ST. CLAIR CATHOLIC DISTRICT SCHOOL BOARD
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ADDENDUM # 002

St. Clair Catholic District School Board

Holy Trinity Catholic School
60 Lorne Cres
Sarnia, Ontario

Classroom and Learning Commons Renovations
Project No. 651-CP1828

Prepared by:

Wilson Diaz Architects Inc.
280 Queens Ave, Suite 1Q
London, Ontario
N6B 1X3

April 6th, 2018

651-CP1828
RWAI Project No. 1747 **Addendum #002**

This addendum forms part of the Contract Bid Documents and amends the original drawings and specifications issued for Bid on March 19th. 2018

TABLE OF CONTENTS

PART A – GENERAL

Questions, comments and discussion from General Contractors:

a. Question:
In room 159 south wall across from new bench and hooks next to door D-159 there looks to be a Whiteboard or Tackboard which is outlined on the floor plan but no elevation. Please advise if this correct.
Answer:
No whiteboard/tack board to be supplied or installed in this location.

PART B – SPECIFICATIONS

9300 – Porcelain Tile 5 Page(s)
Mechanical and Electrical specifications attached. 161 Page(s)

PART C – ARCHITECTURAL DRAWINGS

RESERVED

PART D – STRUCTURAL DRAWINGS

RESERVED

PART E – MECHANICAL / ELECTRICAL DRAWINGS

RESERVED

Architectural Sketches Included

RESERVED

END OF ADDENDUM # 002

PART 1 - GENERAL

1.1. Description

1.1.1. General Requirements

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

1.1.2. Work Performed by Other Sections related to this Section is specified in:

Section 09250 - Gypsum Drywall

1.2. Material Supply

1.2.1. Supply new material for Learning Commons 101A
1.2.2. Salvage tile for patching in Corridor 10

1.3. Quality Assurance

1.3.1. Subcontractor Qualifications

1.3.1.1. Perform tile installation specified in this Section only by a Subcontractor who has adequate plant, equipment, and skilled tradesmen to perform it expeditiously, and is known to have been responsible for satisfactory installations similar to that specified during a period of at least the immediate past five years.

1.4. References

1.4.1. Reference Standards

1.4.1.1. Reference standards quoted in Contract Documents refer to:
1.4.1.2. ANSI A108.1-1976, American National Standard Specifications for Installation of Ceramic Tile.
1.4.1.3. ANSI A118.1-1976, American National Standards Specifications for Dry-Set Portland Cement Mortar. ANSI A118.3-1976, American National Standard Specifications for Chemical Resistant Water-Cleanable Tile-Setting and Grouting Epoxy.
1.4.1.4. ASTM C206-79, Specification for Finishing Hydrated Lime.
1.4.1.5. ASTM C207-79, Specification for Hydrated Lime for Masonry Purposes. CAN/CGSB-75.1-M77, Tile, Ceramic.
1.4.1.6. CAN/CSA-A5-M83, Portland Cements.

1.5. Submittals

1.5.1. Samples

1.5.1.1. Submit 300mm x 300mm panels, or at least 4 units, of tile selected at random from stock.

1.5.2. **Maintenance Instructions**

1.5.2.1. Submit maintenance instructions for incorporation in Project Data Book.

1.6. Site Conditions

1.6.1. **Environmental Requirements**

1.6.1.1. Install tile only when base surfaces and air temperatures have been maintained between 10°C and 21°C for 72 hours preceding installation and until setting materials have cured.

1.7. Warranty

1.7.1. **Extended Warranty**

1.7.1.1. Submit a warranty of tile products and installation specified in this Section covering the period for one year beyond the expiration of the warranty period specified in the General Conditions to the Contract.

PART 2 – PRODUCTS

2.1. Materials

2.1.1. **Setting**

2.1.1.1. Floor Tile – TEC 382 mortar.
2.1.1.2. Portland Cement: To meet specified requirements of CAN/CSA-A5-M83.
2.1.1.3. Hydrated Lime: To meet specified requirements of ASTM Specification C206 or C207 for Type S.
2.1.1.4. Sand: To meet specified requirements of CSA Specification A82.56, passing 1.6mm sieve. Use white sand for white grout.
2.1.1.5. Water Potable, containing no contaminants which cause efflorescence.
2.1.1.6. Additives: for mortar: to meet specified requirements of ANSI Standard A118.4 and CGSB Specification 71-GP-30M, Type 2; acrylic latex; Keraply by Mapei.
2.1.1.7. for grout: to meet specified requirements of ANDI Standard A118.6, Kerapoxy by Mapei.
2.1.1.8. Colour Pigment: Non-fading mineral oxides or carbon black emulsion, unaffected by lime or cement, and which will not stain tile.
2.1.1.9. Primer: To meet requirements of supplier of bond coat.
2.1.1.10. Dry Curing Grout: Premixed, dry set, as recommended by tile supplier.

2.1.2. **Porcelain Floor Tile**

New PCT for Learning Commons 101A

.1	Distributor:	Centura
.2	Tile Series:	Basaltina
.3	Size:	300mm x 600mm
.4	Colour:	To Be Determined
.5	Acceptable Alternate:	As approved by architect.

2.1.3. **Grout**

2.1.3.1. Accucolour XT Floor Grout.

2.1.4. **Cleaner**

2.1.4.1. To meet specified requirements of #1000 Series of Terrazzo, Tile and Marble Association of Canada.

2.1.5. **Galvanizing**

2.1.5.1. To meet specified requirements of ASTM Specifications A525, AF275 Coating Designation for sheet steel: A153 Class B.3 Coating, for hardware, Class 3 Coating, for wire and rods.

2.1.6. **Flooring Accessories**

2.1.6.1. Schluter finishing strip. Finish to be brushed aluminum.
- 2.1.6.1.1. Porcelain Tile to VCT: Schluter Systems RENO-RAMP. Provide accessible slope.
- 2.1.6.1.2. Porcelain Tile to Porcelain Tile: Schluter Systems SCHIENE Radius.

PART 3 – EXECUTION

3.1. Examination

3.1.1. Ensure that environmental conditions and backing surfaces have been provided according to specified requirements.

3.1.2. Defective tile installation resulting from application to unsatisfactory surfaces will be considered the responsibility of this Section.

3.2. Preparation

3.2.1. **Protection**

3.2.1.1. Prevent traffic and construction by other Sections on newly laid tile by barricading areas for at least 48 hours following installation.

3.3. Installation

3.3.1. General

3.3.1.1. Install tile in accordance with details and specifications of Terrazzo, Tile and Marble Association of Canada Installation Manual 200-1979, Ceramic Tile, as applicable, and otherwise in accordance with ANSI Specification A108.1

3.3.1.2. Lay out tile according to architectural drawings such that fields are centered on areas, with no tiles of less than half size included. Maintain heights of panels in full courses to nearest indicated dimension.

3.3.1.3. Lay tile on vertical surfaces with joints plumb and level.

3.3.1.4. Lay tile on floors with joints parallel to walls, at right angles to each other except where pattern is indicated on drawings.

3.3.1.5. Lay tile so that wall and floor joints are in line.

3.3.2. Setting

3.3.2.1. Place as much tile as possible in one operation before setting bed reaches initial set.

3.3.2.2. Clean back and remove bed when it has set before tile is laid.

3.3.2.3. Prime entire backing surface for bond coats.

3.3.2.4. Immediately prior to applying mortar bed over concrete or concrete block, evenly saturate substrate with clean water.

3.3.2.5. Line up joints between tile installed on stairs from tread to tread.

3.3.3. Tile

3.3.3.1. Leave or cut openings to correct sizes to receive accessories, fittings, or other items built into tile.

3.3.3.2. Cut and grind tile accurately, and without damage, to fit openings, at intersections and against trim finish. Rub exposed cut edges smooth with abrasive stone.

3.3.3.3. Drill tile for hardware and for pipes where possible. Otherwise at pipes and fittings, fit tile closely so that escutcheons cover cuts.

3.3.3.4. Extend tile into recesses at windows, doors, or other openings.

3.3.3.5. Extend wall tile behind fitments, mirrors and other applied items of a fixed nature, by a sufficient amount to ensure overlap.

3.3.3.6. Joint Width: 1.6mm wide between ceramic tile units.

3.3.3.7. Provide joints coloured to match tile.

3.3.4. Grouting

3.3.4.1. Remove spacers, strings, ropes or pegs before grouting.

3.3.4.2. Grout tile joints in accordance with grout manufacturer's directions and to fill joints solidly.

3.3.4.3. Fill all gaps and skips, cover setting bed completely. Ensure finish grout is uniform in colour, smooth and without voids, pinholes or low spots.

3.3.4.4. Damp cure grout for at least 72 hours.

3.3.5. **Adjustment**

3.3.5.1. Before Project completion, remove and replace defective, damaged, loose, and unbonded tile; and point defective joints.
3.3.5.2. Wash tile surfaces with water.
3.3.5.3. Wash unglazed surfaces with #1000 Series cleaner. Use 5% solution of muriatic acid only when preceded and followed by a complete drenching of clean water, and only when other cleaning methods are insufficient.

3.4. Cleaning

3.4.1. **Cleaning on Completion of Installation**

3.4.1.1. Remove deposits which affect appearance.
3.4.1.2. Remove protective materials.
3.4.1.3. Clean surfaces by washing with clear water; or with water and soap or detergent; followed by a clear water rinse.
3.4.1.4. Clean and restore stained metal surfaces in accordance with manufacturer's recommendations. Replace if cleaning is impossible.
3.4.1.5. Final cleaning is specified in Section 01711.

3.5. Extra Stock

3.5.1. At the completion of the work, provide ten (10) new, clean packaged ceramic floor tiles of each colour to be turned over to the owner.

End of Section

Chorley+Bisset
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CLASSROOM AND LIBRARY RENOVATIONS

SARNIA ONTARIO

ST. CLAIR CATHOLIC DISTRICT SCHOOL BOARD

CHORLEY + BISSET LTD
CONSULTING ENGINEERS
LONDON ONTARIO

FILE NO. 8393
MARCH 2018

LONDON | 369 YORK ST, SUITE 2B | LONDON, ON N6B 3R4 | P:519-679-8660
OTTAWA | 250 CITY CENTRE AVE, SUITE 403 | OTTAWA, ON K1R 6K7 | P:613-241-0030
www.chorley.com

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G E N E R A L I N D E X

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PART 3 - EXECUTION

DETAIL SHEETS

Detail No.	Title
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2	Typical Detail of Manual Air Vent
3	Air Seal for Drains from Air Handling Equipment
4	Typical Low Velocity Air Duct Turns
5	Duct Fittings
6	Vertical Fire Damper Installation
7	Duct Main and Branch Takeoffs
8	Duct Liner Installation at Fire Damper

1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 This Section and Division 1 - General Requirements applies to and governs the work of all Sections of Division 15.

1.2 **VISITING SITE**

1.2.1 Visit the site and be familiar with working conditions and work involved before submitting Bids. No extras will be granted due to lack of a thorough preliminary investigation of the site.

1.2.2 Remove and replace existing ceiling tile to inspect ceiling space for existing Mechanical, Electrical and Structural obstructions. Include cost of all necessary changes in Bid Price. No extras will be granted due to lack of a thorough preliminary investigation of accessible ceiling spaces.

1.3 **CONTRACT DRAWINGS**

1.3.1 Mechanical Drawings show Mechanical work only and are not intended to show Structural details, Electrical details or Architectural features. Take building dimensions and details from Architectural or Structural Drawings or from job measurements. Any dimensions shown on Drawings are approximate. Verify dimensions by reference to Shop Drawings and field measurement.

1.3.2 Only the general location and route of piping and ductwork is shown. Install all piping and ductwork neatly to conserve headroom. All piping and ductwork to be installed parallel to building lines unless shown otherwise.

1.3.3 The Consultant reserves the right to revise the locations of equipment and outlets within any given room without altering the Contract Price provided Notice of Change is given prior to roughing-in.

1.3.4 In case of conflict between work of other trades and work of this Division, clarify the location of these items with the Consultant before roughing-in.

1.3.5 In the event of any discrepancies or ambiguity of any symbol, note, abbreviation, etc., used in this Specification or on the Contract Drawings, obtain clarification, in writing, from the Consultant prior to submitting Bid. No allowance will be made for additional costs arising from failure to obtain proper clarification of conflicting information before Bid.

1.3.6 Quantities or lengths indicated in any of the Contract Documents are approximate only and will not be held to gauge or limit the work. No adjustment to the Contract Price will be allowed to complete the work.

1.3.7 Verify equipment access and coordinate with equipment supplier to ensure equipment can be physically transported to installation location. Under no circumstances will any claim be allowed for extra cost to disassemble and/or assemble equipment at the final location which will be considered as part of equipment installation.

1.3.8 Provide labour, products and services specified, but not shown on Drawings and vice versa, and all other labour, products and services necessary for completion of the work.

1.3.9 All dimensions and sizes are in SI units. Generally, units are in millimetres. All exceptions to this are noted. Pipe sizes are in accordance with ANSI Standards.

1.4 **SHOP DRAWINGS**

1.4.1 Submit Manufacturers' Shop Drawings, Electrical Wiring Diagrams and Control System Drawings to the Consultant. Provide title sheet for Shop Drawing submitted. Include project name, Shop Drawing item (including specification paragraph reference) and approval stamps. The Consultant reserves the right to have samples submitted of any specified products.

1.4.2 Before submitting shop drawings, provide a complete list of shop drawings to be submitted in Microsoft Excel format. List all shop drawings and approximate date of submission.

1.4.3 Submit all shop drawings electronically in Adobe Acrobat PDF format. File attachments to an email must total no more than 5 MB and must be submitted unzipped. If multiple items are submitted in single PDF file, each individual piece of equipment must be “book marked” using equipment labels as per Design Drawings. All shop drawings submitted electronically must be checked and stamped by the Contractor as specified below.

1.4.4 Catalogues, manuals or price lists will not be accepted as Shop Drawings. Before submission, check Shop Drawings, make necessary corrections, apply stamp “Checked and Certified Correct”, sign and date.

1.4.5 Submit one reviewed set of Shop Drawings with each set of Maintenance and Operating Instructions.

1.4.6 The review of Shop Drawings by Chorley + Bisset Ltd. is for the sole purpose of ascertaining conformance with the general design concept. This review does not mean that Chorley + Bisset Ltd. approves the detail design inherent in the Shop Drawings, responsibility for which remains with the Contractor. Such review does not relieve the Contractor of his responsibility for errors or omissions in the Shop Drawings or of his responsibility for meeting all requirements of the Construction and Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the work of all subtrades.

1.4.7 The Contractor is to review each shop drawing and document the differences between the shop drawing submission and the description listed in the specification. If there are no differences listed, the Contractor implicitly declares the shop drawing meets all requirements of the Specification.

1.4.8 Ensure at least one copy of the reviewed Shop Drawings is kept on site at all times for reference.

1.4.9 Prepare all Drawings in SI units.

1.5 FIELD DRAWINGS

1.5.1 Submit, to the General Contractor, Drawings accurately showing all openings for ducts, pipes, etc. Drawings must include the size of openings and their locations by dimensions, including the location of the structural members framing these openings. Each trade will be responsible for detail layout of their own work.

1.5.2 Assume full responsibility for the detailed coordination of all Division 15 work. Prepare Field Drawings to determine the exact location of each service. On these Drawings, include all mechanical and electrical services, architectural features, and structural details. If a conflict becomes apparent after the installation of services, pay all costs associated with removing and reinstalling these services.

1.6 AS-BUILT DRAWINGS

1.6.1 The Contractor will be provided with the Mechanical Drawings in AutoCAD 2010 compatible electronic format. The Contractor is to plot and print Drawings from the discs.

1.6.2 Revise and maintain the prints as work progresses. Show all revisions, relocations and changes, to scale. Use colour markings.

1.6.3 Transfer information from the marked prints to AutoCAD format on a monthly basis. Have the marked prints and updated AutoCAD prints on site for review by the Consultant at all times. Monthly draws will not be approved unless all changes have been shown.

1.6.4 Prior to testing, balancing and final commissioning, complete the transfer of all information to the AutoCAD Drawings. The Drawing format is to match exactly the layering system of the Consultant. Mark Drawings “As Built Drawings” and insert name and logo of Contractor. Bind all xrefs. Submit one set of As Built Drawing prints for review by the Consultant. Remove Engineers Stamp. Include Contractors name and Logo.

1.6.5 Submit completed As Built Drawings disks in AutoCAD 2010 format and one set of Reproducible Drawings with the Operating and Maintenance Manuals.

1.6.6 For the purposes of Contract payments, As Built Drawings will be assumed to have a value of $2,500.00. This will not be released until As Built Drawings have been accepted as complete and acceptable by the Consultant. This amount is in addition to the normal 10% holdback required by the Construction Lien Act, 1983.

1.7 CONFLICTS AND PRECEDENCE

1.7.1 Immediately upon discovery of any conflict, ambiguity, error or omission in the Contract Documents, request clarification in writing from Consultant prior to starting the work in questions.

1.7.2 Failure to give such written notice will constitute an irrevocable waiver and release of any claim for additional compensation or delays incurred.

1.7.3 Where work fails to conform to Contract Documents, as clarified by Consultant, promptly remove and replace such work as directed, without adjustment to Contract price.

1.8 **FIRESTOPPING**

1.8.1 Before starting any work on site, submit detailed Shop Drawings to the Consultant for review and comments. Include:

1.8.1.1 Manufacturer's technical product data and installation instructions for each specific type and location of penetration.

1.8.1.2 Certification that proposed firestopping materials and assemblies comply with CAN-ULC S115 “Standard Method of Fire Test for Firestop Systems”.

1.8.1.3 For each specific type and location of penetration, provide installation instructions from a recognized independent testing agency.

1.8.2 Mark penetration types and locations on set of white prints. At completion of project, transfer this information to “Record” Drawings.

1.8.3 Comply with all requirements of Ontario Building Code, Clause “Building Services in Fire Separations and Fire Rated Assemblies”.

1.8.4 Submit one sample of the components of each firestop system to the Consultant for review.

1.9 **MAINTENANCE AND OPERATING INSTRUCTIONS**

1.9.1 Assemble three sets of equipment literature (cuts), operating instructions, maintenance instructions, pressure test results, certificate, other pertinent data and Letter of Warranty. Place in three ring binders, complete with index pages, indexing tabs and cover identification at front and side. Submit to Consultant for approval.

1.9.2 Make changes or submit additional information as required to obtain approval. Final Certificate of Completion will not be issued until the Consultant possesses three approved sets. Include copies of approved Shop Drawings and name and address of Spare Parts' Suppliers with manuals.

1.9.3 Provide two electronic copies of the maintenance and operating manual in Adobe Acrobat PDF format on a compact disc or DVD and submit with the final version of manuals. Provide separate files on the disc in accordance with the sections of the hard copy manuals. Divide the maintenance manuals into sections which correspond with Specification Sections.

1.9.4 The following information is to be contained within the Sections:

1.9.4.1 A list of names, addresses and telephone numbers of the Consultants, General Contractor and Mechanical Contractor. Written warranty of the Mechanical systems. A copy of the valve directory, giving number, valve location, normal valve position and purpose of valve.

1.9.4.2 A copy of all pressure tests and operational tests for pumping systems. A list of names, addresses and telephone numbers of all suppliers. A copy of all approved Shop Drawings.

1.9.4.3 A complete and comprehensive lubrication, maintenance and operating instructions details D (daily), W (weekly), M (monthly), SA (semi-annually), A (annually) schedule for maintenance and lubrication.

1.9.4.4 A complete list of all air filter sizes, quantities and types, corresponding with unit designations.

1.9.4.5 Copies of warranties.

1.9.4.6 Complete control diagrams, wiring diagrams and description of control system and the functioning of the system.

1.9.4.7 Copy of the project Testing and Balancing Report.

1.10 **REGULATIONS AND PERMITS**

1.10.1 Carry out all work in accordance with the latest editions of applicable municipal and provincial codes, regulations, bylaws, and requirements of local Authority Having Jurisdiction. In no instance, however, is the standard established by the Drawings and Specifications to be reduced by the codes referred to above. Apply for and obtain any necessary permits. Pay any necessary fees.

