 - .5 Tamco
 - .6 Ruskin
 - .7 Ventex/Alumavent
 - .8 United Enertech

2.4 LOCKING QUADRANTS

- .1 6 mm (1/4") dial regulator with square bearing shaft.
 - .1 18 gauge oval frame, cadmium plated, clearly shows damper position.
 - .2 18 gauge formed handle for easy adjustment.
 - .3 Bolt and wing nut lock damper securely.
 - .4 Offset mounting holes avoid interference with damper movement and mechanical fastening to duct.
- .2 9 mm (3/8") and larger: clamp quadrant with square bearing shaft.
 - .1 Accommodates and securely locks square rod, bearing fitting and adaptor pins.
 - .2 Heavily ribbed 16 gauge steel frame, 3 mm (1/8") thick formed steel handle, cadmium-plated.
 - .3 By tightening nut, bearing is securely locked in handle, preventing slippage and rattle.
 - .4 Neoprene and steel washer assembly seals bearing opening to eliminate air-leakage.
 - .5 Screw holes for mechanically fastening to ductwork.
- .3 High pressure system locking quadrant:
 - .1 Airtight, rattle-proof regulator, designed for ZERO leakage at high pressure. Use for applications up to 500°F constant temperature.
 - .2 Handle design for easy recognition of damper position.
 - .3 Heavy-gauge, zinc-plated steel, 2 high temperature rubber seals and washers, end bearing support, and 2 end bearings. Pressure loss and damper rattle in ductwork has been a constant annoyance for as long as HVAC ductwork has been installed. Now, a truly air-tight, rattle-proof regulator is available. The SPEC-SEAL regulator utilizes a special high-temperature rubber seal to eliminate leakage and rattle even at many times the pressure found in high pressure.

- .4 Soft, comfortable grip handle with a highly-visible, plastic cover which indicates the damper position.
- .5 Handle to accommodate 9 mm (3/8") or 12 mm (1/2") to match damper shaft size, square and round bearing shafts.
- .4 Acceptable manufacturers:
 - Duro Dyne
 - Ductmate
 - Pottorff

Part 3 Execution

3.1 INSTALLATION

- .1 Install where indicated.
- .2 Install in accordance with recommendations of SMACNA and in accordance with manufacturer's instructions.
- .3 For supply, return and exhaust systems, locate balancing dampers in each branch duct.
 - .1 Single blade dampers up to 200 mm (8").
 - .2 Multi-blade dampers over 200 mm (8").
- .4 Runouts to registers and diffusers: install single blade damper located as close as possible to main ducts.
- .5 All dampers to be vibration free.
- .6 Leave all dampers in open position for T.A.B.
- .7 Fasten locking quadrants to ductwork and shaft.
- .8 Place locking quadrants on standoffs where ductwork insulated.
- .9 Lock down quadrant arm in the open position.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
- .3 CAN/ULC-S112, Standard Method of Fire Test of Fire Damper Assemblies.
- .4 CAN/ULC-S112.1, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
- .5 ULC-S505, Fusible Links for Fire Protection Service.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with general requirements.
- .2 Indicate the following:
 - .1 Fire dampers.
 - .2 Operators.
 - .3 Firestop flaps.
 - .4 Fusible links.

1.3 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

1.4 MAINTENANCE MATERIALS

- .1 Provide following:
 - .1 Six (6) fusible links of each type.

1.5 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

Part 2 Products

2.1 FIRE DAMPERS (STATIC)

- .1 Fire dampers: arrangement as indicated, listed and bear label of ULC, meet requirements of provincial fire authority and authorities having jurisdiction. Fire damper assemblies to be fire tested in accordance with CAN/ULC-S112.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
- .3 Top hinged: offset single damper, round or square; multi-blade hinged or interlocking type; guillotine type; sized to maintain full duct cross section.
- .4 Fusible link actuated, weighted to close and lock in closed position when released or having negator-spring-closing operator for multi-leaf type or roll door type in horizontal position with vertical air flow.
- .5 40 mm x 40 mm x 3 mm (1½" x 1½" x 16ga) retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .6 Acceptable materials:
 - .1 Ruskin
 - .2 Nailor
 - .3 E.H. Price
 - .4 T.A. Morrison
 - .5 Tamco
 - .6 Ventex/Alumavent
 - .7 United Enertech
 - .8 Safeair-Dowco (stainless steel)
 - .9 Greenheck
 - .10 Pottorff

2.2 FIRE DAMPERS (DYNAMIC)

- .1 Multi blade or roll type, fire damper suitable for HVAC system velocities up to 2000 fpm (610 m/min), dual direction air flow, max 4" wg pressure.
- .2 Mild steel, factory fabricated for fire rating requirement to maintain integrity of fire wall and/or fire separation.
- .3 Top hinged: offset single damper, round or square; multi-blade hinged or interlocking type; guillotine type; sized to maintain full duct cross section.
- .4 Stainless closure spring to positively close damper upon fusible link release, for horizontal or vertical orientations.
- .5 Linkage concealed in frame.
- .6 40 mm x 40 mm x 3 mm (1½" x 1½" x 16ga) retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.

- .7 Fire damper assemblies and type to meet requirements of provincial fire authority and authority having jurisdiction.
- .8 Acceptable materials:
 - .1 Ruskin
 - .2 Nailor
 - .3 E.H. Price
 - .4 T.A. Morrison
 - .5 Tamco
 - .6 Greenheck
 - .7 Ventex/Alumavent
 - .8 Pottorff

2.3 MULTIBLADE DAMPERS (DYNAMIC OR STATIC)

- .1 Provide and install multiblade dampers where roll type fire dampers do not have a ULC listing for the size of the penetration through the assembly.
- .2 Multi blade type fire dampers shall be suitable for HVAC system velocities up to 2000 fpm (610 m/mm), dual direction air flow, max 4" wg pressure.
- .3 Damper shall be labelled for dynamic or static systems as appropriate for the installed location.
- .4 Frame shall be constructed on 16 ga (1.6) steel hat channel with mitered corners reinforced with die-formed corner gussets for strength.
- .5 Damper blades shall be 14 ga (2.0) equivalent steel formed double skin, airfoil design.
- .6 Damper shall be of opposed blade configuration with an interlocking blade design. Blade seals are not acceptable.
- .7 Blade axels shall be double bolted at each end of the blade to provide positive locking connection.
- .8 Bearings shall be sintered stainless steel type.
- .9 Blade linkage shall be zero-maintenance, concealed in frame and out of the air stream.
- .10 Each damper shall be complete with a UL listed fusible link that will cause the damper to close and lock in closed position by means of an over centre/knee lock linkage for assured closure.
- .11 Each damper shall be provided with an internal manual locking quadrant(s) for setting and locking of blades in desired position.
- .12 Provide a steel sleeve of appropriate gauge and length for the assembly being penetrated.

- .13 Provide a 40 mm x 40 mm x 3 mm (1½" x 1½" x 16ga) retaining angle iron frame, on full perimeter of fire damper, on both sides of fire separation being pierced.
- .14 Fire damper assemblies and type to meet requirements of provincial fire authority and authority having jurisdiction.
- .15 Acceptable materials:
 - .1 Ruskin
 - .2 Nailor
 - .3 E.H. Price
 - .4 T.A. Morrison
 - .5 Tamco
 - .6 Greenheck
 - .7 Ventex/Alumavent
 - .8 Pottorff

2.4 FIRE STOP FLAPS

- .1 To be ULC listed and labelled and fire tested in accordance with CAN/ULC-S112.1.
- .2 Construct of minimum 1.5 mm (16 gauge) thick sheet steel with 1.5 mm (16 gauge) thick non-asbestos ULC listed insulation and corrosion-resistant pins and hinges.
- .3 Flaps to be held open with fusible link conforming to ULC-S505 and close at 74°C (165°F).

Part 3 Execution

3.1 INSTALLATION

- .1 Provide where indicated and at all fire rated partitions indicated, on architectural drawing.
- .2 Install in accordance with ANSI/NFPA 90A and in accordance with conditions of ULC listing.
- .3 Maintain integrity of fire separation.
- .4 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.
- .5 Install access door adjacent to each damper.
- .6 Coordinate with installer of firestopping.
- .7 Static fire dampers: Only on transfer air ducts where ductwork is not connected to a fan/blower.
- .8 Dynamic fire dampers: In all duct work where air is moved by a fan/blower.

END OF SECTION

Part 1 General

1.1 CODES AND STANDARDS

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
- .3 CAN/ULC-S112, Standard Method of Fire Test of Fire Damper Assemblies.
- .4 CAN/ULC-S112.1, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies.
- .5 ULC-S505, Fusible Links for Fire Protection Service.
- .6 CAN/ULC-S524, Installation of Fire Alarm Systems
- .7 CAN/ULC-S1001.11, Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with general requirements indicating the following:
 - .1 Damper type
 - .2 Operators
 - .3 Fusible links
 - .4 Smoke detectors
 - .5 Power requirements
 - .6 Size, orientation, construction

1.3 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

1.4 MAINTENANCE MATERIALS

- .1 Provide following:
 - .1 Six (6) fusible links of each type.

1.5 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

Part 2 Products

2.1 SMOKE DAMPERS

- .1 Provide a complete system, consisting of the damper, damper actuator, smoke detector with duct sample tube, sleeve and all other components necessary for a complete and operable system. **The assembly shall be factory assembled as a single unit.** Field assembly shall be permitted at contractor discretion provided all listings are maintained and the installation follows all manufacturer installation guidelines.
- .2 Damper
 - .1 Damper shall be ULC listed and labelled
 - .2 Both damper and damper actuator to be ULC listed and labelled.
 - .3 Normally closed smoke/seal: folding blade type. Blade edge seals of flexible stainless steel shall provide required constant sealing pressure. Stainless steel negator springs with locking devices shall ensure positive closure for units.
 - .4 Damper shall have Class I leakage rating.
 - .5 Suitable for horizontal or vertical installations.
 - .6 Damper Material: Damper material shall match ductwork it is installed in (i.e., stainless steel in laboratory). Refer to specification section 23 31 13 Metal Ducts.
- .3 Actuator
 - .1 Actuator shall be ULC listed and labelled
 - .2 Motorized actuator: 2-position, spring return, normally open with power on. When power is interrupted damper shall close automatically. Upon return of power, damper shall automatically reset open. Actuators are to be located outside of airstream, unless otherwise specified or shown on drawings.
 - .3 Exterior visualization of damper position.
 - .4 Damper actuator end switches for monitoring damper position by the BAS.
- .4 Factory sleeve.
 - .1 Type and style: matching application.
- .5 Operating Temperature: 0° Celsius to 99° Celsius ambient temperature rating for 300 fpm to 4000 fpm air velocity.
- .6 Smoke Detector:
 - .1 ULC approved photoelectric duct smoke detector;
 - .2 Operates from 300 to 3000 ft/min air velocity (fan system), -4 to 158°F temperature, and 0 to 95% non-condensing humidity;
 - .3 Operates from 100 to 4000 ft/min air velocity, -4 to 158°F temperature and 0 – 95% non-condensing humidity (transfer ducts)

- .4 Test/reset button with LED display;
- .5 The detector housing shall be ULC listed specifically for use in air handling systems; capable of local testing via magnetic switch and test button; duct mounted smoke detector with sampling tube, housing.
- .6 The detector shall incorporate separate 2.0A 30VDC Alarm and Supervisory contacts. Alarm contacts shall be normally open (N.O.) in which closed contacts will indicate an alarm condition to the fire alarm panel. Supervisory contacts shall be normally closed (N.C.) in which open contacts will indicate a trouble condition to the fire alarm panel.
- .7 Damper assembly to operate at 120V with single point power connection.
- .8 Large damper sizes can be provided in multiple sections. Field assembly is acceptable following manufacturer's installation guidelines.
- .9 Size: as indicated on drawings.
- .10 Acceptable materials:
 - E H Price
 - NCA Ltd.
 - Nailor Industries Inc.
 - Ruskin
 - Alumavent
 - United Enertech
 - Safeair-Dowco (stainless steel)
 - Pottorff

2.2 COMBINATION FIRE AND SMOKE DAMPERS

- .1 Provide a complete system, consisting of the damper, damper actuator, smoke detector with duct sampling tube, sleeve and all other components necessary for a complete and operable system. **The assembly shall be factory assembled as a single unit.** Field assembly shall be permitted at contractor discretion provided all listings are maintained and the installation follows all manufacturer installation guidelines.
- .2 Damper
 - .1 Damper shall be ULC listed and labelled
 - .2 Both damper and damper actuator to be ULC listed and labelled.
 - .3 Normally closed smoke/seal: folding blade type. Blade edge seals of flexible stainless steel shall provide required constant sealing pressure. Stainless steel negator springs with locking devices shall ensure positive closure for units.
 - .4 Damper shall have Class I leakage rating.
 - .5 Suitable for horizontal or vertical installations.
 - .6 Damper Material: Damper material shall match ductwork it is installed in (i.e., stainless steel in laboratory). Refer to specification section 23 31 13 Metal Ducts.

- .3 Actuator/Link
 - .1 Actuator shall be ULC listed and labelled.
 - .2 Motorized actuator: 2-position, spring return, normally open with power on. When power is interrupted damper shall close automatically. Upon return of power, damper shall automatically reset open. Actuators are to be located outside of airstream, unless otherwise specified or shown on drawings.
 - .3 Exterior visualization of damper position.
 - .4 Damper actuator end switches for monitoring damper position by the BAS.
 - .5 Combined actuator: electrical control system actuated from smoke sensor or smoke detection system and from fusible link.
 - .6 Fusible link, or electric re-settable link (ERL).
 - .7 Electric fire sensor capable of remote openable control is to be provided in place of fusible link where specifically indicated in project documents.
 - .8 Where ERL or electric fire sensor is used in place of fusible link, this device shall fail closed upon power failure.
- .4 Factory sleeve.
 - .1 Type and style: matching application.
- .5 Operating Temperature: 0° Celsius to 99° Celsius ambient temperature rating for 300 fpm to 4000 fpm air velocity.
- .6 Smoke Detector:
 - .1 ULC approved photoelectric duct smoke detector;
 - .2 Operates from 300 to 3000 ft/min air velocity (fan systems), -4 to 158°F temperature, and 0 to 95% non-condensing humidity;
 - .3 Operates from 100 to 4000 ft/min air velocity, -4 to 158°F temperature and 0 – 95% non-condensing humidity (transfer ducts)
 - .4 Test/reset button with LED display;
 - .5 The detector housing shall be ULC listed specifically for use in air handling systems; capable of local testing via magnetic switch and test button; duct mounted smoke detector with sampling tube, housing
 - .6 The detector shall incorporate separate 2.0A 30VDC Alarm and Supervisory contacts. Alarm contacts shall be normally open (N.O.) in which closed contacts will indicate an alarm condition to the fire alarm panel. Supervisory contacts shall be normally closed (N.C.) in which open contacts will indicate a trouble condition to the fire alarm panel.
- .7 Damper assembly to operate at 120V with single point power connection.
- .8 Large damper sizes can be provided in multiple sections. Field assembly is acceptable following manufacturer's installation guidelines.

- .9 Fire rating to match wall assembly i.e. 1 hour/1 ½ hour/2 hour/ 3 hour.
- .10 Size: as indicated on drawings.
- .11 Acceptable materials:
 - E H Price
 - NCA Ltd.
 - Nailor Industries Inc.
 - Ruskin
 - Alumavent
 - United Enertech
 - Pottorff
 - Safeair-Dowco (stainless steel)
 - Pottorff

2.3 NUMBER OF AIR TYPE SMOKE DETECTORS

- .1 Where air velocities are greater than 1.5 m/s (300 feet per second), one air duct type detector shall be installed for every 1.5 meters square (16 square feet) of cross-sectional duct area.
- .2 Where air velocities are less than 1.5 m/s (300 feet per second), one duct type smoke detector shall be installed for every 0.5 meters square (5.3 square feet) or cross-sectional duct area.

Part 3 Execution

3.1 INSTALLATION

- .1 Provide smoke dampers where indicated and at all duct penetrations through smoke barrier partitions indicated on architectural drawings.
- .2 Provide combination fire and smoke dampers where indicated and at all duct penetrations through fire rated smoke barrier partitions indicated on architectural drawings. To provide separated fire dampers and smoke dampers, obtain approval from the consultant for the alternate arrangement.
- .3 Provide pressure relief doors (both positive and negative as applicable) as follows:
 - .1 For all systems with a combination fire smoke or smoke damper in the duct main of the system when:
 - .1 The system operates at static pressure of 1.0 inches w.g. or higher; and
 - .2 More than 50% of the system airflow passes through the combination fire/smoke or smoke damper.
 - .2 Where/as indicated on the plans.
- .4 Install in accordance with ANSI/NFPA 90A, in accordance with conditions of ULC listing and manufacturer's recommendation.
- .5 Maintain integrity of smoke separation and fire rating.
- .6 After completion and prior to concealment obtain approvals of complete installation from authority having jurisdiction.

- .7 Install access door adjacent to each damper and smoke detector.
- .8 Front grille access for through wall dampers that terminate in a grille is acceptable.
- .9 Provide proper firestopping and duct seal to fire barrier wall.
- .10 Confirm proper operation and test sheets.
- .11 Should contractor provide separated devices mount smoke detector downstream of damper and within 1.5 m (5 ft) of damper.
- .12 Ensure access doors/panels, fusible links, damper actuators and sensors are easily observed and accessible.

3.2 WIRING

- .1 All fire alarm wiring shall be 1 hour rated and in conduit or as per electrical fire alarm wiring requirement.
- .2 When the building has a BAS contractor, the BAS contractor can be used to provide the 120V power wiring.

3.3 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools, and equipment.

3.4 INTEGRATED LIFE SAFETY SYSTEMS TESTING

- .1 Prior to the building Integrated Life Safety Systems Testing the mechanical contractor shall commission/verify the operation of all installed smoke dampers.
- .2 Participate in the Integrated Life Safety Systems Testing to confirm proper operation of all operating smoke dampers and associated Life Safety Systems (i.e. fire alarm).
- .3 This contractor shall work with the Integrated Life Safety Contractor and reset all systems back into proper operation.
- .4 Include all costs associated with participation Integrated Life Safety System Testing in the tender value.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 CAN/ULC-S110, Standard Methods of Test for Air Ducts.
- .3 UL 181, Factory Made Air Ducts and Air Connectors.
- .4 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
- .5 ANSI/NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.
- .6 SMACNA HVAC Duct Construction Standards - Metal and Flexible.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with general requirements.
- .2 Indicate the following:
 - .1 Thermal properties.
 - .2 Friction loss.
 - .3 Acoustical loss.
 - .4 Leakage.
 - .5 Fire rating.

1.3 CERTIFICATION OF RATINGS

- .1 Catalogue or published ratings shall be those obtained from tests carried out by manufacturer or independent testing agency signifying adherence to codes and standards.

Part 2 Products

2.1 GENERAL

- .1 Factory fabricated to CAN/ULC S110.
- .2 Pressure drop coefficients listed below are based on relative sheet metal duct pressure drop coefficient of 1.00.
- .3 Flame spread rating not to exceed 25. Smoke developed rating not to exceed 50.

2.2 METALLIC –INSULATED

- .1 Spiral wound flexible aluminum with factory applied, 25 mm (1") thick flexible glass fibre thermal insulation with vapour barrier and vinyl jacket, Class 1 duct material.
- .2 Performance:
 - .1 Factory tested to 2.5 kPa (10" w.c.) without leakage.
 - .2 Maximum relative pressure drop coefficient: 3.
 - .3 Operating pressure: 300 mm (12").
- .3 Acceptable materials:
 - .1 Flexmaster T/L – VT
 - .2 Ductmate

Part 3 Execution

3.1 DUCT INSTALLATION

- .1 Install in accordance with: SMACNA.
- .2 Maximum length of flexible duct: 1.8 m (6' 0").
- .3 Minimum length of acoustical ductwork; 1.5 m (5' 0") with minimum of 1 bend.
- .4 Provide support at centre of flexible duct with 25 mm (1") wide galvanized hanger.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 SMACNA HVAC Duct Construction Standards, Metal and Flexible.
- .3 ASTM C1071 Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material).
- .4 ASTM C916 Standard Specification for Adhesive for Duct Thermal Insulation.
- .5 ANSI/NFPA 90A, Installation of Air Conditioning and Ventilating Systems.
- .6 ANSI/NFPA 90B, Installation of Warm Air Heating and Air Conditioning Systems.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with general requirements.

Part 2 Products

2.1 DUCT LINER

- .1 General:
 - .1 Acoustical duct liner to be fibreglass duct liner meeting or exceeding requirements of ASTM C1071, Type I, Flexible or Type II, Rigid, and NFPA 90A/90B.
 - .2 Bonded with formaldehyde free bio-based binder.
 - .3 Mat faced airstream surface.
 - .4 Factory applied edge coating.
 - .5 Shall not contain formaldehyde, PBDE's, asbestos, mercury, mercury compounds, lead, contain 50% or greater recycled glass content.
 - .6 Thermal conductivity, ASTM C177/C518/C1114 .24BTU (sf•hr•°F) @ 75°F mean temp).
 - .7 Noise Reduction Coefficient (NRC) 1.5 PCF 1" = .70, 1 ½ " = .80, 2" =.95
ASTM C423, Type A mounting.
 - .8 Noise Reduction Coefficient (NRC) 2.0 PCF 1/2" = .50, 1" = .70, 1 ½ " = .85
ASTM C423, Type A mounting
 - .9 Corrosiveness/corrosion, ASTM C665/C1617. Does not accelerate/pass.
 - .10 Mold and mildew growth/fungi resistance, ASTM C1338, ASTM G21/G22, UL2824. Pass/resistant to mold.

- .11 Maximum service temperature, ASTM C411, 250°F (121°C).
- .12 Maximum rate air velocity, ASTM C1071, 6,000 ft./min. (30.5 m/sec.)
- .13 Water vapor sorption, ASTM C1104, less than 3%.
- .14 Surface burning characteristics, ASTM E84, UL 273, CAN/ULC S102, 20/50 flame spread/smoke development.
- .15 Acceptable material:
 - .1 Knauf Atmosphere Duct Liner
 - .2 Manson
 - .3 Johns Manville
 - .4 Owen Corning
- .2 Rigid:
 - .1 Use on flat surfaces.
 - .2 25 mm (1") thick, to CGSB 51-GP-10M, fibrous glass rigid board duct liner.
 - .3 Density: 96 kg/m³ (6 lb/ft²).

2.2 ADHESIVE

- .1 Meet requirements of ASTM C916.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range -29°C (-20°F) to 93°C (200°F).
- .3 Acceptable material:
 - .1 Duro Dyne 1A-22
 - .2 Ductmate

2.3 FASTENERS

- .1 Weld pins 2.0 mm (14 gauge) diameter, length to suit thickness of insulation. Metal retaining clips, 32 mm (1¼") square.
- .2 Acceptable material:
 - .1 Duro Dyne
 - .2 Ductmate

2.4 JOINT TAPE

- .1 Poly-Vinyl treated open weave fiberglass membrane 50 mm (2") wide.
- .2 Acceptable materials:
 - .1 Duro Dyne FT2
 - .2 Ductmate

2.5 SEALER

- .1 Meet requirements of ANSI/NFPA 90A and ANSI/NFPA 90B.
- .2 Flame spread rating shall not exceed 25. Smoke development rating shall not exceed 50. Temperature range -68°C (-90°F) to 93°C (200°F).
- .3 Acceptable materials:
 - .1 Duro Dyne 1A-94
 - .2 Ductmate

Part 3 Execution

3.1 GENERAL

- .1 Do work in accordance with recommendations of MAIMA Fibrous Glass Duct Liner Standards (FGDLS) or SMACNA duct liner standards.
- .2 Line inside of ducts where indicated.
- .3 Duct dimensions, as indicated, are clear inside duct lining.
- .4 Provide an interior of ductwork from fans from minimum distance of 3 m (10'-0").

3.2 DUCT LINER

- .1 Install in accordance with manufacturer's recommendations, and as follows:
 - .1 Fasten to interior sheet metal surface with 100% coverage of adhesive.
 - .2 In addition to adhesive, install weld pins not less than 2 rows per surface and not more than 300 mm (12") on centres.
- .2 Weld pins are to have cupped or beveled heads to prevent damage to lining surface.
- .3 Store foam liners away from sunlight.

3.3 JOINTS

- .1 Seal all butt joints, exposed edges, weld pin and clip penetrations and all damaged areas of liner with joint tape and sealer. Install joint tape in accordance with manufacturer's recommendations, and as follows:
 - .1 Bed tape in sealer.
 - .2 Apply 2 coats of sealer over tape.
- .2 Replace damaged areas of liner at discretion of Consultant.
- .3 Protect leading and trailing edges of each duct section with sheet metal nosing having 15 mm (1/2") overlap and fastened to duct.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 AMCA 99, Standards Handbook.
- .3 ANSI/AMCA 210, Laboratory Methods of Testing Fans for Certified Aerodynamics Performance Rating.
- .4 AMCA 300, Revised 1987, Reverberant Room Method for Sound Testing of Fans.
- .5 AMCA 301, Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
- .6 ANSI/ASHRAE 51, Laboratory Methods of Testing Fans for Certified Aerodynamics Performance Rating.
- .7 ANSI/NFPA 96 – Ventilation Control and Fire Protection of Commercial Cooking Operations.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with general requirements.
- .2 Product data to include fan curves and sound rating data.

1.3 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for incorporation into manual specified in general requirements.

1.4 CERTIFICATION OF RATINGS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered from independent testing agency signifying adherence to codes and standards in force.
- .2 Provide confirmation of testing.

Part 2 Products

2.1 FANS GENERAL

- .1 Capacity: flow rate, total static pressure Pa, r/min, W (" w.c., r/min, bhp) model and size and sound ratings as indicated on schedule.
- .2 Statically and dynamically balanced. Constructed in conformity with AMCA 99.
- .3 Sound ratings: comply with AMCA 301, tested to AMCA 300.
- .4 Performance ratings: based on tests performed in accordance with ANSI/AMCA 210, and ANSI/ASHRAE 51.

- .5 Bearings: sealed lifetime of self aligning type with oil retaining, dust excluding seals and a certified minimum rated life of 80,000 100,000 h in accordance with AFBMA L10 life standard. Bearings to be rated and selected in accordance with AFBMA 9 and AFBMA 11.
- .6 Provide vibration isolation hangers/pads for all fans.
- .7 Acceptable materials:
 - .1 Penn-Barry
 - .2 Greenheck
 - .3 Cook
 - .4 Jenco (S & P)/Jenn
 - .5 Carnes
 - .6 Acme
 - .7 Zonex
 - .8 Nutone (Range hood)
 - .9 Broan (Range hood)
 - .10 Twin-City
 - .11 Reversomatic
 - .12 Fantech
 - .13 Aerovent
- .8 Provide factory mounted speed control for all direct drive motors.

2.2 CEILING DISCHARGE FANS

- .1 Centrifugal direct drive, with plug in type electric motor suitable for ceiling installation, zinc coated rectangular metal housing.
- .2 Sizes and capacity: as indicated.
- .3 Toggle switch operated complete with integral electrical outlet box with plug-in type receptacle.
- .4 Side duct outlet with integral backdraft damper, size as indicated.
- .5 Wall cap complete with spring loaded backdraft damper with neoprene gasket.
- .6 Silver anodized aluminum grille paint finish.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Provide flexible duct connection for all fans.
- .3 Provide backdraft damper at building exterior penetration.
- .4 Provide and install vibration isolation.

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

- .1 Submit product data in accordance with general requirements.
- .2 Indicate the following:
 - .1 Capacity.
 - .2 Throw and terminal velocity.
 - .3 Noise criteria.
 - .4 Pressure drop.
 - .5 Neck velocity.

1.2 MAINTENANCE MATERIALS

- .1 Include:
 - .1 Keys for volume control adjustment.
 - .2 Keys for air flow pattern adjustment.

1.3 MANUFACTURED ITEMS

- .1 Grilles, registers and diffusers of same generic type to be product of one manufacturer.

1.4 CERTIFICATION OF RATINGS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by them from independent testing agency signifying adherence to codes and standards.

Part 2 Products

2.1 GENERAL

- .1 To meet capacity, pressure drop, terminal velocity, throw, noise level, neck velocity as indicated.
- .2 Frames:
 - .1 Full perimeter gaskets.
 - .2 Plaster frames where set into plaster or gypsum board and as specified.
 - .3 Concealed fasteners.
- .3 Concealed operators.

.4 Colour and Finish: standard as directed by Consultant.

.5 Acceptable materials:

- .1 E.H. Price
- .2 Nailor
- .3 Krueger
- .4 Titus
- .5 Carnes
- .6 Seiho
- .7 Metalaire
- .8 Tuttle and Bailey

2.2 SUPPLY GRILLES AND REGISTERS

- .1 General: with opposed blade dampers as indicated, concealed manual operator and gaskets.
- .2 Type, size, and capacity: as indicated.

2.3 RETURN AND EXHAUST GRILLES

- .1 General: with opposed blade dampers as indicated, concealed manual operator and gaskets and fire stop flap where indicated.
- .2 Type R1: aluminum, channel border, 15 x 15 mm (1/2" x 1/2") egg crate type face bars, baked off white finish. Model: Krueger EGC5 c/w fire flap.
- .3 Type R2: aluminum 25 mm (1") border, 15 mm x 15 mm (1/2" x 1/2") egg crate type face bars, baked off white finish, screwed fastening. Model: Krueger EGC5 c/w fire flap.
- .4 Type, size, and capacity: as indicated.