1.10.2 Enforce all prevailing Provincial and local safety regulations at all times. Abide by all Owner's safety and security policies and procedures and conform to all regulations of the current Occupational Health and Safety Act.

1.10.3 Submit copies of CRN Certificates for all boilers and registered pressure vessels.

1.10.4 Arrange and pay for TSSA inspection and certification.

1.11 **MATERIAL AND EQUIPMENT**

1.11.1 Where an item of material or any equipment is specifically identified by a manufacturer's trade name and/or catalogue number, make no substitution except as provided for in paragraphs 3, 4 and 5 below.

1.11.2 In the case of some items of equipment, one or more additional names of acceptable equal manufacturers are listed in the Clause describing an item or a group of items. The design, layout, space allocation, connection details, etc., are based on the products named first in the description of each item. The products named first in the description of each item establish the quality of manufacture and design standards for all other manufacturers of that item. The general approval indicated by listing the names of other manufacturers is subject to final review of Shop Drawings, performance data, test reports, production samples (if required) by Consultant, and equipment shipped to site. Ensure that the products used meet the requirements specified and as shown on the Contract Drawings.

1.11.3 Suppliers wishing to submit other items of equipment for approval as an equal to those specified must apply to the Consultant at least 8 working days before Bid closing date. Requests must be accompanied by complete description and technical data on the items proposed. Approval for substitution of equipment will only be given on the understanding that all details, accessories, features and performance meet the Specifications unless otherwise stated. Deviations from the Specifications must be stated in writing at time of application for approval.

1.11.4 Include in the Bid, the equipment named in the Specifications or approved as an equal as in paragraph 3 above. This will form the Base Bid. Any number of alternative bids, as defined below, may be included in addition to the Base Bid.

1.11.5 Items of equipment by Manufacturers not named in the Specifications may be offered as alternatives to the manufacturers named in the Specifications. The alternative proposals must be accompanied by full descriptive and technical data, together with the statement of amount of addition or deduction from the Base Bid, if the alternative is accepted. Prior approval by the Consultant is not required on items submitted as alternative bids.

1.11.6 After execution of the Contract, substitution of equipment will be considered only if equipment accepted cannot be delivered in time to complete the work in proper sequence, or if the manufacturer has stopped production of the accepted item. In such cases, requests for substitution must be accompanied by proof of equality and difference in price and delivery, in the form of Certified Quotations from Suppliers of both specified and proposed equipment. Credit any decrease in price involved in substitution to the Owner by reduction of the Contract Price. The Contractor will not be reimbursed for any such increase in price.

1.11.7 Where equipment other than the equipment used as a basis for design, layout and space allocation is used, produce and submit revised layouts of equipment, pipes, ducts, etc., in the areas affected. Submit these Drawings with the Shop Drawings. Failure to produce these Drawings is indication by the Contractor that they are not required and the original space allocations are adequate for the substituted equipment.

1.11.8 Name the Subcontractors and Manufacturers in the Bid as indicated in Clause “List of Mechanical Subcontractors and Manufacturers”.

1.12 INTERPRETATION OF CONTRACT DOCUMENTS

1.12.1 The decision as to which trade provides required labour or materials rests solely with the Contractor. Extra payments will not be considered based on a difference in interpretation of the Contract Documents as to which trade involved provides materials or labour for specific items of work. The Consultant will not enter into such discussions.

1.13 SITE VISITS

1.13.1 The Mechanical Contractor shall have an office representative (not site personnel) at each site meeting and deficiency review. Attendance at these meetings is mandatory.

1.14 PROGRESS DRAWS

1.14.1 Mechanical Contractor shall review all supplier and subcontractor draws submitted to their office to ensure they are fair and reasonable for the amount of work completed on site to date prior to submitting to the General Contractor. Mechanical Contractor will be responsible for the validity of supplier and subcontractor draw claims.

1.15 **WARRANTY**

1.15.1 Warranty all workmanship and make good any defects for one year after Substantial Completion. Warranty material and equipment supplied by the manufacturers for one year after Substantial Completion. Make good damage caused due to defects and workmanship.

1.15.2 Where equipment specified in Sections of Division 15 to have an extended warranty period, e.g. five years, the first year of the warranty period will be governed by the terms and conditions of the warranty in the Contract Documents, and the remaining years of the warranty will be direct from the manufacturer and/or supplier to the Owner. Submit signed and dated copies of the extended warranties to the Consultant before applying for a Certificate of Substantial Performance of the Work.

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal as defined in Clause “Material and Equipment”.

2.2 **BACKFILL**

2.2.1 Use backfill material in accordance with the requirements of Division 2 unless specified or shown otherwise.

2.3 **CONCRETE**

2.3.1 Use concrete in accordance with the requirements of Division 3.

2.4 **SLEEVES**

2.4.1 In general, sleeves are not required through walls or floors except for penetrations through Service Room walls or floors.

2.4.2 For sleeves through mechanical room floors, use Schedule 40 steel pipes with annular fins continuously welded at midpoint.

2.4.3 For rated separation requiring a FT firestopping rating, use materials in conformance with manufacturer's recommendations.

2.5 **FIRESTOPPING**

2.5.1 Use only service penetration firestop components and assemblies tested in accordance with CAN/ULC S115 Fire Tests of Firestop Systems and listed in most recent ULC “List of Equipment and Materials” or by another recognized independent testing and certification agency acceptable to the Consultant.

2.5.2 All pipe insulation passing through the fire separation to be approved with the listing of the firestop system.

2.5.3 Pipe sleeves through fire separations requiring a rating are to be installed as per firestopping manufacturer's recommendations, as some firestopping manufacturers do not allow pipe sleeves within their approved system. Confirm pipe sleeve compatibility prior to starting work on site.

2.5.4 The following manufacturers of the above equipment will be considered equal subject to requirements of Clause “Material and Equipment”:

Tremco

2.6 FIRE CLOSURES

2.6.1 Use only fire damper assemblies tested in accordance with CAN/ULC S115 Fire Tests of Firestop Systems and listed in most recent ULC “List of Equipment and Materials” or by another recognized independent testing and certification agency acceptable to the Consultant.

2.7 ESCUTCHEON PLATES

2.7.1 Use chrome or nickel-plated brass, solid type, with set screws for ceiling or wall mounting.

2.8 ACCESS DOORS

2.8.1 Access doors to be flush to edge of frame, concealed continuous hinge with screwdriver operated cam latch. Non fire-rated door construction to be minimum 14 gauge, with 16 gauge frame. Fire-rated door construction to be a minimum 20 gauge insulated door with 16 gauge frame. Insulation thickness to provide required rating.

2.8.2 Size doors to allow adequate operating/maintenance clearance for devices. Doors to be a minimum 600 mm x 600 mm (24″ x 24″) for body entry, and 300 mm x 300 mm (12″ x 12″) for hand entry, unless noted otherwise. Use the following access doors:

Masonry Walls	- Acudor UF-5000
Drywall Walls	- Acudor DW-5040
Drywall Ceilings	- Acudor BP58, match ceiling thickness
Fire-Rated	- Acudor FW-5050/FB-5060 to match fire separation

2.8.3 The following manufacturers of the above equipment will be considered equal subject to requirements of Clause “Material and Equipment”:

Adam
Ancon LeHage
E. H. Price

2.9 ELECTRICAL EQUIPMENT

2.9.1 This building will be fully sprinklered. Use weatherproof electrical equipment in vaults and electrical rooms or shield equipment in such a way as to prevent the sprinkler system water from entering the electrical equipment and/or interfering with its operation.

2.10 ELECTRIC MOTORS

2.10.1 Provide motors of adequate size and type for intended service. Use CSA approved motors with the following characteristics:

250 watts (1/3 hp) and under	-	115 volt, 60 hertz, single phase
370 watts (1/2 hp) and over	-	60 hertz, three phase, voltage as shown on Drawings.

2.10.2 Motors are to be the voltage specified. Step down or step up transformers will not be accepted.

2.10.3 Motors 250 watts (1/3 hp) and under: Use continuously rated squirrel cage induction type with capacitor start, NEMA Design Class “B” with NEMA “N” or better starting characteristics and a minimum of Class "B" insulation, unless specified otherwise..

2.10.4 Motors 370 watts (1/2 hp) and over: Use continuously rated squirrel cage induction type NEMA Design Class “B” with NEMA “B” or better starting characteristics and a minimum of Class “B” insulation.

2.10.5 Use open drip-proof type motor with a 1.15 service factor for motors located in dry locations indoors, unless specified or required otherwise by the motor location.

2.10.6 Use totally enclosed motors outdoors and in locations subject to water spray. Totally enclosed motors must be fan cooled and have a 1.0 service factor.

2.10.7 Use totally enclosed explosion-proof (TEXP) motors where indicated to prevent ignition of external gas.

2.10.8 All enclosures shall be rolled steel band or cast iron construction. Motor nameplate shall be mounted on enclosure with stainless steel fastening pins and shall have, as a minimum, all information as described in CSA C22.2 No 100-04 (R2009).

2.10.9 Unless specified otherwise, starters for electric motors will be provided by Division 16. Where multi-speed motors are specified, ensure that motors are compatible with starters supplied under Division 16. All two speed motors to be single winding, unless specified otherwise. Provide inverter duty motors where indicated on drawings.

2.10.10 All motors 0.75 kW (1 hp) and above, use premium efficiency type motors in accordance with NEMA Premium efficiency standard.

2.11 ELECTRICAL WIRING

2.11.1 Meet all requirements of Division 16 for all wiring included in Division 15 and pre-wired equipment provided by Division 15.

2.11.2 Ensure all pre-wired electrical equipment is CSA approved. Where this is not possible, arrange and pay for special Electrical Safety Authority approval.

2.11.3 All electrical wiring, both line voltage and low voltage, for equipment supplied by Division 15 is the responsibility of Division 15. Line voltage wiring from power panels to starters and from starters to motors will be supplied and installed by Division 16.

2.12 **IDENTIFICATION NAME LABELS**

2.12.1 Identification name labels, directional arrows and colour bands for ductwork and piping to be plastic coated pressure sensitive “Brady” or “Westline” selfstick labels, waterproof, colourfast, dirt and grease resistant. For pipes up to and including 65 mm (2-1/2″) diameter, use markers 28 mm (1-1/8″) high. For pipes 80 mm (3″) diameter and over, and all ductwork, use markers 57 mm (2-1/4″) high. For all piping exposed to view, use Smillie McAdams Summerlin Coil - Mark pipe covers.

2.13 **VALVE AND CONTROLLER TAGS**

2.13.1 Use brass valve and controller tags with 32 mm (1-1/4″) stamped code lettering and numbers filled with black paint. Hang a copy of the valve chart in Mechanical Room.

2.14 **EQUIPMENT NAMEPLATES**

2.14.1 Use minimum size 90 mm x 40 mm x 2.4 mm (3-1/2″ x 1-1/2″ x 3/32″) thick laminated phenolic plastic nameplates with black face and white lettering. Lettering to be minimum 6 mm (1/4″) high.

2.15 **BELT AND MACHINE GUARDS**

2.15.1 Provide OSHA compliant expanded metal guards in steel frames to protect drives of all belt driven equipment and all equipment with exposed rotating or moving parts. Firmly bolt guards in place and make easily removable for servicing. Provide openings in metal guards to permit use of a tachometer without removing the guard.

2.16 **FLASHING**

2.16.1 For locations with multiple roof penetrations serving a single piece of equipment, such as for roof mounted split system condensing units, use Portals Plus, Inc. Alumi-Flash system consisting of 100 mm (4″) high, one piece spun aluminum base with deck flange and EPDM rubber cap. Use caps suitable for required number and diameter of service penetrations.

2.16.2 For plumbing vent roof penetrations, use Thaler SJ-38 “Stack Jack” insulated flashing consisting of 330 mm (13″) high, one piece spun aluminum base with deck flange, urethane insulation liner and EPDM base seal. Size seals to suit pipe diameter.

2.16.3 For electrical conduit roof penetrations use Lexsuco Flash-Tite ‘Gooseneck’ insulated wire and cable flashing consisting of 220 mm (9″) high, one piece spun aluminum base with deck flange, 50 mm (2″) diameter 430 mm (17″) high stainless steel gooseneck and neoprene insulation liner.

3 Execution

3.1 **GENERAL**

3.1.1 Instruct and supervise other Sections doing related work.

3.1.2 Supply the measurements of equipment to other Sections to allow for necessary openings to be left in the work of other Sections.

3.1.3 Install pipes, ducts and tubing, which are to be concealed, neatly and close to building structure so that the necessary furring can be kept as small as possible.

3.1.4 Install all ceiling components in direct accordance with reflected ceiling plans.

3.1.5 Mechanical Drawings show approximate locations for wall-mounted devices. Clarify exact location and mounting height with Consultant prior to roughing-in.

3.1.6 All serviceable equipment installed on the roof (including boiler vents) to be installed minium 3m (10'-0") from roof edge.

3.2 DISSIMILAR METALS

3.2.1 Separate dissimilar metals by means of gaskets or shims of approved material or use dielectric unions or flanges in order to prevent electrolytic action. Where piping of dissimilar metals is connected, use approved dielectric unions or couplings. A brass fitting or brass valve may also be used in making connections between copper and steel piping.

3.3 STORAGE OF MATERIALS

3.3.1 Provide proper weatherproof storage for the protection of materials and equipment on site. Blank off openings in all equipment until required for use. Consultant may require materials which are not properly stored to be discarded and removed from the site.

3.4 EXCAVATION AND BACKFILL

3.4.1 Be responsible for any excavation and backfill required for work of Division 15. Slope or shore all trenching in accordance with all current regulations and safety standards. Where any pipes pass under building footings, backfill under footings with lean concrete.

3.4.2 Use materials and standards of compaction for backfill in accordance with Division 2 unless specified otherwise.

3.4.3 If changes are required in locations, depth of excavating or related data, advise the Consultant in reasonable time to avoid disruption of work sequence.

3.5 SUPPORTS AND BASES

3.5.1 Provide structural work required for installation of equipment provided under this Division.

3.5.2 Where piping and/or equipment is to be supported by steel stud walls, use brackets and supports which attach to steel studs. Support equipment independently of wall sheathing.

3.5.3 Provide sleeves for insulated pipe large enough to permit free movement of pipe without crushing the insulation.

3.5.4 Set all floor-mounted equipment on concrete bases at least 100 mm (4″) high Provide bases, anchor bolts and any special isolation bases. Concrete bases for air handling equipment are to be sized to suit unit drain air seal requirements, but 100 mm (4″) to remain as minimum. Size concrete equipment bases to suit the equipment actually supplied and in accordance with the Shop Drawings of such equipment. Do not start concrete work until anchor bolts and other embedded parts required for the complete installation, as well as Shop Drawings, are available at the site.

3.5.5 Carry out all concrete work in accordance with requirements of Division 3. Provide wire mesh, rebar and all necessary reinforcing.

3.5.6 For new concrete bases or pads on existing floors, first scrape and remove existing floor finish. Scarify existing floor so that new concrete adheres to it. Dowel new pads to existing floors.

3.6 CONCRETE INSERTS

3.6.1 General

3.6.1.1 Anchors for the support of pipes, ducts and equipment from the underside of suspended structural concrete systems may be by cast-in-place inserts placed prior to the pouring of concrete or by the use of inserts placed in holes drilled after the forms are stripped. The use of inserts cast into the concrete is the preferred option.

3.6.1.2 The safe load capacity of concrete anchors is affected by a number of variables such as specific anchor type, embedment, spacing between individual anchors, edge distances, direction of loading, concrete strength and “prying action”. Refer to the manufacturer's recommendations for each specific insert proposed, including any dynamic or vibratory loads.

3.6.1.3 Be responsible for the proper selection and installation of inserts, including number, type, spacing and accurate placement to provide the necessary safe load capacity and satisfactory long term performance.

3.6.2 **Installation of Cast in Place Inserts**: Ensure that anchors are accurately placed and "fixed" in position with sufficient rigidity to maintain their position during the placement of concrete. Do not displace reinforcing to install anchors without the prior permission of the Consultant.

3.6.3 **Installation of Inserts in Hardened Concrete**:

3.6.3.1 Use inserts placed in pre-drilled holes. Do not use powder driven inserts or self-drilling inserts. Before drilling holes, accurately locate all reinforcing bars in the affected areas using an electro-magnetic locator.

3.6.3.2 Do not drill through or otherwise damage reinforcing bars. If reinforcing is encountered, the inserts must be relocated. Ensure that hole diameter, depth of penetration, spacing, etc., are in strict accordance with the insert manufacturer's recommendations for the specific insert type and load condition.

3.6.3.3 Due to the relatively close spacing of reinforcing bars in the bottom of many of the beams and girders, the preferred location of drilled-in-place anchors in beams and girders is into the sides of these members, rather than upwards into the bottom.

3.6.4 **Sleeves Embedded in Concrete**: Except as approved otherwise by the Consultant, install sleeves embedded in concrete in accordance with the following general guidelines:

3.6.4.1 Centre to centre spacing to be not less than 3 diameters of the maximum size adjacent sleeve.

3.6.4.2 Provide additional reinforcing at points of congestion as directed by the Consultant.

3.6.5 Sleeves through beams will be permitted only as directed by the Consultant.

3.6.6 The reinforcing in beams, slabs and columns must not be displaced from its intended position under any circumstances unless prior written approval is obtained from the Consultant.

3.7 SLEEVES

3.7.1 Provide sleeves for insulated pipe large enough to permit free movement of pipe without crushing the insulation.

3.7.2 Provide sheet metal framing around ducts through masonry walls in exposed areas to ensure a clean finish around ducts.

3.8 FIRESTOPPING

3.8.1 Provide a listed firestop system in accordance with the Ontario Building Code to seal around all piping, tubing, ducts, conduits, electrical wires and cables, and other similar mechanical services which penetrate part of a building assembly required to have a fire resistance rating or a fire separation. Refer to Architectural Drawings and Specifications Section “Firestopping and Smoke Seals” for building assembly and fire separation types and locations.

3.8.2 For all penetrations through fire separations required to have a fire resistance rating, use firestop systems with an F rating not less than the fire resistance rating for the fire separation. This includes the sealing of any sleeves provided for future uses. Provide an FT rating where required by the Ontario Building Code.

3.8.3 All firestopping must be thoroughly reviewed by the Technical Representative of the systems manufacturer on site before any firestopping is concealed and submit a report of compliance with the rating requirements. Technical Representative to complete 3 destructive tests to confirm compliance with ULC listing, minimum one floor test and one wall test, third test to be Contractors choice. Submit a copy of the report to the Consultant.

3.8.4 Install duct fire damper assemblies in strict accordance with manufacturer's instructions provided with each assembly.

3.9 CUTTING AND PATCHING

3.9.1 Do not cut or drill holes through floors, roof or structural members before obtaining permission from the Consultant. All cutting and patching to be done by the trade specializing in the materials to be cut.

3.9.2 For penetrations through walls not required to have a fire rating, seal all spaces between pipe or pipe and surrounding wall construction with a fire-rated foam sealant. Use 3M Fire Barrier, Metacaulk, or Dow Fire Stop UL Classified fire rated foam sealants. Do this as the work progresses, to avoid leaving inaccessible holes at completion of the job. For penetrations through parts of the building assembly required to have a fire resistance rating or acting as a fire separation, see Clause "Firestopping" in this Section.

3.9.3 Where pipes and ducts are shown on the Mechanical Drawings passing through existing walls, floors, and roof, cut and patch the necessary openings. Include the cost of all cutting and patching in the Lump Sum Contract Price for the work of Division 15. Before drilling holes through floors or roof slabs, accurately locate and note sizes for each required hole. Get approval of Consultant before any cutting is started. Electrical conduits with live wiring may be embedded in concrete floor slabs.

3.9.4 Remove and replace ceiling where necessary to complete the work of this Division unless this work is specifically included in another Division.

3.10 ELECTRICAL EQUIPMENT

3.10.1 Where electrical equipment provided by this Division is not of sprinkler proof design, provide shields to prevent the sprinkler system water from entering the electrical equipment and/or interfering with its operation.