2.4 DIFFUSERS

- .1 General: volume control dampers with flow straightening devices and blank-off quadrants, as indicated and gaskets and fire stop flap and fire blanket where indicated.
- .2 Type D1: 4-cone adjustable, steel, square type, having adjustable pattern, 4-cone, baked off white finish, lay-in and or surface mounted (sliding type adjustment will not be accepted). Model: Krueger 1400A.
- .3 Type, size, and capacity: as indicated.

2.5 OPEN MESH SCREEN

- .1 15 mm x 15 mm (1/2" x 1/2") open mesh screen fastened on 25 mm (1") border, screw fasten.
- .2 On all open ends of ductwork and where indicated.
- .3 Size: To match ductwork size.

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Install with flat head screws in countersunk holes where fastenings are visible.
- .3 Bolt grilles, registers and diffusers, in place
- .4 Provide concealed safety chain on each grille, register and diffuser in gymnasium, similar game rooms, and on exposed diffusers, and elsewhere as indicated.
- .5 Clean grilles upon completion.
- .6 Paint ductwork beyond grilles, matte black where visible.
- .7 Ensure all grilles, diffusers, etc. match opening sizes as indicated on the drawings and as fabricated on site by the contractor.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 All codes, standards, etc. as referenced shall be the latest edition.
- .2 ASTM E90, Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions, and Elements.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with general requirements.
- .2 Indicate the following:
 - .1 Pressure drop.
 - .2 Face area.
 - .3 Free area.
 - .4 Colour and finish.

1.3 CERTIFICATION OF RATINGS

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

1.4 TEST REPORTS

- .1 Submit certified data from independent laboratory substantiating acoustic and aerodynamic performance to ASTM E90.

Part 2 Products

2.1 BRICK VENTS (FLANGE FRAME)

- .1 **Construction:** welded with exposed joints ground flush and smooth.
- .2 **Material:** extruded aluminum alloy 6063-T5.
- .3 **Blade:** stormproof pattern.
- .4 **Perimeter flange frame, head, sill and jamb:** 40 mm (1½") deep one piece extruded aluminum, minimum 3 mm (1/8") thick with approved caulking slot, integral to unit.
- .5 **Fastenings:** stainless steel (Society of Automotive Engineers) SAE-194-8F with SAE-194-SFB nuts and resilient neoprene washers between aluminum and head of bolt, or between nut, ss washer and aluminum body.
- .6 **Screen:** 15 mm (1/2") exhaust 20 mm (3/4") exhaust mesh, 2 mm (5/64") diameter wire aluminum birdscreen on inside face of louvres in formed U-frame.

.7 **Finish: Kynar 500**
Colour: to Consultant's approval.

.8 **Options:**
 .1 **Straight duct extension.**
 .2 **Perimeter flange frame.**

.9 **Acceptable materials:**
Greenheck Model BVF
Construction Specialties
E.H. Price
Krueger
Ruskin
Ventmaster
Ventex
Nailor

Part 3 Execution

3.1 INSTALLATION

- .1 In accordance with manufacturers and SMACNA recommendations.
- .2 Reinforce and brace air vents, intakes and goosenecks as indicated.
- .3 Anchor securely into opening.
- .4 Seal with caulking all around to ensure weather tightness.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with general requirements.
- .2 Indicate:
 - .1 Equipment, capacity, piping, and connections.
 - .2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.
 - .3 Special enclosures.
- .3 Primer coat to be off white.

1.2 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

Part 2 Products

2.1 CAPACITY

- .1 As indicated.

2.2 REHEAT COILS

- .1 Extended surface type, constructed of 15 mm (1/2") O.D. seamless copper tube and continuous aluminum plate fins.
- .2 Tubes shall be pressure bonded to the fin collars by expanding the tubes into the fin collars.
- .3 Stagger tube design circuited to optimize capacity with minimum pressure drop.
- .4 Die formed into a rippled pattern aluminum fins to provide maximum capacity with minimum air pressure drop and spaced not closer than 12 fins per 25 mm (per inch).
- .5 Headers shall be seamless copper tubes with 3 mm (1/8") drain and vent connections brazed into tubes.
- .6 Casings shall be constructed of heavy gauge galvanized steel with tube sheets having extruded tube holes.
- .7 Coil shall be factory leak tested at 2070 kPa (300 psig) dry air pressure and shall be designed for 860 kPa (125 psi) working pressure. Maximum water pressure drop shall be 15 kPa (2.17 psi or 5.0 ft w.c.) and maximum air pressure drop shall be 0.1 kPa (0.375 in w.c.).

- .8 Provide minimum two (2) row coil.
- .9 Acceptable materials:
 - .1 Engineered Air
 - .2 McQuay
 - .3 Madoc

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Install in accordance with piping layout and reviewed shop drawings.
- .3 Provide for pipe movement during normal operation.
- .4 Maintain sufficient clearance to permit performance of service maintenance.
- .5 Check final location with Consultant if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Consultant's directive.
- .6 Valves and Accessories
 - .1 Install valves with stems upright or horizontal unless approved otherwise.
 - .2 Install isolating valves on inlet and outlet of each unit.
 - .3 Install temperature control valve on each unit.
 - .4 Install strainer on each unit.
 - .5 Install drain valve with hose, end cap and chain on each unit.
 - .6 Install access doors on each side of coil.
- .7 Venting:
 - .1 Install screwdriver vent on cabinet convactor, terminating flush with surface of cabinet.
 - .2 Install standard air vent with cock on continuous finned tube radiation.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with general requirements.
- .2 Indicate:
 - .1 Equipment, capacity, piping, and connections.
 - .2 Dimensions, internal and external construction details, recommended method of installation with proposed structural steel support, sizes and location of mounting bolt holes.
 - .3 Special enclosures.
- .3 Primer coat to be off white.
- .4 All hydronic heating shall be by a single manufacturer.

1.2 MAINTENANCE DATA

- .1 Provide maintenance data for incorporation into manual specified in general requirements.

Part 2 Products

2.1 DAMPERS

- .1 Factory built, internal damper, complete with operator, at enclosure air outlet grille for each convection type heating unit not thermostatically controlled. Refer to schedules on drawings.

2.2 CAPACITY

- .1 As indicated.

2.3 FINNED TUBE RADIATION (H-1)

- .1 Heating elements: NPS 32 mm (1 1/4") seamless copper tubing, 1.2 mm (18 gauge) minimum wall thickness, mechanically expanded into flanged collars of evenly spaced aluminum fins, 100 mm x 100 mm (4" x 4") nominal, 164 fins per meter (50 fins/ft) suitable for sweat fittings.
- .2 Element hangers: cradle type providing unrestricted longitudinal movement on enclosure brackets. Space brackets 900 mm (36") centres maximum.

- .3 Standard enclosures: 450 mm (18") high, 1.6 mm (16 gauge) thick steel complete with stamped grille, components for wall-to-wall or complete with die formed end caps having no knock-outs, with inside corners, outside corners, as indicated. Provide full length channel and sealer strip at top of wall edge. Height as indicated. Joints and filler pieces to be flush with cabinet. Support rigidly top and bottom, on wall mounted brackets. Joints and filler pieces to be clear of grilles located to provide easy access to valves and vents. Provide access doors for valves. Finish cabinet with factory applied baked primer coat. Enclosure height as indicated. Sloping (flat) top open (sloping) bottom.
- .4 Special enclosures: as indicated.
- .5 Dimensions for enclosures: measure site conditions. Do not scale from drawing.
- .6 Provide for noiseless expansion of all components.
- .7 Expansion compensators: Flexonics at each section by mechanical contractor as specified elsewhere.
- .8 Acceptable materials:
 - .1 Engineered Air WF-1A Series
 - .2 Slant Fin
 - .3 Sigma

Part 3 Execution

3.1 INSTALLATION

- .1 Install in accordance with manufacturer's instructions.
- .2 Install in accordance with piping layout and reviewed shop drawings.
- .3 Provide for pipe movement during normal operation.
- .4 Maintain sufficient clearance to permit performance of service maintenance.
- .5 Check final location with Consultant if different from that indicated prior to installation. Should deviations beyond allowable clearances arise, request and follow Consultant's directive.
- .6 Valves
 - .1 Install valves with stems upright or horizontal unless approved otherwise.
 - .2 Install isolating gate valves on inlet and balancing valves on outlet of each unit.
- .7 Venting:
 - .1 Install screwdriver vent on cabinet convector, terminating flush with surface of cabinet.
 - .2 Install standard air vent with cock on continuous finned tube radiation.
- .8 Clean finned tubes and comb straight.
- .9 Install flexible expansion compensators as indicated.
- .10 Mount wall mounted convectors at 200 mm (8") above finish floor.

- .11 Mount wall mounted radiation at 200 mm (8") above finish floor unless otherwise indicated.
- .12 **Thermostats on outside walls: mount on insulated backplates.**
- .13 On units fed from below floor provide factory manufactured piping shrouds on the exposed piping between base of the radiation cabinet and finished floor. Shroud shall be manufactured by the radiation manufacturer. Shroud shall match finish of the radiation cabinet.

END OF SECTION

Part 1 General

1.1 GENERAL NOTE

.1 GENERAL

- .1 This project is an upgrade of an existing DDC control system. The work shall include an upgrade to the existing and provision of a new BAS system including design, supply, installation, and commissioning a complete microprocessor based automatic control system to achieve the performance specified in the following clauses.
- .2 The control system shall be installed by the control subcontractor but as an integral part of the mechanical sub-contract. The system shall be installed by trade certified electricians regularly employed by the control sub-contractor.
- .3 The controls contractor will specifically read all mechanical and electrical drawings, specifications, and addenda and determine the controls work provided by the mechanical contractor, his subcontractors, and the electrical contractor. The controls contractor is expected to have the expertise to coordinate the work of other contractors and to make a completely coordinated Building Automation Control System (BAS) for the mechanical systems. The controls specifications are specifically written to coordinate the mechanical and electrical systems. Where others are specifically specified to allow for controls work, then the BAS contractor will not allow for that work. This clause is not intended to make the controls contractor responsible for work not specified, but to make the BAS contractor responsible for examining the specifications for contradictions and overlap.
- .4 All work indicated in the plumbing drawings and associated with the fire protection or plumbing systems will be the responsibility of the mechanical contractor unless specifically indicated in the controls sequence of operation or points list.
- .5 The BAS contractor shall provide the necessary engineering, installation, supervision, commissioning and programming for a complete and fully operational system. The contractor will provide as many trips to the job site for installation, supervision, and commissioning as are necessary to complete the project to the satisfaction of the consultant and/or School Board project supervisor.
- .6 The system shall consist of all operator interfaces, microprocessor-based controllers, sensors, wells, automatic control valves, control dampers, transducers, and relays, automatic control valves, and damper actuators.

.2 SCOPE

- .1 This project scope shall include, but not be limited to, the following work:
 - .1 Preparation of control shop drawings for review and approval. See Submittals.
 - .2 Supply and install a network of Building Automation Control System (BAS) panels and field devices. See Hardware, Software and Field Devices.
 - .3 Supply and install customized graphics software to School Board standards, system software, and third party software as specified. See Software.
 - .4 Install, wire and label all BAS control system components. See Installation.
 - .5 Calibrate and commission the installed control system. See Commissioning.
 - .6 Provide maintenance manuals and as-built drawings. See As-Built Documentation.
 - .7 Provide customized training for School Board operations, maintenance and technical staff. See Training.

.3 APPROVED SYSTEMS

- .1 Bids for the BAS contract will only be accepted from authorized vendors/installers of the Reliable Controls product:
 - .1 Set Point Building Automation Inc.
347 Pido Road
Peterborough, Ontario
K9J 6X1
Tel: (705) 745-1600
Contact: Mr. Matthew Jewell

.4 SUBMITTALS

- .1 Submit the six (6) copies of following information to the consultant and/or the KPRDSB project supervisor for review and approval:
- .2 Control Schematics
- .3 Detailed sequence of operation for each control schematic or controlled system.
- .4 System Architecture indicating the proposed interconnection and location of all BAS panels, network connections and key peripheral devices (workstations, modems, printers, repeaters, etc.)
- .5 BAS Points List indicating the panel ID, panel location, hardware address, point acronym, point description, field device type, point type (i.e., AO/DO/AI/DI), end device fail position, end device manufacture and model number, and wire tag ID).
- .6 Wiring diagrams including complete power system, interlocks, control, and data communications.
- .7 Manufacturers' data / specification sheets for all material supplied.

.5 RELATED WORK

- .1 Unless otherwise specified, the following work shall be furnished by others:
- .2 The mechanical sub-contractor shall provide:
 - .1 Water treatment system mechanical wiring.
- .3 The BAS contractor shall provide:
 - .1 AHU freeze stats and high limit
- .4 The mechanical sub-contractor under the supervision of the controls subcontractor shall provide:
 - .1 Installation of control dampers including duct transitions, assembly and inter-connection of multiple section dampers.
 - .2 Supply and installation of sheet metal baffles as required to eliminate air stratification.
 - .3 Supply and installation of access panels for service and installation of control equipment.
 - .4 Installation of automatic valves, wells, flow switches, and other pipe related control devices.

.6 SYSTEM HARDWARE

- .1 The system architecture will be comprised of an Operator Workstation, PCUs (Primary Control Units), PACs (Programmable Application Controllers) and ASCs (Application Specific Controllers) networked together to provide a system of connected controllers that operate as a single BAS for the entire project.
- .2 Supply PCU's, PAC's and ASC's as required to interface to all specified equipment.
- .3 Allow minimum 25% spare program and trend memory capacity in each PCU and PAC.
- .4 Primary Control Units (PCU)
 - .1 Use only Primary Control Units namely Reliable Mach-Global, Mach 2 or Mach 1 to directly control any major mechanical equipment. Major mechanical equipment includes air handling units, and other critical equipment.
 - .2 Every installation shall have a minimum of one (1) Reliable Mach-Global Panel.
 - .3 Each PCU shall provide an RS-232 port for direct connection to a PC.
 - .4 Each PCU shall contain a real time clock and sufficient memory to store its own application database, operating parameters, user programs and trend data storage.
 - .5 Battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours to eliminate operating data reload in case of power failure.

- .6 Each PCU output shall include a Hand/Off/Auto (HOA) selector switch for all analogue and digital outputs used to control major equipment as described above.
- .7 Each PCU shall have a minimum of 10% spare input channels and 10% spare output channels installed onboard the panel and ready for connection at the completion of the project.
- .8 The PCU shall have a minimum of eight (8) inputs and eight (8) outputs.
- .5 Programmable Application Controllers (PAC)
 - .1 PACs are fully programmable controllers namely Mach 1 panels, used for controlling distributed equipment such as radiation, reheat coils, exhaust fans and other distributed equipment. PACs interface to the Primary Control Units via on a sub-network.
 - .2 PACs shall not be used for controlling major mechanical equipment as described above.
 - .3 Each PAC shall contain a real time clock and sufficient RAM to store its own application database, operating parameters, user programs and trend data storage.
 - .4 Battery backup shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours to eliminate operating data reload in case of power failure.
 - .5 Each PAC output shall include a Hand/Off/Auto (HOA) selector switch for all analogue and digital outputs used to control major equipment as described above.
 - .6 The PAC shall have a minimum of eight (8) inputs and eight (8) outputs.
- .6 Application Specific Controllers (ASC)
 - .1 Application Specific Controllers are pre-programmed controllers namely Reliable Mach-Air panels, used to control typical equipment such as rooftop units.
 - .2 ASCs shall not be used to control major mechanical equipment or non-typical equipment.
- .7 Operator's Work Station
 - .1 Supply and install all operating software and dynamic system graphics on the Operator's Workstation. Workstation to be supplied by KPRDSB.
 - .2 Supply licenses for all supplied software directly to the KPRDSB Project Supervisor.
- .8 System Remote Access
 - .1 WAN Access
 - .1 Provide necessary interface and cabling to connect the BAS to the KPRDSB WAN. Obtain the particular WAN system details from the Engineer or KPRDSB Project Supervisor. WAN IP address to be supplied by the School Board.
 - .2 Alarms
 - .1 Provide and wire a dedicated input to monitor alarming and disarming of the building security system.

- .3 Local PC Ports (RS-232)
 - .1 Where BAS points (4 or more) are located in a mechanical room that does not have a local BAS panel installed, a remote serial port connector (9-pin female) shall be provided to allow for local interface to the BAS via the portable maintenance interface.
 - .2 Mount the serial connector in a hinged metal enclosure with key-lock set and lamicoid ID label.
- .7 SYSTEM SOFTWARE
 - .1 Operators Workstation Software and Graphical Interface
 - .1 The Operators Workstation software shall be the latest version of the manufacturers product (RC-Studio) and original software disks / CD's shall be provided to the School Board.
 - .2 The software shall provide access to all controllers, points programs and systems.
 - .3 The Graphical User Interface shall be installed and dynamically updated.
 - .4 The Graphics shall be installed as per the School Board's standards specified in section 15900-16 of this document.
 - .2 Trend Data
 - .1 Provide trend logs for every hardware input and output.
 - .2 All trends should be accessible via the graphical interface.
 - .3 Trends should contain all related variables of a control loop (i.e. setpoint, measured variable and control output) and have the ability to be plotted simultaneously on the same graph. Field Devices Individual trends should provide an appropriate "snapshot" of the variable. Slow reacting variables such as space temperatures should be sampled every 30 - 60 minutes while other variables such as mixed air or boiler water temperatures should be sampled every 5 to 10 minutes. Trends should contain a minimum of 72 hours worth of trend data.
 - .4 The primary input sensor for all control loops must connect to the same panel containing the control loop output.
 - .5 Trend data storage must be in the same panel as the hardware or logical points being trended.
 - .3 User Access
 - .1 The remote connection to the BAS will be configured to allow for the same user commands and functionality as the local front-end connection. The modem connection will allow a remote user to perform panel database uploads/downloads on all BAS panels in the system.
 - .2 The system will be configured so that a remote user (dial-in or LAN) and local user can be logged onto the BAS simultaneously, and be able to access all controllers, points and programs in the system.

.4 Alarms

- .1 The BAS will be configured to provide for remote alarm capabilities. The BAS shall be capable of dialling out to a minimum of three separate telephone numbers. Designated alarms will be capable of being sent to one or more telephone numbers.
- .2 Alarms will be sent in ASCII text format.
- .3 The controls vendor will verify that the designated remote workstation successfully receives a series of test alarms.
- .4 Provide and wire a dedicated output to interface to a designated building security/surveillance. This output will be programmed to initiate whenever specified system alarms are active.

.8 FIELD DEVICES

.1 Automatic Control Valves

- .1 Submit a valve schedule for all valves supplied under this contract. The valve schedule will contain the following information for each valve:
- .2 Valve type, size, manufacturer, model number, flow coefficient, design flow, pressure drop across valve, max. close-off pressure, actuator manufacturer and model number and maximum torque.
- .3 Zone valves shall have a design pressure drop of approximately 1.0 psi. HVAC control valves shall have a design pressure drop between 3 and 5 psi. The minimum allowable CV shall be 0.8 regardless of pressure drop.
- .4 Valves used for throttling applications shall have a linear percentage-to-flow characteristic.
- .5 Ball valves are the preferred valve type for zone and HVAC control valves. Globe and butterfly valves shall be used where required to provide the desired pressure drop and CV.
- .6 Automatic Control valves shall be manufactured by Belimo.

.2 Control Valve Actuators

- .1 Size control valve actuators to provide a tight close off against system head pressures and pressure differentials.
- .2 Valve actuators shall accept a 0-10VDC control voltage for all proportional applications.
- .3 Floating-point control of valves are not acceptable under any circumstances.
- .4 Heating valves shall spring-return fail open and cooling valves shall spring-return fail closed. Non-spring-return control valves may be used for terminal reheat coils and large HVAC control valves requiring a higher close off pressure.

- .3 Damper Actuators
 - .1 Actuators shall be direct coupled for either modulating or two-position control. Actuators shall be powered by an overload-proof synchronous motor. Provide 0-10 VDC control voltage for all proportional applications and either line or low voltage actuators for all two-position applications.
 - .2 Damper actuators are to be manufactured by Belimo.
 - .3 Duct temperature sensors shall be installed in the airflow down stream of every duct mounted reheat coil.
 - .4 Duct temperature sensors shall be installed downstream of all variable air volume boxes with reheat coils installed.
- .4 Automatic Control Dampers
 - .1 All automatic control dampers not furnished with packaged equipment shall be supplied by the controls subcontractor and installed by the sheet metal subcontractor. All dampers in a mixing application shall be opposed blade. Parallel blade shall be permitted in other applications. Dampers shall be a tight closing, low leakage type with replaceable extruded vinyl seals on all outdoor and exhaust applications.
- .5 Room Sensors/Thermostats
 - .1 Mount sensors at a height of 5'-6" unless otherwise indicated.
 - .2 10 k ohm type-3 thermistors only shall be used and shall have end-to-end accuracy +/- 0.3 deg C over the entire operating range.
 - .3 Provide stainless steel plate sensors for public areas such as stairways, vestibules, lobbies and gymnasiums.
 - .4 Room sensors will not normally have setpoint adjustment. Provide an external setpoint adjustment only when specified for specific offices or meeting rooms.
 - .5 Mount thermostats and space sensors as noted on the drawing. Do not mount on outside walls without permission of consultant.
 - .6 Supply and install heavy-duty thermostats for unit heaters, electric radiation or fan coil units where specified.
- .6 Current Switches (Digital)
 - .1 Provide BAS status for fan and pump motors using a mosfet type digital switch. Acceptable manufactures are ACI, Enercorp, Greystone and Veris, and Elkor.
- .7 Pressure Transmitters
 - .1 Technical Performance - Solid State design, operating on capacitance principle, with non-interactive fine resolution, zero and span adjustments. End-to-end accuracy +/- 2% of full-scale pressure range, including temperature compensation. 4-20mA or 0-5 VDC output.
 - .2 Standard of Acceptance – ACI, Enercorp, Greystone, Modus

- .8 Duct Temperature Sensor
 - .1 Probe - Technical Performance – 10 k ohm thermistor sensor encapsulated in a 200mm long, 6mm OD copper or stainless steel probe. Operating range 0-60°C. End-to-end accuracy +/- 0.3 deg C. Assembly complete with wiring housing and mounting flange.
 - .2 Averaging - Technical Performance - 10 k ohm thermistor constructed of FT6 plenum rated cable or soft copper tubing, incorporating numerous temperature sensors encapsulated at equal distances along the length of the element. The assembly acts as a single sensor reporting the average temperature from all individual sensors. End-to-end accuracy +/- 0.3 deg C. Assembly complete with wiring housing and mounting flange. Mount in a zigzag manner to provide continuous coverage of the entire duct cross-sectional area.
- .9 Outdoor Air Temperature Sensor
 - .1 Two outdoor air temperature sensors shall be installed and shall be programmed to check each other for accuracy. In the event of sensor failure the sensor deemed to be accurate should be used to control the systems. The outdoor air sensors shall be located on a north wall if possible and a minimum of three (3) feet from any opening in the building envelope, which could affect the sensor readings. The back face of the sensor enclosure shall be insulated to prevent temperature pick up from the building wall.
 - .2 Technical Performance, 10 k ohm thermistor -50C to 50C in a weatherproof enclosure mounted on north exposure. End accuracy of +/- 0.3 deg C over the entire operating range.
- .10 Pipe Temperature Sensor
 - .1 Well - Technical Performance - 10k ohm thermistor sensor encapsulated in a 6mm OD, 50mm long probe, with screw fitting for insertion into a standard thermowell. Operating range -10 - +100°C. End-to-end accuracy +/- 0.3 deg C over the entire operating range. Comes complete with brass thermowell. Use conductive gel when mounting the sensor in thermowell. Use heat transfer paste when mounting the sensor in thermowell. No surface mount strap on temperature sensors shall be used to monitor fluid temperature unless approved by the engineer.
- .11 CO2 Detector
 - .1 Technical Performance – Infrared CO2 monitor c/w 4-20mA or 0-5 VDC output, accuracy of +/- 40 ppm +3% reading.
 - .2 Standard of Acceptance – Vulcain 90DM4DT-C-2000 duct mount, Vulcain 90DM4ASM wall mount.

.9 INSTALLATION STANDARDS

.1 Power Sources and Wiring Methods

- .1 All wiring line and low voltage shall be installed in EMT conduit unless specifically specified otherwise.
- .2 In accessible ceilings wiring from BAS controllers to sensors and actuators, control system network and low voltage wiring only may be installed with yellow jacket LVT cable. Where the ceiling is used as a return air plenum install plenum rated yellow jacket cable instead of LVT.
- .3 BX or flex conduit may only be used for the final (approximately one meter) run to controls devices, where the controls equipment is mounted on vibrating machinery.
- .4 Install EMT and cable at right angles to building lines, securely fastened, and in accordance with the standards set out in Division 16.
- .5 No wire smaller than 18 gauge wire is to be used on the project except for: wiring between terminal computer devices, wire in standard communication cables, such as printers and short haul modems, wire used in communication networks, i.e. any cable transferring digital data, using twisted shielded pairs.
- .6 All wiring from panels to devices shall be without splicing.
- .7 Provide wells for all specified temperature sensors in hydronic piping system. Strap-on sensors may be only be used where a well installation is not possible. Obtain approval of Engineer for the use of strap-on sensors.
- .8 Power for control system shall not be obtained by tapping into miscellaneous circuits that could be inadvertently be switched off.
- .9 Mount transformers and other peripheral equipment in panels located in serviceable areas. Provide line side breakers/fuses for all transformers.
- .10 All 120 VAC power for any controls equipment shall be from dedicated circuits. Provide a breaker lock for each breaker used to supply the control system. Update the panel circuit directory.
- .11 The controller may be powered from the equipment that it is directly controlling (i.e. heat pump, roof-top unit) only if the controller controls no other equipment and the power supply to the controller remains energized independently of unit operation or status.
- .12 All BAS control panels shall be provided with UPS in the power supply except for Application Specific Controllers (ASC).
- .13 All BAS control wiring shall be yellow jacket for identification purpose.
- .14 The breaker or power isolation location shall be clearly marked on the inside door of each BAS panel enclosure.

.2 Equipment Location

- .1 All distributed equipment such as VAV boxes, Roof top units, unit ventilators, fan coil units, etc. that utilize dedicated BAS controllers, shall have locally mounted controllers, in accessible locations within the building envelope. All locally mounted controllers shall be installed in enclosures suitable for that location. BAS controllers for mechanical equipment other than those listed above shall be mounted in mechanical rooms as noted below, unless specifically approved by the Engineer for this project.
- .2 All other BAS controllers, and interface devices that require regular inspection or that serve multiple HVAC systems shall be located in mechanical rooms, or in pre-approved storage rooms, or janitor closets.
- .3 All BAS panels shall be located within the building envelope, and shall be enclosed in a metal locking enclosure, as specified elsewhere herein.
- .4 All equipment located in mechanical rooms, storage rooms or janitor closets shall be installed in metal cabinets with hinged, lockable covers. Provide an KPRDSB-standard #549 key/lock set for each cabinet.
- .5 Transformers or power supplies shall not be located in ceiling spaces unless approved by the engineer for terminal control valves, actuators or zone controllers. When transformers are installed above ceilings, transformers shall be installed in metal enclosures, and the location shall be clearly labelled on the t-bar ceiling to indicate power transformer location.
- .6 A 120 VAC duplex receptacle for laptop power shall be provided if the cabinet is located further than 1500 mm (5') laterally from the nearest outlet.

.10 IDENTIFICATION AND LABELLING OF EQUIPMENT

- .1 All panels must have a lamicaid tag (min. 3"x1") affixed to the front face indicating panel designation and function (i.e. "BAS Panel 1" or "Relay Panel 3").
- .2 All field sensors or devices must have a lamicaid tag (min. 3"x1") attached with tie-wrap or adhesive indicating the point software name and hardware address (i.e. AHU1_MAT, 2.IP4).
- .3 Room sensors and other sensors in finished areas do not require a device tag.
- .4 All devices within a field enclosure will be identified via a label or tag.
- .5 All BAS panel power sources must be identified by an adhesive label indicating the source power panel designation and circuit number on the outside of the enclosure door (i.e. "120vac fed from LP-2A cct #1).
- .6 All field equipment panels fed from more than one power source must have a warning label on the front cover.
- .7 All wires will be identified with self-adhesive wire labels or clip-on plastic wire markers at both ends.
- .8 All rotating equipment controlled by the BAS will have a tag or label affixed indicating that the equipment may start without warning.
- .9 If a phone line manager is supplied, its location should be indicated via a label affixed to the inside cover of the modem enclosure or BAS panel.

- .10 All BAS panels will have a points list sheet (within a plastic sleeve) attached to the inside door. The points list will identify the following for each point: Panel number, panel location, hardware address, software name, point description, field device type, point type (i.e. AI or DO), device fail position, device manufacturer and model number or reference and wire tag reference.
- .11 Where required, field panels will have wiring diagrams attached to the inside door.
- .12 Provide new or modify existing equipment wiring diagrams (i.e. boilers, chillers, etc.) wherever the BAS interfaces to other equipment.
- .11 COMMISSIONING
 - .1 Confirm and demonstrate to the Engineer Mechanical Contractor, and the Owner's agent that that all systems are programmed and operating correctly.
 - .2 Submit four (4) copies of the system commissioning report to the Engineer for review and approval.
 - .3 Each analogue inputs (i.e. temperatures, pressure, etc.) shall be verified with an approved calibration device. All actual temperature readings should be with +/- 1C of the readings observed at the workstation.
 - .4 Each analogue output shall be verified by manually commanding the output channel from the operator workstation to two or more positions within the 0-100% range and verifying the actual position of the actuator or device. All devices shall operate over their entire 0-100% range from a minimum control range of 10-90%.
 - .5 Digital outputs shall be verified by witnessing the actual start/stop operation of the equipment under control.
 - .6 Digital inputs shall be verified by observing the status of the input point as the equipment is manually cycled on and off.
 - .7 Record all out-of-season or unverified points in the commissioning report as "uncommissioned".
 - .8 The BAS field panel power source shall be toggled on and off to ensure reboot functionality and power down memory retention of all parameters. During the power down test, all connected system components should go to their fail-safe state.
 - .9 All trends should be reviewed to ensure that setpoints are being maintained and excessive cycling of equipment is not occurring.
 - .10 Control loop-tuning parameters can be verified by applying a change to the current setpoint and observing the resulting trend log. Setpoint should be reached in a "reasonable" period of time without excessive cycling or hunting of the controlled device.

.12 TRAINING

- .1 KPRDSB shall provide training for the building operations staff.
- .2 At the completion of the installation and immediately following commissioning provide a ½ day training session on site for the Owner's designated maintenance personnel.

.13 WARRANTY

- .1 Warranty all components supplied under this contract for a period of one year from substantial completion. Replace all controls equipment that fails during this period without cost to the owner.

.14 AS-BUILT DOCUMENTATION

- .1 Within two weeks following substantial completion of the project, update the original submittal documents to reflect the "As Built" conditions of the project and submit as many copies as are required by the consultant and/or the School Board Project Supervisor.
- .2 Provide a separate laminated copy of the control drawings for mounting in the mechanical room or in the controls panels as directed by the consultant or the KPRDSB Project Supervisor.
- .3 Submit diskettes/CD's (including back-up diskettes/CD's) containing up to date copies of the programs in each controller. Provide original program disks and documentation proving registration for all software programs provided as a part of this contract including: the BAS operator interface software, and the BAS graphics (Illustrator files & bitmap files). Provide one set of original disks for every computer supplied under this contract or that the software has been loaded onto.
- .4 Submit (4) printed copies of the final programs that include all point definitions, weekly and annual schedule setting, controller setpoints and tuning parameters, and documented programmed sequences of operation.

.15 GRAPHIC DISPLAY SCREENS

- .1 All Graphic Display Screens shall have the following common elements and functions regardless of system manufacturer. Every site shall have a graphic display screen for Site Graphic, System Architecture, each air handler, boilers, emergency generator, lighting, exhaust fans, heat reclaim, and for each room controlled by the BAS system.
The Graphic Display Screens shall follow the format to be consistent with the established School Board Reliable BAS Systems as displayed in Appendix "A". All operator accessible points shall be yellow text and all information points shall be blue. The specific screens shall include the following:
- .2 Graphic Screens General All Screens
 - .1 Navigation buttons to each major system in the building which indicate current screen display by a change in button colour.
 - .2 Background colour shall be black.
 - .3 Outdoor air temperature shall be displayed on every graphic screen.

- .3 Site Graphic
 - .1 the KPRDSB Logo on the site or opening graphic screen
 - .2 artist concept or scanned in picture of the front of the school
 - .3 access links to all global schedules or specific screens affecting entire building operation
 - .4 access buttons links to Set Time, Holiday Schedule, PD Day Schedule, Alarms, Points on Manual, Conversion °C - °F, 24 Hour Clock, Operations Manual, AutoCAD Drawings, Reliable BAS Manual, and Work Orders.
- .4 System Architecture
 - .1 control panel layout and network architecture
 - .2 indicating BAS panels and panel type (model)
 - .3 panel locations
 - .4 systems controlled by each panel
 - .5 links to points list accessible from each panel
- .5 Floor Plans graphics
 - .1 Room numbers accurate as per room signage
 - .2 Mechanical rooms locations & signage tags
 - .3 space temperatures for every temperature on each floor in appropriate room
 - .4 space focus pick area for individual room control where applicable shall be yellow text.
 - .5 Air Handler symbols indicating areas of the floor plan serviced by each air handler by a corresponding colour, as shown in Appendix "A"
 - .6 Status of Air Handler by colour change Red for off status, or text indication
 - .7 Supply air temperature for each air handler
- .6 Air Handler (AHU) graphic
 - .1 accurate representation of the AHU design
 - .2 all associated control points to be displayed
 - .3 all points to be monitored for automatic mode and shall be displayed when in Manual mode
 - .4 calculated percentage of fresh air shall be indicated on the AHU graphic
 - .5 operator offset adjustment of the supply air setpoint, adjustable directly form the graphic
 - .6 AHU physical location shall be indicated on the graphic
 - .7 weekly occupied time of day schedule for the associated AHU shall be accessible directly from the graphic by selecting an icon
 - .8 weekly student time of day schedule for the associated AHU shall be accessible directly from the graphic by selecting an icon
 - .9 trend logs shall be accessible directly form the graphic by selecting an icon

- .7 Exhaust fans graphic
 - .1 exhaust fans control shall be editable directly from the graphic
 - .2 exhaust fan status shall be indicated in text and a change in the exhaust fan icon
 - .3 exhaust fan physical location shall be indicated on the graphic
 - .4 area of the building being exhausted shall be indicated on the graphic

.16 RELIABLE BAS DATABASE NAMING CONVENTIONS AND PROGRAMS

.1 Miscellaneous Equipment Naming Conventions

INPUTS		OUTPUTS	
Equipment	Point Name	Equipment	Point Name
Exhaust Fan Status	EF # Status	Exhaust Fan Control	EF # Control

- .2 Network Status Panel Naming Conventions should indicate the school, panel location and panel number. The school name can be abbreviated as necessary to fit in the space.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- .1 Plumbing & Drainage
Ventilation & Air Conditioning
Testing & Balancing
HVAC System Commissioning
Electrical
- .2 Supply all necessary efforts to provide the project DDC system as specified.

1.3 DESCRIPTION OF SYSTEM

- .1 This is an upgrade and/or modification of an existing DDC control system. Furnish and install all components, devices and control wiring for a fully integrated Energy Management and Environmental Control System incorporating Direct Digital Control (DDC), and equipment monitoring. The system shall control and monitor HVAC equipment, HVAC systems, and other equipment as specified in this section.
- .2 Refer to demolition drawings for removal of all existing control devices. All existing exposed pneumatic tubing and equipment which is not reused shall be removed complete. All concealed existing pneumatic tubing shall be abandoned.
- .3 Furnish and install all components, devices and control wiring for a fully integrated Energy Management and Environmental Control System incorporating Direct Digital Control (DDC), and equipment monitoring. The system shall control and monitor HVAC equipment, HVAC systems, and other electrical loads as specified in this section. The work shall include but is not limited to the following:
 - .1 Extension of the existing programmable building automation control (BAS) system
 - .2 Control and monitoring of indoor space temperature.
 - .3 Local/remote system control/monitoring via BACnet/IP TCP/IP Ethernet LAN/WAN connections
 - .4 Heat Vent Unit Control

- .5 Trap Primer Control
- .6 Radiation heating control
- .7 Force Flow Control/Unit Heater
- .8 Building low temperature Low building temperature alarm (all spaces with sensor)
- .9 All control valves, dampers, operators, etc, required under this contract
- .10 All electric wiring, switches, relays, etc., for a complete operating system
- .11 All wiring incidental to controls system
- .12 System and equipment trending and scheduling
- .13 System training
- .4 All the necessary controls, valves, motors, control wiring, conduit, control panels, instrumentation, computer software, and network access units, for the specified system shall be provided under this section. The installed system shall incorporate electronic and digital control devices to perform the control sequences and programs outlined herein. Specific control sequence requirements are as detailed in subsequent sections of this specification and on the drawings.
- .5 All electrical wiring, mechanical installations, and control sequences shall comply with local and provincial electrical and mechanical codes.
- .6 Testing, debugging, confirmation of total system operation and owner training on the complete operation of the system and the computer software shall also be provided in this section.

1.4 SYSTEM ACCEPTANCE

- .1 System commissioning and interface to facilities management network shall be performed by the Building Automation contractor.
- .2 On project completion, the contractor shall issue a report to the consultant stating that the system is complete, that all hardware and software functions have been verified and that the system is operating in accordance with the specifications. A demonstration of complete system operation shall then be made to the owner's authorised representative.
- .3 Upon successful completion of the system demonstration, the owner's representative shall be requested to approve, in writing, the satisfactory operation of the DDC System, interface devices and accessories.
- .4 The consultant shall verify through the owner's representatives that the entire system is complete and operating to the satisfaction of the owner before final acceptance is approved.

1.5 MAINTENANCE DATA AND SERVICE

- .1 Provide maintenance data for controls and instrumentation for incorporation into maintenance manual.
- .2 After acceptance, seasonally check and readjust control systems for change over. Make 2 site trips. Notify Engineer of scheduled dates. Carry out any preventive maintenance required including parts and labour. Report to Engineer, in writing, results or resetting made.
- .3 Provide as-built information in accordance with Section 15010, requirement.

1.6 TESTING AND BALANCING

- .1 During the system testing and balancing by an independent agency fully demonstrate the operation of all sensors, dampers, actuators, controls, valves, etc. This contractor shall be present during the testing and balancing and make adjustments as often as necessary to satisfy the testing and balancing agency.

Part 2 Products

2.1 ELECTRIC AND MECHANICAL DEVICES

- .1 All electric switch devices shall be selected for the applied load and UL listed and labeled for the application and environment to which they are applied. Miscellaneous, electric, and mechanical devices shall include:
- .2 Provide any automatic control dampers not specified to be integral with other equipment. Frames shall not be less than 2.5 mm (13 gauge) galvanized steel. Blades shall not be over 200 mm (8") wide nor less than 1.6 mm (16 gauge) galvanized steel roll formed. Bearings shall be oilite, ball bearing or nylon with steel shafts. Side seals shall be stainless steel of the tight-seal spring type. Dampers and seals shall be suitable for temperature ranges of -40°C to 93°C (-40°F to 200°F).
 - .1 All proportional control dampers shall be opposed or parallel blade type as hereinafter specified and all two-position dampers shall be parallel blade types.
 - .2 Dampers shall be sized to meet flow requirements of the application. The sheet metal contractor shall furnish and install baffles to fit the damper to duct size. Baffles shall not exceed 150 mm (6").
 - .3 Dampers shall be minimum leakage type to conserve energy and the temperature control manufacturer shall submit leakage data for all control dampers with the temperature control submittal. Maximum leakage for dampers in excess of sixteen inches square shall be 152 l/s/m² (30 cfm/ft²) at static pressure of 25 mm (1") of w.c.
 - .4 Where ultra-low leakage dampers are specified the blade edges shall be fitted with replaceable, snap-on, inflatable seals to limit damper leakage to 2.8 l/s/m² (6 cfm/ft²) for dampers in excess of sixteen inches square at 25 mm (1") of w.c.

- .3 Automatic control valves 65 mm (2½") and smaller shall be screwed type, and valves 80 mm (3") and larger shall be flanged. Valves shall be ANSI-rated to withstand the pressures and temperatures encountered. Valves shall have stainless-steel stems and spring loaded Teflon packaging with replaceable discs.
- .1 All modulating straight-through water valves shall be provided with equal-percentage contoured throttling plugs. All three-way valves shall be provided with linear throttling plugs such that the total flow through the valve shall remain constant regardless of the valve's position. Valves shall be sized for a pressure drop equal to the coil they serve but not to exceed 34 kPa (5 psi).
- Unitary valves shall provide precision flow control of hot or chilled water in various heating or cooling applications. The unitary valves shall consist of a valve body and replaceable characterized cartridge assembly and shall be compatible with a valve actuator that meets the requirements of UL94-5V fire retardancy for mounting in return air plenums. The actuators shall have conformally coated printed circuit boards for humidity resistance.
- The actuators shall de-energize when the valve is not in motion to extend service life. The unitary valves shall provide proportional flow in modulating, diverting or mixing applications. They shall operate silently and resist water hammer.
- The unitary valve and actuator assembly shall be equipped with a manual opener and position indicator.
- .4 All automatically controlled devices, unless specified otherwise elsewhere, shall be provided with actuators sized to operate their appropriate loads with sufficient reserve power to provide smooth modulating action or two-position action and tight close-off. All actuators (valves, dampers etc.) shall be by this contractor.
- Acceptable material:
Belimo

Part 3 Execution

3.1 GENERAL

- .1 The DDC controls project shall be performed in accordance with the general conditions of the contract. The contractor shall conduct all on-site work in conjunction with building operating staff to streamline the new system startup.
- .2 The summary of input/output channels describe the DDC system points. It is the responsibility of the Contractor to ensure compatibility of the mechanical systems, devices, and actuators with the DDC system.
- .3 All digital output control points located in unconditioned spaces shall be relocated to an accessible ventilated indoor location. All control devices, DDC panels; other shall be located inside the conditioned space of the building envelope.
- .4 All DDC system equipment will become the property of the Owner.

3.2 ON SITE TESTING

- .1 Provide Engineer-approved operation and acceptance testing of the complete system. The Consultant/Owner will witness all tests.
- .2 Field Test: When installation of the system is complete, calibrate equipment and verify transmission media operation before the system is placed on-line. The installer shall complete all testing, calibrating, adjusting and final field tests. Provide a detailed cross-check of each sensor within the system by making a comparison between the reading at the sensor and a standard traceable to the National Bureau of Standards.

Provide a cross-check of each control point within the system by making a comparison between the control command and the field-controlled device. Verify that all systems are operable from local controls in the specified failure mode upon panel failure or loss of power. Submit the results of functional and diagnostic tests and calibrations to the Engineer for final system acceptance.
- .3 Compliance Inspection Checklist: Submit in the form requested, the following items of information to the Owner's Representative and Consultant for verification of compliance to the project specifications. Failure to comply with the specified information shall constitute non-performance of the contract. The contractor shall submit written justification for each item in the checklist that he is unable to comply with. The Owner's Representative and the Consultant will initial and date the checklist to signify contractor's compliance before acceptance of system.
 - .1 Verify to the Owner's Representative and Consultant in letterform that supplier has in-place support facility. Letter shall show location of support facility, name and titles of technical staff, engineers, supervisors, fitters, electricians, managers and all other personnel responsible for the completion of the work on this project.

User	Date	Consultant	Date
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 - .2 Manually generate an alarm at a remote DDC Controller as selected by the Consultant to demonstrate the capability of the workstation and alarm printer to receive alarms within 5 seconds.

User	Date	Consultant	Date
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 - .3 Disconnect an operator workstation in the central control room and manually generate an alarm at a remote DDC Controller to demonstrate the capability of the system printer to receive alarms when the workstation is disconnected from the system.

User	Date	Consultant	Date
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 - .4 Disconnect one DDC Controller from the network to demonstrate that a single device failure shall not disrupt or halt peer-to-peer communication. Panel to be disconnected shall be selected by the Consultant.

User	Date	Consultant	Date
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- .5 At a DDC Controller of the Consultant's choice, display on the portable operator's terminal:
 - .1 At least one temperature set point and at least one status condition, i.e., on or off for a system or piece of equipment attached to that panel as well as for points at another DDC Controller on the network.
 - .2 The diagnostic results as specified for a system or piece of equipment attached to that panel as well as for a system or piece of equipment attached to another DDC Controller.
 - .3 The ability to add a new point to the DDC Controller with the POT and have it automatically uploaded to the workstation to modify that panel's stored database.

User	Date	Consultant	Date
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3.3 INSTALLATION

- .1 Install systems and related controls in accordance with approved shop drawings and manufacturer's recommendations using factory-trained journeymen certified by the Province of Ontario.
- .2 Locate room sensors, etc., at height and as required per Ontario Building Code.
- .3 Secure approval for damper motor locations and supports. Submit detail of damper motor location and support for approval.
- .4 Provide dampers, for installation by the sheet metal contractor.
- .5 Provide valves for installation by the piping contractor.

3.4 POINT DESCRIPTORS

- .1 Adopt and utilize a consistent naming convention in order to identify points and facilitate wild-card calling of all points, systems, and programs to the standards of the school board.

3.5 SYSTEM OPERATION

- .1 General

Where Optimum Start Stop (OSS) is specified, equipment shall start-up based on global outdoor temperature, space temperature, and system response to assure that comfort conditions are reached at scheduled occupancy time (occupancy schedules are defined under time programs), and operate in both heating and cooling cycles. In all cases, the optimum start program shall operate fully stand-alone in the local GPC.

OSS shall include a Night Cycle program applying to (heating cycle only) (both heating and cooling cycle) with the outdoor air dampers closed. The space temperature shall be used to determine the "fan on" and/or "supply heat" command to maintain a low limit of 50-55 degrees for the heating cycle and the "fan on" and "supply cooling" command to maintain 82 degrees for the cooling cycle.

Where an Economizer Cycle (EC) is specified, it shall automatically enable the economizer mode based upon an enthalpy comparison of outdoor air and return air of each AHU.

.2 Data Control (D/C) and Graphics Summary

All hardware, custom software, application software, graphics, etc., necessary to accomplish the control sequences and display the graphics specified shall be provided as part of this contract. Provide all controllers, inputs, outputs, valves, dampers, actuators and flow meters required to provide the control and graphic data described. Provide software setpoints required for display in logical groups and graphics.

Each digital output shall have a software-associated monitored input. Any time the monitored input does not track its associated command output within a programmable time interval, a "command failed" alarm shall be reported.

Where calculated points (such as CFM) are shown, they shall appear in their respective logical groups

Unless otherwise specified or approved prior to bidding, the primary analog input and the analog output of each DDC loop shall be resident in a single remote panel containing the DDC algorithm, and shall function independent of any primary or UC communication links. Secondary (reset type) analog inputs may be received from the primary network, but approved default values and/or procedures shall be substituted in the DDC algorithm for this secondary input if network communications fail or if the secondary input becomes erroneous or invalid.

In addition to the Unitary DDC Controller data points specified to be presented on colourgraphic displays, technical data for each zone mechanical apparatus shall be presented to operators on the OWS in full English menu text displays including the apparatus name; heating and cooling PID loop P, I and D gains; primary CFM airflow (if measured); damper position (% open); reheat status/value; cooling setpoint; heating dead-band; minimum and maximum CFM setpoints; reheat CFM setpoint; unoccupied temperature setpoint; temperature sensor calibration offset; bypass push button time, in minutes; smoke purge mode damper position; smoke pressurization mode damper position; smoke depressurization mode damper position; and morning warm-up mode damper position. All such points shall be presented in complete and direct read-write (command) format, unless they are provided in commandable colourgraphic displays.

In addition to Graphics of building systems with dynamic data points as noted in the following Data and Control and Graphic Summary, the following additional graphics shall be provided:

- Facility layout (showing buildings, streets, etc.)
- Individual area layouts or isometrics
- Any other graphics necessary for logical penetration
- Individual HVAC systems graphics
- Sequences of operation
- Flowcharts for critical DDC loops
- Supervisor graphics
- System configuration

.3 Application Requirements

.1 Software

The microprocessor-based control system shall rely on software for non-critical interlocks and time delays. Where required by the specifications, these functions shall be provided by separate thermostats, relays, and delay timers.

.2 Interlocks

Safety and other interlocks may require relays depending on the specific devices being used. Some devices may require a special power supply as shown in the wiring details. Safeties shall be hardwired into the control circuit and shall also be monitored by the BMCS.

.3 Sensors

Select duct insertion sensors to suit the application. For large ducts, use sensors with longer probe lengths. For heating and cooling coil freeze protection, use a long capillary type sensor. For mixed air and coil discharge temperature sensing, use averaging capillary type sensors.

.4 Valves

Ensure that actuators meet all the job requirements (i.e., control signal, close off, action, etc.). Control valves shall be selected to suit both the medium and the specified configuration (i.e., Straight-thru, 3-way, screwed, flanged, etc.).

.5 Damper Actuators

The total number of actuators may vary depending on the damper size. Consult the actuator's application literature to determine sizing requirements and use no less than 30% of the minimum number of actuators recommended

.6 Graphics

.1 The Warm-up Panel shall permit the operator to monitor the status of the warm-up mode (on or off), and to change the setpoint of the warm-up temperature.

.2 The Unoccupied Cycle control panel shall permit the operator to monitor the status of the mode (occupied or unoccupied), and to change the unoccupied periods setpoints.

.3 The Mixed Air Dampers control panel shall permit the operator to monitor the economizer mode (on or off), monitor the damper position, and to change the minimum position setpoint.

.4 The Optimum Start/Stop control panel shall permit the operator to monitor and change optimum start/stop program parameters.

.5 The Reset Schedule control panel shall permit the operator to monitor and change reset schedule program parameters.

It is not acceptable to monitor and change these modes of control in a manner other than that specified. Having to edit, compile and reload application programs to achieve monitoring and control of these modes is not acceptable.

.6 Provide the text of the control sequence so that it may be displayed on the operator screen by clicking on the Sequence control button on the system graphic. The sequence will incorporate all parameter values and setpoints and will update them dynamically as they change or are changed.

.7 Graphic Display Screens

All Graphic Display Screens shall have the following common elements and functions regardless of system manufacturer. Every site shall have a graphic display screen for Site Graphic, System Architecture, each air handler, boilers, emergency generator, lighting, exhaust fans, heat reclaim, and for each room controlled by the BAS system. The Graphic Display Screens shall follow the format to be consistent with the established KPRDSB Reliable BAS Systems as displayed in Appendix "A". All operator accessible points shall be yellow text and all information points shall be blue. The specific screens shall include the following:

.1 Graphic Screens General All Screens

- .1 Navigation buttons to each major system in the building which indicate current screen display by a change in button colour.
- .2 Background colour shall be black.
- .3 Outdoor air temperature shall be displayed on every graphic screen.
- .4 Site Graphic.
- .5 The KPRDSB Logo on the site or opening graphic screen
- .6 Artist concept or scanned in picture of the front of the school.
- .7 Access links to all global schedules or specific screens affecting entire building operation.
- .8 Access buttons links to Set Time, Holiday Schedule, PD Day Schedule, Alarms, Points on Manual, Conversion °C - °F, 24 Hour Clock, Operations Manual, Autocad Drawings, Reliable BAS Manual, and Work Orders s shown in Appendix "A".

.2 System Architecture.

- .1 control panel layout and network architecture.
- .2 indicating BAS panels and panel type (model).
- .3 panel locations room number text on screen.
- .4 systems controlled by each panel.
- .5 links to points list accessible from each panel.

.3 Architecture Panel Layout (Locations on Floor Plans)

- .1 Locations of each panel on each floor plan level.
- .2 Panel types indicated by different icon.
- .3 Controls transformers locations.
- .4 Main network wiring and sub-network wiring layout.

.4 Floor Plans Graphics

- .1 Room numbers accurate as per room signage.
- .2 Mechanical rooms locations and signage tags.
- .3 space temperatures for every temperature on each floor in appropriate room.
- .4 space focus pick area for individual room control where applicable shall be yellow text.

- .5 Air Handler symbols indicating areas of the floor plan serviced by each air handler by a corresponding colour, as shown in Appendix "A".
- .6 Status of Air Handler by colour change Red for off status, or text indication.
- .7 Supply air temperature for each air handler.
- .5 HVAC Unit Graphic
 - .1 accurate representation of the HVAC design.
 - .2 all associated control points to be displayed.
 - .3 all points to be monitored for automatic mode and shall be displayed when in Manual mode.
 - .4 a calculated percentage of fresh air shall be indicated on the HVAC graphic.
 - .5 operator offset adjustment of the supply air setpoint, adjustable directly from the graphic.
 - .6 HVAC physical location shall be indicated on the graphic.
 - .7 weekly occupied time of day schedule for the associated HVAC shall be accessible directly from the graphic by selecting an icon.
 - .8 weekly student time of day schedule for the associated HVAC shall be accessible directly from the graphic by selecting an icon.
 - .9 trend logs shall be accessible directly from the graphic by selecting an icon.
- .6 Exhaust Fans Graphic
 - .1 exhaust fans control shall be editable directly from the graphic.
 - .2 exhaust fan status shall be indicated in text and a change in the exhaust fan icon.
 - .3 exhaust fan physical location shall be indicated on the graphic.
 - .4 area of the building being exhausted shall be indicated on the graphic.
- .4 Design Requirements
 - .1 Safeties: Smoke detector or high temperature interlocks will be hard-wired to the supply fan starter. These points will be assigned addresses in the DDC controller for alarm annunciation purposes only. AHU's with flows greater than 15,000 CFM will require a smoke detector or high temperature detector in the supply and return air ducts.
 - .2 Schedules: Time schedules will default to 6AM to 6PM, Monday through Friday.
 - .3 Actuators: Actuator output points will display as follows:
 - .1 0% = 2-way valve, closed.
 - .2 0% = 3-way valve, closed to the coil.
 - .3 0% = Mixed air dampers, full return air position.
 - .4 100% = 2-way valve, open.

- .5 100% = 3-way valve, open to the coil.
- .6 100% = Mixed air dampers, full fresh air.
- .7 These requirements shall be the case no matter how the actuator is sequenced or whether it is a reverse or direct acting valve.
- .4 Valves: Heating coil valves shall fail open to the coil. Mixed air dampers shall fail to the full return air position.
- .5 Outdoor Sensors: Outdoor air temperatures and humidities (where applicable) are assumed to be Global points transferred to DDC controllers. If the BMCS system lacks global point capability, global points shall be replaced by hardware points connected to specific controllers; the I/O capacity of the controller being used must be checked to make sure the added points will fit in the controller and upgraded in point capacity if necessary.

3.6 SEQUENCE OF OPERATION

.1 SEQUENCE OF CONTROL

.1 General

- .1 The control programs shall be modular and structured in order to provide specific control operation of all HVAC components indicated.
- .2 All control programs shall provide a minimum of 20% spare memory for expansion.
- .3 Each control program shall contain "REM" statements which explain the program operation.
- .4 Each control program shall open with a list of the I/O points used and controlled in the program.

- .2 DDC Sensors and Devices - are listed in the Points Summary that is part of this specification. Provide 5% spare I/O capacity.

Implement the following control program concepts in full, or partial as required, to provide complete HVAC equipment control. The programs shall perform all control strategies on the basis of protecting equipment operation, saving operational energy costs, and indicating alarm conditions.

Programs, which increase the system energy consumption or cause equipment failures, will be refused and resolved by the contractor accordingly at not additional cost to Owner.

- .3 Where Optimum Start Stop (OSS) is specified, equipment shall start-up based on global outdoor temperature, space temperature, and system response to assure that comfort conditions are reached at scheduled occupancy time (occupancy schedules are defined under time programs), and operate in both heating and cooling cycles. In all cases, the optimum start program shall operate fully stand-alone in the local GPC.

OSS shall include a Night Cycle program applying to (heating cycle only) (both heating and cooling cycle) with the outdoor air dampers closed. The space temperature shall be used to determine the "fan on" and/or "supply heat" command to maintain a low limit of 50-55 degrees for the heating cycle and the "fan on" and "supply cooling" command to maintain 82 degrees for the cooling cycle.

- .4 Where an Economizer Cycle (EC) is specified, it shall automatically enable the economizer mode based upon an enthalpy comparison of outdoor air and return air of each AHU.
- .5 System Architecture: The control sequences will be performed by DDC controllers arranged as indicated in the following architecture diagram:
- .6 Boiler Graphic (glycol Loop Similar)
 - .1 boiler graphic piping layout shall be accurate as per piping layout
 - .2 all associated control points for the boiler system to be displayed
 - .3 operator offset adjustment of the scheduled water setpoint, adjustable directly from the graphic
 - .4 lead boiler and boiler stages shall be indicated
 - .5 lead pump shall be indicated
 - .6 boiler status shall be indicated graphically
 - .7 pump status shall be indicated graphically
 - .8 operator offset editable directly from the graphic screen
 - .9 weekly time of day schedule for the building occupied schedule shall be accessible directly from the graphic by selecting an icon
 - .10 trend logs shall be accessible directly from the graphic by selecting an icon
- .2 RADIATION HEATING CONTROL
 - .1 A space temperature sensor operating through a DDC ASC shall modulate the incremental heating valve to maintain the space temperature setpoint.
- .3 BUILDING LOW TEMPERATURE
 - .1 All space sensors shall be capable of indicating building low temperature. Alarm building low temperatures at OWS.
- .4 EXHAUST FANS
 - .1 Provide programmable start/stop control at the OWS.
 - .2 Provide dual voltage relays for exhaust fans rated for 120V/1/60. Install dual voltage relays in accessible ceiling space adjacent to exhaust fan.
 - .3 Wire through dual voltage relay or magnetic starters as indicated. Magnetic starters will be provided by Electrical Division.
 - .4 A pressure differential switch located where indicated modulated EF-3 speed (thru ECM controller) to maintain a room negative pressure in the spaced of +/- 0.06" wg.
- .5 TRAP PRIMER SOLENOID VALVE CONTROL
 - .1 Energize solenoid valve for five minutes (adj) each 24 hour period (adj) during unoccupied times.
 - .2 Sequence valves so that no more than two (2) valves operate at the same time.

.6 EXISTING CONTROL

.1 Provide new DDC control and components for the existing systems indicated

.1 Existing Roof Mounted Exhaust Fans.

.7 INDIVIDUAL ROOM CONTROL (REHEAT COIL)

.1 The space temperature sensor modulates the 3-way reheat coil heating valve to maintain setpoint. Provide setback setpoint for unoccupied periods.

3.7 ELECTRICAL

.1 Rules and Regulations: The entire installation shall conform to Division 16 and shall comply with the Canadian Electrical Code and all local and Provincial codes. The contractor shall obtain an ESA certificate for his work.