3.11 ELECTRICAL WORK

3.11.1 Perform all electrical work included in the work of this Division in accordance with the requirements of Division 16.

3.12 PAINTING

3.12.1 With the exception of prime painting of miscellaneous steel, painting of interior of ductwork behind grilles and other specific requirements as specified under the respective sections of Division 15, all painting will be provided under general trades, including painting of exterior of ductwork and interior piping exposed to view unless specifically noted below.

3.12.2 Touch up minor damage to finish on equipment supplied with factory applied baked enamel finish. Completely refinish items suffering damage which, in the opinion of the Consultant, is too extensive to be remedied by touchup.

3.12.3 Paint all steel framework provided by this Division with a chromium oxide primer.

3.12.4 Paint all exposed piping on roof. Use two coats of paint. Use colours as selected by the Consultant.

3.12.5 Paint all new and existing gas piping. Use bright yellow colour. Use two coats of paint.

3.13 ACCESS DOORS

3.13.1 Supply access doors wherever equipment, valves, dampers, life safety devices, etc., are concealed behind walls or inaccessible ceilings. All devices installed requiring periodic maintenance to be made accessible. Doors will be installed by Division 9.

3.14 IDENTIFICATION

3.14.1 Identify all piping and ductwork using name labels. Apply labels at 7 m (24′) intervals and at all branch connections, valves, and access panel locations. Neatly stencilled labels will be acceptable above accessible ceilings on insulated piping and on ductwork.

3.14.2 Mark each pipe in a space or area less than 7 m (24′) at least once with a name label. Apply flow directional arrows beside each name label.

3.14.3 To ensure permanent bond, apply 3M Adhesive EC-1341 to the surface of the insulation or pipe material. Apply the label with its own adhesive on this surface. Remove any labels “lifting”or “peeling”. Clean the surface and repeat the procedure specified with a new label. Where labels do not adhere, use pipe banding tape spirally wrapped for full length of label. Apply label over the banding tape.

3.14.4 Provide nameplate identifying equipment type, identification number, service and area served on each piece of mechanical equipment. Contractor is to complete a SCCDSB Bar Code/Asset Tag Information Form for new and/or replaced piece of equipment. Obtain form from SCCDSB.

3.14.5 Identify all manual and automatic control valves on all systems using brass tags attached with non-ferrous chains. Prepare a schedule of all tags for each system showing designating number, service and function. Include these schedules in the Operating and Maintenance Manuals and in the Mechanical Room.

3.14.6 Provide identification of all duct balancing dampers. Identify both support points of balancing damper and bottom of duct. Fluorescent orange spray paint is acceptable.

3.14.7 Where equipment is concealed above accessible ceilings, indicate location using coloured-coded marking devices, approved by Consultant, fastened to the ceiling components.

3.15 PIPING

3.15.1 General

3.15.1.1 Conceal all piping except in equipment rooms, unfinished areas, and where specifically noted. Unless shown otherwise, install all above ground piping parallel to building walls and partitions.

3.15.1.2 Install escutcheon plates at walls, floors and ceilings where piping is exposed. Install piping to conserve headroom.

3.15.1.3 In locations where space is provided for future or other equipment requiring connection to systems installed under this Contract, install services with shutoff valves and caps to allow connection to the system without interruption.

3.15.2 **Drain Hose Connections**: Provide drain hose connections at the base of all risers, on the suction side of all pumps and in all locations shown on Drawings.

3.15.3 **Supports and Hangers**

3.15.3.1 Provide all hangers, supports and sway braces in accordance with ANSI B31.1 and the Ontario Building Code. Support all piping in accordance with the Ontario Building Code.

3.15.3.2 Use Anvil beam clamps.

3.15.3.3 Use line size adjustable wrought steel clevis type hangers for horizontal piping 32 mm and less (1-1/4″ and less). For copper pipe, wrap pipe with tape at all hangers or use Anvil Figure CT-99C adjustable tubing ring hangers.

3.15.3.4 For piping 40 mm and over (1-1/2″ and over) use adjustable wrought steel clevis type hangers large enough for pipe insulation. See Section 15260 for insulation shields.

3.15.3.5 Where specified and/or shown on Drawings and in schedules, use spring hangers. See Drawings for details.

3.15.3.6 Unless specified otherwise, support piping at maximum spacing as shown and within 460 mm (18″) of each side of all valves and bends.

3.15.3.7 Support all plumbing piping in accordance with the Ontario Plumbing Code.

3.15.3.8 Support horizontal cast iron drainage piping at 1.5 m (5′) maximum spacing. Where the drain has successive fittings with no pipes between the fittings exceeding 800 mm (1′)in length, support the drain at intervals not exceeding 1 m (3′). Where mechanical joints are used, provide double hangers and sway bracing.

3.15.3.9 Where cast iron pipe with mechanical joints is used, support piping on both sides of horizontal joints within 460 mm (18") of joint each side, at all branch ends, and at all points where there is a change in direction. Where the pipe is 150 mm (6″) or larger in horizontal runs, brace to prevent horizontal movement at each branch or change in direction. Use braces, blocks, rodding or other suitable method recommended by the joint manufacturer. Provide Inspection Report from the manufacturer's representative certifying the installation is in accordance with their published installation data.

3.15.3.10 Do **not** support piping from other piping or equipment, or from metal roof decking.

3.15.3.11 **Schedule**:

Pipe Size mm	**20**	**25**	**32**	**40**	**50**	**65**	**80**	**100 to 200**
Max. Span m	1.8	2.1	2.4	2.4	3	3.4	3.7	4.3

3.15.4 **Anchors**: Install anchors where shown and where required. Use “U” bolts for piping 80 mm (3″) in diameter and less. For piping over 80 mm (3″) diameter, use steel fabricated anchors welded directly to pipe.

3.15.5 **Provision for Expansion**: Make proper allowance for thermal expansion and contraction whether shown on the Drawings or not. Use adequate offsets on all takeoffs to allow for expansion and contraction of mains. Weld all steel pipe forming an expansion loop regardless of size. Silver solder all copper pipe forming an expansion loop regardless of size. Use Flexonics or Anvil pipe alignment guides where shown and where required. Provide pipe guides for piping on either side of expansion loops, expansion joints and expansion compensators in accordance with "Standards of the Expansion Joint Manufacturers Association, Inc.".

3.16 USE OF FANS

3.16.1 Do not use any fan supplied under this Contract for ventilation while the building is under construction. The building must be "broom clean" and all painting finished before permission will be granted for testing fans.

3.16.2 The Consultant reserves the right to use any piece of equipment, device, or material for such reasonable lengths of time and at such times as may be required to make a complete and thorough test of the same before final completion and acceptance of the work. Such tests are not to be construed as evidence of acceptance of the work, and it is agreed and understood that no claim for damage will be made for injury or breakage to any part or parts of the equipment and/or materials due to the aforementioned tests, where such injuries or breakage are caused by a weakness or inaccuracy of parts, or by defective materials and/or workmanship of any kind. Supply all labour and equipment required for such tests. Trial usage will not initiate or affect in any way the warranties required for devices being tested.

3.17 INSPECTION AND TESTING

3.17.1 **General**: Inspect and test all piping. Repair any leaks and retest until satisfactory. Do not cover or close in piping until inspection and tests are completed. Thoroughly test all systems before making arrangements for the final demonstration in the presence of the Owner's staff. At the completion of the work, demonstrate operation of all systems to the Owner's representative and the Consultant. Promptly rectify any malfunction found and retest.

3.17.2 **Soil, Waste, Vent and Building Drains**: Seal all openings in section under test, then fill with water to a height of 3 m (10′) above top of section. Maintain water level for at least two hours. Test in sections as the work progresses. After all fixtures have been placed, apply a smoke test to the satisfaction of the local Plumbing Inspector.

3.17.3 **Domestic Hot and Cold Water - Heat Pump Water**: Apply a hydrostatic test of 1034 kPa (150 psig) or 1-1/2 times working pressure, whichever is greater, for two hours.

3.18 PERFORMANCE VERIFICATION

3.18.1 All systems must be thoroughly tested by the Technical Representative of the system manufacturers before arrangements are made for the final demonstration in the presence of the Owner's staff.

3.18.2 At the completion of the work, demonstrate operation of all systems to the Owner's representative and the Consultant. Promptly rectify any malfunction found.

3.18.3 For the following Systems, the manufacturer's representative must be present for the test period and submit a Certificate of Operation to the Consultant:

Controls
Heat Pumps

3.18.4 The manufacturer's representative must be present for the test period and submit a Certificate of Operation to the Consultant.

3.19 **START-UP SERVICES**

3.19.1 Provide the services of a qualified person to be in the building daily from 0800 hours to 1700 hours Monday through Friday for one week after work of this Contract is taken over by the Owner. Assist Owner's staff to become familiar with the system operation. Provide a similar service for one week after switchover to the opposite air conditioning cycle (heating or cooling).

3.20 **WELDING**

3.20.1 All welding is to be compliant with CSA W59-03 (for steel) or CSA W59.2-M (for aluminum). Welding is to be performed by tradesmen certified to CSA W47.1 (steel) or CSA W47.2 (aluminum). Inspectors shall be qualified to CSA W178.2. Provide proof of certification upon request.

3.20.2 For welding of stainless steel, use the provisions of the American Welding Society standard AWS D1.6/1.6M. When provisions of this standard conflict with provisions of applicable CSA standards, the CSA standards shall take precedence.

3.20.3 Welding and cutting tasks shall be carried out in accordance with CSA 117.2.

3.21 **PLACING IN OPERATION**

3.21.1 Upon completion of all work and before turning over the job, test each system for proper operation.

3.21.2 Flush through all drains and properly adjust flush valves and other fixtures.

3.21.3 Open and clean all new and existing traps, strainers and scale pockets after two weeks' operation.

3.21.4 Clean out all new and existing room heating units, terminal heating units, heat pumps and all air handling equipment with a vacuum cleaner when building is completed.

3.21.5 For each new filter bank, provide one extra set of filters.

3.21.6 Engage chemical treatment vendor of Owner’s choice to oversee cleaning and treatment of hydronic system. Completely flush system and refill with chemical cleaning compound. Operate the system for 24 hours at as high a temperature as possible with all control valves wide open, so that the compound reaches all parts of system. Drain, thoroughly flush and refill. Add corrosion treatment chemicals in recommended quantity to final filling. Provide report from chemical treatment vendor at completion of work.

3.22 COOPERATION BETWEEN TRADES

3.22.1 Cooperate and coordinate with other trades as required for satisfactory and expeditious completion of work. Take field dimensions relative to work. Fabricate and erect work to suit field dimensions and field conditions. Pay cost of extra work caused by and make up time lost as result of failure to provide necessary cooperation information or items to be fixed to or built-in, in adequate time.

3.23 MAINTENANCE OF EXISTING SERVICES

3.23.1 Take every precaution to locate and protect existing services so that no unscheduled interruption occurs. If any existing service is damaged due to the work of this Division, arrange and pay for repair. Bear any costs due to interruption of existing services.

3.23.2 The operation of the building by the Owner for day-to-day activities takes precedence over all construction related scope of work. The Contractor may be asked to cease work immediately in these instances and directed to work at another time. Assume all construction related activities which will impact the day-to-day operations of the facilities will be done after hours. Include all costs associated with after hours and overtime hours in the Base Bid. Additional costs related to after hours or overtime hours after Award of Contract will not be entertained.

3.23.3 Permission from the Owner is required before making any connections to or rerouting of existing services. Before any interruptions of service or restriction of use of any service, provide seven days prior written notice to the Consultant and Owner.

3.24 PROTECTING AND MAKING GOOD

3.24.1 Be responsible for protection of Owner's property, as well as finished and unfinished work, from damage due to execution of work under this Contract. Repair damage resulting from failure to provide such protection to the satisfaction of the Consultant, at no expense to the Owner.

3.24.2 Provide temporary heating, cooling and humidification systems for protection of existing Gymnasium wood floor at all times when central systems are not fully operational. This area must be maintained between 22 and 24C (72 to 75F) and 30 to 55% RH at all times during the work of this contract. Provide temporary vapour tight barrier between the Gymnasium and all adjacent areas where environmental conditions are not closely maintained. Provide a minimum of two temperature and humidity sensors in the area with LCD displays, for the duration of the contract. Monitor conditions in this space regularly. Pay for repair/replacement of any and all damage to the floor which occurs during the work of this contract.

3.24.3 Attach and fasten fixture and fittings in place in safe, sturdy, secure manner so that they cannot work loose or fall or shift out of position during occupancy of building, as the result of vibrating or other causes in normal use of building.

3.25 REMOVAL OF EXISTING MATERIAL AND EQUIPMENT

3.25.1 Remove existing material and equipment where shown or specified. Unless noted or specified otherwise, all material and equipment which is removed becomes the property of the Contractor and must be immediately removed from the site.

3.26 **FIRE SAFETY IN EXISTING BUILDINGS**

3.26.1 Where temporary shutdown of sprinkler systems, standpipe systems or other fire protection systems is required, do all work in compliance with Article 1.1.1.2, Clause 2.8.2.1.1.G and Subsections 6.4.1 and 6.5.2 of the Fire Code.

3.27 **DEFICIENCY REVIEW**

3.27.1 The Mechanical Contractor shall confirm in writing that the work is complete and ready for inspection. The Consultant will schedule a site visit to review the work and provide a written deficiency list. Once deficiencies have been corrected, the Mechanical Contractor shall confirm in writing to the Consultant that all deficiencies have been corrected. The Consultant will schedule a second site visit to review the correction of noted deficiencies. Should any noted deficiencies be found to be still outstanding, the Mechanical Contractor shall correct them and again notify the Consultant in writing. Charges to the Mechanical Contractor may result from repeat visits after the second visit.

3.27.2 The Mechanical Contractor is required to complete all work above ceilings and allow time for deficiency reviews and correction of noted deficiencies in a timely manner in order to accommodate the current Construction Schedule. This includes time for reinspection as required prior to concealing (drywall enclosures, drywall ceilings and acoustic tile ceilings) of any service. The Mechanical Contractor will be responsible for uncovering any concealed services for inspection.

3.28 **OWNER SUPPLIED EQUIPMENT**

3.28.1 The heat pumps will be purchased by the Owner and turned over to the Contractor. Contractor is responsible for receiving, installing and commissioning the heat pumps.

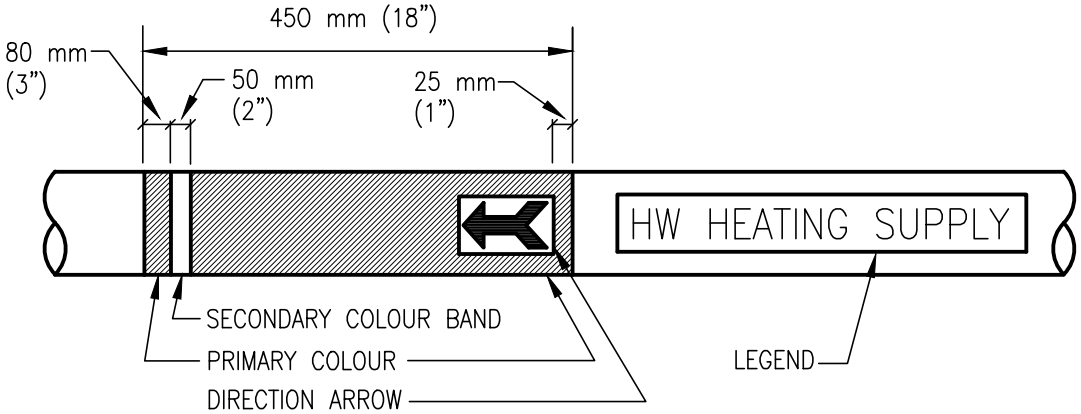
3.29 **LIST OF MECHANICAL SUBCONTRACTORS**

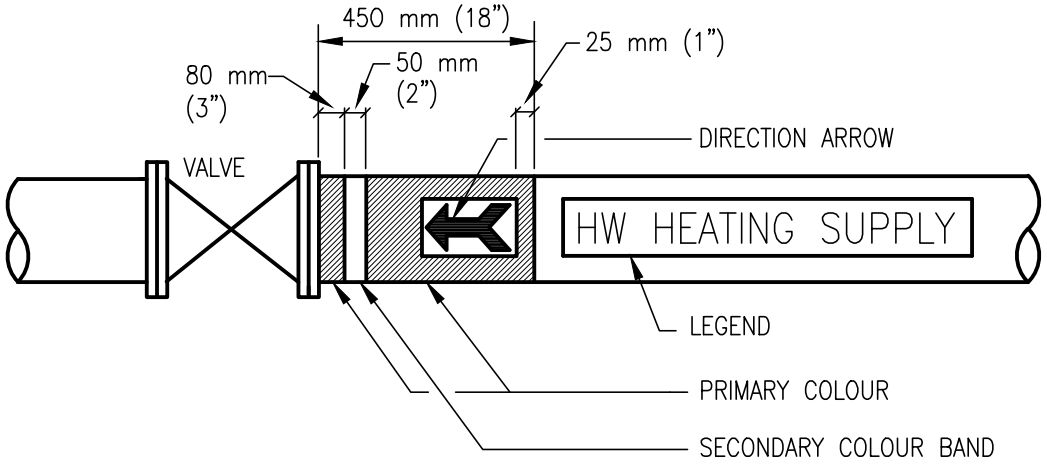
3.29.1 In the Bid documents, name the Subcontractors for the trades listed below. Use only one name for each item. See Clause “Material and Equipment”. Where the name of a manufacturer is not entered on the Bid Form, the Contractor will be required to use the base specified manufacturer.

3.29.2 **Subcontractors**

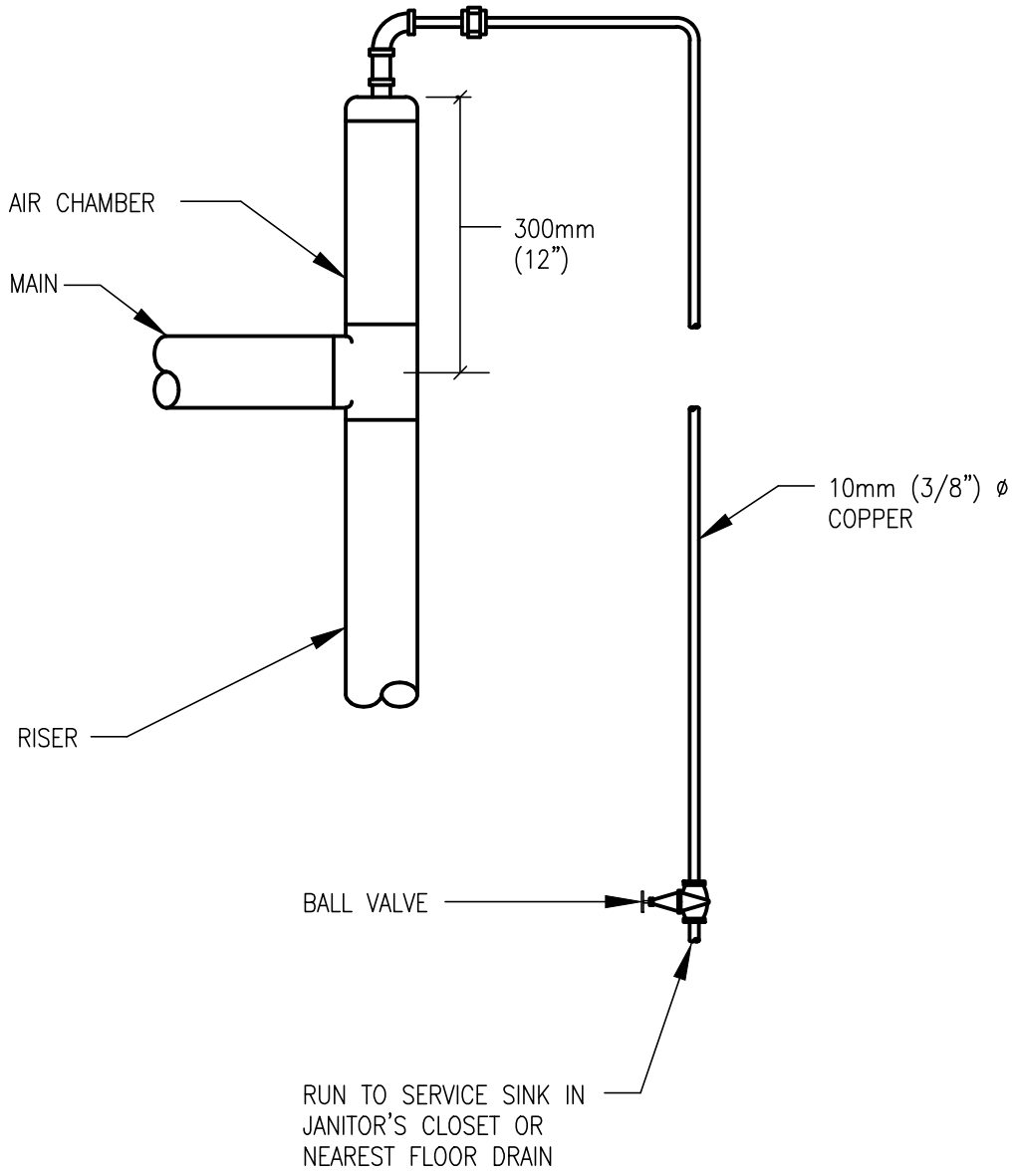
Sheet Metal
Testing and Balancing

END OF SECTION

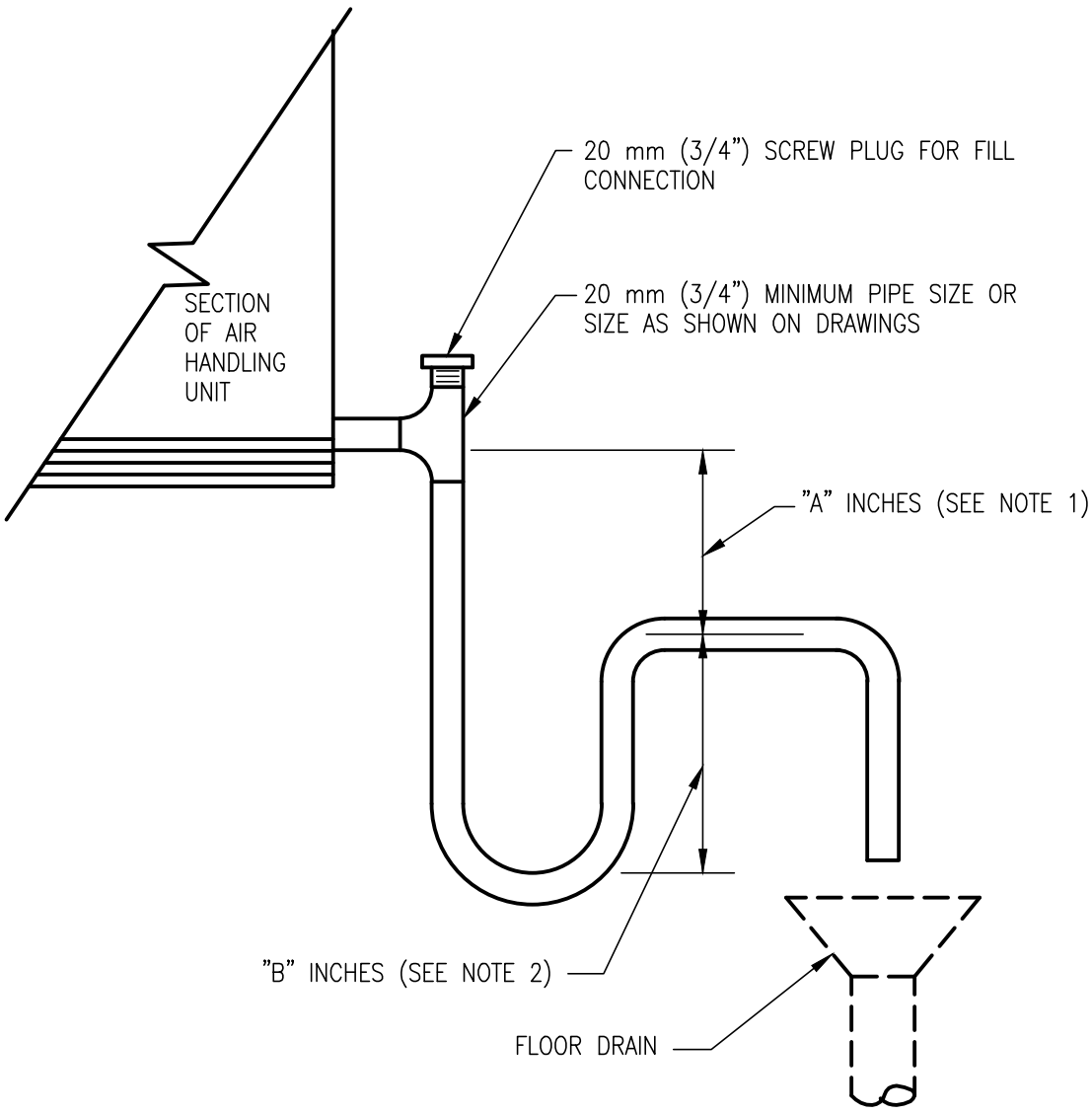




Chorley + Bisset CONSULTING ENGINEERS	TITLE IDENTIFICATION OF PIPING SYSTEMS	DETAIL NO. 001



Chorley + Bisset CONSULTING ENGINEERS	TITLE TYPICAL DETAIL OF MANUAL AIR VENT	DETAIL NO. 002

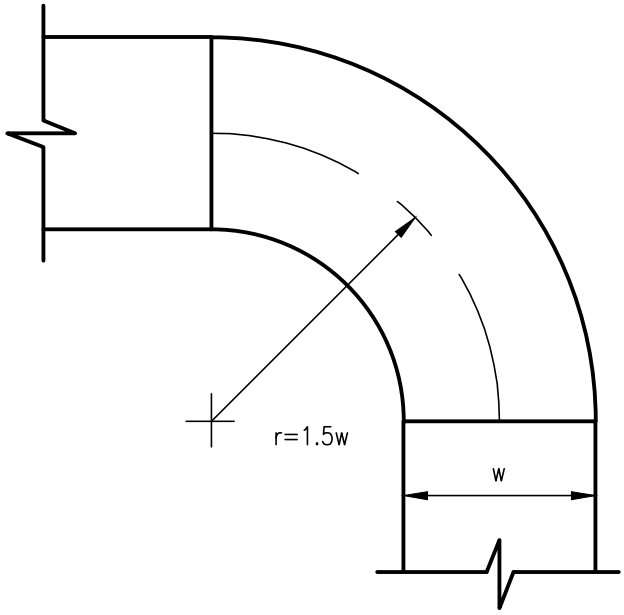


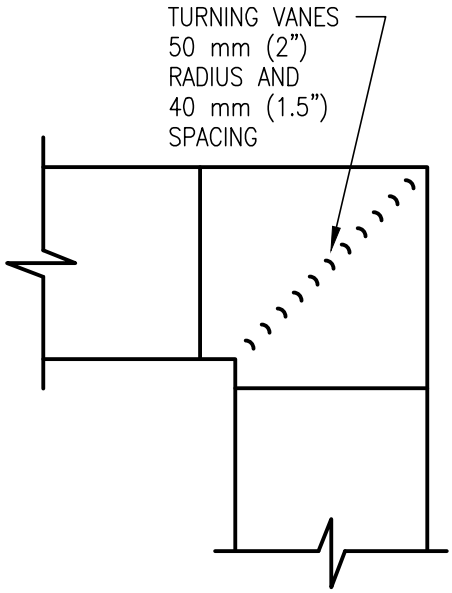
NOTES

1. "A" MUST BE EQUAL TO OR GREATER THAN THE NEGATIVE STATIC PRESSURE INSIDE THE SECTION REQUIRING DRAINAGE DURING NORMAL OPERATING CONDITIONS.(DRAW THROUGH COIL)

2. "B" MUST BE EQUAL TO OR GREATER THAN 1/2 OF THE NEGATIVE STATIC PRESSURE INSIDE THE SECTION REQUIRING DRAINAGE DURING NORMAL OPERATING CONDITIONS.(DRAW THROUGH COIL)
   OR
   "B" MUST BE EQUAL TO OR GREATER THAN THE POSITIVE STATIC PRESSURE INSIDE THE SECTION REQUIRING DRAINAGE DURING NORMAL OPERATING CONDITIONS.(BLOW THROUGH COIL)

Chorley + Bisset CONSULTING ENGINEERS	TITLE: AIR SEAL FOR DRAINS FROM AIR HANDLING EQUIPMENT	DETAIL NO. 003





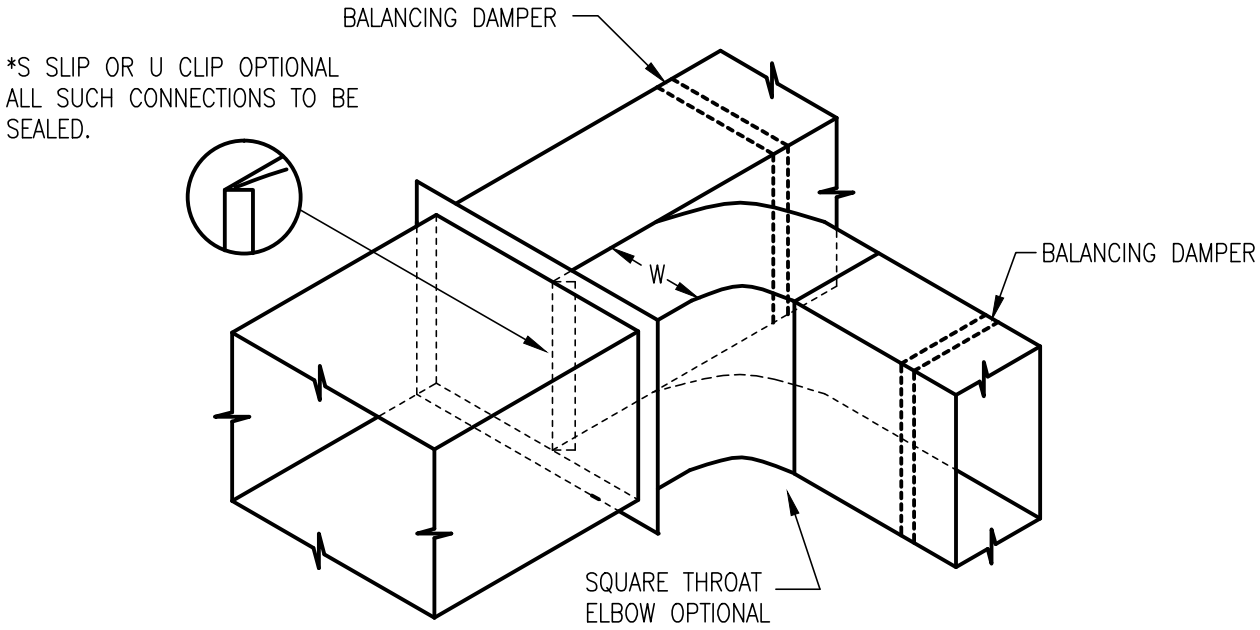
Chorley + Bisset
CONSULTING ENGINEERS

TITLE

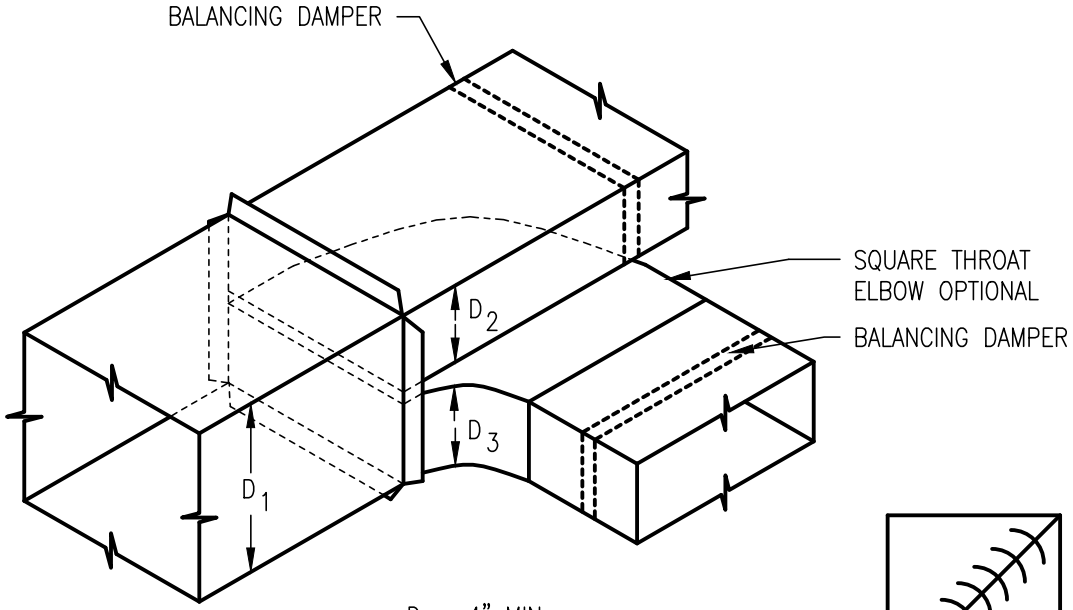
TYPICAL LOW VELOCITY
AIR DUCT TURNS

DETAIL NO.

004



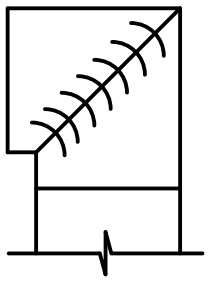
W =4" MIN.



D_2 =4" MIN.

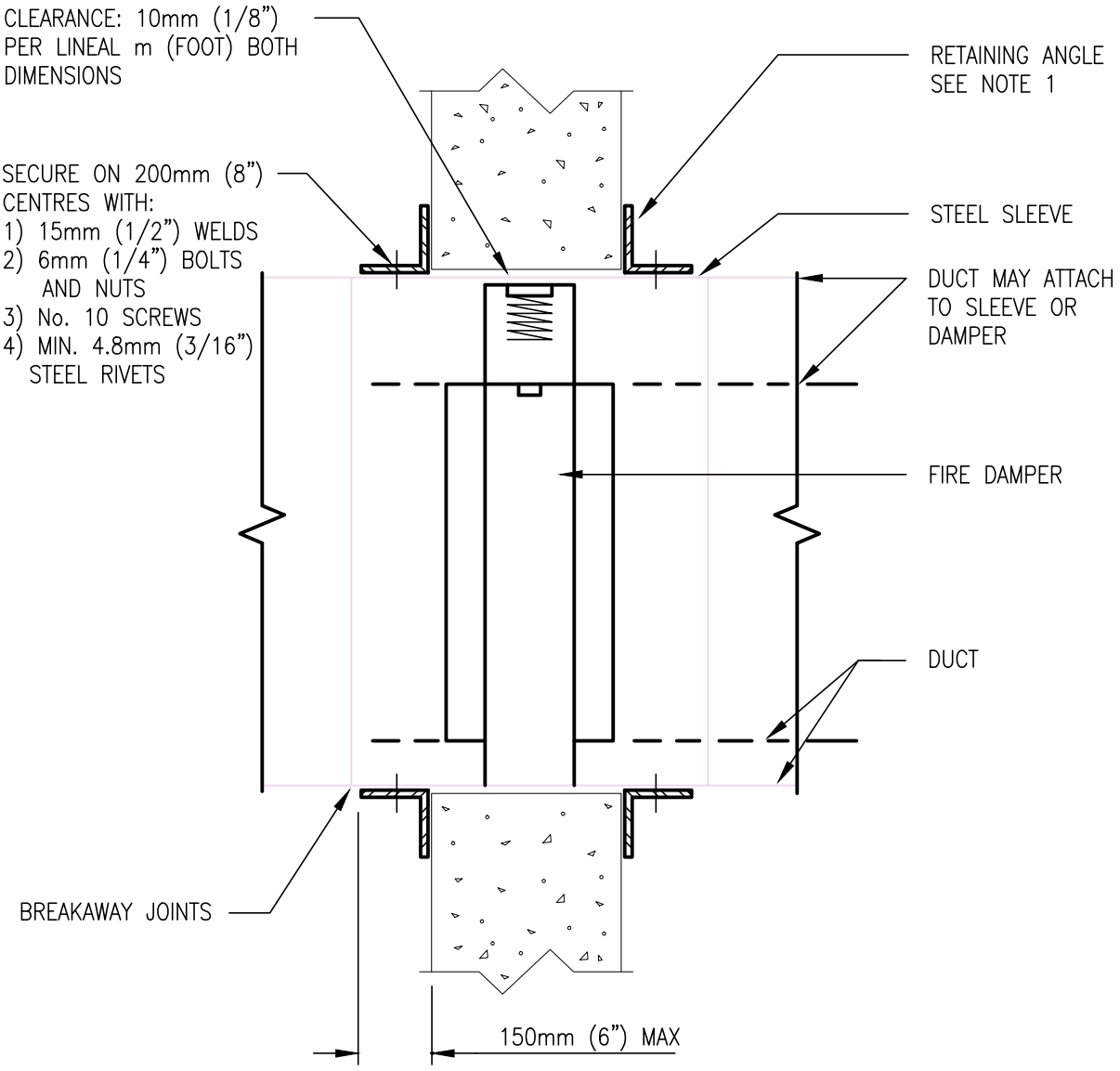
D_3 =4" MIN.