.2 Refer to equipment wiring schedule or electrical drawings for wiring responsibilities.

.3 Arrange for all the necessary inspections and approvals of built-up and modified control systems and relay panels by governing authorities. All electrical equipment , material , and its installation shall conform to the current requirements of the following authorities:

.1 C.S.A

.2 Ontario Hydro Safety Authority

.3 O.B.C. Building Codes / Fire Codes.

.4 All wiring shall conform to governing codes and shall be inspected by request of the contractor for approval. The contractor shall obtain and purchase all necessary permits as required.

.5 Wiring: All electric wiring in connection with this project shall be furnished and installed under this section.

.1 The Contractor shall be aware that cables carrying high currents run through ceiling and wall cavities. Signal interference or sensor inaccuracy or failure caused by existing cable runs shall be the responsibility of the Contractor and shall be covered under the warranty. The Contractor shall select sensors and use shielded cable or transmitters as necessary to prevent electrical interference with the control system operation.

.2 The Contractor shall coordinate fully the interconnection of factory assembled portions of system controls, field installed control systems and the electrical power system to provide a complete working installation.

.3 Power for control equipment shall not be taken from equipment motor leads. Power shall be from circuits dedicated for controls only.

.4 Transformers shall be sized for 150% of engineered capacity.

.5 All wires are to be numbered using wire labels at each end. These labels shall correspond to wire identification on the shop drawings and "as-built" drawings.

.6 All wiring concealed in walls and chases and all exposed wiring shall be run in conduit.

- .6 Electrical Isolation of I/O Points: To prevent serious damage to the field panels from surges, or RFI electrically induced spikes, protection in the following form shall be provided, as a minimum:
 - .1 Digital outputs singularly or collectively shall be galvanically isolated from the main panel processor.
 - .2 Analog outputs shall be galvanically isolated from each other and the main panel processor.
 - .3 Digital inputs shall be galvanically isolated from the main panel processor.
- .7 Panel Documentation: Mount an input/output layout sheet within each controller field panel. This sheet shall include the name of the points connected to each controller channel.
- .8 Conduits: All wiring in finished areas shall be concealed. All exposed wiring, whether for power, sensors, actuators, or data communications, shall be in metallic conduit. This includes all wiring runs in and around rooftop HVAC units. All conduits shall have a minimum inside diameter of 13mm.
 - .1 All conduits shall be installed out of the way in traffic areas, and parallel to the lines of the building. Flexible conduit may be used only in areas of vibration or expansion joints. All conduits shall be supported at least every 4 feet. Supports shall be located at each connector end of each conduit. High and low voltage wire shall not be run in the same conduit. Only wires of similar purpose shall be run in the same conduit; i.e. sensor or control, power, and communication wire shall be in separate conduit.
- .9 Pull Boxes and Junction Boxes: Pull boxes shall be located at a minimum spacing of 30m. The contractor is responsible for getting approvals from the Owner for locating pull boxes. Pull boxes shall comply with the Canadian Electrical Code. All boxes shall be clearly marked as part of the automated control system.
- .10 Enclosures: All enclosures shall be mounted such that the doors can open fully without interference with new or existing equipment. Except where expressly permitted in writing by the Owner or Engineer, enclosures shall be mounted in easily accessible locations where a technician can clearly see and easily access all components inside without a stool or ladder.
- .11 Power Protection: During the warranty period, the Contractor shall be responsible for parts and labour to repair or replace any system equipment damaged by power quality problems (spikes, sags, waveform anomalies, etc.). with that in mind, the Contractor shall provide appropriate power protection.
- .12 All wiring shall conform to governing codes and shall be inspected by request of the contractor for approval. The contractor shall obtain and purchase all necessary permits as required.
- .13 It is the responsibility of this contractor to provide dedicated 120 V, power from the spare breaker for the automation system from the nearest electrical panel. Provide typewritten information on panel directory.

3.8 RELIABLE BAS DATABASE NAMING CONVENTIONS AND PROGRAMS

.1 Programs Architecture

- .1 All BAS programs shall be created in each panel in logical order as determined by the equipment being controlled by each panel on the network. The Outdoor Air Temperature Program shall be in its own program named OAT PG.

- .2 The programs shall be created in the following order:

- .1 Air Handlers Example: Common for all air handlers and rooftop air handlers.

AH # Start PG – contains all start stop parameters for the air handler.

AH # Setpoint PG – contains all setpoint calculations for the specific air handler.

AH # Control PG – contains all control points for the air handler for both occupied and unoccupied modes.

AH # Zone Setpoint PG – contains all setpoint calculations and limitations for zones serviced by the air handler.

AH # Zone Feedback PG – contains calculation of zone temperature averages, coldest and warmest spaces.

All Rooftop air handlers shall start with the letters RT in the naming conventions.

- .2 Boilers, Pumps, and Hydronic Heating Systems Examples:

Heating Enable PG – contains all enable/disable calculations for the entire heating system.

Heating Setpoint PG – contains all setpoint calculations for scheduled water temperatures for both occupied and unoccupied periods.

Heating Control PG – contains control strategies for all heating equipment controlled from the panel.

Pump Control PG – contains control strategies for circulation pumps including pump cycle when heating system is not enabled.

- .3 Specialty and Miscellaneous Equipment Programs – specialty equipment with more than three (3) control points, shall be controlled in a separate program and shall be named according to the devices the program controls. The programs for specialty equipment shall be named the following the examples for air handlers and Heating equipment. Miscellaneous equipment with less than three (3) control points may be placed in a program called Misc. PG, and should contain all control parameters in the programs.

- .4 Alarm Programs – Each Panel shall have an alarm program for General Warning alarms named P# Alarm PG, and an alarm program for Critical Alarms, named P# Critical PG. The alarms being sent to central monitoring shall be in the panel where the output is connected to the security panel and the programming to activate the Remote Alarm shall be in its own program named Remote Alarm PG.
- .5 Point Naming Inputs & Outputs – The listings indicated below are the most common inputs and outputs used in system. Equipment not listed should always indicate clearly the equipment system, function and location in the name if possible. Point naming conventions shall be in upper and lower case for easier readability.

Air Handler Systems Naming Conventions

INPUTS

OUTPUTS

Equipment	Point Name		Equipment	Point Name
Supply Fan Status	AH# SF Status		Supply Fan Control	AH# SF Control
Return Fan Status	AH# RF Status		Return Fan Control	AH# RF Control
Supply Fan Speed Status	AH# SF Spd St		Supply Fan Speed Control	AH# SF Spd Ctrl
Return Fan Speed Status	AH# RF Spd St		Return Fan Speed Control	AH# RF Spd Ctrl
Supply Air Temperature	AH# Supply Temp		Damper Control	AH# Mixed Air Dmpr
Return Air Temperature	AH# Return Temp		Coil Heating Valve Control	AH# Heating Valve
Mixed Air Temperature	AH# Mixed Temp		Cooling Coil Valve Control	AH# Cooling Valve
Return Air C02	AH# Return C02		DX Cooling Stage Control	AH# DX# Control
Air Handler Coil Pump Status	AH# P# Status		Air Handler Coil Pump Control	AH# P# Control
Air Handler Filter Status	AH# Filter		Reclaim Damper Control	AH# Reclaim Dmpr
Air Handler Freezestat Status	AH# Freeze		Reclaim Valve Control	AH# Reclaim Vlv
Reclaim Pump Status	AH# RclP# Stat		Reclaim Pump Control	AH# RclP# Ctrl
Reclaim Temperature Air Entering	AH# Rcl In Temp			
Reclaim Temperature Air Leaving	AH# Rcl Out Temp			
Reclaim Supply Fluid Temperature	AH# Rcl SW Temp			
Reclaim Return Fluid Temperature	AH# Rcl RW Temp			
Duct Pressure	AH# Duct Press			
Building Pressure	Bldg Pressure			

Heating Systems Naming Conventions

INPUTS

OUTPUTS

Equipment	Point Name		Equipment	Point Name
Boiler Status	Blr# Status		Boiler Control	Blr# Control
Outdoor Air Temperature 1	OAT1		Boiler Stage Control	Blr# Stg# Ctrl
Outdoor Air Temperature 2	OAT2		Boiler Modulation	Blr# Modulation
Boiler Pump Status	Blr P# Status		Boiler Pump Control	Blr# P# Control
Heating Pump Status	Heating P# Status		Heating Pump Control	Heating P# Control
Glycol Pump Status	Glycol P# Status		Glycol Pump Control	Glycol P# Control
Heating System Pressure	Htg Pressure		Heating Valve Control	Htg Valve Ctrl
Glycol System Pressure	Gly Pressure			
Heating Supply Water Temperature	Htg Supply Temp			
Heating Return Water Temperature	Htg Return Temp		Heating Differential Pressure Valve	Heating DP Valve
Glycol Supply Water Temperature	Gly Supply Temp		Heat Exchanger Control Valve	HX Vlv Control
Glycol Return Water Temperature	Gly Return Temp			

Lighting Equipment Naming Conventions

INPUTS

OUTPUTS

Equipment	Point Name		Equipment	Point Name
Outdoor Photocel	Outdoor Light Levels		Outdoor Light Control	Outdoor Ltg Ctrl
Outdoor Light Override	O/S Lgt Override			
Room Motion Sensor	Rm# Motion		Room Lighting Control	Rm# Ltg Ctrl
Corridor Motion Sensor	Corr# Motion		Corridor Lighting Control	Corr# Ltg Ctrl

Miscellaneous Equipment Naming Conventions

INPUTS

OUTPUTS

Equipment	Point Name		Equipment	Point Name
Exhaust Fan Status	EF# Status		Exhaust Fan Control	EF# Control
Domestic Hot Water Recirc Pump Status	DHW P# Status		Dom Hot Water Pump Control	DHW P# Control
Urinal Motion Detector	Ur Rm# Motion		Urinal Flush Control	Ur Rm# Control
Electrical Meter	Elect Meter			
Water Meter	Water Meter		Main Water Valve Control	Main Water Vlv
Gas Meter	Gas Meter			
Sump Level Alarm	Sump Alarm			
Area Water Flush Flow	East DWater Flow		Area Domestic Water Flush Control	East DW Flush Ctrl
			Area Flush Flow Alarm Light	East Flush Alarm
Building Security Status	Bldg Security		Building Remote Alarm	Bldg Remote Alarm
Building Override	Bldg Override			

Network Status Panel Naming Conventions should indicate the school, panel location, and panel number. The school name can be abbreviated as necessary to fit the space.

3.9 POINTS LIST

- .1 The points list appended here to shall be read in conjunction with the drawings and specification. Should the control functions be indicated in the specification and not indicated on the points list or indicated in the points list and not in the specification, it does not relieve in the contractor in provide a complete system. It is the contractor's responsibility to ensure the BAS system is installed and operates as specified.

END OF SECTION

[illegible]

Division 26 Common Requirements for Electrical

26 00 11	Electrical Specification Index
	Common Contract Requirements for Electrical
26 01 13	Electrical Supplemental Tender Form
26 01 16	Electrical General Requirements
26 01 17	Demolition and Renovation
26 01 20	Commissioning and Integrated Testing of Life Safety and Fire Protection System
	Common Work Results for Electrical
26 05 19	Wires and Cables
26 05 20	Splitters, Junction, and Pull Boxes
26 05 21	Outlet Boxes, Conduit Boxes and Fittings
26 05 22	Wire and Box Connectors – 0 –1000 V
26 05 26	Grounding Secondary
26 05 33	Conduits, Conduit Fastenings and Conduit Fittings
26 05 75	Auxiliary Systems
	Switchboard and Panelboards
26 24 16	Panelboards
26 24 17	Moulded Case Circuit Breakers
	Low-Voltage Distribution Equipment
26 27 26	Wiring Devices
	Low Voltage Circuit Protective Devices
26 28 16	Disconnect Switches
	Lighting
26 51 13	Lighting Equipment
26 51 16	Digital Occupancy & Daylight Control Systems

Division 27 Communications

	Voice Communications Switching and Routing Equipment
27 31 40.1	ICT Infrastructure

Division 28 Electronic Safety and Security

	Fire Detection and Alarm
28 31 25	Fire Alarm System (Addressable)

END OF SECTION

Part 1 General

1.1 INSTRUCTIONS TO BIDDERS

.1 The Electrical Supplemental Tender Form must be submitted to the architect and consultant (dei@deiassociates.ca) within 2 hours of tender closing. Electrical contractors shall identify all sub-contractors he/she intends to use and must complete all information requested. The requisite information shall be given at the office of the Consultant. Contractor shall sign and date this page and initial and date each page thereafter.

.2 Should the Electrical Supplemental Form not be submitted then the contractor shall use Basis of Design manufacturers as listed.

.3 CONTRACTOR

I/We certify that I/We have the authority to bind the company.

COMPANY NAME

AUTHORIZED SIGNATURE

ADDRESS

PRINTED SIGNATURE

CITY

TITLE

TELEPHONE NUMBER

DATE

FAX

CONTRACTOR'S NAME: _____ DATE: _____

.4 SUB-CONTRACTORS

The Contractor shall state below the name of the ICT Infrastructure Sub-contractor he intends to use, which shall not be changed without the consent of the Consultant.

ICT Infrastructure _____

Life Safety Systems Commissioning Agent _____

- .5 The Stipulated Bid Sum shall be for the basis of design manufacturer or supplier equipment only, unless otherwise indicated. Where a choice of this equipment is given, this Contractor shall indicate the supplier or manufacturer he intends to use. Where no choice is indicated, the basis of design supplier or equipment shall be used.
- .6 Equipment or materials manufactured by firms named in the following listing only shall be deemed equal to the equipment or material specified, provided the equipment or material will have capacity, performance, rating, construction, physical dimensions, accessories and features which, in the opinion of the Consultant, are equal to those of the specified equipment or material. The Electrical Contractor shall not indicate equipment, materials or suppliers which are not listed.
- .7 Where modifications to the work of other trades are required as a result or part of the alternative offered, include the cost of said modifications in the work.
- .8 Submit the following list of basis of design and alternative suppliers in accordance with the bid requirements:

Spec. Reference Section	Equipment	Basis of Design	Acceptable Alternate Manufacturer	Indicate Manufacturer Or Supplier
26 28 16	Disconnect Switches	Eaton	Schneider Electric Siemens GE Industrial	
26 51 13	LED Lighting	Cooper	Lithonia Signify	
26 51 13	Exit Lighting	Aimlite	Stanpro	
26 51 13	Emergency Battery Units	Aimlite	Stanpro	
26 51 13	Emergency Fixtures	Aimlite	Stanpro	
26 51 16	Lighting Controls	Wattstopper	Sensor Switch Cooper Controls	
28 31 25	Fire Alarm System (Addressable)	Notifier	N/A	

.9 LABOUR RATES

- .1 The following labour rates shall apply for calculating the cost of credit or extras on Change Notices. The rates shall include any employee benefits. The labour rates do not include overhead and profit.

Apprentice Electrician \$_____/hr

Journeyman Electrician \$_____/hr

1.2 ELECTRICAL TENDER PRICE (EXCLUDING HST)

- .1 Having carefully examined all Drawings and Specifications and the Addenda to the Drawings and Specifications, and having carefully examined the sites and all conditions affecting the work, we, the undersigned thereby offer to provide all plant, labour, materials and incidentals required to complete the work of all trades for: All the work specified for herein for

the Total Stipulated Price of: \$_____

(in writing)

in lawful money of Canada; included in which are all applicable excise taxes, custom duties, freight, exchange, and all other charges. HST is not included.

END OF SECTION

CONTRACTOR'S NAME: _____ DATE: _____

Part 1 General

1.1 GENERAL

- .1 This Section covers items common to Electrical Divisions.**
- .2 This section supplements requirements of Division 1.
- .3 Furnish labour, materials, and equipment necessary for completion of work as described in contract documents.

1.2 INTENT

- .1 Mention herein or indication on Drawings of articles, materials, operations, or methods requires: supply of each item mentioned or indicated, of quality, or subject to qualifications noted; installation according to conditions stated: and, performance of each operation prescribed with furnishing of necessary labour, equipment, and incidentals for electrical work.
- .2 Where used, words "Section" and "Division" shall also include other Subcontractors engaged on site to perform work to make building and site complete in all respects.
- .3 Where used, word "supply" shall mean furnishing to site in location required or directed complete with accessory parts.
- .4 Where used, word "install" shall mean secured in place and connected up for operation as noted or directed.
- .5 Where used, word "provide" shall mean supply and install as each is described above.

1.3 TENDERS

- .1 Complete Supplemental Tender Form including list of equipment and materials to be used on this project and forming part of tender documents.
- .2 Submit Supplemental Tender Form as noted.
- .3 Submit tender based on specified described equipment or Alternates listed.
- .4 State in Tender, names of all Subcontractors proposed for work under this Division.

1.4 LIABILITY INSURANCE

- .1 This contractor must maintain and produce at the request of the consultant proof of proper insurance to fully protect the Owner, the Consultant and the Contractor from any and all claims due to accidents, misfortunes, acts of God, etc.

1.5 DRAWINGS

- .1 Electrical Drawings do not show structural and related details. Take information involving accurate measurement of building from building drawings, or at building. Make, without additional charge, any necessary changes or additions to runs of conduits and ducts to accommodate structural conditions. Location of conduits and other equipment may be altered by Consultant without extra charge provided change is made before installation and does not necessitate major additional material.

- .2 As work progresses and before installing fixtures and other fittings and equipment which may interfere with interior treatment and use of building, provide detail drawings or obtain directions for exact location of such equipment and fitments.
- .3 Electrical drawings are diagrammatic. Where required work is not shown or only shown diagrammatically, install same at maximum height in space to conserve head room (minimum 2200 mm (88") clear) and interfere as little as possible with free use of space through which they can pass. Conceal wiring, conduits and ducts in furred spaces, ceilings and walls unless specifically shown otherwise. Install work close to structure so furring will be small as practical.
- .4 Before commencing work, check and verify all sizes, locations, grades, elevations, levels and dimensions to ensure proper and correct installation. Verify existing/municipal services.
- .5 Locate all electrical equipment in such a manner as to facilitate easy and safe access to and maintenance and replacement of any part.
- .6 In every place where there is indicated space reserved for future or other equipment, leave such space clear, and install services so that necessary installation and connections can be made for any such apparatus. Obtain instructions whenever necessary for this purpose.
- .7 Relocate equipment and/or material installed but not co-ordinated with work of other Sections as directed, without extra charge.
- .8 Where drawings are done in metric and product not available in metric, the corresponding imperial trade size shall be utilized.

1.6 INTERFERENCE AND CO-ORDINATION DRAWINGS

- .1 Prepare interference and equipment placing drawings to ensure that all components will be properly accommodated within the constructed spaces provided.
- .2 Prepare drawings to indicate co-ordination and methods of installation of a system with other systems where their relationship is critical. Ensure that all details of equipment apparatus, and connections are co-ordinated.
- .3 Ensure that clearances required by jurisdictional authorities and clearances for proper maintenance are indicated on drawings.
- .4 Upon consultant's request submit copies of interference drawings to consultant.

1.7 QUALITY ASSURANCE

- .1 The installations of the division must conform to the latest edition of the Electrical Safety Code as well as its supplemental bulletins and instructions. Provide materials and labour necessary to comply with rules, regulations, and ordinances.
- .2 Complete underground systems in accordance with CSA C22.3 No. 7-94 except where specified otherwise.
- .3 Abbreviations for electrical terms: to CSA Z85-1983.

- .4 In case of differences between building codes, provincial laws, local ordinances, utility company regulations, and Contract Documents, the most stringent shall govern. Promptly notify Consultant in writing of such differences.

1.8 ALTERNATES AND SUBSTITUTIONS

- .1 Throughout these sections are lists of "Alternate Equipment" manufacturers acceptable to Consultant if their product meets characteristics of specified described equipment.
- .2 Each bidder may elect to use "Alternate Equipment" from lists of Alternates where listed. Include for any additional costs to suit Alternated used. Prices are not required in Tender for Alternates listed except where specifically noted as "Separate Price". Complete the Supplementary Tender Form.
- .3 It is responsibility of this Division to ensure "Alternate Equipment" fits space allocated and gives performance specified. If an "Alternate Equipment" unit is proposed and does not fit space allotted nor equal specified product in Consultant's opinion, supply of specified described equipment will be required without change in Contract amount. Only manufacturers listed will be accepted for their product listing. All other manufacturers shall be quoted as substitution stating conditions and credit amount.
- .4 If item of material specified is unobtainable, state in Tender proposed substitute and amount added or deducted for its use. Extra monies will not be paid for substitutions after Contract has been awarded.

1.9 EXAMINATION

- .1 Site Inspection
 - .1 Examine premises to understand conditions, which may affect performance of work of this Division before submitting proposals for this work.
 - .2 No subsequent allowance for time or money will be considered for any consequence related to failure to examine site conditions.
- .2 Drawings:
 - .1 Electrical Drawings show general arrangement of fixtures, power devices, equipment, etc. Follow as closely as actual building construction and work of other trades will permit.
 - .2 Consider Architectural, Mechanical, and Structural Drawings part of this work insofar as these drawings furnish information relating to design and construction of building. These drawings take precedence over Electrical Drawings.
 - .3 Because of small scale of Drawings, it is not possible to indicate all offsets, fittings, and accessories, which may be required. Investigate structural and finish conditions affecting this work and arrange work accordingly, providing such fittings, valves, and accessories required to meet conditions.
- .3 Ensure that items to be furnished fit space available. Make necessary field measurements to ascertain space requirements including those for connections and furnish and install equipment of size and shape so final installation shall suit true intent and meaning of Contract Documents. If approval is received by Addendum or Change

Order to use other than originally specified items, be responsible for specified capacities and for ensuring that items to be furnished will fit space available.

1.10 SEQUENCING AND SCHEDULING

- .1 It is understood that while Drawings are to be followed as closely as circumstances permit, this Division will be held responsible for installation of systems according to the true intent and meaning of Contract Documents. Anything not clear or in conflict will be explained by making application to Consultant. Should conditions arise where certain changes would be advisable, secure Consultant's approval of these changes before proceeding with work.
- .2 Coordinate work of various trades in installing interrelated work. Before installation of electrical items, make proper provision to avoid interferences in a manner approved by Consultant. Changes required in work specified in these sections caused by neglect to do so shall be made at no cost to Owner.
- .3 Arrange fixtures, conduit, ducts, and equipment to permit ready access to junction boxes, starters, motors, control components, and to clear openings of doors and access panels.
- .4 Furnish and install inserts and supports required by these sections unless otherwise noted. Furnish sleeves, inserts, supports, and equipment that are an integral part of other Divisions of the Work to Sections involved in sufficient time to be built into construction as the Work proceeds. Locate these items and see that they are properly installed. Expense resulting from improper location or installation of items above shall be borne by the electrical trade.
- .5 Adjust locations of ducts, conduits, equipment, fixtures, etc, to accommodate work from interferences anticipated and encountered. Determine exact route and location of each conduit and duct prior to installation.
 - .1 Make offsets, transitions, and changes in direction of ducts, and electrical raceways as required to maintain proper head room and pitch of sloping lines whether or not indicated on Drawings.
 - .2 Supply and install pull boxes, etc, as required to effect these offsets, transitions, and changes in direction.

1.11 DRAW BREAKDOWN

- .1 This Contractor **MUST** submit a breakdown of the tender price into classifications to the satisfaction of the Consultant, with the aggregate of the breakdown totaling the total contract amount. **Each item must be broken out into material and labour costs.** Progress claims, when submitted are to be itemized against each item of the draw breakdown. This shall be done in table form showing contract amount, amount this draw, total to date, % complete and balance.
- .2 Breakdown shall be as follows:
 - .1 Permits and fees
 - .2 Mobilization (maximum 1%)
 - .3 Demolition

- .4 Branch conduits
- .5 Feeder cables
- .6 Branch wiring
- .7 Lighting fixtures
- .8 Emergency lighting
- .9 Lighting controls
- .10 Fire alarm system
- .11 ICT (Voice/Data, Public address) system
- .12 Starters, contactors and control devices
- .13 Wiring for mechanical equipment
- .14 Wiring for owner's equipment
- .15 Electrical contractor closeout requirements (minimum of 3% but not less than \$5,000.00)
- .3 The breakdown must be approved by the Consultant prior to submission of the first draw.
- .4 Breakdowns not complying to the above will not be approved.
- .5 Breakdown must indicate total contract amount.
- .6 **Mobilization amount may only be drawn when all required shop drawings have been reviewed by the consultant.**

1.12 SHOP DRAWINGS AND PRODUCT DATA

- .1 General
 - .1 Furnish complete catalog data for manufactured items of equipment to be used in the Work to Consultant for review within 30 days after award of Contract.
 - .2 Provide a complete list of shop drawings to be submitted prior to first submission.
 - .3 Before submitting to the Consultant, review all shop drawings to verify that the products illustrated therein conform to the Contract Documents. By this review, the Contractor agrees that it has determined and verified all field dimensions, field construction criteria, materials, catalogue numbers, and similar data and that it has checked and coordinated each shop drawing with the requirements of the work and of the Contract Documents. The Contractor's review of each shop drawings shall be indicated by stamp, date and signature of a qualified and responsible person possessing by the appropriate authorization.
 - .4 If material or equipment is not as specified or submittal is not complete, it will be rejected by Consultant.
 - .5 Additional shop drawings required by the contractor for maintenance manuals, site copies etc., shall be photocopies of the "reviewed" shop drawings. All costs to provide additional copies of shop drawings shall be borne by the contractor.
 - .6 **Submit all shop drawings for the project as a package. Partial submittals will not be accepted.**

- .7 Catalog data or shop drawings for equipment, which are noted as being reviewed by Consultant or his Engineer shall not supersede Contract Documents.
- .8 Review comments of Consultant shall not relieve this Division from responsibility for deviations from Contract Documents unless Consultant's attention has been called to such deviations in writing at time of submission, nor shall they relieve this Division from responsibility for errors in items submitted.
- .9 Check work described by catalog data with Contract Documents for deviations and errors.
- .10 Shop drawings and product data shall show:
 - .1 Mounting arrangements.
 - .2 Operating and maintenance clearances. e.g. access door swing spaces.
- .11 Shop drawings and product data shall be accompanied by:
 - .1 Detailed drawings of bases, supports, and anchor bolts.
 - .2 Manufacturer test data where requested.
 - .3 Manufacturer to certify as to current model production.
 - .4 Certification of compliance to applicable codes.
- .12 State sizes, capacities, brand names, motor HP, accessories, materials, gauges, dimensions, and other pertinent information. List on catalog covers page numbers of submitted items. Underline applicable data.
- .13 Once these shop drawings are returned "reviewed" or "reviewed as noted" fabrication, production, and installation may commence. **NOTE: If a shop drawing is returned "reviewed as noted" this Contractor must provide written indication that the comments have been complied with.**

A partial list of shop drawings includes:

- .1 Fire alarm system components
 - .2 Luminaires and drivers
 - .3 Emergency battery units and fixtures
 - .4 ICT (Voice/Data, Public address) system components
 - .5 Starters, contactors and control devices
 - .6 Firestopping materials
 - .7 Wiring devices
 - .8 Clocks
 - .9 Occupancy sensors & digital lighting controls including completed engraving sheets
 - .10 Miscellaneous distribution equipment
 - .11 Integrated Life Safety System Testing Plan (ITP)
 - .12 Cable management hangers
-
- .2 Submissions shall be submitted electronically as per the following directions:

- .1 Electronic Submissions:
 - .1 Electronically submitted shop drawings shall be prepared as follows:
 - .1 Use latest software to generate PDF files of submission sheets.
 - .2 Scanned legible PDF sheets are acceptable. Image files are not acceptable.
 - .3 PDF format shall be of sufficient resolution to clearly show the finest detail.
 - .4 PDF page size shall be standardized for printing to letter size (8.5"x11"), portrait with no additional formatting required by the consultant. Submissions requiring larger detail sheets shall not exceed 11"x17".
 - .5 Submissions shall contain multiple files according to section names as they appear in Specification.
 - .6 File names shall include consultant project number and description of shop drawing section submitted.
 - .7 Each submission shall contain an index sheet listing the products submitted, indexed in the same order as they appear in the Specification. Include associated PDF file name for each section.
 - .8 On the shop drawing use an "electronic mark" to indicate what is being provided.
 - .9 **Each file shall bear an electronic representation of the "company stamp" of the contractor. If not stamped the file submission will not be reviewed.**
 - .2 Email submissions shall include subject line to clearly identify the consultants' project number and the description of the shop drawings submitted.
 - .3 Electronic attachments via email shall not exceed 10MB. For submissions larger than 10MB, multiple email messages shall be used. Denote related email messages by indicating "1 of 2" and "2 of 2" in email subject line for the case of two messages.
 - .4 Electronic attachments via web links (URL) shall directly reference PDF files. Provide necessary access credentials within link or as username/password clearly identified within body of email message.
 - .5 On site provide one copy of the "reviewed" shop drawings in a binder as noted above.
 - .6 Contractor to print copies of "reviewed" shop drawings and compile into maintenance manuals in accordance with requirements detailed in this section.

1.13 CARE, OPERATION AND START-UP

- .1 Instruct Consultant and operating personnel in the operation, care and maintenance of equipment.
- .2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components.
- .3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.14 VOLTAGE RATINGS

- .1 Operating voltages: to CAN3-C235-83.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.15 PERMITS, FEES AND INSPECTION

- .1 A submission has been made (if required by this scope of project) by the consultant to the Electrical Safety Authority for review of this project. The payment of the required review costs will be co-ordinated by the consultant. A copy of the Electrical Safety Authority review report will be forwarded to the successful contractor for information and action.
- .2 The contractor is required to include in his tender all required inspection costs by the Electrical Safety Authority. Permit application is the responsibility of the contractor.
- .3 Reproduce drawings and specifications required by Electrical Safety Authority at no cost.
- .4 Notify Consultant of changes required by Electrical Safety Authority prior to making changes.
- .5 Furnish Certificates of Acceptance to Engineer from Electrical Safety Authority and other authorities having jurisdiction upon completion of work.
- .6 This contractor must furnish any certificates required to indicate that the work completed conforms with laws and regulations of authorities having jurisdiction.

1.16 MATERIALS AND EQUIPMENT

- .1 Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Electrical Safety Authority.
- .2 Factory assemble control panels and component assemblies.

1.17 ELECTRIC MOTORS, EQUIPMENT, AND CONTROLS

- .1 Supplier and installer responsibility is indicated in the Equipment Wiring Schedule on electrical drawings.
- .2 Control wiring and conduit is specified in the Electrical specifications except for conduit, wiring and connections below 50 V, which are related to control systems specified in the Mechanical specifications.

1.18 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint outdoor electrical equipment "equipment green" finish.
 - .2 Paint indoor switchgear and distribution enclosures light grey.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .3 Clean and prime exposed non-galvanized hangers, racks, fastenings, and conduits etc. to prevent rusting.

1.19 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
- .2 Nameplates:
 - .1 Lamicoid 3 mm (1/8") thick plastic engraving sheet, black face, white core, mechanically attached with self tapping screws.

NAMEPLATE SIZES

Size 1	9 mm x 50 mm (3/8" x 2")	1 line	3 mm (1/8") high letters
Size 2	12 mm x 70 mm (1/2" x 2 1/2")	1 line	5 mm (3/16") high letters
Size 3	12 mm x 70 mm (1/2" x 2 1/2")	2 lines	3 mm (1/8") high letters
Size 4	20 mm x 90 mm (3/4" x 3 1/2")	1 line	9 mm (3/8") high letters
Size 5	20 mm x 90 mm (3/4" x 3 1/2")	2 lines	5 mm (3/16") high letters
Size 6	25 mm x 100 mm (1" x 4")	1 line	12 mm (1/2") high letters
Size 7	25 mm x 100 mm (1" x 4")	2 lines	6 mm (1/4") high letters

- .3 Wording on nameplates labels to be approved by Consultant prior to manufacture.
- .4 Allow for average of twenty-five (25) letters per nameplate.
- .5 Identification to be English.
- .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .7 Nameplates for disconnects, starters and contactors must indicate equipment being controlled and voltage.

1.20 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

1.21 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m (45') intervals.
- .3 Colour bands must be 25 mm (1") wide.

	<u>Prime</u>
up to 208 V	yellow
ICT Voice/Data system	green
ICT Public address	black
Fire alarm	red
Emergency lighting (DC)	pink
- .4 This contractor must paint all system junction boxes and covers in conformance with the above schedule.

1.22 PROTECTION OF OPENINGS

- .1 Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to system.

1.23 WIRING TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

1.24 MANUFACTURERS AND CSA LABELS

- .1 All labels must be visible and legible after equipment is installed.

1.25 WARNING SIGNS

- .1 To meet requirements of Electrical Safety Authority and Consultant.
- .2 Provide porcelain enamel signs, with a minimum size of 175 mm x 250 mm (7" x 10").

1.26 LOCATION OF OUTLETS

- .1 Do not install outlets back-to-back in wall; allow minimum 150 mm (6") horizontal clearance between boxes.
- .2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3 m (10'), and information is given before installation.
- .3 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

1.27 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise. Coordinate with block coursing (if applicable).
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1100 mm (43.3").
 - .2 Wall receptacles:
 - .1 General: 400 mm (16").
 - .2 Above top of continuous baseboard heater: 200 mm (8").
 - .3 Above top of counters or counter splash backs: 100 mm (4").
 - .4 In mechanical rooms: 1200 mm (48").
 - .3 Panelboards: as required by Code or 1400 mm (56").
 - .4 Voice/Data outlets: At height of adjacent outlet or at 400 mm (16").
 - .5 Fire alarm stations: 1200 mm (3' - 11").
 - .6 Fire alarm visual and signal devices: 2250 mm (88 ½").
 - .7 Television outlets: 400 mm (16").
 - .8 Thermostat: 1200 mm (3'-11").
 - .9 Clocks: 2100 mm (84").
 - .10 Heaters: 200 mm (8" AFF) to bottom of heater.
 - .11 Emergency call switches and/or pushbuttons: 900 mm (36").

1.28 LOAD BALANCE

- .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

1.29 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete shall be schedule 40 steel pipe, sized for free passage of conduit, and protruding 50 mm (2") beyond either side.
- .2 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

1.30 FIELD QUALITY CONTROL

- .1 Conduct and pay for following tests:
 - .1 Power distribution system including phasing, voltage, grounding, and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
 - .5 Systems: fire alarm system, communications, security.
- .2 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .3 Insulation resistance testing.
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .4 Carry out tests in presence of Consultant.
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
- .6 Submit test results for Consultant's review.

1.31 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings as indicated on drawings or as determined from co-ordination study.

1.32 GUARANTEE AND WARRANTY

- .1 At the substantial completion stage of this project this Contractor must provide a written guarantee indicating that any defects, not due to ordinary wear and tear or improper use which occur within the first year from the date of substantial completion will be corrected at the contractors expense.
- .2 **If the electrical sub-contractor's office is 50 kilometers (30 miles) or more from the project site, the sub-contractor is to provide a service/warranty work agreement for warranty period with a local electrical sub-contractor approved by Consultant. Include**

copy of service/warranty agreement in warranty section of operation and maintenance manual.

- .3 Warranty period shall start from date of substantial completion.
- .4 Refer to individual specification sections for information on any special manufacturer's equipment warranties.

1.33 SYSTEM START UP

- .1 Provide consultant with written notice verifying all equipment operation and installation is complete prior to scheduled start-up period.
- .2 Start up shall be in presence of the following: owner or representative, contractor, and manufacturer's representative. Each person shall witness and sign off each piece of equipment. Consultant's attendance will be determined by consultant.
- .3 Arrange with all parties and provide 72 hours notice for start up procedure.
- .4 Simulate system start up and shut down and verify operation of each piece of equipment.
- .5 These tests are to demonstrate that the systems and equipment installed are operational as specified.
- .6 The contractor must describe during the start up session the required maintenance for each piece of equipment according to the manufacturer.
- .7 The contractor must provide all necessary tools (including a digital multimeter) to successfully complete the start up procedure.

1.34 OPERATION AND MAINTENANCE MANUAL

- .1 Provide operation and maintenance data for incorporation into manual as specified in other Sections of this Division.
- .2 Operation and maintenance manual to be approved by, and final copies deposited with, Consultant before final inspection. Make changes as requested and re-submit as directed by Consultant.
- .3 Submit one manual for approval. Three (3) manuals will be required at project completion. Each of which shall be in a three ring binder (minimum 50 mm (2") ring) labelled:
 - .1 Operation and Maintenance Manual.
 - .2 Project Name.
 - .3 Location.
- .4 Each manual must include (in "tabbed" sections) the following:
 - .1 Index
 - .2 List of General, Mechanical, Electrical Contractors and all associated sub-contractor names, addresses and contact numbers.
 - .3 List of suppliers and equipment wholesalers local to the project.
 - .4 One year warranty letter for all parts, equipment and workmanship.

- .5 List of manufacturers, spare parts list and source.
 - .6 Copy of typewritten schedules for all new and renovated panels.
 - .7 Final certificate from the Electrical Safety Authority.
 - .8 Final Fire alarm verification certificate including field technician device sheets.
 - .9 Certificate of exit/emergency lighting testing as per the specification.
 - .10 Copy of electrical shop drawings which have been stamped and reviewed by Consultant
 - .11 Any special warranties on equipment required (i.e. LED lighting, digital lighting control).
 - .12 Certificate of completion from all associated sub-contractors.
 - .13 Cable test results and floor plans containing address labels.
 - .14 Lighting Controls System commissioning certificate and report.
- .5 Upon acceptance of Operation and Maintenance Manual by the consultant, a pdf file of the entire manual is to be provided on a USB stick. Only one USB stick is to be provided containing both the approved manuals and as-built drawings.

1.35 AS-BUILT DRAWINGS

- .1 Site records:
 - .1 Contractor shall provide 2 sets of reproducible electrical drawings. Provide sets of white prints as required for each phase of the work. Mark thereon all changes as work progresses and as changes occur. This shall include field and contract changes to electrical systems.
 - .2 On a weekly basis, transfer information to reproducibles, revising reproducibles to show all work as actually installed.
 - .3 Use different colour waterproof ink for each service.
 - .4 Make available for reference purposes and inspection at all times.
- .2 As-built drawings:
 - .1 Identify each drawing in lower right hand corner in letters at least 3 mm (1/8") high as follows: - "AS-BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW ELECTRICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (date).
 - .2 Submit hard copy to Consultant for approval. When returned, make corrections (if any) as directed.
 - .3 Once approved, submit completed reproducible paper as-built drawings as well as a scanned pdf file copy on USB stick with Operating and Maintenance Manuals.

1.36 DEMONSTRATION AND OPERATING AND MAINTENANCE INSTRUCTIONS

- .1 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.
- .2 Manufacturers or their representatives are to provide demonstrations and instructions.

- .3 Use operation and maintenance manual, As-built drawings, audio visual aids, etc. as part of instruction materials.
- .4 Instruction duration time requirements as specified in appropriate sections.
- .5 Where deemed necessary, Consultants may record these demonstrations on video tape for future reference.

1.37 SUBSTANTIAL PERFORMANCE

- .1 Complete the following to the satisfaction of the consultant prior to submission of substantial performance.
 - .1 As-built Drawings.
 - .2 Maintenance Manuals.
 - .3 System Start up.
 - .4 Instructions to Owners.
 - .5 Final Certificates (Electrical Safety Authority, Fire Alarm, Integrated Life Safety Systems Commissioning, Emergency Lighting, ICT (Voice/Data, Public Address) systems).

1.38 TRIAL USAGE

- .1 Consultant or owner may use equipment and systems for test purposes prior to acceptance. Supply labour, material, and instruments required for testing.

1.39 REVISION TO CONTRACT

- .1 Provide the following for each item in a given change notice:
 - .1 Itemized list of material with associated costs.
 - .2 Labour rate and itemized list of labour for each item.
 - .3 Copy of manufacturers/suppliers invoice if requested.

1.40 EQUIPMENT SUPPORTS

- .1 Equipment supports supplied by equipment manufacturer: shall be installed by the electrical contractor.
- .2 Equipment supports not supplied by equipment manufacturer: fabricate from structural grade steel meeting requirements of - Structural Steel Section. Submit structural calculations with shop drawings if necessary.
- .3 Mount base mounted equipment on chamfered edge housekeeping pads, minimum of 100 mm (4") high and 150 mm (6") larger than equipment dimensions all around. This installation of this pad shall be the responsibility of the electrical contractor.
- .4 This contractor shall be responsible for providing all anchor bolts and associated formed concrete bases for lighting standards as detailed.

1.41 SLEEVES

- .1 Pipe sleeves: at points where pipes pass through masonry, concrete, or fire rated assemblies and as indicated.
- .2 Schedule 40 steel pipe.
- .3 Sleeves with annular fin continuously welded at midpoint:
 - .1 Through foundation walls.
 - .2 Where sleeve extends above finished floor.
- .4 Sizes: minimum 6 mm (1/4") clearance all around, between sleeve and conduit.
- .5 Terminate sleeves flush with surface of concrete and masonry walls, concrete floors on grade and 25 mm (1") above other floors.
- .6 Through foundation walls PVC sleeves are acceptable.
- .7 Fill voids around pipes:
 - .1 Caulk between sleeve and pipe in foundation walls and below grade floors with waterproof fire retardant non-hardening mastic.
 - .2 Where sleeves pass through walls or floors, provide space for firestopping. Where pipes/ducts pass through fire rated walls, floors and partitions, maintain fire rating integrity.
 - .3 Fill future-use sleeves with easily removable filler.

1.42 FIRESTOPPING

- .1 Firestopping material and installation within annular space between conduits, ducts, and adjacent fire separation.
- .2 Provide materials and systems capable of maintaining effective barrier against flame, smoke, and gases.
- .3 Comply with the requirements of CAN4-S115-M35, and do not exceed opening sized for which they have been tested.
- .4 Systems to have an F or FT rating (as applicable) not less than the fire protection rating required for closures in a fire separation.
- .5 Provide "firewrap" blanket around services penetrating firewalls. Extent of blanket must correspond to ULC recommendations. In general wrap individual conduits with approved firewrap materials on each side of firewall. Refer to architectural drawings for FT ratings. Provide 1 and/or 2 layers of firewrap with transverse and longitudinal seams overlapped and/or butted (second layer offset from first layer). Cut edges are to be sealed with aluminum foil tape. Provide 50 mm stainless steel banding at 200 mm intervals. Install firewrap to manufacturers' recommendations for proper FT rating. Acceptable manufacturers are 3M Firemaster ductwrap or approved equal.
- .6 The firestopping materials are not to shrink, slump or sag and be free of asbestos, halogens and volatile solvents.

- .7 Firestopping materials are to consist of a component sealant applied with a conventional caulking gun and trowel.
- .8 Firestop materials are to be capable of receiving finish materials in those areas, which are exposed and scheduled to receive finishes.
- .9 Firestopping shall be inspected and approved by local authority prior to concealment or enclosure.
- .10 Install material and components in accordance with ULC certification, manufacturers instructions and local authority.
- .11 **Submit product literature and installation material on firestopping in shop drawing and product data manual.**
- .12 Acceptable manufacturers:
 - .1 Fyresleeve Industries Inc.
 - .2 General Electric Pensil Firestop Systems
 - .3 International Protective Coatings Corp.
 - .4 Rectorseal Corporation (Metacaulk)
 - .5 Proset Systems
 - .6 3M
 - .7 AD Systems
 - .8 Hilti
 - .9 Royal

Note: Fire stop material must conform to requirements of local authorities having jurisdiction. Contractor to confirm prior to application and ensure material used is compatible with that used by other trades on site.

- .13 Ensure firestop manufacturer representative performs on site inspections and certifies installation. Submit inspection reports/certification at time of substantial completion.

1.43 PAINTING

- .1 Refer to Section Interior Painting and specified elsewhere.
- .2 Apply at least one coat of corrosion resistant primer paint to ferrous supports and site fabricated work.
- .3 Prime and touch up marred finished paintwork to match original.
- .4 Restore to new condition, or replace equipment at discretion of consultant, finishes which have been damaged too extensively to be merely primed and touched up.

1.44 ACCESS DOORS

- .1 Supply access doors to concealed electrical equipment for operating, inspecting, adjusting and servicing.

- .2 Flush mounted 600 mm x 600 mm (24" x 24") for body entry and 300 mm x 300 mm (12" x 12") for hand entry unless otherwise noted. Doors to open 180°, have rounded safety corners, concealed hinges, screwdriver latches and anchor straps.
- .3 Material:
 - .1 Special areas such as tiled or marble surfaces: use stainless steel with brushed satin or polished finish as directed by Consultant.
 - .2 Remaining areas: use prime coated steel.
 - .3 Fire rated areas: provide ULC listed access doors
- .4 Installation:
 - .1 Locate so that concealed items are accessible.
 - .2 Locate so that hand or body entry (as applicable) is achieved.
 - .3 Installation is specified in applicable sections.
- .5 Acceptable materials:
 - .1 Le Hage
 - .2 Zurn
 - .3 Acudor
 - .4 Nailor Industries Inc.

1.45 DELIVERY STORAGE & HANDLING

- .1 Follow Manufacturer's directions in delivery, storage, and protection, of equipment and materials.
- .2 Deliver equipment and material to site and tightly cover and protect against dirt, water, and chemical or mechanical injury, but have readily accessible for inspection. Store items subject to moisture damage (such as controls) in dry, heated space.

1.46 REPAIR, CUTTING, CORING AND RESTORATION

- .1 Be responsible for required digging, cutting, and patching incident to work of this Division and make required repairs afterwards to satisfaction of Consultant. Cut carefully to minimize necessity for repairs to existing work. Do not cut beams, columns, or trusses.
- .2 Patch and repair walls, floors, ceilings, and roofs with materials of same quality and appearance as adjacent surfaces unless otherwise shown. Surface finishes shall exactly match existing finishes of same materials.
- .3 Each Section of this Division shall bear expense of cutting, patching, repairing, and replacing of work of other Sections required because of its fault, error, tardiness, or because of damage done by it.
- .4 Cutting, patching, repairing, and replacing pavements, sidewalks, roads, and curbs to permit installation of work of this Division is responsibility of Section installing work.
- .5 Slots, cores and openings through floors, walls, ceilings, and roofs shall be provided by this contractor but performed by a trade specializing in this type of work. This Division

shall see that they are properly located and do any cutting and patching caused by its neglect to do so.

1.47 EXISTING SYSTEMS

- .1 Connections into existing systems to be made at time approved by Consultant. Request written approval of time when connections can be made.
- .2 Be responsible for damage to existing plant by this work.

1.48 CLEANING

- .1 Clean interior and exterior of all electrical equipment provided including light fixture lenses.
- .2 In preparation for final acceptance, clean and refurbish all equipment and leave in operating condition.

1.49 DISCONNECTION AND REMOVAL

- .1 Disconnect and/or remove equipment as indicated.
- .2 Cap and conceal all redundant and obsolete connections.
- .3 Provide a list of equipment to be removed to the owner, for his acceptance of same. Remove all equipment from site, which the owner does not retain.
- .4 Store equipment to be retained by owner on site where directed by consultant.

1.50 OWNER SUPPLIED EQUIPMENT

- .1 Connect to equipment supplied by the owner and make operable.

1.51 ENCLOSURES

- .1 This contractor must ensure that all electrical equipment mounted in sprinklered areas is provided with an enclosure in conformance with the Electrical Safety Code.

END OF SECTION

Part 1 General

1.1 GENERAL PROVISIONS

- .1 Conform to the General Provisions of Division 1 and Electrical General Requirements Section.
- .2 This project is one of a retrofit nature in part, and which will require extensive demolition.
- .3 Allow for all remedial work in areas indicated on the drawings and as generally defined in the relevant sections of the specifications.

1.2 SCOPE OF WORK

- .1 The scope of work is essentially the selected disconnection and/or removal of services and/or equipment, devices etc. as indicated or required to complete the work.

Part 2 Products

2.1 GENERAL

- .1 This Division is to liaise with the Owners or Consultant for equipment being removed that may be suitable for reuse to that specified or handed over to the owner.
- .2 This Division to take full responsibility for any special tools or equipment required to disassemble or remove material from building.

Part 3 Execution

3.1 GENERAL

- .1 The general requirements are indicated on the drawings and on the outline specification in Division 1.
- .2 The general execution of the demolition is to be carried out in a clean and efficient manner.
- .3 Demolition of existing ceiling, walls etc., to facilitate removal of existing services or equipment or installation of new to be kept to a minimum and then restored to match existing.
- .4 All openings or holes created by removal of existing electrical systems which are not being reused are to be patched with the same material surrounding surfaces.
- .5 All new holes and openings to facilitate electrical systems are to be patched to match surrounding surfaces.
- .6 Protect all existing furnishings materials and equipment. Any damage occurring as a result of the work of this Division shall be repaired or replaced at the expense of this Division.

- .7 Where work involves breaking into or connecting to existing services, carry out work at times directed by the Owners in an expedient manner with minimum disruption to the facility and systems downtime.
- .8 Where unknown services are encountered immediately advise Consultant and confirm findings in writing.
- .9 Where the location of any services has been shown on the plans, such information is not guaranteed. It is this Division's responsibility to verify locations, etc., immediately after moving on site. Should for any reason the information obtained necessitates changes in procedure or design, advise the Consultant at once. If verification of existing conditions is not done at the outset and any problems arise, the responsibility for same is entirely this Division's.
- .10 Disconnect and/or remove equipment, devices, cabling, services, etc. as indicated.
- .11 Remove all redundant and obsolete systems, connections, and wiring.
- .12 Provide a list of equipment to be removed to the owner, for their acceptance of same. Remove all equipment from site that the owner does not retain.
- .13 Maintain equipment to be retained by owner on site where directed by consultant.
- .14 Demolition of all parts of the work must be completed within the confines of the work area and in such a way as the dust produced and risk to injury of will not adversely affect the building users.
- .15 Demolition shall take place within areas isolated from all other areas with appropriate hoarding, scaffolding, netting, fencing or other means of security between building users and the work.

END OF SECTION

Part 1 General

1.1 INTENT

- .1 Life safety and fire protection systems are to be installed to comply with the provisions of the current Ontario Building and Fire Codes. As a result, testing of these integrated systems must be performed as a whole to ensure the proper operation and inter-relationship between systems (functional testing).
- .2 The testing is to provide functional verification and documented confirmation that these building systems satisfy the intent of the Building Code.
- .3 These systems as applicable to any given project include but are not limited to fire alarm system, fire/smoke damper devices, and suppression systems.

1.2 GENERAL

- .1 This testing process is the responsibility of the Integrated Testing Firm as a sub-contractor to the electrical trade. Electrical trade to include all costs associated with the Integrated Testing Coordinator in contract.
- .2 This process must be co-ordinated with suppliers and sub-contractors associated with these systems (mechanical and/or electrical).
- .3 This process must be co-ordinated with the project construction schedule and be completed, including all associated documentation, prior to the consultant's certification of the project for occupancy.
- .4 All applicable contractors, sub-contractors, and suppliers are to include all required costs in their respective tender costs.
- .1 All work is to be performed in accordance with CAN/ULC S1001-2011. Special consideration is to be given to the Sample Integrated Testing Plan (ITP), the review of life safety system design documents, and the provision of test plans and reports.
- .2 The work to be performed by this contractor is also described in CAN/ULC S1001-2011.
- .3 Refer to CAN/ULC S1001-11 Rev1-2019 Informative Annex (C) for Sample Integrated Testing Plan (ITP).

1.3 QUALITY ASSURANCE

- .1 The following criteria must be met in order to be considered an acceptable Integrated Testing Coordinator for this project:
 - .1 Manufacturers: Firms regularly engaged in functional testing and implementation of life safety and fire protection systems for not less than five years.
 - .2 Qualifications: Firms with at least five years of successful experience in facility construction, inspection, acceptance testing or commissioning as it relates to fire protection and life safety and equipment similar to that required for this project.

- .3 The Contractor shall be an established commissioning contractor that has had and currently maintains a locally run and operated business for at least five years.
- .4 The Contractor shall show satisfactory evidence, upon request, that he maintains a fully equipped service organization capable of furnishing adequate inspection and service to the systems.
- .2 For bidder information only, experienced Life Safety Systems Testing Firms include these listed below or local branches of the companies noted in the vicinity of this project:
 - .1 Georgian Bay Fire and Safety Ltd.
1700 20th Street East
Owen Sound, Ontario
 - .2 Vintage Fire and Life Safety Ltd.
25 Coverdale Cres.
Kitchener, Ontario N2M 4X1
 - .3 Troy Life and Fire Safety
805 Boxwood Dr., Unit #201
Cambridge, Ontario N3E 1A4
 - .4 Control Tech Systems
31 Regal Road
Guelph, Ontario N1K 1B6
 - .5 Lonergan Engineering
4 Industrial Parkway South
Aurora, Ontario L4G 3W1

NOTE: This agent must be a third party firm NOT associated with this project in any way and be under contract with the electrical sub-contractor not the fire alarm supplier.

- .3 Other firms to these listed above, who feel they are capable, must submit in writing, to the Consultant's office confirmation of the items listed in the criteria above, a minimum of one week prior to tender close in order to be considered as a bidder.

1.4 GENERAL REQUIREMENTS

- .1 The Commissioning Process shall generally encompass and co-ordinate the following key areas:
 - .1 Integrated systems testing planning.
 - .2 Integrated systems testing implementation (functional testing).
 - .3 Integrated systems testing documentation

1.5 RESPONSIBILITIES

.1 General Contractor:

- .1 The general contractor shall verify completeness of the building envelope, perimeter and interior items which affect proper operation of the noted systems.
- .2 The general contractor will assure participation and co-operation of Sub-Contractors and Specialty Contractors (mechanical, electrical, building management, etc.) under the General Contractor's jurisdiction as required for the commissioning process.

.2 Electrical Contractor:

- .1 The Integrated Life Safety Systems Testing Coordinator (ITC) is being retained by the electrical contractor, however; this contractor's work to satisfy the ITC requirements shall be included in the tender price.
- .2 Verify Functional performance of electrical systems for compliance with design intent as specified in the appropriate Specification sections.
- .3 Provide the documentation with standard Functional performance reports on completion of the testing.
- .4 Verify submissions for electrical system operation and maintenance manuals, as-built documents, spare parts listing, special tools listing, and other items as may be specified.
- .5 As a minimum this contractor must include for:
 - .1 Providing the ITC with documentation of design and shop drawings.
 - .2 Provide documents for sequence of operation and maintenance of system.
 - .3 Testing of all components and accessories to confirm Alarm/Supervisory/Trouble at the fire panel.
 - .4 Testing and operation of any generator (s) as applicable to the project.
 - .5 Other items that may be requested by the ITC.
 - .6 Re-commissioning of any items that may have failed.
 - .7 Re-setting of the system to proper operation after tests are completed.

.3 Equipment Manufacturers:

- .1 The equipment manufacturers shall be responsible for providing labour, material, equipment, etc., required within the scope of the respective equipment to facilitate the commissioning process.
- .2 The equipment manufacturers will perform Pre-Functional and Functional Performance Tests required by the commissioning process.

.4 Design Engineer:

- .1 The design engineer shall observe Functional Performance Testing, at his discretion.
- .2 The design engineer shall provide technical capabilities for resolution of deficiencies, where required.

Part 2 Commissioning Process

2.1 OPERATIONS AND MAINTENANCE MANUALS

- .1 Furnish Final, reviewed Operation and Maintenance Manuals to the Consultant fourteen (14) days prior to scheduled Functional Performance Tests.

2.2 FUNCTIONAL PERFORMANCE TEST

- .1 The contractor shall be responsible for the Functional Performance Tests. These tests ensure that all equipment and systems are installed in accordance with the Specifications, Drawings, and manufacturers' requirements.
- .2 The contractor shall be responsible for co-ordinating schedule for Functional tests of various equipment and systems.
- .3 In the Functional Test, all noted systems and sub-systems shall be checked for the following:
 - .1 Verify that each element has been properly installed, properly identified, and that all connections have been made correctly.
 - .2 Verify that tests, meter readings, and specific mechanical/electrical performance characteristics agree with those required by equipment or system manufacturer.
 - .3 Re-commission any item(s) that may have failed.
 - .4 Notify the consultant in writing, at least fourteen (14) days prior to the date of Functional Performance Testing. Schedule the Functional performance tests over a period of consecutive business days.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA C22.2 No.0.3-92, Test Methods for Electrical Wires and Cables.

1.2 PRODUCT DATA

- .1 Submit product data in accordance with Electrical General Requirements Section.

Part 2 Products

2.1 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger.
- .2 Minimum size: 12 AWG.
- .3 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material 90°C (194°F) rated T90 for indoor above grade installations and RW90 for below grade installations.

2.2 ARMoured CABLES

- .1 Conductors: insulated, copper minimum size as indicated above.
- .2 Type: AC90 (minimum size 12 AWG).
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Connectors must be suitable for installed environment and approved for use with armoured cable.

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

- .1 Install wiring from source to load through raceways as specified.
- .2 Provide separate neutral conductors for all lighting circuits and circuits originating from surge protected panels. Size raceways accordingly.

3.2 INSTALLATION OF ARMoured CABLES

- .1 Group cables wherever possible.
- .2 Terminate cables in accordance with Wire and Box Connectors - 0 - 1000 V Section.

- .3 These cables are to be installed in concealed locations only. These concealed locations are considered to be stud walls and “drops” to stud walls, lighting fixtures, and ceiling mounted devices.
- .4 These “drops” shall not be permitted to exceed 2.4 m (8'-0"). To limit these “drops” to lengths noted above provide additional branch wiring in conduit.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data for cabinets in accordance with Electrical General Requirements Section.

Part 2 Products

2.1 MATERIALS

- .1 Splitters must conform to CSA C22.2 No. 76 (latest edition).
- .2 Junction and pull boxes must conform to CSA C22.2 No. 40 (latest edition)

2.2 SPLITTERS

- .1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.
- .2 Main and branch lugs to match required size and number of incoming and outgoing conductors as indicated.
- .3 At least three spare terminals on each set of lugs in splitters less than 400 A.
- .4 Splitter length must match arrangement of equipment unless indicated otherwise.

2.3 JUNCTION AND PULL BOXES

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm (1") minimum extension all around, for flush-mounted pull and junction boxes.

Part 3 Execution

3.1 SPLITTER INSTALLATION

- .1 Install splitters and mount plumb, true and square to the building lines on 19 mm (3/4") painted plywood backboards.

3.2 JUNCTION AND PULL BOXES INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Install junction and pull boxes so as not to exceed 30 m (100') of conduit run between pull boxes and in conformance with the Electrical Safety Code.

3.3 IDENTIFICATION

- .1 Provide equipment identification in accordance with General Electrical Requirements Section.
- .2 Install size 2 identification labels indicating system name, voltage and phase.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Outlet boxes, conduit boxes, and fittings must conform to CSA C22.2 No. 18 (latest edition).