B.D.=BALANCING DAMPER



SQUARE THROAT

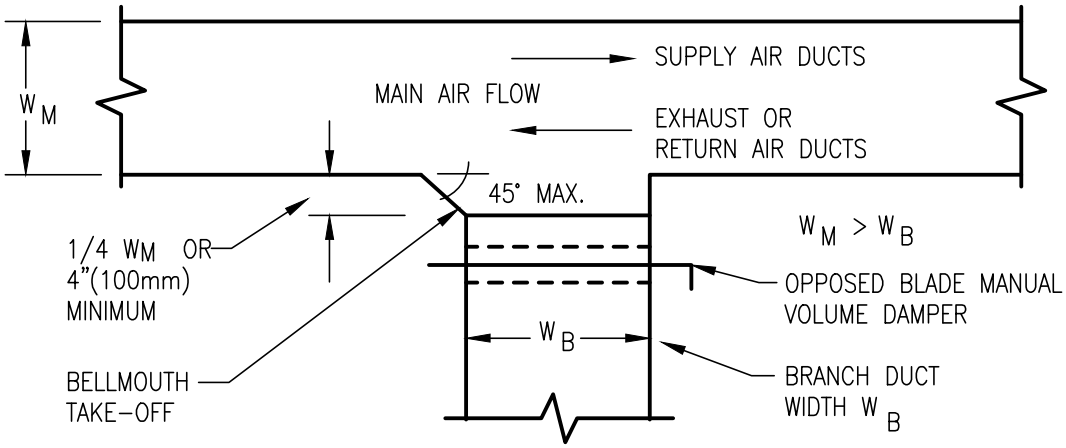
Chorley+Bisset CONSULTING ENGINEERS	TITLE DUCT FITTINGS	DETAIL NO. 005



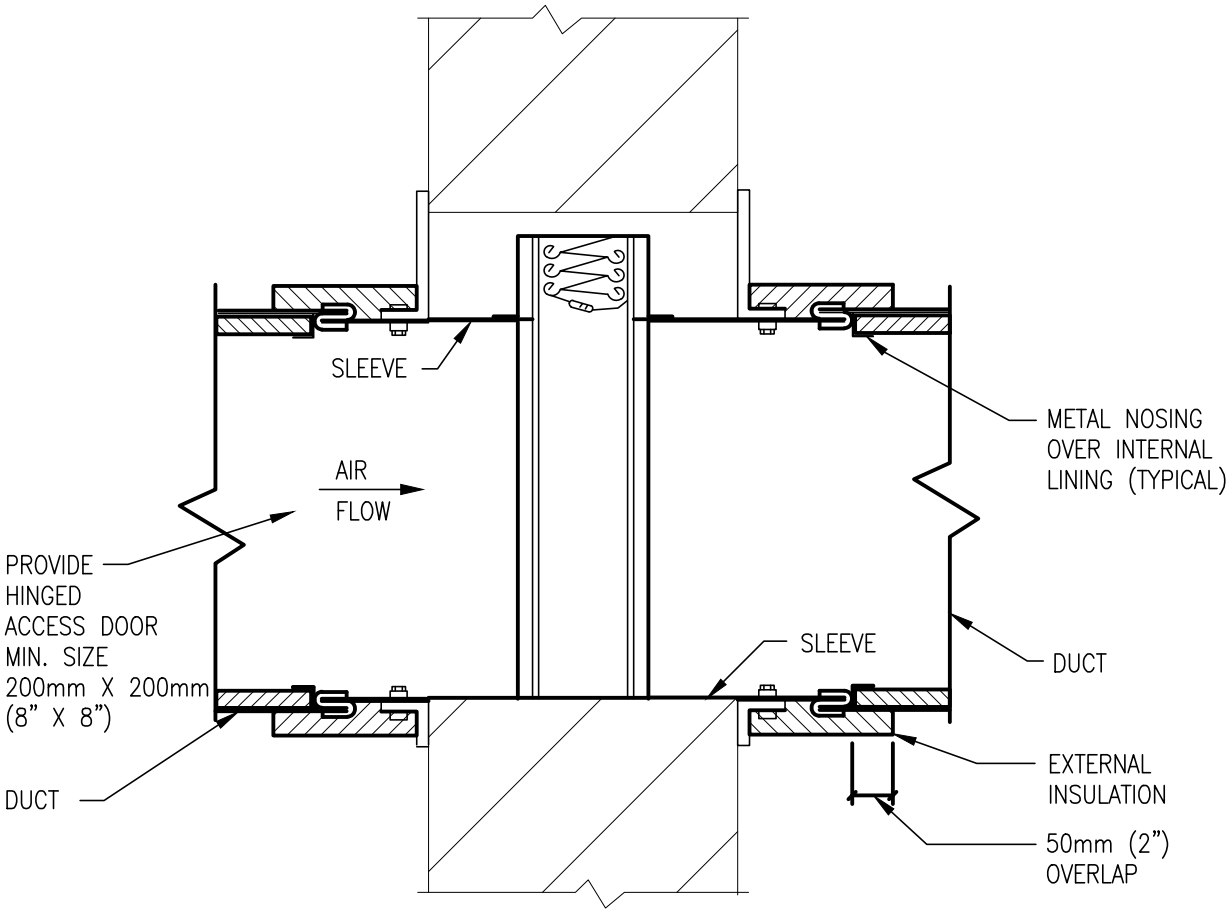
NOTES:

1. RETAINING ANGLES – MINIMUM 40 x 40 x 1.37mm (1 1/2" x 1 1/2" x 0.54" (16 GA)). ANGLES TO OVERLAP STRUCTURE A MINIMUM OF 25mm (1") ALL SIDES.
2. INSTALL ACCESS DOOR. LOCATE ON CORRIDOR SIDE IF POSSIBLE
3. MANUFACTURER U.L. APPROVED INSTALLATION PROCEDURES MUST BE USED IN LIEU OF THE ABOVE DETAILS WHERE APPLICABLE.

Chorley + Bisset CONSULTING ENGINEERS	TITLE VERTICAL FIRE DAMPER INSTALLATION	DETAIL NO. 006



Chorley+Bisset CONSULTING ENGINEERS	TITLE DUCT MAIN AND BRANCH TAKE OFFS	DETAIL NO. 007



Chorley + Bisset CONSULTING ENGINEERS	TITLE DUCT LINER INSTALLATION AT FIRE DAMPER	DETAIL NO. 008

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 15001, “Mechanical General Provisions”.

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1 **Heat Pump Water System**: The existing water source heat pump system will be modified to serve renovated areas.

2 Products

2.1 **GENERAL**

2.1.1 Furnish all test equipment. All equipment will remain the property of the testing and balancing company. Use recently calibrated instruments. Provide verification of calibration to the Consultant when requested.

2.1.2 Approved testing and balancing companies for this project are:

Air Audit Inc., Cambridge
C. J. Zettler & Associates Ltd., London

2.2 **MATERIALS**

2.2.1 Use materials specified herein or approved equal as defined in Section 15001, “Mechanical General Provisions”, Clause “Material and Equipment”.

2.3 **DUCT ACCESS HOLE PLUGS**

2.3.1 Use Duro-Dyne Type IP-4 duct access hole plugs.

3 Execution

3.1 **GENERAL**

3.1.1 Include all labour, engineering and test equipment required to adjust and balance all heating, ventilating, air conditioning and exhaust systems installed or altered under this Contract.

3.1.2 Check rotation of all fans. Advise appropriate trade if any corrections are needed. Ensure corrections are made before starting any testing or balancing.

3.1.3 Ensure that all control valves, devices and equipment interlocks are operating in the manner required for the correct performance of the systems.

3.1.4 Where existing systems are modified, balance the entire system, including terminals in non-renovated areas.

3.1.5 Carry out testing and balancing under both extreme summer and extreme winter conditions. If you wish to simulate these conditions, obtain approval from the Consultant before beginning work.

3.2 **JOB CONDITIONS**

3.2.1 Schedule this work in cooperation with other trades involved.

3.2.2 Do not begin testing and balancing until the systems have been completely installed, tested and put in running order. Correct operation of equipment and system components and cleanliness of piping and ductwork is the responsibility of the appropriate trade.

3.3 **SUBMITTALS**

3.3.1 Record all test data and submit four copies of completed reports to the Consultant. A copy of the final report to be included in each of the Operation and Maintenance Manuals.

3.3.2 Use data sheets which are approved by the Consultant to record measurements. Include schematic diagrams of all systems identifying branches, inlets, outlets and equipment. Submit sample sheets for review using same procedure as for Shop Drawings.

3.3.3 Provide a Deficiency List to the Contractor for all materials and installation methods which are found not to be complying with the Specifications and, where specified, quantities could not be achieved within the required tolerances. Submit copy of Deficiency List to the Consultant at the same time it is issued to the Contractor.

3.3.4 Submit report in hard cover 3-ring binder, complete with index page, indexing tabs and cover identification at front and side.

3.3.5 Record all test data in SI units.

3.4 **AIR SYSTEMS**

3.4.1 Test and adjust fan speeds and dampers to deliver the required air quantities. For belt-driven fans, determine size of sheaves required to properly balance systems and operate systems at minimum static pressures. Install selected sheaves. Sheaves for new equipment will be supplied by fan supplier. For existing equipment supply and install new sheaves, pulleys and belts as required.

3.4.2 **Constant Volume Systems**: Make pitot tube traverse of main supply and return air ducts to measure total air quantities.

3.4.3 Seal duct access holes with plugs. Do not use duct tape to seal access holes.

3.4.4 Test and adjust each diffuser, grille and register to within 10% of design requirements and also adjust so as to minimize drafts in all areas. After locking balancing dampers at desired position, mark “locked” position on damper for reference purposes.

3.4.5 Coordinate with Section 15600, “Liquid Heat Transfer”, to adjust wire taps on heat pump units to give required air quantities. **Where required air quantities fall between heat pump speeds, use higher speed setting rather than lower one.**

3.4.6 Record data as specified in Clause “Balancing Data”.

3.5 **WATER SYSTEMS**

3.5.1 Prior to testing and balancing of these systems:

3.5.1.1 Verify that all new and existing strainers are clean.

3.5.1.2 Check new and existing expansion tanks and ensure that the systems are not air bound and are completely filled with water as required.

3.5.1.3 Check air vents at coils and high points of the systems to verify that all are installed and operating freely.

3.5.1.4 Position all automatic valves, hand valves, and balancing valves for full flow through coils, heat exchangers, heat pumps, individual room heating elements, etc.

3.5.2 Measure and adjust circulating water pump flow capacities to design quantities.

3.5.3 Balance all main branches and terminal equipment where balancing devices are installed. See Piping Schematics for locations. Lock all balancing valves. This includes heat pumps, force flow units and convectors, etc. Balance to within 5% of design requirements.

3.5.4 Mark and record flow readings of balancing devices. Where flow measuring devices are not installed, balance using design temperature differences.

3.5.5 Record data as specified in Clause “Balancing Data”.

3.6 **BALANCING DATA**

3.6.1 Include the following information in the test report:

3.6.1.1 **Motors:**

Manufacturer
Model and/or Serial Number
Rated amperage and voltage
Rated kW (hp)
Rated rpm
Corrected full load amperage
Measured amperage and voltage
Calculated kW (hp)
Measured rpm
Sheave size, type and manufacturer

3.6.1.2 **Fans:**

Manufacturer
Model and/or Serial number
Rated L/s (cfm)
Rated rpm
Rated pressure rise
Measured L/s (cfm)
Measured rpm
Measured pressure rise

Pulley size, type and manufacturer
Belt size and quantity
Performance curve by manufacturer

3.6.1.3 **Air Systems (including inlets and outlets):**

Grille, register or diffuser reference number and manufacturer
Grille, register or diffuser location
Design air quantity
Effective area factor and size
Measured air quantity

3.6.1.4 **Heat Transfer Elements (Coils, Convertors etc.):**

Manufacturer and type
Design inlet and outlet temperatures (air and water side)
Design pressure drop (air and water side)
Measured inlet and outlet temperatures (air and water side)
Measured pressure drop (air and water side)
Measured flow rate (air and water side)

3.6.1.5 **Testing and Balancing Instruments:**

Types
Serial Numbers
Dates of calibration

3.7 **DUCT LEAK TESTING**

3.7.1 Perform leakage testing on representative sections, as selected by the Consultant, involving at least 25% of the duct distribution systems. Include all ductwork types (rectangular, round) and pressure classifications in the leak testing.

3.7.2 Test duct systems to the following SMACNA standards.

Pressure Class	Seal Class	Leakage Class
All	A	6

3.7.3 Refer to Section 15800, Clause “Duct Leak Testing”.

3.7.4 Test ductwork before ducts are insulated painted or concealed.

3.7.5 Immediately advise Contractor of any defects discovered during test. Retest systems after defects have been corrected.

3.8 **FINAL INSPECTION AND ACCEPTANCE**

3.8.1 After submission of balancing report, arrange a final inspection with the Consultant.

3.8.2 At final inspection recheck points or areas selected by the Consultant.

3.8.3 For each system, if more than 10% of the measurements at the selected recheck stations deviate by 10% or more from those in the Report, then the Report for that system will be rejected as unacceptable.

3.8.4 If Report is rejected, re-balance systems deemed to be unacceptable, submit new Reports, and make reinspection at no extra cost to the Owner.

3.8.5 After acceptance of Reports by Consultant, permanently mark settings of valves, splitters, dampers and other adjustment devices so that adjustment can be restored if disturbed. Type of marking and method of application to be approved by the Consultant.

END OF SECTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 15001, “Mechanical General Provisions”.

1.1.2 Under no circumstances may any insulation product containing asbestos fibre be used on this project.

1.1.3 All products used must have a flame spread rating less than 25 and a smoke developed classification not more than 50 when tested in accordance with CAN/ULC-S102-M88.

1.1.4 **Submittals:** Provide shop drawings which include product description, list of materials and thickness for each service and manufacturers' installation instructions.

1.1.5 **Environmental Requirements*:*** Maintain ambient temperature and conditions required by manufacturers of adhesives, mastics and insulation cements.

1.1.6 **Quality Assurance*:*** Insulation materials must be manufactured at facilities certified and registered to ISO 9000 Quality Standard.

1.1.7 **Storage of Materials*:*** Protect materials from dirt, water, chemical and mechanical damage before, during and after installation. Provide and install waterproof sheeting to protect insulation in unfinished areas as required. Remove any damaged materials from the site immediately. Remove and replace at no additional cost any installed materials which are damaged.

1.1.8 **Delivery**: Deliver insulation, coverings, cements, adhesive coatings, etc., to the site in Manufacturer’s original containers with the manufacturer's stamp or label affixed showing flame and smoke ratings of the products, name of manufacturer and brand.

1.2 **DEFINITIONS**

1.2.1 In this Specification, “exposed to view” means all surfaces of all services within Equipment Rooms, Service Corridors, plus all other areas of the building where the services are not enclosed within ceilings or shafts.

1.2.2 In this Specification, “exposed to weather” means all services located outdoors without an architectural enclosure.

1.3 **SHOP DRAWINGS**

1.3.1 Provide shop drawings which include product description, list of materials and thickness for each service and manufacturers' installation instructions.

1.3.2 Submit Shop Drawings in accordance with the Clause “Shop Drawings” in Section 15001 for the following equipment and materials:

- Canvas Covering
- Duct and Piping Insulation Types, noting application for each product
- Finishing Cement
- Lagging Adhesive

- Pipe and Duct Coverings
- Piping Insulation Inserts
- PVC Jackets

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal as defined in Section 15001, “Mechanical General Provisions”, Clause “Material and Equipment”.

2.2 **PIPING INSULATION INSERTS**

2.2.1 Make rigid insulation inserts equal in thickness to the adjoining insulation. Use Johns Manville Thermo 12/Gold hydrous calcium rigid pipe insulation. Minimum width should be equal to 50% of pipe circumference. Use the following insert lengths:

Nominal Pipe Size		Insert Length	
mm	(inches)	mm	(inches)
40 - 65	(1-1/2 - 2-1/2)	250	(10)
80 - 150	(3 - 6)	300	(12)
200 - 250	(8 - 10)	400	(16)

2.3 **PIPING INSULATION INSERT SHIELDS**

2.3.1 Use minimum 18 gauge galvanized metal shields. Form shields to fit insulation and extend up to the pipe centre line. Make length 100 mm (4″) less than length of associated insert.

2.4 **PIPE INSULATION**

2.4.1 **Piping**

2.4.1.1 Use Johns Manville Micro-Lok glass fibre insulation with factory applied AP-T Plus jacket. Jacket to consist of aluminum foil vapour barrier reinforced with fibreglass scrim and laminated to a fire resistant kraft facing.

2.4.1.2 In areas exposed to view, finish with Johns Manville Zeston 2000 PVC 0.51 mm (20 mil) thickness “Cut and Curled” jacketing. Use Zeston “Perma-Weld” solvent welding adhesive to permanently seal all PVC joints. Use white jackets.

2.4.2 **Valves and Fittings**: Insulate valves and fittings with factory precut Johns Manville Hi-Lo temp insulation inserts or Johns Manville Microlite 16 kg/m³ (1 lb/ft^3) density glass fibre insulation. Finish with Johns Manville Zeston 2000 PVC insulated fitting covers 0.51 mm (20 mil) thickness or finishing cement. Use white jackets.

2.4.3 **Pipe Thickness Schedule**

Pipe Insulation Schedule

Fluid Design Operating Temperature Range (°C)	Insulation Conductivity		Nominal Diameter (mm)				
	Conductivity Range W/(m°C)	Mean Rating Temperature (°C)	less than 25	25 to 32	40 to 80	100 & 150	200 & up
Heat Pump Systems							
Below 4	0.033 - 0.039	24	25	40	40	40	40
Domestic Hot Water							
40 & greater	0.035 - 0.040	38	25	25	40	40	40
Domestic Cold Water (Condensate Drains)							
4 - 24	0.033 - 0.039	24	25	25	25	25	25

2.4.4 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause “Material and Equipment”:

CertainTeed
Johns Manville
Knauf
Kooltherm
Manson
Ottawa Fibre
Owens Corning
Roxul

2.5 **AIR DUCTS**

2.5.1 On all round ducts, and on rectangular ducts not exposed to view with both dimensions 610 mm (24″) and smaller, use Johns Manville Microlite Type 75 flexible blanket fibreglass insulation with FSK facing. Product must meet the requirements of ASTM C 1290, and include aluminum foil vapour barrier reinforced with fibreglass scrim and laminated to a fire resistant kraft facing. Maximum thermal conductivity 0.042 W/m°C (0.29 Btu-in/hr^{2}ft2°F) in accordance with ASTM C 518. Use 40 mm (1-1/2″) thickness.

2.5.2 On rectangular ducts exposed to view, and on rectangular ducts not exposed to view with one dimension 660 mm (26″) or larger, use Johns Manville Spin-Glas Type 814 rigid fibreglass insulation board, 48 kg/m3 (3 lb/ft3) density, with FSK facing. Product must meet the requirements of ASTM C 612, and include aluminum foil vapour barrier reinforced with fibreglass scrim and laminated to a fire resistant kraft facing. Maximum thermal conductivity 0.033 W/m°C (0.23 Btu-in/hr^{2}ft2°F) at 24°C (75°F) mean temperature. Use 40 mm (1-1/2″) thickness.

2.5.3 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause “Material and Equipment”:

CertainTeed
Johns Manville
Knauf
Kooltherm
Manson
Ottawa Fibre
Roxul

2.6 **FINISHING CEMENT**

2.6.1 Use Ryder hydraulic setting finishing cement.

2.7 **LAGGING ADHESIVE**

2.7.1 Use white Childers CP-50A HV or Fosters 81-42W water based fire retardant lagging adhesive.

2.8 **CANVAS COVERING**

2.8.1 Use UL listed fabric 220 g/m² (6.5 oz/y^2) fire retardant canvas covering.

3 Execution

3.1 **GENERAL**

3.1.1 Install all insulation in strict accordance with manufacturer's published recommendations.

3.1.2 Install all insulation continuous through walls and sleeves.

3.1.3 Do not apply insulation until piping has been tested and approved.

3.1.4 Do not insulate unions or flanges at connections to equipment. In these locations, and in all other locations where insulation ends, finish with vapour resistant mastic.

3.1.5 Insulate ALL components of insulated systems unless specifically excluded.

3.1.6 Extend all surface finishes to protect all surfaces, ends and raw edges of insulation.

3.1.7 Patch and make good any existing insulation and covering which is damaged during the work of this Contract. Use material of the same quality as existing.

3.2 **FIRESTOPPING**

3.2.1 Where an insulated pipe passes through a fire separation, use only ULC labelled piping insulation in accordance with ULC Listed firestop system being used. See Section 15001, Clause “Firestopping”.

3.2.2 Extend ULC labelled pipe insulation through fire separation and 50 mm beyond fire separation on both sides. Tightly butt joints and wrap with approved joint tape.

3.3 **PIPING SYSTEMS**

3.3.1 **Other Systems**: Insulate the following piping systems in their entirety:

- Heat Pump Water
- Domestic Cold Water (potable, non potable)
- Domestic Hot Water
- Domestic Hot Water Recirculating
- Condensate Drains

3.3.1.1 Use the following Mean Rating Temperatures when selecting insulation thicknesses:

Heat Pump Water	:	4 - 40°C	(40 - 105°F)
Domestic Hot Water	:	60 - 93°C	(141 - 200°F)
Domestic Cold Water	:	4 - 13°C	(40 - 55°F)
Domestic Hot Water Recirculating	:	60 - 93°C	(141 - 200°F)

3.3.2 **Insulation Application**

3.3.2.1 **Hanger Points**: Provide an insulation insert and shield at each hanger point on all systems. On cold lines, vapour seal butt joints on each side of insert.

3.3.2.2 **Pipe**: Apply insulation over clean dry pipe. Butt all joints firmly together. Seal all jackets neatly in place. Wrap butt joints with a minimum 75 mm (3″) wide strip of the jacketing material. Use a vapour barrier adhesive on all "cold" lines. Finish with specified jackets in all areas where piping is exposed to view.

3.3.2.3 **Fittings and Valves**

3.3.2.3.1 For pipe sizes 40 mm (1-1/2″) and smaller, insulate with factory precut insulation inserts or with fibreglass blanket wrapped firmly under compression (minimum 2:1) to a thickness matching adjoining insulation. Finish with PVC fitting covers. In areas where insulation is not exposed to view, insulation ends may be mitred at elbows and sealed with tape.

3.3.2.3.2 For pipe sizes 50 mm (2″) and larger, insulate with factory precut insulation inserts. Finish with PVC fitting covers. In areas where insulation is not exposed to view, insulation ends may be mitred at elbows and sealed with tape.