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm (4") square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.
- .5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 mm x 50 mm x 64 mm (3" x 2" x 2½") or as indicated. 102 mm (4") square outlet boxes when more than one conduit enters one side with extension and plaster rings as required. Iberville 1104 Series.
- .2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted EMT conduit **in utility rooms**, minimum size 102 mm x 57 mm x 38 mm (4" x 2¼" x 1½"). Iberville 1110 Series.
- .3 102 mm (4") square or octagonal outlet boxes for lighting fixture outlets.
- .4 102 mm (4") square outlet boxes with extension and plaster rings for flush mounting devices in finished tile walls.

2.3 CONDUIT BOXES

- .1 Cast FS or FD feraloy boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle **in areas (other than utility rooms) where surface conduit is used.**

2.4 OUTLET BOXES FOR NON-METALLIC SHEATHED CABLE

- .1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 mm 50 mm x 63 mm (3" x 2" x 2-1/2") with two double clamps to take non-metallic sheathed cables.

2.5 FITTINGS- GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm (1- 1/4") and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm (1/4") of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .5 Outlets if unwired are to be provided with blank coverplates to suit related sections of this specification.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CSA C22.2 No.65-1956(R1965) Wire Connectors.

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as indicated.
- .2 Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors for armoured cable and flexible conduit as required.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
 - .3 Install fixture type connectors and tighten. Replace insulating cap.

END OF SECTION

Part 1 **General**
Not Applicable.

Part 2 **Products**

2.1 **MATERIALS**

- .1 Grounding equipment must conform to CSA C22.2 No 41 (latest edition).

2.2 **EQUIPMENT**

- .1 Insulated grounding conductors: green with insulation type that matches specified phase conductors. Gauge shall be in conformance with the latest edition of the Electrical Safety Code to suit required installation conditions.
- .2 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Bonding jumpers, straps.
 - .5 Pressure wire connectors.

Part 3 **Execution**

3.1 **INSTALLATION GENERAL**

- .1 Install complete permanent, continuous grounding system including 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, electrodes, using copper welding by thermit process inspectable wrought copper compression connectors to ANSI/IEEE 837.
- .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.

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, and outdoor lighting.

3.3 COMMUNICATION SYSTEMS

- .1 Install grounding connections for ICT, fire alarm systems as indicated.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Electrical General Requirements Section.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA C22.2 No.18-92, Outlet Boxes, Conduit Boxes, and Fittings.
 - .2 CSA C22.2 No.56-1977(R1977), Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .3 CSA C22.2 No.83-M1985(R1992), Electrical Metallic Tubing.
 - .4 CAN/CSA C22.2 No.227.3-M91, Flexible Nonmetallic Tubing.

Part 2 Products

2.1 CONDUITS

- .1 Epoxy coated conduit: to CSA C22.2 No.45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .2 Electrical metallic tubing (EMT) with couplings: to CSA C22.2 No.83.
- .3 Flexible metal conduit: to CSA C22.2 No.56, aluminum and liquid-tight flexible metal.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 53 mm (2") and smaller. Two hole steel straps for conduits larger than 53 mm (2").
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.5 m (5'0") oc.
- .4 Threaded rods, 6 mm (1/4") diameter, to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 EMT fittings shall be set screw style (zinc alloy).
- .2 Flexible metal conduit fittings shall be screw-in type.
- .3 Liquid type flexible metal conduit fittings shall be sealtite type.
- .4 Coating: same as conduit.
- .5 Factory "ells" where 90° bends are required for 27 mm (1") and larger conduits.
- .6 Where bushings are noted to be provided they must be "screwed" type fastened to a conduit connector. Push-fit or glued in place bushings will NOT be accepted.

2.4 FISH CORD

- .1 Nylon twine.

Part 3 Execution

3.1 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical/ electrical service rooms and in unfinished areas. Where devices are to be installed on existing walls in finished area, which cannot be "fished", install feeds in a surface metal raceway equal to Wiremold V700 series. Co-ordinate surface installations with consultant prior to rough-in.
- .3 **Use electrical metallic tubing (EMT) for all branch circuits unless specified otherwise.**
- .4 Use flexible metal conduit for connection to motors in dry areas, connection to recessed fixtures without a prewired outlet box, connection to surface or recessed fixtures, work in movable metal partitions.
- .5 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations and for connections to kitchen equipment.
- .6 Conduits terminating at electrical equipment in sprinklered areas are to be provided with insulated compression style connectors equal to Thomas & Betts Cat. #TC8XXSC or approved equal.
- .7 **Minimum conduit size for branch circuits shall be 21 mm (3/4").** Single drops from ceiling mounted junction boxes down to a light switch or duplex receptacle may be reduced to 16 mm (1/2").
- .8 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .9 Mechanically bend steel conduit over 27 mm (1") diameter.
- .10 Install fish cord in empty conduits.
- .11 Run 2- 27 mm (1") spare conduits up to accessible ceiling space from each flush panel. Terminate these conduits in 152 mm x 152 mm x 102 mm (6" x 6" x 4") junction boxes in ceiling space.
- .12 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .13 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m (5') clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended or surface channels.
- .5 Do not pass conduits through structural members except as indicated.
- .6 Do not locate conduits less than 75 mm (3") parallel to steam or hot water lines with minimum of 25 mm (1") at crossovers.
- .7 Do not fasten surface conduit larger than 25 mm (1") to roof deck. Provide standoffs or supports as manufactured by Caddy or use unistrut trapeze fastened to structure.**

3.3 CONCEALED CONDUITS

- .1 Do not install horizontal runs in masonry walls.
- .2 Do not install conduits in terrazzo or concrete toppings.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS

- .1 Submit shop drawings for each system in Conformance with The Electrical General Requirements Section.

1.2 PRODUCT/MAINTENANCE DATA

- .1 Submit product/maintenance data for each system for inclusion in maintenance manual conforming to The General Electrical Requirements Section.

1.3 SCOPE

- .1 The scope of this Section will include the following systems.
 - .1 ICT Infrastructure system rough-in.
 - .2 Miscellaneous clocks.
 - .3 Occupancy sensors.
 - .4 Cable management hangers.

Part 2 Products

2.1 ICT INFRASTRUCTURE SYSTEM ROUGH-IN

- .1 Outlets where noted shall be single gang flush mounted in wall or surface raceways.
- .2 Outlets if unwired are to be provided with blank coverplates to suit related sections of this specification.
- .3 Refer to ICT Infrastructure section for additional requirements.

2.2 MISCELLANEOUS CLOCKS

- .1 Room and/or office clocks shall be surface mounted 300 mm (12") round style, battery operated. Finish to suit Architect.
- .2 Library and general purpose room clocks shall be surface mounted 375 mm (15") round style, battery operated. General purpose room clocks must be provided with wire guard. Finish to suit Architect.
- .3 Manufacturers shall be as follows:
 - .1 300 mm (12"):
 - Edwards Cat. #2941-2B
 - Simplex Cat. #BAT Series
 - American Time Cat. #E56BADD304
 - .2 375 mm (15"):
 - Edwards Cat. #2942-2B

Simplex Cat. # BAT Series
American Time Cat. # E66BADD304
.3 Wireguard for 375 mm (15") clock:
Edwards Cat. #2091A
Simplex Cat. # BAT Series
American Time Cat. #G2366

2.3 OCCUPANCY SENSORS

- .1 Where noted on drawings the wall mounted (passive technology) occupancy sensor used in storage and service rooms shall be either:
 - .1 Wattstopper Cat. #PW-100-VOLT-X (colour by Architect).
 - .2 Sensor switch Cat. #WSX-VOLT-X (colour by architect).
 - .3 Equal by Cooper Controls.
- .2 Where noted on the drawings, the wall mounted switch style occupancy sensor used in Administrative Offices and Seminar/Meeting Rooms shall be a dual technology switch with either single or double relay (circuit) as noted on the drawings. Colour to suit architect.

Note: For dual relay switches, program the sensor for 15 minute off delay, enabled walk-thru, audible alert enabled, relay 1 on mode: auto on, relay 2 on mode: manual on.

 - .1 Single relay (circuit): Wattstopper Cat. #DW-100
 - .2 Dual relay (circuit): Wattstopper Cat. #DW-200
 - .3 Approved equal:
 - .1 Cooper Controls.
 - .2 Sensor switch.
- .3 Provide other occupancy sensors to suit the detail on the drawings.
- .4 All sensors shall be set to 5 minutes "delay to off" unless otherwise directed.

2.4 CABLE MANAGEMENT HANGERS

- .1 Hangers where noted are to be complete with the following features:
 - .1 Approximately 150 mm (6") high by 80 mm (3 1/4") protrusion.
 - .2 Constructed from 5 mm (3/16") x 20 mm (3/4") flat steel bar and formed to resemble the letter "G".
 - .3 Seven 6 mm (1/4") diameter mounting holes are to be provided around the hanger perimeter.
 - .4 Matte black finish.
 - .5 Suitable for wall or suspended mounting.
 - .6 Acceptable Manufacturers:
 - .1 EMF Cat. #H-533-S
 - .7 Manufacturer Contact:
Electron Metal Fabricators Inc.

2160 Dagenais Boulevard West
Laval, Quebec
H7L 5X9
Phone: 450-625-8064 or 1-800-267-8064
Fax: 450-625-8004

- .8 Acceptable Alternate:
Wiremold Cat. #GH030406
Mono System Cat. # The Hook H-433
Cablofil Cat. #CSGH-3-4-6

- .2 **As an alternate to the hanger system detailed the contractor may**
a) **use as an equal one run of 50 mm (2") x 150 mm (6") wire mesh cable management system equal to Cablofil Cat. #CF 54/150 EZ complete with Cat. #FAS L 150 universal wall bracket where noted to be wall mounted and Cat. # FAS C 200 where noted to be hung. The hangers are to be installed at intervals as recommended by the manufacturer but no greater than 2.4 m (8' - 0") on centre.**

Part 3 Execution

3.1 ICT INFRASTRUCTURE SYSTEM ROUGH-IN

- .1 Conduits terminated into ceiling spaces must be within 3m (10') of zone conduits (if applicable).
.2 Ensure specified zone conduits are installed back to service backboard.
.3 Outlets are to be installed complete with 25 mm (1") conduit to corridor ceiling space or nearest zone conduit (if applicable).
.4 Provide insulated bushings on all conduits terminated in ceiling space.
.5 Refer to ICT Infrastructure Section for additional requirements.

3.2 MISCELLANEOUS CLOCKS

- .1 Ensure clocks are installed where noted complete with batteries and all necessary mounting hardware.
.2 Set clocks to proper time of day and ensure all are operational at the time of final inspection.

3.3 OCCUPANCY SENSORS

- .1 Install power packs in accessible maintenance areas.
.2 Provide access doors if power packs are installed above drywall ceilings.
.3 It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper coverage within the range of coverage as per the manufacturer's recommendations. The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided

with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective rooms.

- .4 It is the contractor's responsibility to arrange a pre-installation meeting with the manufacturer's factory authorized representative, at the facility, to verify placement to sensors and installation criteria.
- .5 The contractor shall also provide the on-site training necessary to familiarize the owner's personnel with the operation, use, adjustment and problem solving diagnosis of the occupancy sensing devices systems.
- .6 Upon completion of the installation, the system shall be completely commissioned by the manufacturer's factory authorized technician who will verify all adjustments and sensor placement to ensure a trouble-free occupancy-based lighting control. Submit commissioning report with closeout documents.

3.4 CABLE MANAGEMENT HANGERS

- .1 Install hangers as per details in configuration noted.
- .2 Prior to installation co-ordinate location with other services within the ceiling space.
- .3 Co-ordinate with noted sub-contractors to install cables noted to be utilizing these hangers. Cables are to be installed such that the maximum sag between hangers does not exceed 25 mm (1"). This electrical contractor is to coordinate.
- .4 **Attaching cable to any t-bar support rods is not acceptable.**

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

- .1 Submit product data in accordance with Electrical General Requirements Section.
- .2 Drawings to include electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

Part 2 Products

2.1 PANELBOARDS

- .1 Panel boards must conform to CSA C22.2 No. 29 (latest edition).
- .2 Panelboards: product of one manufacturer.
- .3 Install circuit breakers in panelboards before shipment.
- .4 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand. **Series rating is acceptable – submit information with shop drawings. Provide lamicaid label on feeder breaker. Lamicaid label to state "Series Rating Breaker." Lamicaid label to be size 2.**
- .5 Bus and breakers must be rated for 22KA (symmetrical) interrupting capacity or as indicated.
- .6 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.
- .7 Panelboard mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .8 Two keys for each panelboard and key panelboards alike.
- .9 Aluminum bus with neutral of same ampere rating as mains.
- .10 Mains must be suitable for bolt-on breakers. Provide main (if applicable) and branch breakers as bolt-on style.
- .11 Trim with concealed front bolts and hinges.
- .12 Trim and door finish must be baked grey enamel.
- .13 All panels regardless of voltage and amperage must be provided with a lockable door.
- .14 Branch circuit panelboards (250 AMP or smaller) must be one of the following:
 - .1 Eaton Cat # POW-R-LINE-C PRL-1 or PRL-2
 - .2 Schneider Electric Cat # NQ Series for up to 240V or NF Series for up to 600V
 - .3 Siemens Cat #Sentron P1 Series
- .15 Panels ranging in width from 368 to 558 mm (14½" to 22"), depth from 100 to 150 mm (4" to 6") and height from 533 to 1143 mm (21" to 45") are to be retrofitted. Retrofit panels must allow for the installation of new panel interior and trim to suit the existing

recessed panel tub. Note: Panel manufacturers bidding this project that do not carry a panel retrofit kit must allow in their price the cost to remove the existing panel tub and replace with new including all necessary wall repairs. Retrofit panelboards shall be: Cutler Hammer Cat. # PIR-X-3-A-X-X.

2.2 BREAKERS

- .1 Breakers: to Moulded Case Circuit Breakers Section.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker (as specified) must be separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for fire alarm, stairway, exit and night light circuits.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Electrical General Requirements Section.
- .2 Nameplate for each panelboard size 4 engraved description as indicated. In finished areas install label on inside of panel, and in service areas install label on exterior of panel.
- .3 Nameplate for each circuit in distribution panelboards size 2 engraved "name of load" as indicated.
- .4 Complete circuit directory with typewritten legend showing location of each circuit. **Include a copy of the directories in the maintenance manuals.**

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. Plywood shall be 21mm (3/4") fire rated or painted with intumescent fire block paint having a minimum of 1h rating, unless noted otherwise.
- .3 Mount panelboards to height specified in Electrical General Requirements Section or as indicated.
- .4 Connect loads to circuits.
- .5 Connect neutral conductors to common neutral bus.
- .6 Install series rating lamicoids adjacent to all breakers utilized to achieve series ratings.

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

- .1 Submit product data in accordance with Electrical General Requirements Section.

Part 2 Products

2.1 BREAKERS GENERAL

- .1 Moulded case circuit breakers must conform to CSA C22.1 No.5.1-M91 (latest edition.)
- .2 Bolt-on moulded case circuit breaker quick-make, quick-break type, for manual and automatic operation.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Unless otherwise indicated 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.

Part 3 Execution

3.1 INSTALLATION

- .1 Install circuit breakers as indicated complete with all necessary mounting hardware and filler panels if necessary.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Electrical General Requirements Section.

Part 2 Products

2.1 SWITCHES

- .1 General purpose AC switches must conform to CSA C22.2 No. 111 (latest edition).
- .2 15 or 20 A, 120 V, single pole, double pole, three-way, four-way, keyed, or motor rated switches complete with pilot light.
- .3 Manually-operated general purpose ac switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine molding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 Toggle style (Rocker style) (architect to select colour).
- .4 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .5 Switches of one manufacturer throughout project.
- .6 Acceptable materials:
 - single pole: Hubbell Cat # HBL1201 Series
 - three way: Hubbell Cat # HBL1203 Series
 - four way: Hubbell Cat # HBL1204 Series
 - Keyed: Hubbell Cat. #HBL1221 Series complete with 2 keys per switch
 - (Keys): Hubbell Cat. #HBL1209
 - Motor rated: Hubbell Cat. #HBL1221PL c/w pilot light (20 A):
- .7 Acceptable alternate manufacturers include:
 - .1 Pass & Seymour
 - .2 Leviton.

2.2 RECEPTACLES

- .1 Receptacles, plugs, and other similar wiring devices must conform to CSA 22.2 No 42 (latest edition).
- .2 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, with following features (20A where noted):
 - .1 Urea molded housing (Colour by architect).
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.
- .5 Acceptable materials:

Standard duplex receptacle	Hubbell Cat # HBL5252CN
Ground fault protected T-slot receptacles	Hubbell Cat. # GF20L A complete with Decora style coverplate to suit specification below
T-slot receptacles	Hubbell Cat. #HBL5352
Dryer receptacle	Hubbell Cat # HBL9430A
Range receptacle	Hubbell Cat # HBL9450A
Tamper resistant receptacle	Hubbell Cat # BR15TR
Tamper resistant T-slot receptacle	Hubbell Cat. #BR20TR
Tamper resistant ground fault protected receptacle	Hubbell Cat. #GFTR15
Tamper resistant ground fault protected T-slot receptacle	Hubbell Cat. #GFTR20 complete with Decora style coverplate to suit specification below

- .6 Acceptable alternate manufacturers include:
 - .1 Pass & Seymour
 - .2 Leviton

2.3 COVER PLATES

- .1 Cover plates from one manufacturer throughout project.
- .2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .3 Stainless steel, brushed, 1 mm (1/32") thick cover plates for wiring devices mounted in flush-mounted outlet box.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .5 Weatherproof cover plates complete with gaskets and "heavy-duty in use" covers in conformance with the Electrical Safety Authority. Provide product equal to Intermatic Cat. #WP5100C.

Part 3 Execution

3.1 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height specified in Electrical General Requirements Section or as indicated.
- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height specified in Electrical General Requirements Section or as indicated.
- .3 Cover plates:
 - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
 - .2 Install suitable common cover plates where wiring devices are grouped.
 - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END OF SECTION

Part 1 General

1.1 PRODUCT DATA

- .1 Submit product data in accordance with Electrical General Requirements Section.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Enclosed manual air break switches must conform to CSA C22.1 No.4 (latest edition).
.2 Fuseholder assemblies must conform to CSA C22.2 No.39 (latest edition).
.3 Fusible, and/or non-fusible, horsepower rated disconnect switches, size as indicated.
.4 Provision for padlocking in off switch position by three locks.
.5 Mechanically interlocked door to prevent opening when handle in ON position.
.6 Fuses: size as indicated, to Fuses - Low Voltage Section.
.7 Fuseholders: relocatable and suitable without adaptors, for type and size of fuse indicated.
.8 Quick-make, quick-break action.
.9 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Electrical General Requirements Section.
.2 Indicate name of load controlled on size 4 nameplate.

2.3 ACCEPTABLE MANUFACTURERS

<u>Manufacturer</u>	<u>General Purpose</u>	<u>Weather Proof</u>
Eaton	IHD Series	3HD Series
Schneider Electric	Type A Series	Type R Series
Siemens	ID Series	NFR/FR Series
GE Industrial	TH Series	TH Series

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.
- .2 Connect auxiliary contacts to elevator controller using conduit, wire and route approved by the elevator supplier.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE C62.41- 1991, Recommended Practices for Surge Voltages in Low-Voltage AC Power Circuits.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM F1137- 88 (1993), Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.
- .3 United States of America, Federal Communications Commission (FCC)
 - .1 FCC (CFR47) EM and RF Interference Suppression.
- .4 IESNA LM-79-08, IES Electrical Method for the Electrical and Photometric Measurements of Solid State Lighting Products.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Electrical General Requirements Section for all light fixtures supplied under this contract.
- .2 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Consultant.
- .3 Photometric data to include: VCP Table spacing criterion.

1.3 SCOPE

- .1 This contractor is responsible to supply and install all lighting fixtures as scheduled and/or indicated including lamp and those accessories required for a complete lighting system. This contractor must coordinate lighting installations with all other Divisions of this project.
- .2 All fixtures must be CSA approved or approved at this contractor's expense by the Special Inspection Division of the Electrical Safety Authority.

1.4 GUARANTEE

- .1 Guarantees for materials replacement shall be as follows from date of substantial completion.
 - .1 LED fixtures, and driver: 5 years.
- .2 The labour required to replace these ballasts, lamps or drivers must be included in the above guarantee, however only for the extent of the contract guarantee and warranty period as noted in Electrical General Requirements.

Part 2 Products

2.1 FIXTURE CONSTRUCTION

- .1 Fixtures must be constructed of 20 gauge (minimum) cold rolled steel. All metal edges require smooth finish.
- .2 Light leaks must be prevented by providing gasketting, stops, and barriers.
- .3 Fixtures must be finished in high reflective baked white enamel. This surface must have a reflectance of not less than 85%.

2.2 FIXTURE LENS

- .1 Unless otherwise noted fixture lenses shall be as follows:
 - .1 Lens thickness: 3.2 mm (1/8")
 - .2 Material: injection moulded clear prismatic virgin acrylic
 - .3 Frame: hinged, latched, steel.

2.3 LED FIXTURES

- .1 Fixture LED's must be tested in conformance with IESNA LM80 standard.
- .2 LED's must be selected using a binning algorithm to ensure colour and lumen output of a given fixture are consistent, as well as meet or surpass ANSI C78.377 specification for the rated lifetime of the fixture. Colour accuracy between products must be within a 2-step MacAdam ellipse.
- .3 Luminaires must be tested to IESNA LM79 by an independent approved laboratory.
- .4 Luminaires must be tested prior to shipping.
- .5 Luminaires must be ULC certified and approved for use in Canada.
- .6 Fixtures must maintain a minimum of 90% of their initial light output for 60,000 hours. Submit test results upon request.
- .7 Lumen values indicated for fixtures in the project documents are to be considered as "absolute" or "delivered" values.
- .8 Other than for specialty fixtures, and unless otherwise indicated, the maximum driver current is to be 750 mA.
- .9 Fixtures must be energy star or pcc rated.

2.4 ACCEPTABLE LIGHTING MANUFACTURERS

- .1 Refer to the light fixture schedule as indicated on drawings.

Part 3 Execution

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated. Luminaires are not to be supported from the roof deck. Provide additional unistrut support channel and/or support from structure. Co-ordinate with consultant on site.
- .2 Ball align hangers must be provided for rod suspended fixtures.
- .3 Fixtures surface mounted to suspended ceilings must be secured through ceiling assembly to cross member supports. These supports are to be steel channels or angles independently secured **to structure** using # 12 "jack" chain. Each chain must be secured so no fixture weight is added to the ceiling assembly.
- .4 Plaster frames/flange kits must be provided by this Division for fixtures recessed in plaster and/or drywall ceilings.
- .5 Where specified, fixtures to be chain hung shall be hung using "jack" chain with a capacity to suit the fixture weight. Branch circuit wiring feeding these fixtures shall be AC90 cable "ty-wrapped" at 900mm (36") intervals along length of drop. Final appearance must be neat and professional.
- .6 Install exit lighting units with illuminated faces and chevrons/arrows indicating path(s) of exit as indicated. Unless otherwise noted install exit fixtures at 2400 mm (8' 0") above finished floor.
- .7 Install emergency lighting units and associated remote mounted fixtures as indicated.
- .8 Direct "heads" on units and remote mounted fixtures to illuminate path(s) of exit.
- .9 Install emergency lighting units and remote fixtures at 300mm (12") below finished ceiling, unless indicated otherwise.
- .10 **Special installation: Secure fixtures to structure to conform to the Electrical Safety Code using "jack chain" NOT ceiling suspension wire. Where coreslab is used, suspension point must be independent of the one used for suspension of the ceiling assembly. As an alternate to jack chain the contractor may use a pre-manufactured aircraft cable suspension and fastening system as manufactured by Gripple (Gripple Cat. #HF02-10F2). Provide minimum 2 per fixture.**
- .11 All battery units are to be provided with a visible lamicaid label indicating the unit number as per drawings.

3.2 WIRING

- .1 Connect luminaires to lighting circuits as indicated.
- .2 Connect exit fixtures to exit lighting circuits and unit equipment (if applicable).
- .3 Connect unit equipment to circuits as indicated.
- .4 All wiring of remote emergency fixtures shall be minimum #10 T90 for each circuit and run in conduit. Wiring must be sized in conformance with manufacturer's recommendations for distances required.

3.3 LUMINAIRE ALIGNMENT

- .1 Align luminaires mounted in continuous rows to form straight uninterrupted line.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.4 DELIVERIES

- .1 Fixtures are to be completely assembled at the manufacturer's plant and delivered to the project site in original unitized containers. Ensure that a dry, protected and secure space is available for proper storage before scheduling delivery of fixtures.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE).
- .2 Underwriter Laboratories of Canada (ULC).
- .3 International Electrotechnical Commission.
- .4 International Organization for Standardization (ISO).
- .5 National Electrical Manufacturers Association (NEMA).

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings in accordance with Section 26 01 16.
- .2 Submit composite wiring diagrams and control schedule for each room control circuit type as proposed to be installed. Include load type, sequence of operation, sensor parameters, time delays, sensitivities and daylighting set points.
- .3 Catalog cut sheets with performance specifications demonstrating compliance with specified requirements.

1.3 SCOPE

- .1 This contractor is responsible to supply and install all equipment and control wiring as specified for the digital occupancy and daylight control systems. This contractor must coordinate these control systems with the lighting fixtures being supplied for the project to ensure intended function as specified.
- .2 Control Intent: Control Intent includes, but is not limited to:
 - .1 Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
 - .2 Initial sensor and switching zones.
- .3 All equipment must be CSA approved or approved at this contractor's expense by the Special Inspection Division of the Electrical Safety Authority.
- .4 Reference section 26 51 13 for Lighting information.
- .5 Reference section 26 05 75 for line voltage occupancy sensors and switches (hard wired analog).

1.4 SYSTEM DESCRIPTION AND OPERATION

- .1 The Digital Lighting Control (room level) as defined under this section covers the following equipment:
 - .1 Digital Room Controllers – Self-configuring, digitally addressable one, two or three relay controllers.

- .2 Digital Occupancy Sensors – Self-configuring, digitally addressable and calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.
- .3 Digital Switches – Self-configuring, digitally addressable pushbutton switches, dimmers, and scene switches with two-way active infrared (IR) communications.
- .4 Digital Photosensors – Single-zone closed loop sensors with two-way active infrared (IR) communications can provide switching or dimming control for daylight harvesting.
- .5 Configuration Tools – Handheld remote for room configuration provides two-way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from an accessible location.

1.5 LIGHTING CONTROL APPLICATIONS

- .1 Provide a minimum application of intended lighting control functions as detailed on design drawings and specified herein. Control functions shall include the following:
 - .1 Space Control Requirements – Provide occupancy/vacancy sensors with Manual-ON functionality in all spaces except toilet rooms, storerooms, or other applications where hands-free operation is desirable and Automatic-ON occupancy sensors are more appropriate. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner-mounted sensors.
 - .2 Bi-Level Lighting – Provide single zone, multi-level controls in any enclosed office, conference room, meeting room, and training room in all enclosed spaces except where variable dimming or multi-zone switching is used.
 - .3 Daylit Areas – All luminaires closest to the daylight source, and zoned separately from other fixtures in the space, shall be controlled separately from luminaires outside of daylit zones. Multiple-leveled switched daylight harvesting controls may be utilized for areas marked on drawings.

1.6 WARRANTY

- .1 Provide a five-year complete manufacturer's warranty on all products to be free of manufacturers' defects.
- .2 The labour required to replace these products must be included in the above warranty, however only for the extent of the contract guarantee and warranty period as noted in Electrical General Requirements.

1.7 QUALITY ASSURANCE

- .1 Manufacturer: Minimum 10-years experience in manufacture of lighting controls.

Part 2 Products

2.1 MANUFACTURERS

- .1 Basis of design product: Acuity Controls (nlight). No Alternates.

2.2 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR SYSTEM

- .1 Wall or ceiling mounted (to suit installation) passive infrared (PIR), ultrasonic or dual technology digital (passive infrared and ultrasonic) occupancy sensor. Furnish the Company's system which accommodates the square-foot coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors and accessories which suit the lighting and electrical system parameters.
- .2 Digital Occupancy Sensors shall provide calibration and electronic documentation for the following features:
 - .1 Digital calibration and pushbutton programming for the following variables:
 - .1 Sensitivity – 0-100% in 10% increments
 - .2 Time delay – 1-30 minutes in 1 minute increments
 - .3 Test mode – Five second time delay
 - .4 Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
 - .5 Walk-through mode
 - .6 Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
 - .2 Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.
 - .3 Device Status LEDs including:
 - .1 PIR Detection
 - .2 Ultrasonic detection
 - .3 Configuration mode
 - .4 Load binding
 - .4 Manual override of controlled loads.
 - .5 One (1) or two (2) RJ-45 port(s) for connection to DLM local network.
- .3 Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.

2.3 DIGITAL WALL SWITCHES

- .1 Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5, and 8 button configuration; colour per architect, compatible with wall plates with decorator opening. Wall switches shall include the following features:
 - .1 Two-way infrared (IR) transceiver for use with personal and configuration remote controls.
 - .2 Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.
- .2 Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required to achieve multi-way switching.

- .3 The following switch attributes may be changed or selected using a wireless configuration tool:
 - .1 Load and Scene button function may be reconfigured for individual buttons (from Load to Scene, and vice versa).
 - .2 Individual button function may be configured to Toggle, On only or Off only.
 - .3 Individual scenes may be locked to prevent unauthorized change.
 - .4 Switch buttons may be bound to any load on a room controller and are not load type dependent; each button may be bound to multiple loads.
- .4 Two (2) RJ-45 ports for connection to DLM local network.
- .5 Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required to achieve multi-way switching.