3.3.2.3.3 **Cold Systems and Dual Temperature Systems**: Provide a continuous vapour barrier on the insulation for the following systems:

- heat pump water
- domestic cold water (potable, non potable)
- condensate drains

3.3.2.3.4 On components which require service, fabricate easily removable and reusable insulation sections e.g. suction guides for circulating pumps and pump casings. Test ports on balancing valves to be accessible outside of insulation.

3.3.3 **Pipe Insulation Covering**: In all locations where the insulation will be exposed to view, finish with PVC insulation covering. Use solvent welding adhesive to permanently seal all PVC joints. Taping or tacking of jackets will not be accepted. Follow strictly manufacturer's installation procedures for cold and hot systems. In Public spaces, use white covering.

3.4 **AIR DUCTS**

3.4.1 **General**

3.4.1.1 Seal all vapour retardant jacket seams and penetrations with UL Listed tape and adhesive.

3.4.1.2 See Section 15800, “Air Distribution”, for internal duct insulation. Where ducts are shown on the drawings to be internally lined, external duct insulation is not required.

3.4.1.3 Externally insulate all ductwork specifically identified on the Drawings.

3.4.1.4 Externally insulate all heat pump and other supply air ducts not located in return air plenums (i.e. located over washrooms, change rooms, etc.). External insulation is not required for sections of ductwork shown to have internal lining.

3.4.1.5 Externally insulate the first 1.5 m (5′) of all supply, return and exhaust ductwork adjacent to outside walls or roof.

3.4.1.6 Externally insulate fire damper sleeve assemblies where duct system is internally lined. See Detail Sheet in Section 15001.

3.4.2 **Application**

3.4.2.1 On round ducts adhere insulation to ducts with a flame resistant, quick tacking adhesive. Apply adhesive in 100 mm (4″) wide strips at 200 mm (8″) centres. Butt all circumferential joints and overlap all longitudinal joints a minimum 50 mm (2″). Staple all joints on 150 mm (6″) centres. Tape all joints with minimum 76 mm (3″) wide reinforced vapour barrier tape as recommended by insulation manufacturer.

3.4.2.2 On rectangular ducts, use adhesive and impale insulation over mechanical fasteners. Provide 100% coverage of adhesive on sheet metal, all exposed insulation edges, and all transverse joints. Provide mechanical fasteners per Insulation Manufacturer's published recommendations. Insulate behind duct balancing damper operators.

3.4.3 **Finish**

3.4.3.1 In locations where the insulation will be exposed to view, finish with canvas for rectangular ducts, and white PVC jackets for round ducts. Securely paste canvas on with a two coat application of lagging adhesive over the entire surface. Apply canvas between coats of adhesive, while first coat is still wet. Stretch canvas tight and smooth with overlapping seams located where least visible. Apply second coat of adhesive immediately following application of canvas. Do not use metal bands. For PVC jackets follow instructions for piping system jacketing.

3.4.3.2 Seal canvas with off-white sizing to leave a smooth non-porous surface ready to receive paint application.

3.4.3.3 Self adhesive aluminum covering will be acceptable in lieu of canvas. Follow manufacturer's installation recommendations.

END OF SECTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 15001, “Mechanical General Provisions”.

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1 **Fire Extinguishers**: Provide portable fire extinguishers meeting all requirements of the Ontario Building Code and the Ontario Fire Code.

1.2.2 **Sprinkler System:** Extend the existing sprinkler system to completely protect the renovated area of the Building, as shown on the Drawings. Design the system in accordance with the requirements of NFPA No.13, the Ontario Building Code and Factory Mutual. Follow Factory Mutual guidelines for Occupancy Hazard Classification and water flow rate requirements.

1.3 **SHOP DRAWINGS**

1.3.1 Submit Shop Drawings in accordance with the Clause “Shop Drawings” in Section 15001 for the following equipment and materials:

- Fire Extinguishers and Cabinets
- Sprinkler Heads

1.3.2 See requirements for Design Drawings in Part 3 of this Section.

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal as defined in Section 15001, “Mechanical General Provisions” Clause “Materials and Equipment”.

2.1.2 Use only material and equipment which is Underwriters' Laboratories of Canada Listed and Factory Mutual approved for the application intended.

2.2 **PIPE AND FITTINGS**

2.2.1 Unless specified otherwise, use standard black steel pipe with screwed or flanged cast iron sprinkler fittings suitable for 1200 kPa (175 psig) pressure, cold water, non-shock. Use screwed or flanged type joints between pipe and fittings or valves. Mechanical type Victaulic or Gruvlok couplings, Canadian Underwriter's Listed and Factory Mutual approved, may be used. Ensure wall thickness of pipe is in accordance with NFPA No. 13 for the type of connections used.

2.3 **FIRE EXTINGUISHERS AND CABINETS**

2.3.1 Use National Fire Equipment Ltd. Model No. ABC-5, 2.3 kg (5 lb) multi-purpose dry chemical extinguishers with a rating of 2A10BC. Provide complete with wall brackets.

2.3.2 In cooking areas and Kitchens without automatic fire suppression systems, use National Fire Equipment Ltd. Model No. PDC-050WWD 5 lb. dry chemical extinguisher with a rating of 10BC.

2.3.3 The following manufacturer of the above equipment will be considered equal subject to requirements of Clause “Material and Equipment”:

Wilson & Cousins

2.4 **SPRINKLER HEADS**

2.4.1 Use ULC listed Tyco quick response sprinkler heads as follows:

- Model RFII concealed sprinkler with white finish in all areas with suspended ceilings, unless shown or noted otherwise
- Upright sprinkler, chrome finish in all areas without suspended ceilings, unless shown or noted otherwise
- Pendant or upright sprinkler, rough bronze finish, guard, in mechanical and electrical rooms without suspended ceilings only (corrosion resistant where noted)

2.4.2 Use wire sprinkler guards with baked synthetic red enamel finish where shown on the Drawings.

2.4.3 Provide Tyco Sprinkler Cabinets with spare sprinklers and accessories. Use minimum 0.9 mm thick (20 gauge) steel cabinets finished in red lacquer and suitably labelled. Cabinets to contain:

- Spare sprinklers of each type per NFPA 13

2.4.4 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

Grinnell Fire Protection Systems
Reliable Automatic Sprinkler Co.
Tyco Fire and Building Products
Viking Corp.

3 Execution

3.1 **INSTALLATION**

3.1.1 **Sprinkler System**: Provide complete system extension designed, constructed, installed and tested in accordance with NFPA 13, Factory Mutual and the Ontario Building Code.

3.2 **WATER SERVICE**

3.2.1 Existing shop drawings will be available from the Owner upon request.

3.3 DRAWINGS

3.3.1 The Fire Protection Drawings show sprinkler types and locations, main piping layouts and zoning. Use this information as a basis to produce a set of Fabrication Drawings for a sprinkler system which will completely protect all of the building areas. Coordinate the preparation of these Drawings with all other trades to avoid conflict with other services.

3.3.2 Sprinkler systems are to be designed by a Fire Protection Engineer using hydraulic calculations. Engage an Engineer registered with Professional Engineers Ontario who specializes in Fire Protection Engineering and is both qualified and insured in accordance with the requirements of Division C of the 2006 OBC. The Fire Protection Engineer will apply his or her seal to all Fire Protection Drawings prepared for construction. Submit Engineer's proof of liability insurance with Shop Drawings.

3.3.3 The Fire Protection Engineer is to size all piping and indicate sprinkler head and pipe locations on working Drawings. Sprinkler head locations and quantities shown in the Bid Documents are for general layout purposes only, to identify approximate locations and quantities and sprinkler head types to be used. The Contractor is responsible for determining exact locations and quantities of sprinkler heads. Piping locations are shown where critical only. The Contractor is responsible for determining exact locations for piping.

3.3.4 Piping is to be sized to suit available pressure from the city water main without use of a fire pump. Use low pressure requirement sprinkler heads where required.

3.3.5 Provide sufficient number of sprinkler heads, whether shown on the drawings or not, to achieve coverage as required by NFPA 13 and Factory Mutual.

3.3.6 Prepare the Drawings in AutoCAD 2010. Show sprinkler heads on Architectural Reflected Ceiling Plans. Architect will provide AutoCAD drawing files for overlays.

3.3.7 Before starting installation, submit six copies of Fabrication Drawings and Hydraulic Calculations to Factory Mutual for approval. Submit copies of Drawings, duly approved by the Owner's Insurance Underwriters, to the Consultant for final review prior to commencing work. Submit two copies to local Building Department for plan review.

3.3.8 Use sprinkler heads, piping and fittings suitable for the temperature of the environment (e.g. extremes of hot or cold, humidity). Use high temperature heads in Mechanical and Electrical Rooms.

3.4 DRAINS, AIR VENTS AND TEST CONNECTIONS

3.4.1 Provide drain cocks with hose thread at all low points of the system not drainable through the main drain valve at service entrance. Provide air vents, flushing and test connections as required to comply with Canadian Underwriters' regulations.

3.5 COOPERATION

3.5.1 Cooperate with other trades on the job and so arrange work that no delay is caused to any other trade. Examine all Drawings paying particular attention to lighting fixtures, structural steel, heating and plumbing piping, ductwork and electrical conduit, so that the installation of the sprinkler system will not interfere with other

work.

3.6 **IDENTIFICATION**

3.6.1 Provide every valve with a tag indicating its purpose (i.e. sprinkler drain valve, sprinkler test valve and sprinkler control valve. This is in addition to the tag required for the valve chart. Securely fasten tags to the valves so they are not easily removed.

3.7 **SPRINKLER GUARDS**

3.7.1 Provide guards where specifically identified on drawings.

3.8 **TESTING**

3.8.1 Test complete system in accordance with Underwriters' Laboratories of Canada and Factory Mutual requirements. Notify the Consultant 48 hours prior to testing of all fire protection systems so arrangements can be made to have these tests witnessed.

3.8.2 Test the operation of every valve supervisory device, flow alarm switch and pressure switch.

3.9 **SYSTEM FLUSHING**

3.9.1 Flush the complete sprinkler systems after installation.

3.10 **FIRE EXTINGUISHERS**

3.10.1 Install fire extinguishers in accordance with the manufacturer's recommendations.

3.11 **SPACING OF SPRINKLERS**

3.11.1 Sprinkler heads must be centred **both** ways in ceiling tiles.

3.12 **EXPOSED AREAS**

3.12.1 In all areas exposed to view, provide a decorative grade installation. Pay particular attention to neat pipe layout. Degrease all pipe and fittings, to be suitable for painting. Chrome plate all exposed piping serving window sprinklers.

END OF SECTION

INDEX - SECTION 15400

PART 1 - GENERAL

PART 2 - PRODUCTS

PART 3 - EXECUTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 15001, “Mechanical General Provisions”.

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1 **Domestic Cold Water**: Extend system complete with connections to fixtures and equipment requiring cold water connections as shown and/or as specified.

1.2.2 **Domestic Hot Water**: Extend system complete with connections to fixtures and equipment requiring hot water connections as shown and/or as specified.

1.2.3 **Sanitary Drainage**: Extend soil and waste drainage system complete with connections to fixtures and equipment as shown and/or as specified.

1.2.4 **Condensate Drainage**: Provide indirect condensate drainage system complete with connections to fixtures and equipment as shown and/or as specified.

1.3 **SHOP DRAWINGS**

1.3.1 Submit Shop Drawings in accordance with Section 15001, “Shop Drawings” for the following equipment and materials:

- Cleanouts
- Floor Drains
- Plumbing Fixtures
- Shock Absorbers
- Trap Seal Valves
- Valves

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal as defined in Section 15001, “Mechanical General Provisions” Clause “Material and Equipment”.

2.2 **PIPE AND FITTINGS**

2.2.1 Select the most economical use of the materials named below. Unless specified or shown otherwise, either material may be used or a combination of materials, whichever provides the greatest economy.

2.2.2 For all piping systems, use only solder and fluxes containing no lead.

2.2.3 **Sanitary Drainage Piping (Including Vent Piping)**: Use cast iron Class 4000 with cast iron fittings and mechanical joints, or copper type DWV to ASTM B306 with cast or wrought copper fittings and soldered joints. For below grade sanitary piping, use PVC pipe and fittings in accordance with ASTM Standard D3034 and CSA B182.1.

2.2.4 **Condensate Drainage Piping**: Use copper Type DWV to ASTM B306 with cast or wrought copper fittings and soldered joints.

2.2.5 **Domestic Water Piping (Hot, Cold, Recirc.)**: Copper, Type "L" with soldered joints and wrought copper fittings. For below grade piping only use Wirsbo Aquapex or Rehau or copper tubing in a PVC sleeve.

2.3 **CLEANOUTS**

2.3.1 Standard TY branch or Y branch and bend, Watts Bolted Cover Cleanout No. CO-450-50. For stack cleanouts, use Watts Ancon No. CO-460 Series complete with "S" Series satin bronze wall access cover and gasketed plug.

2.3.2 Use cleanouts of the same size as drainage pipe on piping up to 100 mm (4″) diameter, not less than 100 mm (4″) on size 150 mm (6″) and 200 mm (8″), and not less than 150 mm (6″) on larger size pipe. No aluminum components will be permitted.

2.3.3 In floor with vinyl or similar finish, use Watts CO-200-T-1-34 inlay type cleanout with round recessed nickel bronze hinged access cover and frame and secondary closure plug.

2.3.4 In concrete floors, use Watts CO-200-RX-50-34 floor level type cleanout with secondary closure plug and XH CI cover.

2.3.5 In carpeted floors, use Watts CO-100-RC-1-34 with secondary closure plug and round nickel bronze access cover, with carpet marker.

2.3.6 In quarry tile floors, use Watts CO-200-S-1-34 square nickel bronze access cover with clear epoxy coating.

2.3.7 In terrazzo floors use Watts CO-200-U-1-34 square nickel bronze access cover with closure plug and clear epoxy coating.

2.3.8 Provide CO-100 bodies and membrane clamps where cleanouts are installed in floors with membranes. Use Watts CO-100-C-RFC-7-1-34 in floors with surface membrane.

2.3.9 Use clear epoxy coating on all nickel bronze finishes.

2.3.10. The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

Enpoco
Jay R. Smith
Mifab
Zurn

2.4 **FLOOR DRAINS**

2.4.1 **General**: Use floor drains equipped with trap primer tappings. No aluminum components will be permitted. Provide flashing clamps on all drains installed in floors with membranes.

2.4.2 **All Finished Areas Not Specifically Designated**: Watts Ancon FD-200-5-1 cast iron floor drain with XH, adjustable 140 mm (5-1/2″) diameter Type NB, heavy duty nickel bronze strainer with clear epoxy coating. Provide separate cast iron "P" trap.

2.4.3 **Funnel Floor Drains in Millwork (Drawing Reference FFD)**: Watts Ancon FD-200-EF-1 cast iron floor drain with adjustable heavy duty cast iron grate. Provide separate cast iron “P” trap and Type NB, 100 mm (4″) round funnel.

2.4.4 **Funnel Floor Drains in Unfinished Floor (Drawing Reference FFD)**: Watts Ancon FD-300-G-50 cast iron floor drain with adjustable heavy duty cast iron grate. Provide separate cast iron “P” trap and Type CI, 100 mm x 230 mm (4″ x 9″) oval funnel.

2.4.5 In floors with surface membrane, use Watts Ancon FD-100-C-FC7-1 with strainer and surface membrane clamp.

2.4.6 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

Enpoco
Jay R. Smith
Mifab
Zurn

2.5 **VALVES**

2.5.1 Use valves of same manufacturer except where approved otherwise by the Consultant.

2.5.2 Use the following valves for all piping systems provided by this Section, unless specified otherwise. Use rising stem where space permits. Use flanged, screwed or solder ends to suit pipe lines, and non-heating malleable iron handles.

2.5.3 Use only industrial class valves complying with ANSI, ASTM, ASME and applicable MSS Standards.

2.5.4 Unless otherwise specified, use valves designed for 1380 kPa (200 psig) CWP (cold working pressure) minimum. Use rising stem where space permits. Use flanged, screwed, or soldered ends to suit pipe lines, and non-heating malleable iron handles. Use valves which are repackable under pressure. Use valves with extended valve stems where piping is to be insulated.

2.5.5 All valves must have a valid and current Canadian Registry Number (CRN).

2.5.6 All new valves and fittings to be lead free to meet California Standard AB1953 for Lead Free Plumbing Fixtures with lead content below 0.25%.

2.5.7 **Domestic Water Systems**

2.5.7.1 **Ball Valves**: For sizes 50 mm (2") and under, use 1034 kPa (150 psig) / 600 W.O.G., Brass Body to ASTM C49300 (Lead Free Brass), Full Port, PTFE Seats, Double "O" Ring or Teflon packing, TEA Plated Forged Brass C49300 Vented Solid Ball, Blowout Proof Stem, Lever Handle.

Screwed Ends - Kitz 858
Solder Ends - Kitz 859

2.5.7.2 **Drain Hose Connections**: Use Kitz 68C bronze body ball valve, 4140 kPa (600 psig) CWP complete with brass threaded cap and chain.

2.5.8 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause "Material and Equipment":

Jenkins	(Industrial Class)
Kitz	(Industrial Class)
Nibco	(Industrial Class)

2.6 SHOCK ABSORBERS

2.6.1 Provide Ancon SG Series or P.P.P. SC Series shock absorbers ahead of all solenoid valves, flush valves, or other quick-closing valves. Provide in other locations where shown on Drawings.

2.6.2 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

Jay R. Smith
P.P.P.
Mifab
Zurn

2.7 ESCUTCHEON PLATES

2.7.1 Provide one piece, brushed aluminum escutcheon plates at all points where pipes pass through walls, floors or ceilings into finished areas.

2.8 TRAP SEAL VALVES

2.8.1 PPP, P Series trap primer valves. Provide chrome plated finish In exposed locations.

2.8.2 Proset trap guard drain inserts may be used in lieu of trap seal valves.

2.8.3 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

Jay R. Smith
Zurn

2.9 PLUMBING FIXTURES

2.9.1 General

2.9.1.1 Use only first quality fixtures. Warped or distorted fixtures will not be accepted. Use fixtures of a single manufacturer only where possible. Likewise use a single manufacturer for faucets, supplies and drains.

2.9.1.2 All plumbing fixtures and faucets to meet California Standard AB1953 for Lead Free plumbing fixtures, with lead content below 0.25%.

2.9.1.3 Use only new plumbing fixtures, certified by CAN/CSA-B45.0 and closet seats, fittings and trim, certified by CAN/CSA B125, and free from cracks, scratches, wrench marks, or imperfections of any kind. Replace any permanently stained, chipped or marred fixtures or connections.

2.9.1.4 Use factory chrome plated items for all visible parts of the fixture trim including faucets, escutcheons, waste, strainers, traps, supplies, stops, etc.

2.9.1.5 Unless specified otherwise, the following manufacturers of the above equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

- Plumbing Brass - Delta Commercial, Chicago Faucets
- Stainless Steel Sinks - Franke/Kindred Canada, Architectural Metal Industries

2.9.2 **Single Compartment Sink (Drawing Reference SS1)**

2.9.2.1 **Sink**: Franke Kindred Commercial LBS6808, 521 mm x 508 mm x 203 mm (20″ x 20-1/2″ x 8″) 20 gauge, Type 302 stainless steel single bowl countertop sink, with backledge drilled for 200 mm (8″) centre faucet set. Sink complete with 90 mm (3-1/2″) crumb cup strainer and 40 mm (1-1/2″) tailpiece, self-rimming with gasket and hold down clamps.

2.9.2.2 **Faucet**: Chicago Faucets Ecast 1100-GN8AVPA-369CP deck mounted faucet, chrome plated, 200 mm (8″) centres, solid cast brass lead-free body, 1/4 turn ceramic disc valve cartridges, 200 mm (8″) cast brass rigid gooseneck spout with 8 lpm (2.2 gpm) flow aerator outlet and cast brass lever handles. Provide stops on supply piping and wall escutcheons.

2.9.1.6 **Waste**: Cast brass P trap, 40 mm (1-1/2″), with unions, cleanout and escutcheon.

3 Execution

3.1 **SANITARY PIPING**

3.1.1 Where pipe sizes are not shown on the Drawings and are not specified, size in accordance with the requirements of the Ontario Plumbing Code.

3.1.2 Install piping and connect to, or rough-in for, all fixtures as shown or as specified. Conceal piping in walls or ceilings in finished areas. Where sewers pass under footings, backfill with lean concrete.

3.1.3 Use the following minimum slopes on horizontal drains, unless indicated otherwise on the Drawings:

Fixture waste or drains	2%
Drains up to and including 80 mm (3″)	2%
Drains 100 mm (4″) and up to 150 mm (6″)	1%
Drains over 150 mm (6″)	0.5%

3.2 **UNIT DRAIN CONNECTIONS**

3.2.1 Connect up all drains, condensate drains from heat pumps. Run drains to funnel floor drains or open hub drains without crossing or interfering with walkways.

3.3 **VENTING**

3.3.1 Vent all fixtures in accordance with local and provincial regulations. Run vents as directly as possible and grade properly to drain back to the fixture connection. Connect the bottom of all vent stacks into soil or waste stacks for drainage. Conceal vents in walls and ceilings in finished areas. Carry vent stacks through roof where shown or where required and project at least 600 mm (24″) above roof deck.

3.4 **FLASHING**

3.4.1 Carry vent, waste and soil stacks through roof where shown on Drawings or where required. Use materials specified in Section 15001 and make a watertight joint at roof. Supply all flashing materials.

3.5 **CLEANOUTS**

3.5.1 Install cleanouts behind walls so that the bolted cover on the cleanout will be within 25 mm (1″) of the finished wall. Wall cleanout access doors to be installed minimum 200 mm (8″) above finished floor.

3.5.2 Conceal cleanouts in finished walls with access doors. See Section 15001 “Mechanical General Provisions” for access doors.

3.5.3 Place cleanouts where shown, at end of all drainage lines, at all changes of direction greater than 45°, and at the base of all stacks.

3.5.4 Bring cleanouts up to floor level in all buried pipe and in all horizontal runs above grade where specifically shown. For all other cleanouts in horizontal runs above grade, leave with access from ceiling space. Bring cleanouts in concealed vertical pipes to a wall surface.

3.5.5 Locate floor cleanouts clear of fixed furniture and equipment. In corridors, locate cleanouts near walls but clear of wall base.

3.6 **WATER PIPING**

3.6.1 Connect required service to plumbing fixtures, hose bibbs, etc., as shown or as specified.

3.6.2 After installation, thoroughly flush out complete system of water piping and remove all scale, etc.

3.7 **VALVES**

3.7.1 Install a valve at takeoff point in each main branch which takes off from main and in all locations shown.

3.7.2 Install drain valves with hose connections at all low points and at all branch valves for upfeed risers.

3.7.3 Use line size ball valves unless noted otherwise.

3.8 **PLUMBING FIXTURES**

3.8.1 Provide compression type shutoff valves or ball valves at each fixture in addition to the faucets on each fixture. For countertop sinks, use ball valves.

3.8.2 Where fixture connections pass into walls, floors, or ceilings, provide proper escutcheons.

3.8.3 When installing accessories, take great care to avoid marring chrome plating. Wrench or other tool marks on the plating will be sufficient cause for rejection.

3.8.4 Unless shown otherwise, use the following sizes of hot and cold water and waste connections to fixtures:

Fixture mm (in)	Hot Water mm (in)	Cold Water mm (in)	Waste mm (in)
Sink	15 (1/2)	15 (1/2)	32 (1-1/4)

3.8.5 Confirm all mounting heights with Architect prior to roughing in.

3.9 **VACUUM BREAKERS AND BACKFLOW PREVENTERS**

3.9.1 Provide vacuum breakers and backflow preventers on all plumbing fixtures and equipment where required by Ontario Plumbing Code.

3.9.2 Size vacuum breaker to suit maximum design flow rates of fixture or equipment served.

3.9.3 Install backflow preventers in accordance with CAN/CSA-B64.10, Manual for the Selection, Maintenance and Field Testing of Backflow Prevention Devices, including mounting height and clearance recommendations.

3.10 **ROUGHING-IN**

3.10.1 Where shown on Drawings, rough-in hot and cold water systems, drain and vent.

3.10.2 Cap off all piping and provide shutoff valves on hot and cold water branch piping.

3.11 **STERILIZATION OF POTABLE WATER SYSTEMS**

3.11.1 All chlorination and sampling must be completed and tested by a person holding a Water Distribution Licence Class 1 thru 4 and sampling submitted to an accredited laboratory. Provide certified reports.

3.11.2 Thoroughly flush the domestic hot and cold water piping systems using clean potable water to remove dirt and other contaminants. Remove all faucet screens prior to flushing and reinstall after completion of flushing.

3.11.3 Disinfect domestic hot and cold water piping systems using a liquid chlorine solution. Introduce the liquid chlorine to ensure the chlorine is distributed throughout the sections being tested. Apply chlorine to a achieve a minimum chlorine concentration of 10 mg/L throughout the sections being tested. Leave the 10 mg/L chlorine solution in place for 24 hours.

3.11.4 Test the chlorine residual after 24 hours. If tests show a minimum chlorine residual of 5 mg/L, flush the disinfected sections and recharge with potable water. If the chlorine residual is found to be less than 5 mg/L, repeat the disinfecting procedure until satisfactory results are obtained.

3.11.5 After the systems have been flushed and recharged with potable water, arrange and pay for bacteriological tests to be conducted by an independent testing agency. Provide certified reports. If there is evidence of contamination, repeat the disinfecting procedure until satisfactory results are obtained. Obtain the Building Inspector's permission before placing the systems in normal operation.

END OF SECTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 15001, “Mechanical General Provisions”.

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1 **Heat Pump Water System**: The existing water source heat pump system will be modified to serve a relocated heat pump.

1.3 **SHOP DRAWINGS**

1.3.1 Submit Shop Drawings in accordance with Section 15001, Clause “Shop Drawings”, for the following equipment and materials:

- Air Vents
- Valves

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal as defined in Section 15001, “Mechanical General Provisions” Clause “Material and Equipment”.

2.2 **PIPING AND FITTINGS**

2.2.1 **General**

2.2.1.1 Use the following materials for all piping systems provided by this Section.

2.2.1.2 Use long radius elbows. Where the mains are 100 mm (4″) diameter or greater and where branches are smaller by two pipe sizes or more, cut-ins will be permitted. For all other branch connections, use manufactured tees.

2.2.1.3 For flanged connections use stainless steel spiral wound graphite gaskets and high tensile strength bolts, nuts and washers. Use welding neck, RF flanges.

2.2.2 **Water Piping for Sizes 50 mm (2″) and Smaller**. Use either copper or steel pipe as follows:

2.2.2.1 **Copper**

Pipe - Type L hard drawn copper
Joints - Solder
Fittings - Wrought copper or cast bronze
Unions - 1030 kPa (150 psig) octagon end, bronze

2.2.2.2 **Steel**

Pipe - Black steel, Schedule 40, ASTM A-53B
Joints - Screwed
Fittings - 860 kPa (125 psig) cast iron
Unions - 1030 kPa (150 psig) malleable iron, brass to iron ground joint seat

2.2.3 **Water Piping for Sizes 65 mm (2-1/2″) and Larger:**

Pipe - Black steel, Schedule 40, ASTM A-53B
Joints - Welded and flanged
Fittings - 1030 kPa (150 psig) Schedule 40 steel
Unions - 1030 kPa (150 psig) slip-on

2.3 **VALVES**

2.3.1 **General**

2.3.1.1 Use the following valves for all piping systems provided by this Section, unless specified otherwise.

2.3.1.2 Use only industrial class valves complying with MSS Specification SP-80.

2.3.1.3 All valves supplied for this project shall have a current and valid Canadian Registration Number for the Province of Ontario with TSSA. Upon request, suppliers shall provide a copy of statutory declaration for valves, stamped, signed and dated by TSSA as validation of the CRN registration.

2.3.1.4 All valves to have extended locking handles complying with MSS Specification SP-80.

2.3.2 **Ball Valves**

2.3.2.1 Kitz 68/69, bronze body, full port (CGA approved) with stainless steel ball and stem. Use valves with extension stems when installed in insulated piping. Use locking lever handle where “lockable valve” is noted on the Drawings.

2.3.2.2 The following manufacturers of the above two items of equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

Jenkins
Kitz
Nibco

2.3.3 **Drain Hose Connections**

2.3.3.1 Full port, bronze body ball valves with stainless steel stems and ball – Kitz 68 with brass hose adaptor, cap and chain.

2.3.3.2 The following manufacturers of the above item of equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

Jenkins
Kitz
Nibco

2.4 **AIR VENTS**

2.4.1 Use Spirax Sarco Canada Type 13W, AWN-150, 1030 kPa (150 psig) float type air vents with semi-steel body and cap, stainless steel float, stainless steel valve seat and neoprene valve head.

2.4.2 The following manufacturers of the above equipment will be considered equal, subject to requirements of Clause “Material and Equipment”:

Hoffmann

3 Execution

3.1 **PIPING**

3.1.1 **General**

3.1.1.1 Use flanges or unions on all piping connections to equipment.

3.1.1.2 Support all piping connected to isolated equipment with spring hanger supports for at least the first three support points.

3.1.1.3 See Section 15001 “Mechanical General Provisions” Clause “Piping”.

3.1.2 **Water Piping**

3.1.2.1 Provide drain valves with hose connections at base of all risers, at all low points in piping distribution, and at low points on all equipment connections. Drain valves to be ball valves.

3.1.2.2 For upfeed take off top of pipe. For downfeed take off bottom of pipe.

3.2 **VALVES**

3.2.1 Unless specifically noted, shown or specified otherwise, shutoff valves may be either butterfly valves or ball valves. Do not use ball valves for sizes greater than 50 mm (2″). Where butterfly valves are required to isolate a piece of equipment, provide an extra set of flanges if necessary to allow removal or repair of equipment without disturbing valves.

3.2.2 Use line sized valves unless shown or specified otherwise.

3.3 **AIR VENTS**

3.3.1 Provide automatic air vents at all high points in piping system and at all points where piping drops to form loops.

3.3.2 Use manual air vents only where shown or specified.

3.3.3 See Detail Sheet included with Section 15001 “Mechanical General Provisions” for installation requirements.

3.4 **ACCESS DOORS**

3.4.1 Provide access doors with quick fastening latches for access to all dampers, coils, thermostats, valves and any other concealed devices which require servicing.

3.5 **AIR AND WATER SYSTEM TESTING AND BALANCING**

3.5.1 Cooperate with and assist the air and water testing and balancing company. See Section 15200, “Testing and Balancing”.

3.5.2 Change wire taps on individual heat pump units to allow for proper air balancing.

3.5.3 Be responsible for the initial alignment and tension of all fan pulleys and belts.

3.5.4 Provide any changes to fan drives, pulleys and belts as required to allow a proper air balance as recommended by the Testing and Balancing Company for equipment supplied under this Contract.

END OF SECTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 15001, “Mechanical General Provisions”.

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1 **Heat Pump Water System**: A geothermal water source heat pump system serves the building and will be extended to suit the renovations.

1.3 **SHOP DRAWINGS**

1.3.1 Submit Shop Drawings in accordance with Section 15001, Clause “Shop Drawings” for the following equipment and materials:

- access doors
- backdraft dampers
- duct sealer
- ductwork gauges, material and methods of support for each pressure type, shape (i.e. round, rectangular) and size range.
- fire dampers
- grilles, registers and diffusers

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal as defined in Section 15001 “Mechanical General Provisions”, Clause “Material and Equipment”.

2.2 **DUCTWORK**

2.2.1 **Standards**: Construct all ductwork in accordance with the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) Manual “HVAC Duct Construction Standards - Metal and Flexible”.

2.2.2 **Materials**: Unless specified otherwise, fabricate all ductwork from galvanized steel. Use SMACNA recommended thicknesses except where specified otherwise. Where aluminum construction is shown or specified, use utility grade aluminum. For aluminum construction, use equivalent to galvanized steel to aluminum thickness adjustments as listed in current SMACNA Manual “HVAC Duct Construction Standards - Metal and Flexible”.

2.2.3 **Rectangular - Low Pressure**: Use SMACNA 2″ W.G. pressure class. Use SMACNA recommended sheet metal thicknesses.

2.2.4 **Rectangular - Medium Pressure**: Fabricate according to current SMACNA standards for static pressures in duct up to 1490 Pa (6″ W.G.).

2.2.4.1 Where round ductwork is exposed to view, a decorative grade installation is required. Arrange for special handling and shipping to avoid dents and minimize scratches.

2.2.5 **Flexible Type Round Ducts**

2.2.5.1 Where not exposed to view, use Thermaflex Type M-KC or FlexMaster equivalent insulated flexible duct with a woven fibreglass fabric core with a flame resistant coating permanently bonded to a coated wire helix. Minimum positive pressure rating of 4 kPa (16"w.g.) for sizes 100 to 250 mm (4 to 10 ″) and 2.5 kPa (10″ w.g.) for sizes 300 to 410 mm (12 to 16″). Insulate duct with minimum 40 mm (1-1/2″) thickness of 12 kg/m³ (0.75 lb/ft³) density fibreglass and bidirectional reinforced metallized film outer vapour barrier.

2.2.5.2 Flexible ductwork will not be permitted where exposed to view.

2.2.5.3 Flexible duct must bear ULC approval labels and conform to flame spread and smoke developed ratings as required by the Ontario Building Code.

2.3 **FIRE DAMPERS**

2.3.1 Use only dynamic type fire damper assemblies tested in accordance with CAN4-S112-M "Standard Method of Fire Test of Fire Damper Assemblies" and listed in most recent ULC "List of Equipment and Materials" or by another recognized independent testing and certification agency acceptance to the Consultant. Label each damper to indicate compliance with these requirements. Provide fusible links with a 70°C (158°F) rating unless noted otherwise on Drawings. Links shall comply with ULC-S505 "Standard for Fusible Links for Fire Protection Service". Fabricate all dampers from galvanized steel except in copper and aluminum duct systems. In these systems, use all stainless steel construction.

2.3.2 Provide damper assemblies whose fire protection ratings comply with Ontario Building Code requirements for the fire resistance ratings of the fire separations through which the protected openings pass. Provide an approval label, stating the fire rating, from a recognized independent testing laboratory acceptable to the Consultant, on each assembly.

2.3.3 For ducts with either face dimension of 300 mm (12″) or less, and for all medium pressure ducts, use low resistance type dampers with 100% free area.

2.3.4 Provide with each fire damper, detailed installation instructions. Include illustrations and adequate information to attain proper and safe installation of the fire damper assemblies.

2.3.5 The products of the following manufacturers will be considered equal, subject to the requirements of Clause "Material and Equipment":

Alumavent
Controlled Air Mfg. Limited.
Nailor Industries Inc.
Ruskin

2.4 **INTERNAL DUCT LINING**

2.4.1 Use Schuller/Manville "Permacote Linacoustic" fibreglass duct liner with air stream surface protected with "Permacote", acrylic coating. Coating to be treated with anti-microbial agent so as not to support growth of fungus or bacteria as determined by ASTM G21 and G22. Liner to meet or exceed Life Safety Standards as

established by NFPA 90A and 90B, have a NRC not less than 0.7, and a thermal conductivity of 0.36 W/m.K (0.0208 Btuh x ft x °F) at 23.9°C (75°F).

2.4.2 The following manufacturers of the above equipment will be considered as equal, subject to requirements of Clause “Material and Equipment”:

Knauf
Manson
Fiberglas

2.5 DUCT ACCESS DOORS

2.5.1 Use Nailor Industries Inc. 0800 Series duct access doors. For duct dimension up to 300 mm (12″) use 250 mm x 150 mm (10″ x 6″) door. For duct dimension up to 600 mm (24″), use 380 mm x 250 mm (15″ x 10″) door. For all larger ducts, use 660 mm x 510 mm (26″ x 20″) door.

2.5.2 For insulated ducts, use doors factory insulated with 25 mm (1″) thick fibreglass insulation.

2.5.3 The following manufacturer will be considered equal, subject to the requirements of Clause “Material and Equipment”:

NCA
Price

2.6 GRILLES, REGISTERS AND DIFFUSERS

2.6.1 Use E. H. Price Limited grilles, registers and diffusers. Provide types, accessories and finishes as noted in the Equipment Schedules. See Drawings for sizes.

2.6.2 The following manufacturers of the above equipment will be considered as equal, subject to requirements of Clause “Material and Equipment”:

Kreuger
Nailor
Titus
Tuttle & Bailey

2.7 BALANCING DAMPERS

2.7.1 For ducts 930 cm² (144 in²) and less in cross sectional area, use single blade dampers with locking quadrant and pin on far side. For larger ducts use, multi-blade, opposed blade dampers with external operator and locking quadrant. Provide spacers to maintain clearance between duct and damper blades.

2.8 DUCT SEALER

2.8.1 Use Duro Dyne DSW water based high pressure duct sealer.

2.8.2 The following manufacturers of the above material will be considered as equal, subject to requirements of Clause “Material and Equipment”:

Childers
Multi-Purpose
3M Canada Inc.
United Sheet Metal

2.9 **TURNING VANES**

2.9.1 Use Rouane turning vanes as manufactured by S.E. Rozell and Sons Ltd. in all square elbows. Assemble vanes with Duro Vane Rail JVR-2 for 50 mm (2″) radius vanes spaced 38 mm (1-1/2″).

3 Execution

3.1 **DUCTWORK**

3.1.1 **General**

3.1.1.1 Construct ALL ductwork located inside Mechanical Equipment Rooms to Medium Pressure duct standards. Construct all ducts designated on Drawings as round to Medium Pressure duct standards. Unless specified otherwise, construct ALL other ductwork to Low Pressure duct standards.

3.1.1.2 Fabricate and install ductwork in accordance with the Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) Manual "HVAC Duct Construction Standards - Metal and Flexible".

3.1.1.3 Pay particular attention to Section 15001 “Mechanical General Provisions”, Clause “Cutting and Patching”. This will be strictly enforced on this project. Coordinate work with trades responsible for floor and wall construction to reduce difficulty of making tight seals.

3.1.1.4 Fabricate all ductwork to the clear inside dimensions shown on the Drawings. Where internal lining is specified, dimensions shown are inside insulation.

3.1.1.5 Do not suspend ducts from metal roof deck.

3.1.1.6 Make duct connections to fans and heat pumps with flexible duct connectors.

3.1.1.7 Install access doors for easy access to each damper, thermostat, coil, valve, or other concealed device which requires servicing.

3.1.1.8 Provide backdraft dampers where shown or specified.

3.1.1.9 Install fire damper assemblies in strict accordance with manufacturer's instructions provided with each fire damper. See Detail Sheet in Section 15001 for installation requirements where ducts are internally lined.

3.1.1.10 Where ductwork has to be altered from dimensions shown due to construction conditions, use the same effective cross sectional areas, without exceeding a 4 to 1 aspect ratio. Carry out such changes at no additional cost to the Owner.

3.1.1.11 Install ductwork to maximize clear floor to ceiling heights.

3.1.1.12 Transitions are described in the direction of air flow. For converging transitions, use a maximum slope of 1 in 4 and, for diverging transitions, use a maximum slope of 1 in 7.

3.1.1.13 Paint interior of ductwork for at least 610 mm (24″) behind supply, return and exhaust grilles and registers with matte black paint so as to render ductwork invisible from occupied space. Do not paint ductwork which is internally lined.

3.1.1.14 Apply one coat zinc chromate primer over all welded surfaces.

3.1.1.15 If there is a conflict between the duct sizes shown on the floor plans and the duct sizes shown on sections, elevations or details, the floor plans will govern.

3.1.1.16 Install duct smoke detectors supplied by Division 16.

3.1.2 **Low Pressure - Rectangular Ductwork**

3.1.2.1 Fabricate and install according to current SMACNA standards. Use 2″ W.G. pressure class. Use SMACNA recommended sheet metal thicknesses. Fabricate with all flat surfaces wider than 450 mm (18″) either cross broken or transverse beaded, regardless of whether the duct is insulated, lined or bare.