2.4 DIGITAL POWER PACKS (ROOM CONTROLLERS)

- .1 Room Controllers automatically bind the room loads to the connected devices in the space without commissioning or the use of any tools. Room Controllers shall be provided to match the room lighting load and control requirements. The controllers will be simple to install and will not have, dip switches, potentiometers or require special configuration. The control units will include the following features:
 - .1 Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
 - .2 Simple replacement – Using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf unit without requiring any configuration or setup.
 - .3 Device Status LEDs to indicate:
 - .1 Data transmission
 - .2 Device has power
 - .3 Status for each load
 - .4 Configuration status
 - .4 Quick installation features including:
 - .1 Standard junction box mounting
 - .5 Plenum rated
 - .6 Manual override and LED indication for each load
 - .7 120 VAC, 60 Hz operation.
 - .8 Zero cross circuitry for each load.
- .2 On/Off Room Controllers shall include:
 - .1 One (1) or multiple relay configuration to suit control details
 - .2 Efficient 150 mA switching power supply
 - .3 Sufficient sensor connection points to suit indicated function without the requirement for additional hardware
 - .4 Discrete model listed for connection to receptacles, for schedule-based control of plug loads within the space.

- .1 One (1) relay configuration only.
 - .2 Automatic-ON/OFF configuration.
 - .3 Optional Network Bridge for BACnet MS/TP communications
- .5 Four RJ-45 DLM local network ports.
- .3 On/Off Room/Dimming enhanced Room Controllers shall include:
 - .1 One (1) or multiple relay configuration to suit control details.
 - .2 Efficient 250 mA switching power supply.
 - .3 One (1) 0–10-volt analog output per relay for control of compatible ballasts and LED drivers.
 - .4 The following dimming attributes may be changed or selected using a wireless configuration tool:
 - .1 Establish preset level for each load from 0-100%.
 - .2 Set high and low trim for each load.
 - .3 Set lamp burn in time for each load up to 100 hours.
 - .5 Four (4) RJ-45 DLM local network ports.
 - .6 Optional Network Bridge for BACnet MS/TP communications.

2.5 DIGITAL ROOM CONTROL SYSTEMS

- .1 Digital occupancy and daylight control system designed to control a small area of a building (room level). Digital devices connect to the room controller(s) using CAT 5e cables (LMRJ) with RJ-45 connectors which provide both data and power to room devices. Features of the system shall include:
 - .1 Plug n' Go automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.
 - .2 Simple replacement of any device in the system with a standard off the shelf unit without requiring commissioning, configuration or setup.
 - .3 Push n' Learn configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices which are part of the local system.
 - .4 Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.

2.6 CONFIGURATIONS TOOLS

- .1 A configuration tool facilitates optional customization of digital lighting control system featuring infrared communications.
- .2 Features and functionality of the wireless configuration tool shall include:
 - .1 Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
 - .2 Read, modify and send parameters for occupancy sensors, daylighting sensors, room controllers and buttons on digital wall switches.

- .3 Save up to nine occupancy sensor setting profiles, and apply profiles to selected sensors.

Part 3 Execution

3.1 INSTALLATION

- .1 Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated.
- .2 When using wire for connections other than the DLM local network (LMRJ Cat 5e with RJ-45 connectors), provide detailed point to point wiring diagrams for every termination. Provide wire specifications and wire colors to simplify contactor termination requirements.

- .3 Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.
 - .1 Adjust time delay so that controlled area remains lighted for 5 minutes after occupant leaves area.
- .4 Install power packs in accessible maintenance areas unless noted otherwise. Provide access doors if power packs are installed above drywall ceilings.
- .5 Install sensors in gym where noted on plan at mid-height of wall.
- .6 It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper coverage within the range of coverage as per the manufacturer's recommendations. The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective rooms.
- .7 Provide written or computer-generated documentation on the commissioning of the system including room by room description including:
 - .1 Sensor parameters, time delays, sensitivities, and daylighting setpoints.
 - .2 Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
 - .3 Load Parameters (e.g. blink warning, etc.)
- .8 Re-commissioning – After 30 days from occupancy re-calibrate all sensor time delays and sensitivities to meet the Owner's Project Requirements. Provide a detailed report to the Architect / Owner of re-commissioning activity.

3.2 FACTORY COMMISSIONING

- .1 Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a complete fully functional system.
- .2 The electrical contractor shall provide both the manufacturer and the electrical engineer with ten working days written notice of the system startup and adjustment date.
- .3 Upon completion of the system commissioning the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.
- .4 Factory commissioning shall include functional testing and documentation of the control system conforming to the "Functional Testing" requirements included in the current ASHRAE standard. This cost shall be included in the Tender Price.

END OF SECTION

Part 1 General

1.1 SHOP DRAWINGS

- .1 Submit 6 sets of shop drawings to the electrical contractor for submission to the consultant for review.
- .2 Submit shop drawings of materials and equipment to be supplied on the project. Submission shall include manufacturer, dimensions, appearance and specifications.
- .3 Submit shop drawings for all system components noted herein.

1.2 PRODUCT/MAINTENANCE DATA

- .1 Submit product/maintenance data for each system for inclusion in maintenance manual conforming to Electrical General Requirements Section.

1.3 SCOPE

- .1 **This specification section is the basis for the Kawartha Pine Ridge District School Board ICT Infrastructure system (voice/data network, telephone, public address, classroom audio-visual) installation standard for new builds. Not all sections or components may apply to this particular renovation. Review the site to confirm existing conditions and equipment. Refer to scope of work for this particular renovation.**
- .2 The scope of work for this renovation will include the following revisions to existing systems:
 - .1 Voice/data network installations revisions to suit new drops and/or reworking of wireless access point connections.
 - .2 Public Address system device installation or relocation.
 - .3 Classroom Audio-Visual equipment (Screens and Da-Lite Boards) rough-ins.

Part 2 Products

2.1 NETWORK AND TELEPHONY CABLING

- .1 Data cables to be Cat6 with dark blue outer sheath.
- .2 Phone cables to be Cat6 with dark blue outer sheath.
- .3 PA speaker cables to be Cat6 with white outer sheath.
- .4 All cable to be FT6 rated when used in plenum spaces.
- .5 All data drops to be home-run to nearest appropriate Communications Room.
- .6 Ensure all cable lengths are enough to allow for slack, vertical runs, wastage and future moves.
- .7 The maximum cable run length is not to exceed 91.4m (300'). If this cannot be met, contractor must consult with Owner to determine a suitable alternative.

- .8 In renovations/refreshes, Ethernet TIA cabling standard to be maintained consistently throughout school (i.e. for example, if TIA standard "A" is prevalent in the school, continue with "A" standard for all new cabling in the school).
- .9 All cabling to be run within existing conduit/raceways/cable trays/cable hooks/paths wherever possible.
- .10 All data drops and corresponding cables removed in construction, which are not re-used immediately as part of the project, are to be fully removed and un-terminated from the patch panel to which it connects. This includes full removal of the redundant cable from applicable ceilings/walls/conduits/raceways/cable trays/cable hooks, and the removal of labels at the patch panel. If pulling the wire all the way out is not feasible, Owner may accept just un-terminating the affected cables from the patch panel and orphaning the cable in the ceiling.
- .11 If construction is occurring inside a Communications Closet, contractor must protect the equipment by sealing it off from (i.e. by tarping it off). In cases in which this is not possible, contractor to engage with Owner to arrange for alternative measures.
- .12 All copper cabling to follow standards as dictated by TIA 568.0-D, 568.01-D, 568.02-D in each respective scenario.
- .13 All cabling to be grounded and bonded as needed by TIA 607-D standards.
- .14 All cabling to be concealed and protected in appropriate cable trays or conduit or raceway, unless otherwise safely and aesthetically hidden in ceiling or wall space.
- .15 Modular jacks to be Category 6 compliant.
- .16 Marettes are not to be used with any network or telephony cabling. Bean "B" connectors are acceptable when properly used.

2.2 FACEPLATES

- .1 Faceplates shall be UL Listed and CSA Certified.
- .2 Faceplate material and colour to match electrical faceplates.
- .3 Faceplate sizing to match electrical faceplates.
- .4 Faceplates shall be available to mount up to six in a single gang, and up to twelve in a double gang configuration.

2.3 BACKBONE CABLE

- .1 Provide fibre optic backbone cables from the main Communications Room to all new or relocated secondary Communications Rooms, each as a dedicated home run.
- .2 Provide 25 pair cat6 backbone cable from the main Communications Room to all new or relocated secondary Communications Rooms, each as a dedicated home run. If cat6 in 25 pair is not available, cat5e for the 25 pair is acceptable.

2.4 FIBRE OPTIC CONNECTORS AND ADAPTORS

- .1 Fibre Optic connectors shall be LC style multimode.

- .2 Fibre Optic Adapters shall be LC duplex multimode with ceramic sleeves.
- .3 All fibre optic cabling to follow standards as dictated by TA 569-E.

2.5 COMMUNICATIONS ROOMS AND PATCH PANELS

- .1 Existing IT rack and all associated components, devices, patch panels, patch cable management, communication cables, etc., shall be disconnected and relocated as noted on contract drawings.
- .2 Relocated IT rack must include fibre optic backbone cable to primary Communications Room.

2.6 LABELLING

- .1 Supply and install labels at each terminated location. Labels shall be affixed to the faceplate on the space provided by the manufacturer.
- .2 Labels shall be mechanically or digitally printed. Handwritten labels are not acceptable.
- .3 For Data and Voice cables, labelling at the faceplate (or on keystone for Wireless Access Points) on the client end and the network rack patch panel to be in the format "*ROOM# {dash} COMMUNICATIONS CLOSET LETTER {dash} DROP#*". For example, a cable terminating in Room 101 wired to Communications Room 'A' into patch panel drop 12, is to be labelled as "101-A-12" at both ends.
- .4 PA cables are to be labelled in the format "*ROOM# {dash} COMMUNICATIONS CLOSET LETTER*". For example, a PA speaker terminating in Room 101 wired to Communications Room 'A' is to be labelled as "101-A" at both ends.
- .5 BIX panels are to be labelled with corresponding room numbers.
- .6 PA cabling for speakers in hallways may use "HallA" and "HallB" instead of a room number. For example, Hall1-A for the first chain of speakers going to Hub A, Hall2-A for the second chain.
- .7 Port numbers within a room should be sequential and maintain sequential numbering across adjacent rooms.

2.7 PHONE SYSTEMS

- .1 New voice jacks for existing digital (non-VoIP) systems are to be run and patched to main phone system. Confirm this location with Owner, as it is not always in the main Communications Room.
- .2 New voice jacks for new or existing Avaya VoIP phone systems are to be installed as a standard data drop to the nearest appropriate Communications Room.
- .3 All new voice cabling, whether for Digital or VoIP systems, are to be installed as cat6 with a dark blue outer sheath.
- .4 For all existing digital (non-VoIP) phone systems, a 25 pair cable must be terminated at the Voice Patch Panel into a 24 port loaded patch panel, with the other end terminated at the BIX1A punch down blocks mounted in BIX10A at phone system.

- .5 All new phone system installs are to be the 'Avaya IP Office 500v2' VoIP phone system with the following features (part number in brackets): IP Office R10+ IP Endpoint LIC (383110, minimum 7 per school), IP Office R10+ 2Channels Lic (383127), IP Office R11 LIC (396445), Power Cord 18AWG (700289770), Rack Mounting Kit (700429202), V2 System SD Card (700479710), IP Office 500 Version 2 Control Unit (700501510), IP500 V2 Combo Card ATM4 V2 TAA (700504897), J139 IP Phone (700513916, minimum 4 per school), J179 IP Phone (minimum 3 per school).
- .6 Contractor to collaborate with Owner to configure new phone systems and moves/adds/changes to existing phone systems.
- .7 For VoIP systems, Avaya J179 handsets are to be used for Principals, VPs, and secretaries; with Avaya J139 handsets in all other locations..
- .8 For all Digital (non-VoIP) phone systems, Avaya 9508 digital telephones are to be used for Principals, VPs, and secretaries: with Norstar Cat. #T-7208 handsets for all other locations.

2.8 WIFI AND WIRELESS ACCESS POINTS (APS)

- .1 Wherever possible mount APs in middle of room on dropped ceiling.
- .2 When installing APs in a dropped ceiling, cut discrete hole for the data cable to come through, allowing the ceiling tile to lay flat.
- .3 Contractor to install/reinstall all APs. Physical mounting instructions can be found here: https://documentation.meraki.com/MR/Installation_Guides/MR42_Installation_Guide . Refer to the 'Installation Instructions' heading.
- .4 Data drops for APs to be terminated as a fully contained data jack. An example is the Panduit CBX1WH-A surface mount box (link: <https://www.panduit.com/en/products/copper-systems/faceplates-boxes/surface-mount-boxes/cbx1wh-a.html>) with the Panduit CJ688TGBU UTP Jack Module (link: <https://www.panduit.com/en/products/copper-systems/connectors/jack-modules/cj688tgbu.html>).
- .5 APs that are temporarily removed during construction must be re-installed back to their original location, unless otherwise specified by Owner or the plans.
- .6 APs that are 'existing to be removed' must be safely removed by the contractor and returned to Owner.
- .7 When APs are being removed (to be reinstalled), APs must be securely stored by contractor and be temporarily labelled (i.e. with masking tape) with room number, and in cases with multiple APs per room to also include coordination N, E, S, W marking.
- .8 APs must always remain below or mounted on T-Rail ceilings, they must never be left or installed above a T-Rail ceiling. If a new T-Rail ceiling is installed under an existing AP, the AP must be moved to mount onto the new ceiling.
- .9 For APs that are damaged or not returned, a charge back cost of \$1,000 will be applied.
- .10 For new APs not already existing, contractor must be provided a minimum of 5 business days notice to Owner, allowing Owner to prepare and supply APs to the contractor.

2.9 PUBLIC ADDRESS (PA) SYSTEM

- .1 Contractor to collaborate with Owner to configure new PA systems and moves/adds/changes to existing PA systems.
- .2 All new or moved PA cables must be run back to the main PA system. Confirm this location with Owner, as it is not always in the main Communications Room.
- .3 All new or moved PA cables must be terminated on a 36D BIX or BIX1A or similar modular Jack which must be installed 4'-6" A.F.F. where space permits.
- .4 All new PA Systems to be Carehawk model 'CH1000-2I-2A-2PG' with the following hardware features (part numbers in brackets): Email Alert Module (EAM), Switch Security Cards as needed (SS16 or SS32), Administrative Phone (AC1) with PA-AP1 Power Supply, Telephone Communications Card (TC2-KIT), Digital 100 Watt Class D Paging/Power Amplifier 25V with enclosure (DAF100-25) as needed, Attenuator 25V (AT1) as needed.
- .5 Each 'SS16' or 'SS32' is to have a dedicated homerun, via cat6 cable, to the main PA system.
- .6 Each room to be configured as its own dedicated channel.
- .7 Each hallway to be configured as a single channel but can be adapted as needed for specific circumstances. All hallways programmed to the hallway zone (Zone 2).
- .8 Require Cat6 cable run from main PA system to PA console (microphone or phone). The console is usually located in the main office.
- .9 Require a shielded 4 wire 18 gauge cable from main PA system to the tuner box. Note the tuner box is usually located in the main office near the secretary.
- .10 Configuration of PA system to include bells on school's schedule, pre-recorded messages including but not limited to lockdown messaging. If configuration is not able to be completed, contractor must work with Owner to arrange alternative.
- .11 Outdoor horns to be Bogen Paging horns 25V 15 watt.
- .12 In suspended ceilings, speakers must be McBride white square grill. Speakers to be installed on the ceiling T-bars with 25 Volt transformers. Speaker part number without grill: 8LS822-19 (link: <https://mcbrideloudspeaker.com/images/specs/8LS82219.pdf>)
- .13 PA speakers are to have white grills
- .14 As required, install the McBride MCT25 Transformer (<https://qcomponents.ca/McBride-MCT25.html>)
- .15 In suspended ceilings, speaker rails must be supported by ceiling rails.
- .16 Ceiling mounted speakers are not to have call buttons.
- .17 Speakers in the following spaces to be programmed for emergency paging only: calming / quiet rooms and spaces used primarily by third-party facility partners (i.e. daycares).
- .18 Gyms and hallways require multiple speakers each, spaced approximately 20' apart.
- .19 In offices speakers are to be tapped to 0.25 Watt.

- .20 In all other applications speakers to be tapped to 1 Watt.
- .21 In shop classes, gyms, and mechanical rooms; a quantity of at least two (upwards of 4) McBride 8LS822-19 speakers are required, spread throughout the room to provide coverage throughout the room, tapped to 1 Watt each.
- .22 Shop classes to include 1 Carehawk HS100 "Handset Station" connected to the PA speaker.
- .23 There must be a white toggle call button installed in every classroom, meeting room, resource room, staff room, and office.
- .24 In gyms, install a white toggle call button in a recessed box with cover.
- .25 In shops install a white toggle call button as well as a PA handset.
- .26 Do not connect to privacy switch in any room.
- .27 All unused wire pairs are to be cut flush and wrapped with electrical tape or other appropriate means of securing them and preventing unwanted connections.
- .28 PA systems to be installed in a clean, well organized, and thoroughly labelled manner. A proper backboard and cable management is required. Example pictured below.
- .29 All wires not used on a speaker are to be taped individually or cut and taped so that the wires do not touch metal or each other.
- .30 The white/blue pair is to be terminated to the speaker and not continue down to the call button.

Image of ideal CH1000 installation and BIX panel



2.10 OPERATIONAL TECHNOLOGY

- .1 All data connections for Building Automation Systems (BAS) and other Operational Technology to be installed under the same standards as all other data cabling, including cat6 cabling and a home run to the nearest Communications Room.
- .2 Electronic Signs that must be plugged into a specific switch port and configured with the specific IP address information as defined by Owner. This includes placing the sign's network interface on Owner's "VLAN 12" to ensure network security requirements are met.

2.11 THIRD PARTY FACILITY PARTNERS

All other standards within this document are to be adhered to in these spaces. Specific additional requirements for these spaces are listed here.

- .1 The priority for location of third-party IT equipment is to utilize a space within the rented area. If no reasonable space exists for the operator/renter's IT equipment they may, where space allows, place their equipment in Owner's Communication Room. In these cases, the Facility Partner's cabling is to be connected to their own independent data rack, keeping it separate from Owner's equipment, creating both a logical and physically separate entity for the networks.
- .2 Facility Partner is responsible for supplying and paying for their own internet and telecommunications access and infrastructure.
- .3 Facility Partner may choose to have their service providers install their modem/demarcation equipment into KPR's Communication Room but must connect to the Facility Partner's own data rack.
- .4 Facility Partner is responsible for the setup and maintenance of their own network, telecommunications, and other technology infrastructure.
- .5 Any cabling required for network connectivity, telephone systems, point of sale systems, et al must be specified by Facility Partner.
- .6 Facility Partner's wireless communications equipment is not to cause interference with Owner's wireless communications. While the Owner may at times collaborate to assist, Facility Partner is responsible for any configuration and costs associated to ensuring this need is met.
- .7 PA speakers in these spaces to be programmed for emergency paging only.
- .8 If Facility Partner does not provide specifications for data and telecom infrastructure, the following defaults will be applied: 1x network drop installed in each room, 1x phone drop installed in each room, 1x network drop installed above ceiling in each room.

2.12 TESTING AND DOCUMENTATION

- .1 All cables and termination hardware shall be 100% tested for defects in installation and to verify cabling system performance.
- .2 All Fibre and Cat 6 cabling should be 100% tested to current standards.
- .3 All call buttons and speakers to be tested individually.

- .4 As-Built to include any newly installed or moved telephone systems, PA systems, network closets, and back bone cable runs.

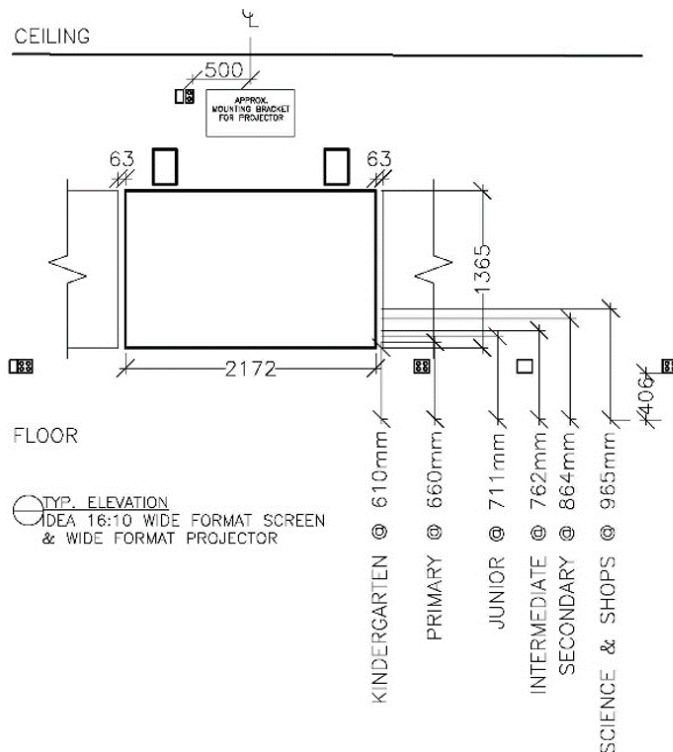
2.13 MOBILE TECHNOLOGY CHARGING TOWERS

- .1 Purchase of Powergistics mobile charging tower is to be coordinated by Owner.
- .2 Charging tower dimensions: 51.5" H X 10.75" W X 19.5" D (1308mm H X 273mm W X 495mm D).
- .3 Space of 355mm W must be available on wall for installation and door opening.
- .4 Require a duplex receptacle on a separate circuit within 250mm of the charging tower.

2.14 AUDIO VISUAL EQUIPMENT

- .1 Screens and Da-Lite Boards
 - .1 Height of Da-Lite IDEA whiteboard installation to be confirmed by Owner under the guidelines shown in Figure 1 below.
 - .2 No services including surface mounted conduit are to be run behind space where Da-Lite IDEA whiteboard is to be installed on teaching wall.
 - .3 Da-Lite IDEA whiteboard to be installed on teaching wall between whiteboards/tack boards with a minimum 63mm gap between boards.
- .2 Projects and Speakers
 - .1 Projector and speakers to be installed above Da-Lite IDEA screen +/- 203-254mm by Owner.
 - .2 Allow 762mm X 406mm at centre line for projector mounting bracket.
 - .3 Do not install any services including surface mounted conduit at this location.
 - .4 Blocking required behind new drywall at location of projector install.
 - .5 Blocking required over existing drywall at location of projector install.
 - .6 Duplex receptacle and data for projector to be installed at high level to a maximum of 3048mm AFF and 500mm from centre of Da-Lite IDEA screen.
 - .7 Speakers to be wall mounted above the Da-Lite IDEA screen by Owner.
 - .8 Where existing conduit does not exist, cabling for projector and speakers to be surface mounted and run through channel between Da-Lite IDEA screen and adjoining whiteboard/tack board ending in surface mounted control box.
 - .9 Per below drawing (Figure 1) IDEA screen to be installed at specific height AFF based on room use.
 - .1 Kindergarten @ 610mm
 - .2 Primary @ 660mm
 - .3 Junior @ 711mm
 - .4 Intermediate @ 762mm
 - .5 Secondary @ 864mm
 - .6 Science and Shops @ 965mm

IDEA Screen Installation



IDEA WIDE FORMAT SCREEN

CENTRE LINE OF WHITEBOARD

- CENTRED BETWEEN TACK AND/OR MARKER BOARDS
- MIN. DISTANCE BETWEEN 63mm

ELECTRICAL RECEPTACLE FOR PROJECTOR

- AT CEILING HEIGHT TO A MAXIMUM OF 3048 AFF
- 500MM AWAY FROM CENTRE TO ALLOW FOR INSTALLATION OF MOUNTING BRACKET

MOUNTING BRACKET FOR PROJECTOR

- INSTALLED AT CEILING HEIGHT ON THE WALL
- +/- 203-254mm ABOVE WHITE BOARD
- ALLOW 762mm X 406mm @ CENTRE LINE (DO NOT INSTALL ANY SERVICES @ THIS LOCATION)

POWER & DATA

- PROJECTOR - DUPLEX RECEPTACLE INSTALLED AT HIGH LEVEL ON THE WALL
- MIN. 500mm FROM CENTRE LINE, MAX. 3048 A.F.F.

- DATA REQUIRED AT THIS LOCATION

- QUAD RECEPTACLE AT RIGHT CORNER OF TEACHING WALL BELOW ADJOINING TACKBOARD/WHITEBOARD

- QUAD RECEPTACLE AT LEFT CORNER OF TEACHING WALL

- KINDERGARTEN CLASSROOMS WILL REQUIRE A QUAD RECEPTACLE TO BE INSTALLED IMMEDIATELY TO THE RIGHT AND BELOW THE IDEA BOARD

BLOCKING

- AS REQUIRED AT WALL TYPES WITH DRYWALL

SEPEAKERS

- WALL MOUNTED ABOVE SCREEN WITH CONTROL BOX BELOW AND TO THE SIDE (BY SCREEN SUPPLIER)

.3 Science Rooms and Shops

- 1 Da-Lite Screen to be installed at 965 mm to provide students with clear view of board above science/shop bench.
- 2 Projector to have conduit at 2" (51mm) from projector location to science/shop bench at side of shelving. The run for this conduit is not to exceed 30' (9144mm). Runs beyond the limit of 30' must be communicated to Owner to determine suitable alternative.

2.15 APPENDIX A – PANDUIT PARTS LIST

- 1 Although Panduit brand parts are only required for patch panels, this list of commonly used parts is available for convenience and reference of architects and contractors. If other manufacturers are chosen for these products, the contractor must ensure they are of similar quality.

Product Category	Part Number	Manufacturer	Part Description
Copper Cabling Products			
	PUP6C04BU-F	Panduit	Category 6 copper cable, 4-pair, 23AWG, U/UTP, CMP, Blue 1000 feet in a carton.

Product Category	Part Number	Manufacturer	Part Description
	CJ688TGBU	Panduit	The Category 6, RJ45, 8-position, 8-wire, UTP Mini-Com® universal jack module has TG-style termination and is blue.
	CPPL48FMWBLY	Panduit	Mini Com 48-port modular patch panel with faceplates in black, with label and label covers, (2RU).
	CPPL24FMWBLY	Panduit	Mini Com 24-port modular flush mount patch panel in black, (1RU).
	CFG2WH	Panduit	Mini Com rectangular adapter, mounts behind standard GFCI faceplates, accepts two Mini-Com® Module, White.
	CFG4WH	Panduit	Mini Com rectangular adapter, mounts behind standard GFCI faceplates, accepts two Mini-Com® Module, White.
	CFG6WH	Panduit	Mini Com rectangular adapter, mounts behind standard GFCI faceplates, accepts two Mini-Com® Module, White.
	CFPF12WH-2G	Panduit	Mini Com Classic Series double gang kit, includes faceplate frame and six flat inserts (two port each), accepts twelve Mini-Com® modules. White
	CBXQ2WH-A	Panduit	Mini-Com® surface mount box accepts two Mini-Com® modules. Includes quick release cover. Supplied with cable ties, adhesive backing, label and label cover. White.
	UTPSP7BUY	Panduit	Category 6, UTP patch cord with TX6™ PLUS Modular Plugs on each end. Blue, 7 ft. (Rack end)
	UTPSP10BUY	Panduit	Category 6, UTP patch cord with TX6™ PLUS Modular Plugs on each end, 10 ft. (Workstation end)
CAT 6A WAP DROPS			
	PUP6AV04BU-G	Panduit	Copper Cable, Cat 6A, Vari-MaTriX, 4-Pair, 23 AWG, UTP, CMP, Blue, 1000ft/305m
	CJ6X88TGYL	Panduit	Category 6A, RJ45, 10 Gb/s, 8-position, 8-wire universal module, Yellow.
	CBX1WH-A	Panduit	Mini-Com® surface mount box accepts one Mini-Com® Module. Supplied with adhesive backing. White.
	UTP28X1YL	Panduit	Category 6A Performance, 28AWG, UTP Patch Cord, CM/LSZH, Yellow, 1ft.

Product Category	Part Number	Manufacturer	Part Description
	UTP6ASD7YL	Panduit	Category 6A (SD), 10 Gb/s UTP patch cord with TX6A™ 10Gig™ Modular Plugs on each end. Yellow, 7 ft. (Rack End)
Voice Tie Cable Termination			
	DP245E88TGY	Panduit	DataPatch 24-port category 5e punchdown flat patch panel in black, (1 RU).
Fiber Cabling Products			
	FODPX06Y	Panduit	50um OM3 6 Fiber Indoor Distribution Cable, Plenum (OFNP), 900um Buffered Fibers.
	FODPX12Y	Panduit	50um OM3 12 Fiber Indoor Distribution Cable, Plenum (OFNP), 900um Buffered Fibers.
	FRME1U	Panduit	The Panduit® Opticom® Rack Mount Fiber Enclosure ensures network reliability by housing, organizing, managing and protecting up to 72 fiber optic cable, terminations, splices, connectors and patch cords using up to 3 FAP or FMP adapter panels or FOSM splice modules.
	FAP6WAQDLCZ	Panduit	LC 10Gig™ OM3/OM4 FAP loaded with six LC 10Gig™ Duplex Multimode Fiber Optic Adapters (Aqua) with zirconia ceramic split sleeves.
	FLCSMCXAQY	Panduit	The LC OptiCam® OM3/OM4 50/125µm multimode simplex connector in aqua with zirconia ceramic ferrules is intended for 900µm tight-buffered fiber installations which are outside the scope of the RoHS directive.
	FX2ERLNLNSNM002	Panduit	2 fiber OM3 LC duplex to LC duplex patch cord OFNR (riser) rated, 16mm jacketed cable Std IL 2 meters.

Product Category	Part Number	Manufacturer	Part Description
Racks, Cabinets, and Cable Management			
	R2P	Panduit	The Panduit Two-post Rack System provides a reliable foundation for mounting telecommunication and data center equipment. The modular rack can be used to manage high performance copper and fiber patch cables using Panduit horizontal and vertical cable managers and accessories, such as power outlet unit brackets. Aluminum, 45 RU, #12-24 Threaded Mounting Holes, Black, 1pc + hardware kit and paint piercing bonding kit.
	R4P	Panduit	The premium Panduit Four-post Rack System combines the stability of a cabinet with the accessibility of an open rack to provide the user with maximum flexibility when designing a data-center network layout. Four steel vertical posts and adjustable front and rear mounting rails provide the required strength and flexibility needed to work with various types of active equipment. Steel, 45 RU, 30in deep, #12-24 Threaded Mounting Holes, Black, 1pc + hardware kit and paint piercing bonding kit.
	WMPVF45E	Panduit	The Panduit® NetRunner® Vertical Cable Manager cost-effectively organizes, manages and protects cables on the front of the rack. Plus, bend radius control helps guard against kinks and snags. Single-sided, ABS Plastic, 45RU, Black, 1pc + Cover.
	WMPVHCF45E	Panduit	The Panduit® NetRunner® Vertical Cable Manager cost-effectively organizes, manages and protects cables on the front of the rack. Plus, bend radius control helps guard against kinks and snags. Single-sided, ABS Plastic, 45RU, Black, 1pc + Cover.
	NMF2	Panduit	The Panduit® NetManager® High Capacity Horizontal Cable Manager cost-effectively organizes and protects copper and fiber network cabling in any standard EIA 19in (483mm) rack or cabinet. Large front finger openings easily accommodate Category 6 and 10G cables, reducing installation time and maintenance costs. Hinged front cover only, ABS Plastic, 2RU, Black, 1pc.

Product Category	Part Number	Manufacturer	Part Description
Bonding and Grounding			
	GB2B0306TPI-1	Panduit	1/4" x 2" x 12" Telecommunications Grounding Busbars.
	RGRB19CN	Panduit	Grounding busbar; 19" (483mm) length; tin-plated; twenty holes arranged for flexibility in mounting with twenty #12-24 x 1/2" hex head screws installed; mounting hole sets have 5/8" (15.9mm) spacing; provided with two cage nut bonding studs and four #12-24 bonding nuts.
	HTCT250-2-1	Panduit	Copper Compression HTAP with code 250 kcmil - #2 AWG Run, code #2 - #6 AWG STR/SOL Tap 1 and code #8 - #14 AWG Tap 2 or flex 4/0 - #2 AWG Run, flex #2 - #8 AWG Tap 1 and flex #8 - #14 AWG Tap 2.
	RGCBNJ660P22	Panduit	#6 AWG (16mm ²) jumper, 60 (1.52m) length, 45° bent lug on grounding strip side, provided with .16 oz. (5cc) of antioxidant, two each #12-24 x 1/2, M6 x 12mm, #10-32 x 1/2 and M5 x 12mm thread-forming screws and a copper compression HTAP.
	RGEJ657PFY	Panduit	#6 AWG (16mm ²) jumper, 90° bent lug on grounding strip side, provided with .16 oz. (5cc) of antioxidant and two each #12-24 x 1/2, M6 x 12mm, #10-32 x 1/2 and M5 x 12mm thread-forming screws.
	CNBK	Panduit	Green bonding cage nut, includes 50 #12-24 bonding cage nuts (.06 – .11 thick panel) and 50 #12-24 x 1/2" bonding screws with #2 Phillips/slotted combo hex head (use 5/16" or 8mm socket).

Product Category	Part Number	Manufacturer	Part Description
	RGESD2B-1	Panduit	This two-hole ESD Port Kit with 5/8 spacing is a telecommunications grounding accessory that helps protect against electrostatic discharge to network equipment. It includes a .17 oz (5 cc) tube of antioxidant paste, 1 ESD protection sticker, two 12-24 HDW bonding studs, one M6 x 12mm thread-forming screw, two bonding cage nut HDWs, and one cleaning pad. Designed for flexibility and ease of installation, this kit reduces the risk of damage when a technician performs routine cable maintenance or accidentally touches an I/O port.
	RGESDWS	Panduit	This adjustable, fabric ESD wrist strap with 4mm snap is designed to ground a technician working on highly sensitive electronic equipment. This antistatic device reduces the buildup or discharge of static electricity. It connects to the ground via a 6' (1.8 m) coiled cable, banana plug, and 1 megohm resistor and helps protect the wearer from shock hazards.
Cable Pathways			
J Hooks – Ceiling Mount			
	JP131CMB-L20	Panduit	J-PRO Cable support system, with ceiling mount bracket that has one 3/16 (M5), 1/4 (M6), and 3/8 (M10) mounting hole, 1.31 (33.3mm) max. bundle capacity, nylon 6.6 with metal attachments, black, 50 pc. package quantity.
	JP2CMB-L20	Panduit	J-PRO Cable support system, with ceiling mount bracket that has one 3/16 (M5), 1/4 (M6), and 3/8 (M10) mounting hole, 2.00 (50.8mm) max. bundle capacity, nylon 6.6 with metal attachments, black, 50 pc. package quantity.
	JP4CMB-X20	Panduit	J-PRO Cable support system, with ceiling mount bracket that has one 3/16 (M5), 1/4 (M6), and 3/8 (M10) mounting hole, 4.00 (101.6mm) max. bundle capacity, nylon 6.6 with metal attachments, black, 10 pc. package quantity.

Product Category	Part Number	Manufacturer	Part Description
J Hooks – Wall Mount			
	JP131WP2B-L20	Panduit	J-PRO Cable support system, with ceiling mount bracket that has one 3/16 (M5), 1/4 (M6), and 3/8 (M10) mounting hole, 1.31 (33.3mm) max. bundle capacity, nylon 6.6 with metal attachments, black, 50 pc. package quantity.
	JP2WP2B-L20	Panduit	J-PRO Cable support system, for powder actuated installation on walls, one 5/32 (M4) mounting hole for user supplied fasteners, 2.00 (50.8mm) max. bundle capacity, nylon 6.6 with metal attachments, black, 50 pc. package quantity.
	JP4WP2B-X20	Panduit	J-PRO Cable support system, for powder actuated installation on walls, one 5/32 (M4) mounting hole for user supplied fasteners, 4.00 (101.6mm) max. bundle capacity, nylon 6.6 with metal attachments, black, 10 pc. package quantity.
Network Labeling			
	S100X150YAJ	Panduit	Laser/ink jet self-laminating label, 1" W x 1.50" L, Cat. 5e/Cat. 6 UTP/Cat. 6e UTP/Cat. 5e FTP/10 – 6 AWG, white print-on area, polyester, 7 labels/row, 42 labels/sheet, 2500 pc. package quantity. (cable wrap around labels for CAT 6 & CAT 6A laser jet labels)
	S100X150YAJ	Panduit	Laser/ink jet self-laminating label, 1" W x 1.50" L, Cat. 5e/Cat. 6 UTP/Cat. 6e UTP/Cat. 5e FTP/10 – 6 AWG, white print-on area, polyester, 7 labels/row, 42 labels/sheet, 2500 pc. package quantity. (cable wrap around labels for CAT 6 & CAT 6A LS8 Labels)
	C252X030FJJ	Panduit	Laser/ink jet network label, 2.52" W x 0.30" H, 4-port identifier, adhesive polyolefin, white, 3 labels/row, 75 labels/sheet, 1000 labels per package. (Modular patch panel labels laser jet labels)
	C252X030FJC	Panduit	Network label, P1 cassette, 2.52" W x 0.30" H, polyolefin, white, 125 labels/cassette, 1 pc. package quantity. (Modular Patch Panel LS8 Labels)

Product Category	Part Number	Manufacturer	Part Description
	C061X030FJJ	Panduit	Laser/ink jet network label, 0.61" W x 0.30" H, 1-port identifier, adhesive polyolefin, white, 13 label/row, 325 labels/sheet, 5000 labels per package. (2 ports Decora plate laser jet labels)

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 CAN/ULC-S524 (latest edition), Installation of Fire Alarm Systems.
- .2 ULC-S525 (latest edition), Audible Signal Appliances for Fire Alarm Systems.
- .3 CAN/ULC-S526 (latest edition), Visual Signal Appliances, Fire Alarm.
- .4 CAN/ULC-S527 (latest edition), Control Units, Fire Alarm.
- .5 CAN/ULC-S528 (latest edition), Manual Pull Stations.
- .6 CAN/ULC-S529 (latest edition), Smoke Detectors.
- .7 CAN/ULC-S530 (latest edition), Heat Actuated Fire Detectors, Fire Alarm.
- .8 CAN/ULC-S536 (latest edition), Inspection and Testing of Fire Alarm Systems.
- .9 CAN/ULC-S537 (latest edition), Verification of Fire Alarm Systems.
- .10 OBC-2012, Ontario Building Code.

1.2 DESCRIPTION OF SYSTEM

- .1 System includes:
 - .1 Replacement control panel to carry out fire alarm and protection functions including receiving alarm signals, initiating general alarm, supervising system continuously, actuating zone annunciators, initiating trouble signals and replacement for all incompatible devices.
 - .2 Trouble signal devices.
 - .3 Power supply facilities.
 - .4 Addressable manual alarm stations.
 - .5 Addressable automatic alarm initiating devices.
 - .6 Audible and visual signal devices.
 - .7 End-of-line devices.
 - .8 Annunciators.
 - .9 Ancillary devices.
 - .10 Interface and zone modules.
 - .11 Remote trouble indicator.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Electrical General Requirements Section.
- .2 Include:
 - .1 New devices and components.

1.4 OPERATION AND MAINTENANCE DATA

- .1 Provide operation and maintenance data for Fire Alarm System for incorporation into manual specified in Electrical General Requirements Section.
- .2 Include:
 - .1 Operation and maintenance instructions for complete fire alarm system to permit effective operation and maintenance.
 - .2 Technical data - illustrated parts lists with parts catalogue numbers.
 - .3 Copy of approved shop drawings.
 - .4 List of recommended spare parts for system.

1.5 SYSTEM OPERATION

- .1 Operation of any alarm initiating device to:
 - .1 Cause audible and visual signal devices to sound throughout building.
 - .2 Transmit signal to fire department via monitoring station.
 - .3 Cause zone of alarm device to be indicated on control panel and remote annunciator(s).
 - .4 Cause air conditioning and ventilating fans to shut down and to function so as to provide required control of smoke movement.
 - .5 Cause fire doors and smoke control doors if normally held open, to close automatically.
 - .6 Log the alarm in the historical alarm log file.
- .2 System Reset
 - .1 It shall not be possible to reset the fire alarm system until all the alarm zones have been properly reset or cleared.
- .3 System Trouble Operation
 - .1 Any system trouble shall cause the following to occur:
 - .1 An audible and visual trouble signal shall sound at the main control panel LCD Display Only until acknowledged by an operator.
 - .2 Log the trouble condition in the separate Historical Trouble Log File.

1.6 PERFORMANCE CRITERIA

- .1 These specifications describe the minimum functional requirements for an electronically supervised, microprocessor based, fully integrated system. The initial installation shall include all the necessary electronic hardware, software and memory for a completely operable system in accordance with these specifications.

1.7 QUALITY ASSURANCE

- .1 Each and all items of the fire alarm system shall be listed as the products of a single manufacturer under the appropriate category by the Underwriter's Laboratories of Canada and shall bear the "U.L.C." label.
- .2 Each and all items of the fire alarm system shall be covered by a one year parts and labour warranty covering defects resulting from faulty workmanship and materials. The

warranty shall be deemed to begin on the date the system is accepted by the Project Manager on issuance of the substantial performance certificate for the project.

- .3 All control equipment must have Transient Protection Devices to comply with U.L.C. requirements.

Part 2 Products

2.1 GENERAL

- .1 The existing fire alarm system is an addressable, single stage, zoned, non-coded, indicating, fully integrated fire alarm. Relocate devices and/or provide new to suit renovation drawings.

2.2 ADDRESSABLE MANUAL ALARM STATIONS

- .1 Manual alarm stations shall be addressable, single action, non-coded, semi-flush mounted type. Pull stations shall be break-glass style. Contacts are to activate when the handle is pulled down.
- .2 Addressable pull station electronics shall be mounted to the back plate of the station. The station's address will be set at the time of installation. Device addressing shall be accomplished by either an electrical or mechanical means.
- .3 Where noted on drawings, stations are to be equipped with tamperproof guard equal to Stopper II Cat. # STI-1100.

2.3 INTELLIGENT DETECTORS-GENERAL OPERATION

- .1 Addressable devices shall use simple to install and maintain decade, numbered 0 to 9, address switches. Detectors that have expanded addressing will have decade switch numbered from 0 to 15 for the most significant digit to allow detector addressing from 1 to 250.
- .2 Device addressing shall be accomplished by either an electrical or mechanical means.
- .3 Detectors shall be intelligent (analog) and addressable, and shall connect with two wires to the fire alarm control panel signalling line circuits.
- .4 Addressable smoke detectors shall provide dual alarm and power/polling LEDs. Both LEDs shall flash under normal conditions, indicating that the detector is operational and in regular communication with the control panel, and both LEDs shall be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. If required, the LED flash shall have the ability to be removed from the system program. An output connection shall also be provided in the base to connect an external remote alarm LED.
- .5 The fire alarm control panel shall permit detector sensitivity adjustment through field programming of the system. Sensitivity shall be automatically adjusted by the panel on a time-of-day basis.
- .6 Using software in the FACP, detectors shall automatically compensate for dust accumulation and other slow environmental changes that may affect their performance.

- .7 The detectors shall be ceiling-mount and shall include a separate twist-lock base with tamper proof feature.
- .8 The detectors shall provide a test means whereby they will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself (by activating a magnetic switch) or initiated remotely on command from the control panel.
- .9 Detectors shall also store an internal identifying type code that the control panel shall use to identify the type of device (PHOTO, THERMAL).
- .10 Detectors will operate in an analog fashion, where the detector simply measures its designed environment variable and transmits an analog value to the FACP based on real-time measured values. The FACP software, not the detector, shall make the alarm/normal decision, thereby allowing the sensitivity of each detector to be set in the FACP program and allowing the system operator to view the current analog value of each detector.
- .11 Detectors shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. LEDs shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.
- .12 Addressable devices shall provide address-setting means using decimal switches and shall also store an internal identifying code that the control panel shall use to identify the type of device. LED(s) shall be provided that shall flash under normal conditions, indicating that the device is operational and is in regular communication with the control panel.
- .13 The sensors shall be of a low profile design and ULC listed for both ceiling and wall mount applications.
- .14 Automatic smoke sensors shall be equipped with a dust cover, which shall be removed at the time of verification to prevent dust and dirt entering the smoke chamber during construction.
- .15 A magnetic test switch shall be provided to test detectors and modules. Detectors shall report an indication of an analog value reaching 100% of the alarm threshold.

2.4 INTELLIGENT MULTI-DETECTOR

- .1 The intelligent multi-detector shall be an addressable device, which is designed to monitor photoelectric, ionization, and thermal technologies in a single sensing device. This detector shall utilize advanced electronics which react to smaller products of combustion found in fast flaming fires (ionization), slow smouldering fires (photoelectric), and heat (thermal) all within a single sensing device.
- .2 The multi-detector shall include two bicolor LEDs, which flash green in normal operation and turn on steady red in alarm.
- .3 Detectors are to be provided with relay base where noted on the drawings.
- .4 Separately mounted photoelectric ionization and heat detectors in the same location are not acceptable alternatives.

2.5 FIXED TEMPERATURE HEAT DETECTOR

- .1 These heat detectors shall have a low mass thermistor heat sensor and operate at a fixed temperature. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the/ time required to process an alarm. The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. The heat detector shall have a nominal alarm point rating of 57°C (135°F). The heat detector shall be rated for ceiling installation at a minimum of 21.3m (70') centres and be suitable for wall mount applications.

2.6 FIXED TEMPERATURE / RATE OF RISE HEAT DETECTOR

- .1 These heat detectors shall have a low mass thermistor heat sensor and operate at a fixed temperature and at a temperature rate-of-rise. It shall continually monitor the temperature of the air in its surroundings to minimize thermal lag to the time required to process an alarm, The integral microprocessor shall determine if an alarm condition exists and initiate an alarm based on the analysis of the data. Systems using central intelligence for alarm decisions shall not be acceptable. The intelligent heat detector shall have a nominal fixed temperature alarm point rating of 57°C (135°F) and a rate-of-rise alarm point of 9°C (15°F) per minute. The heat detector shall be rated for ceiling installation at a minimum of 21.3m (70') centres and be suitable for wall mount applications.

2.7 PHOTOELECTRIC SMOKE DETECTOR

- .1 The intelligent photoelectric detector shall utilize a light scattering type photoelectric smoke sensor to sense changes in air samples from its surroundings. The integral microprocessor shall dynamically examine values from the sensor and initiate an alarm based on the analysis of data. The detector shall continually monitor any changes in sensitivity due to the environmental affects of dirt, smoke, temperature, aging, and humidity. The photo detector shall be rated for ceiling installation at a minimum of Soft (Olin) centres and be suitable for wall mount applications.
- .2 The percent smoke obscuration per foot alarm set point shall be field selectable to any of five sensitivity settings ranging from 1.0% to 3.5%. The photo detector shall be suitable for operation in the following environment:
 - .1 Temperature: 0°C to 49°C (32°F to 120°F)
 - .2 Humidity: 0-93% RH, non-condensing
 - .3 Elevation: no limit
- .3 Detectors are to be provided with relay base where noted on the drawings.

2.8 STANDARD DETECTOR MOUNTING BASES

- .1 Provide standard detector mounting bases suitable for mounting on North American 1-gang, 85mm (3 ½ ") or 100 mm (4") octagon box and 100 mm (4") square box. The base shall, contain no electronics, support all detector types and have the following minimum requirements:

- .1 Removal of the respective detector shall not affect communications with other detectors.
- .2 Terminal connections shall be made on the room side of the base. Bases which must be removed to gain access to the terminals shall not be acceptable.

2.9 AUDIBLE/VISUAL SIGNAL DEVICES

- .1 Mini Horns: flush mounted temporal mini horn, 24Vdc operation, selectable HIGH/LOW setting 94.5 dBA (high)/89.8 dBA (low) at 3 m (10'), white or red coverplate, FM and ULC listed. Suitable for mounting on a single gang box.
- .2 Strobe: semi-recessed, 24Vdc operation, complete with selectable 15/30/75/110 candela output (unless otherwise noted set at 75 cd), synchronized strobe, red finish, FM and ULC listed. Suitable for mounting on a single gang box.
- .3 Mini Horn/Strobe: flush mounted temporal combination mini horn/strobe, 24 Vdc operation, selectable HIGH/LOW setting 94.5 dBA (high)/89.8 dBA (low) at 3 m (10') selectable 15/30/75/110 candela output (unless otherwise noted set at 75 cd), synchronized strobe white or red coverplate, FM and ULC listed. Suitable for mounting on a single gang box.

NOTES:

- .1 Signal devices with integral strobe lights in high abuse areas (i.e. gymnasium, change rooms, etc.) must be provided with protective wireguards.
- .2 Any surface mounted signal devices must be provided with suitable backboxes supplied by the manufacturer.
- .3 Provide synchronization modules to suit signal devices (if required by manufacturer).
- .4 Set signal devices in classrooms to LOW setting.

2.10 END OF LINE RESISTORS

- .1 End-of-line resistors for signalling circuits shall be sized to ensure the correct supervisory current flows in each circuit.
- .2 End-of-line resistors shall be mounted on a stainless steel plate for mounting on a standard single gang box and bear the ULC label.

2.11 INTELLIGENT MODULES – GENERAL OPERATION

- .1 The modules shall have a minimum of 2 diagnostic LED's mounted behind a finished coverplate. A green LED shall flash to confirm communication with the loop controller. A red LED shall flash to display alarm status. The module shall be capable of storing up to 24 diagnostic codes, which can be retrieved for troubleshooting assistance. Input and output circuit wiring shall be supervised for open and ground faults. The module shall be suitable for operation in the following environment:
 - .1 Temperature: 0°C to 49°C (32°F to 120°F).
 - .2 Humidity: 0-93% RH, non-condensing.

2.12 MONITOR MODULE

- .1 The monitor modules shall have the following operating characteristics:

A flashing LED indicates that the module is in communication with the control panel. The LED latches steady on alarm (subject to current limitations on the loop).
- .2 The monitor modules shall have the following features:

Nominal operating voltage: 15 to 32 VDC.
Maximum current draw: 5.1 mA (LED on)
Average operating current: 400 uA (LED flashing)
EOL resistance: 47K ohms.
Temperature range: 0°C to 49°C (32°F to 120°F)
Humidity range: 10% to 93% noncondensing
Dimensions: 114.3mm (4.5") high x 101.6 mm (4") wide x 31.75 mm (1.25") deep. Mounts to a 101.6 mm (4") square x 53.975 mm (2.1/8") deep box.

2.13 ISOLATOR MODULE

- .1 Fault isolator modules shall be provide to automatically isolate wire-to-wire short circuits on an SLC loop. The fault isolator module shall limit the number of modules or detectors that may be rendered inoperative by a short circuit fault on the SLC loop. If a wire-to wire short occurs, the fault isolator module shall automatically open-circuit (disconnect) the SLC loop. When the short circuit condition is corrected, the fault isolator module shall automatically reconnect the isolated section of the SLC loop. The fault isolator module shall not require any address-setting, and its' operations shall be totally automatic. It shall not be necessary to replace or reset a fault isolator module after its normal operation. The fault isolator module shall mount in a standard 10.16 cm (4") deep electrical box, in a surface-mounted backbox, or in the fire alarm control panel. It shall provide a single LED which shall flash to indicate that the isolator is operational and shall illuminate steadily to indicate that a short circuit condition has been detected and isolated.

2.14 CONTROL MODULE

- .1 Addressable control modules shall be provided to supervise and control the operation of one conventional NACs of compatible, 24 VDC powered, polarized audio/visual notification appliances. For fan shutdown and other auxiliary control functions, the control module may be set to operate as a dry contract relay.
- .2 The control module NACs may be wired for Style Z or Style Y (Class A/B) with up to 1 Amp of inductive A/V signal, or 2 Amps of resistive A/V signal operation, or as a dry contact (Form-C) relay. The relay coil shall be magnetically latched to reduce wiring connection requirements, and to ensure that 100% or all auxiliary relay or NACs may be energized at the same time on the same pair of wires.
- .3 The control module shall be suitable for pilot duty applications and rated for a minimum of 0.6 Amps at 30 VDC.

2.15 REMOTE TROUBLE INDICATOR

- .1 A system remote trouble indicator where noted on the drawings shall be provided complete with the following features:

- .1 Flush mounted in a double gang box.
- .2 Trouble LED.
- .3 Trouble buzzer.

2.16 SYSTEM WIRING

- .1 The system wiring must be FSA rated in conformance with the Electrical Safety Code to suit the type of installation.
- .2 Wiring shall be minimum #18 AWG twisted shielded pair in conduit. "Securex 2" armoured cable will be permitted to be used for "drops" to devices on accessible ceilings.
- .3 As indicated on system riser diagram initiating device wiring shall be run in a loop with a home run from the last device to the control panel (Class 'A' configuration). Wiring from the "loop" module to conventional devices must be supervised, run in conduit, and conform to the standards of the Electrical Safety Code.
- .4 Signal wiring is to be cross connected in a class 'B' configuration.
- .5 Install isolator modules and end of line resistors in service rooms no higher than 2.4 M AFF. Provide location of these devices at the time of shop drawing submission.
- .6 **These are the basic wiring requirements for system operation. Prior to tender close manufacturer and contractor are to confirm all necessary wiring specifications and requirements.**

2.17 APPROVED EQUIPMENT

<u>DEVICE</u>	<u>NOTIFIER</u>
<u>Control Panel</u>	
	NFS-320SYS
<u>Intelligent Devices</u>	
Addressable Multi-Sensor	FSP-851TA
Addressable Base	B710LPA
Addressable Base c/w Relay	B224RBA
Monitor Module	FMM-1A

Control Module	FCM-1 or FRM-1
Isolator Module	ISO-XA
Annunciator	ACM-24AT

**Conventional
and Auxiliary
Devices**

Thermal Detectors	CR Series
Smoke Detectors (System Type)	C2W-BA Series
Smoke Detectors (System Type c/w Relay Base)	C2WR-BA
Duct type Smoke Detector (c/w Air Sampling Tubes.)	DH100PA / ST-X
Mini Horn	MHRA (System Sensor)
Mini Horn complete with strobe	P2RA (System Sensor)
Strobe	SRA (System Sensor)
Remote Trouble Indicator	RTB

Part 3 Execution

3.1 INSTALLATION

- .1 New components shall be installed in accordance with CAN/ULC-S524 (latest edition) and approved manufacturers manuals and wiring diagrams. The contractor shall furnish all conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary

for the complete installation, All wiring shall be of the type recommended by the Electrical Safety Code, approved by local authorities having jurisdiction for the purpose, and shall be installed in dedicated conduit throughout.

- .2 Locate and install manual alarm stations and connect to alarm circuit wiring.
- .3 Locate and install detectors and connect to alarm circuit wiring. **Do not mount detectors within 1 m (39") of air outlets.** Maintain at least 600 mm (24") radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.
- .4 Connect alarm circuits to main control panel.
- .5 Locate and install signal devices and connect to signalling circuits.
- .6 Connect signalling circuits to main control panel.
- .7 Install end-of-line devices at end of applicable alarm and signalling circuits.
- .8 **Connect smoke damper integral detector outputs to monitor modules and include dual voltage relay for supervision of AC power to smoke damper as trouble condition as detailed on design drawings.**

3.2 FIELD QUALITY CONTROL

- .1 The system shall be installed and fully tested under the supervision of trained manufacturer's representative. The system shall be demonstrated to perform all the functions as specified.

3.3 ACCEPTABLE INSTALLER

- .1 The fire alarm / life safety system specified herein shall be installed by an Authorized Electrical Contractor who is CFAA certified.

3.4 EXAMINATION

- .1 Prior to the commencement of any of the work detailed herein, an examination and analysis of the area(s) where the Fire Alarm / Life Safety System and all associated components are to be installed shall be made.
- .2 Any of these area(s) which are found to be outside the manufacturers' recommended environments for the particular specified products shall be noted on a Site Examination Report which shall be given to the Building Owners Representative, and the Consultant.
- .3 Any shorts, opens, or grounds found on existing wiring shall be corrected prior to the connection of these wires to any panel component or field device.

3.5 DEMONSTRATION

- .1 Each of the intended operations of the installed Fire Alarm / Life Safety System shall be demonstrated to the Building Owners' Representative and the Consultant.

3.6 SYSTEM TEST

- .1 Perform tests in accordance with General Electrical Requirements Section and CAN/ULC-S537- (latest edition) Standard for the Verification of Fire Alarm Systems.
- .2 Fire alarm system:

-
- .1 Test each device and alarm circuit to ensure noted devices transmit alarm to control panel and actuate general alarm and ancillary devices.
 - .2 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 middlemost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
 - .2 Test each conductor on all circuits for capability of providing alarm signals during ground-fault condition imposed near middlemost point of circuit. Reset control unit after each alarm function and correct imposed fault after completion of each test.
 - .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.
 - .3 The control panel shall continuously perform as automatic self-test routine on each sensor, which will functionally check the sensor electronics and ensure the accuracy of the valves being transmitted to the control panel.
 - .4 Automatic testing will occur at a rate of one sensor every four minutes.
 - .5 The sensor's average analogue value is the average of the last 2000 recorded analogue entries of its chamber.
 - .6 Any sensor that fails this test shall indicate a '**SELF-TEST ABNORMAL**' trouble condition with the sensor's address at the control panel.
 - .7 The system shall automatically indicate when an individual sensor needs cleaning. When the sensor's average value reaches a predetermined value, a '**DIRTY SENSOR**' trouble condition shall be audibly and visually indicated at the local control panel for that sensor. IF a '**DIRTY SENSOR**' indication is left unattended and its average value increases to a second predetermined value, an '**EXCESSIVELY DIRTY SENSOR**' trouble condition shall be indicated at the local control panel for that sensor. To prevent false alarms, these '**DIRTY**' conditions shall in no way decrease the amount of smoke obscuration necessary to generate an alarm condition.
 - .8 An operator having a proper access level, shall have the capability to manually access the following information from the control panel:
 - .1 Primary Status
 - .2 Device Type
 - .3 Present Average Value
 - .4 Present Sensitivity Selected*
 - .5 Highest Peak Detection Values (HVP)*

.6 Sensor Range (Normal, Dirty, Excessively Dirty)

* Values shall be in 'percent of smoke obscuration' format so that no interpretation is required by the operator.

- .9 **Provide "Integrated Testing" of this life safety system in conformance with the noted specification section. Include all associated costs in tender.**

END OF SECTION