3.1.2.2 Use elbows in the following order of preference:

3.1.2.2.1 Full radius elbows with inside radius equal to duct width.

3.1.2.2.2 Square elbows with turning vanes.

See Detail Sheets included with Section 15001 “Mechanical General Provisions”.

3.1.2.2.3 For duct takeoff to a single register, diffuser, grille or branch, use balancing dampers. Do **NOT** use splitter dampers. See Detail Drawing in Section 15001, “Mechanical General Provisions”.

3.1.2.2.4 Fabricate all duct fittings in accordance with Detail Drawings in Section 15001, “Mechanical General Provisions”. Provide all balancing dampers as shown on Details. These details apply to supply, return and exhaust air systems.

3.1.2.2.5 Seal all transverse joints, longitudinal seams and duct wall penetrations to SMACNA Seal Class A standards.

3.1.2.3 **Round Ductwork**

3.1.2.3.1 Provide a decorative grade installation where ductwork is exposed to view, outside of Mechanical Rooms. Use satin coat finish, degreased and suitable for field painting without etching duct surfaces.

3.1.2.3.2 Make all joints in ductwork exposed to view using “Spiralmate” round duct connector system or equivalent.

3.1.2.3.3 Rotate spiral seams on duct-to-duct joints so that the seam provides a continuous helical pattern across the joint.

3.1.2.3.4 Fasten diffuser collars to duct using pop rivets. Provide a finishing filet of elastomer seal at the collar-duct junction.

3.1.2.3.5 Space hangers at equal intervals. Fasten hangers to duct system using ring collars as shown on the Drawings.

3.2 INTERNAL DUCT LINING

3.2.1 Install lining in accordance with liner manufacturer's published recommendations and SMACNA "HVAC Duct Construction Standards - Metal and Flexible". Use both adhesive and mechanical fasteners. Select pin lengths to limit insulation compression to 3 mm (1/8″). Butter butt joints with a fire resistant coating and extend 50 mm (2″) on either side of joint to stop air from lifting insulation. Repair liner surface penetrations with adhesive meeting ASTM C919. Pins must be welded to duct.

3.2.2 Internally line ducts where shown on Drawings. Use 25 mm (1″) thickness, unless designated otherwise.

3.2.3 Where acoustic plenums are not specified, internally line outside air intake ducts and plenums with 37 mm (1-1/2″) thickness. Finish with two 3 mm (1/8″) thick coats of asphalt or vinyl mastic. Apply glass reinforcing fabric between coats. Lap joints by 100 mm (4″).

3.3 GRILLES, REGISTERS AND DIFFUSERS

3.3.1 Cooperate on the job with other trades so that grilles, registers and diffusers do not conflict with lights, etc. Bring any conflict between grilles, registers and diffusers and the work of other trades to the attention of the Consultant before any ductwork is installed. See Architect's reflected ceiling plan for location of grilles, registers and diffusers.

3.3.2 Install frame for each grille, register and diffuser to suit the type of building construction.

3.4 TESTING AND BALANCING

3.4.1 Cooperate with the Testing and Balancing trade. See Section 15200, “Testing and Balancing”. Make any changes deemed necessary by the Testing and Balancing trade to permit proper testing and balancing of the systems.

3.4.2 Provide additional balancing dampers where required by the Testing and Balancing Company.

3.4.3 Be responsible for the initial alignment and tension of all fan pulleys and belts.

3.4.4 Provide any changes to fan drives, pulleys and belts as required to allow a proper air balance as recommended by the Testing and Balancing Company for equipment supplied under this Contract.

3.5 DUCT LEAK TESTING

3.5.1 Duct leakage tests are specified in Section 15200, "Testing and Balancing".

3.5.2 Cap and seal ducts for the test sections as directed by the Testing and Balancing trade. Provide all necessary fittings and duct connections as required for the leak testing procedure.

3.5.3 Ensure all required duct access doors are installed before tests are started.

3.5.4 Immediately correct defects discovered during test and arrange for retesting until satisfactory results are obtained.

3.6 **EQUIPMENT CONNECTIONS**

3.6.1 Be responsible for all connections to Owner's equipment, whether equipped with duct connections or not.

END OF SECTION

INDEX - SECTION 16001

PART 1 - GENERAL

PART 2 - PRODUCTS

INDEX - SECTION 16001

PART 3 - EXECUTION

1 General

1.1 **GENERAL PROVISIONS**

1.1.1 This Section and Division 1 - General Requirements apply to and govern the work of all Sections of Division 16.

1.2 **VISITING SITE**

1.2.1 Visit the site and be familiar with working conditions and work involved before submitting Bids. **NO EXTRAS WILL BE GRANTED DUE TO LACK OF A THOROUGH PRELIMINARY INVESTIGATION.**

1.2.2 Remove and replace existing ceiling tiles to inspect ceiling for existing Mechanical, Electrical and Structural obstructions. Include cost of all necessary changes in Bid Price. No extras will be granted due to lack of a thorough preliminary investigation of accessible ceiling spaces.

1.2.3 Contractors visiting for site investigation must sign in at the main office. Upon arrival, review and sign the on-site Designated Substances Report prior to site investigation.

1.3 **CONTRACT DRAWINGS**

1.3.1 Electrical Drawings show Electrical work only and are not intended to show Structural details, Mechanical details or Architectural features. Take building dimensions and details from Architectural or Structural Drawings or from job measurements only.

1.3.2 Electrical Drawings indicate only the general locations of equipment and outlets. Wiring requirements are shown diagrammatically. Responsibility for the detailed layout of equipment, outlets, raceways and wiring is part of the work of this Division. Specific outlet locations are detailed on elevations.

1.3.3 If shown, only the general location and route of conduit, cable trays and communication hooks are shown. Install all services neatly to conserve headroom. All conduit, cable trays and communication hooks are to be accessible after work by other trades is complete. Install all services parallel to building lines unless shown otherwise.

1.3.4 The Consultant reserves the right to revise the locations of equipment and outlets within any given room without altering the Contract Price provided Notice of Change is given prior to roughing-in.

1.3.5 In case of conflict between work of other trades and work of this Division, clarify the location of these items with the Consultant before roughing-in.

1.3.6 In the event of any discrepancies or ambiguity of any symbol, note, abbreviation, etc., used in this Specification or on the Contract Drawings, obtain clarification, in writing, from the Consultant prior to submitting Bid. No allowance will be made for additional costs arising from failure to obtain proper clarification of conflicting information before Bid.

1.3.7 All dimensions and sizes are in SI units, Generally units are in millimetres. All exceptions to this are noted.

CONDUIT SIZES

Imperial (Inches)	½	¾	1	1-¼	1-½	2	2-½	3	3-½	4	4-½	5	6
S.I. (metric) (mm)	16	21	27	35	41	53	63	78	91	103	116	129	155

1.4 **SHOP DRAWINGS**

1.4.1 Submit Manufacturers' Shop Drawings, Electrical Wiring Diagrams and Control System Drawings to the Consultant. Provide title sheet for Shop Drawing submitted. Include project name, Shop Drawing item (including Specification paragraph reference) and approval stamps. The Consultant reserves the right to have samples submitted of any specified products.

1.4.2 Before submitting shop drawings, provide a complete list of shop drawings to be submitted in Microsoft Excel format. List all shop drawings and approximate date of submission.

1.4.3 Submit all shop drawings electronically in Adobe® Acrobat® PDF format. File attachments to an email must total no more than 5 MB and must be submitted unzipped. If multiple items are submitted in single PDF file, each individual piece of equipment must be “book marked” using equipment labels as per Design Drawings. All shop drawings submitted electronically must be checked and stamped by Contractor as specified below.

1.4.4 Catalogues, manuals or price lists will not be accepted as Shop Drawings. Before submission, check Shop Drawings, make necessary corrections, apply stamp “Checked and Certified Correct”, sign and date.

1.4.5 Submit one reviewed set of Shop Drawings with each set of Maintenance and Operating Instructions.

1.4.6 The review of Shop Drawings by Chorley + Bisset Ltd. is for the sole purpose of ascertaining conformance with the general design concept. This review does not mean that Chorley + Bisset Ltd. approves the detail design inherent in the Shop Drawings, responsibility for which remains with the Contractor. Such review does not relieve the Contractor of his responsibility for errors or omissions in the Shop Drawings or of his responsibility for meeting all requirements of the Construction and Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for coordination of the work of all subtrades.

1.4.7 The Contractor is to review each shop drawing and document the differences between the shop drawing submission and the description listed in the specification. If there are no differences listed, the Contractor implicitly declares the shop drawing meets all requirements of the Specification.

1.4.8 Ensure at least one copy of the reviewed Shop Drawings is kept on site at all times for reference.

1.4.9 Prepare all Drawings in SI units.

1.4.10 Shop Drawings to include the following:

1.4.10.1 Indicate details of construction, dimensions, capacities, weight and electrical performance characteristics of equipment or material.

1.4.10.2 Where applicable, include wiring, single line and schematic diagram including interconnect with work of other sections.

1.4.10.3 Include manufacturer's special installation instructions where applicable.

1.5 FIELD DRAWINGS

1.5.1 Submit, to the General Contractor, Drawings accurately showing all openings for busducts, conduits, etc. Drawings must include the size of openings and their locations by dimensions, including the location of the structural members framing these openings. Each trade will be responsible for detail layout of their own work.

1.5.2 Assume full responsibility for the detailed coordination of all Division 16 work. Prepare Field Drawings to determine the exact location of each service. On these drawings, include all mechanical and electrical services, architectural features, and structural details. If a conflict becomes apparent after the installation of services, pay all costs associated with removing and reinstalling these services.

1.5.3 If the General Contractor separates the Communication, Security or similar work from the other work of Division 16, the General Contractor assumes full responsibility for this coordination work including the preparation of the Field Drawings.

1.6 AS-BUILT DRAWINGS

1.6.1 The Contractor will be provided with the Electrical Drawings in AutoCAD Version 2010 compatible electronic format. The Contractor is to plot and print Drawings from the disc.

1.6.2 Revise and maintain the prints as work progresses. Show all revisions, relocations and changes, to scale. Use colour markings.

1.6.3 Contractor shall take as-built measurements, prior to backfill, of all buried ductbanks and conduits under floor slab. Show routing, depths and dimensions from fixed points on as-built drawings.

1.6.4 Transfer information from the marked prints to AutoCAD format on a monthly basis. Have the marked prints and updated AutoCAD prints on site for review by the Consultant at all times. Monthly draws will not be approved unless all changes have been shown.

1.6.5 Prior to testing and final commissioning, complete the transfer of all information to the AutoCAD Drawings. The Drawing format is to match exactly the layering system of the Consultant. Mark Drawings “As-Built Drawings” and insert name and logo of Contractor. Bind all xrefs. Submit one set of As-Built Drawing prints for review by the Consultant. Remove Engineers Stamp. Include Contractors Name and Logo.

1.6.6 Submit completed As-Built Drawings in AutoCAD Version 2010 format and one set of Reproducible Drawings with the Operating and Maintenance Manuals.

1.6.7 For the purposes of Contract payments, As-Built Drawings will be assumed to have **a value of $1,500.** This will not be released until As-Built Drawings have been accepted as complete and acceptable by the Consultant. This amount is in addition to the normal 10% holdback required by the Construction Lien Act, 1983.

1.7 **SIMULTANEOUS PROJECTS**

1.7.1 Other projects may be under construction simultaneously on this site during the course of this construction project. The Owner will not be the "constructor" as defined by The Ontario Health & Safety Act & Regulations. This Contractor is to maintain a separation between this project and all other Contractors, by time or space, as defined by The Ontario Health & Safety Act & Regulations.

1.8 **CONFLICTS AND PRECEDENCE**

1.8.1 Immediately upon discovery of any conflict, ambiguity, error or omission in the Contract Documents, request clarification in writing from Consultant prior to starting the work in questions.

1.8.2 Failure to give such written notice will constitute an irrevocable waiver and release of any claim for additional compensation or delays incurred.

1.8.3 Where work fails to conform to Contract Documents, as clarified by Consultant, promptly remove and replace such work as directed, without adjustment to Contract price.

1.9 **FIRESTOPPING**

1.9.1 Before starting any work on site, submit detailed Shop Drawings to the Consultant for review and comments. Include:

1.9.1.1 Manufacturer's technical product data and installation instructions for each specific type and location of penetration.

1.9.1.2 Certification that proposed firestopping materials and assemblies comply with CAN4-115-M.

1.9.1.3 For each specific type and location of penetration, provide installation instructions from a recognized independent testing agency.

1.9.2 Mark penetration types and locations on set of white prints. At completion of project, transfer this information to As Built Drawings.

1.9.3 Comply with all requirements of Ontario Building Code Clause 3.1.9, “Building Services in Fire Separations and Fire Rating Assemblies”.

1.10 MAINTENANCE AND OPERATING INSTRUCTIONS

1.10.1 For the Electrical Division 16 work only, assemble one set of equipment literature (cuts), operating instructions, maintenance instructions, voltage test results, certificate, other pertinent data and Letter of Warranty. Place in three ring binders, complete with index pages, indexing tabs and cover identification at front and side. Submit to Consultant for approval.

1.10.2 Make changes or submit additional information as required to obtain approval. Final Certificate of Completion will not be issued until the Consultant possesses approved sets. Include copies of reviewed Shop Drawings and name and address of Spare Parts' Suppliers with manuals.

1.10.3 Provide two electronic copies of the maintenance and operating manual in Adobe Acrobat PDF format on a USB Drive and submit with the final version of manuals. Electronic copy of manual to be provided as one file formatted with bookmarks in accordance with the sections of the hard copy manuals. Do not include separate files in sub folders. Divide the maintenance manuals into sections which correspond with Specification Sections.

1.10.4 The following information is to be contained within the Sections:

1.10.4.1 **Section 1:** A list of names, addresses and telephone numbers of the Consultants, General Contractor and Electrical Contractor. Written warranty of the Electrical systems.

1.10.4.2 **Section 2:** Electrical Safety Authority Inspection Permit, Fire Alarm Verification Report and Certificate, Emergency Lighting Verification Letter.

1.10.4.3 **Remaining Sections - By Specification Section**

1.10.4.3.1 A list of names, addresses and telephone numbers of all suppliers. A copy of all reviewed Shop Drawings.

1.10.4.3.2 A complete and comprehensive maintenance and operating instructions details D (daily), W (weekly), M (monthly), SA (semi-annually), A (annually) for maintenance.

1.10.4.3.3 Copies of warranties.

1.10.4.3.4 Complete control diagrams, wiring diagrams and description of applicable control systems and the functioning of the system.

1.11 REGULATIONS AND PERMITS

1.11.1 Carry out the work in accordance with the latest editions of relevant codes, local bylaws, and requirements of local Authority Having Jurisdiction. Apply for and obtain permits and pay all fees. Consultant will submit Drawings to Electrical Safety Authority if required.

1.11.2 Enforce all prevailing Provincial and local safety regulations at all times. Abide by all Owner’s safety and security policies and procedures and conform to all regulations of the current Occupational Health & Safety Act.

1.11.3 After completion of the work, furnish to Consultant a Certificate of Unconditional Approval from Inspecting Authorities.

1.12 **MATERIAL AND EQUIPMENT**

1.12.1 Where an item of material or any equipment is specifically identified by a manufacturer's trade name and/or catalogue number, make no substitution except as provided for in paragraphs 3, 4 and 5 below.

1.12.2 In the case of some items of equipment, one or more additional names of acceptable equal manufacturers are listed in the Clause describing an item or a group of items. The design, layout, space allocation, connection details, etc., are based on the products named first in the description of each item. The products named first in the description of each item establish the quality of manufacture and design standards for all other manufacturers of that item. The general approval indicated by listing the names of other manufacturers is subject to final review of Shop Drawings, performance data, test reports, production samples (if required) by Consultant, and equipment shipped to site. Ensure that the products used meet the requirements specified and as shown on the Contract Drawings.

1.12.3 Suppliers wishing to submit other items of equipment for approval as an equal to those specified must apply to the Consultant at least 8 working days before Bid closing date. Requests must be accompanied by complete description and technical data on the items proposed. Approval for substitution of equipment will only be given on the understanding that all details, accessories, features and performance meet the Specifications unless otherwise stated. Deviations from the Specifications must be stated in writing at time of application for approval.

1.12.4 Include in the Bid, the equipment named in the Specifications or approved as an equal as in paragraph 3 above. This will form the Base Bid. Any number of alternative bids, as defined below, may be included in addition to the Base Bid.

1.12.5 Items of equipment by Manufacturers not named in the Specifications may be offered as alternatives to the manufacturers named in the Specifications. The alternative proposals must be accompanied by full descriptive and technical data, together with the statement of amount of addition or deduction from the Base Bid, if the alternative is accepted. Prior approval by the Consultant is not required on items submitted as alternative bids.

1.12.6 After execution of the Contract, substitution of equipment will be considered only if equipment accepted cannot be delivered in time to complete the work in proper sequence, or if the manufacturer has stopped production of the accepted item. In such cases, requests for substitution must be accompanied by proof of equality and difference in price and delivery, in the form of Certified Quotations from Suppliers of both specified and proposed equipment. Credit any decrease in price involved in substitution to the Owner by reduction of the Contract Price. The Contractor will not be reimbursed for any such increase in price.

1.12.7 Where equipment other than the equipment used as a basis for design, layout and space allocation is used, produce and submit revised layouts of equipment, pipes, ducts, etc., in the areas affected. Submit these Drawings with the Shop Drawings. Failure to produce these Drawings is indication by the Contractor that they are not required and the original space allocations are adequate for the substituted equipment.

1.12.8 Name the Subcontractors and Manufacturers in the Bid as indicated in Clause “List of Electrical Subcontractors and Manufacturers”.

1.13 INTERPRETATION OF CONTRACT DOCUMENTS

1.13.1 The decision as to which trade provides required labour or materials rests solely with the Contractor. Extra payments will not be considered based on a difference in interpretation of the Contract Documents as to which trade involved provides materials or labour for specific items of work. The Consultant will not enter into such discussions.

1.14 SITE VISITS

1.14.1 The Electrical Contractor shall have an office representative (not site personnel) at each site meeting and deficiency review. Attendance at these meetings is mandatory.

1.15 PROGRESS DRAWS

1.15.1 Electrical Contractor shall review all supplier and subcontractor draws submitted to their office to ensure they are fair and reasonable for the amount of work completed on site to date prior to submitting to the General Contractor. Electrical Contractor will be responsible for the validity of supplier and subcontractor draw claims.

1.16 WARRANTY

1.16.1 Warranty all workmanship, material and equipment supplied by Division 16 for one year after Substantial Completion except where specifically specified otherwise. Make good damage caused due to defects and workmanship.

1.16.2 Where equipment specified in Sections of Division 16 to have an extended warranty period, e.g. five years, the first year of the warranty period will be governed by the terms and conditions of the warranty in the Contract Documents, and the remaining years of the warranty will be direct from the manufacturer and/or supplier to the Owner. Submit signed and dated copies of the extended warranties to the Consultant before applying for a Certificate of Substantial Performance of the Work.

1.17 DIMENSIONS AND QUANTITIES

1.17.1 Dimensions shown on Drawings are approximate. Verify dimensions by reference to Shop Drawings and field measurement.

1.17.2 Verify equipment access and coordinate with equipment supplier to ensure equipment can be physically transported to installation location. Under no circumstances will any claim be allowed for extra cost to disassemble and/or assemble equipment at the final location which will be considered as part of equipment installation.

1.17.3 Quantities or lengths indicated in any of the Contract Documents are approximate only and will not be held to gauge or limit the work. No adjustment to the Contract Price will be allowed to complete the work.

1.17.4 Provide labour, products and services specified, but not shown on Drawings and vice versa, and all other labour, products and services necessary for completion of the work.

1.17.5 Make any necessary changes or additions to routing of conduit, cables, cable trays, and the like to accommodate structural, mechanical and architectural conditions, without adjustment to Contract price.

1.17.6 Provide work in accordance with the approved Schedule to meet completion date and specified interim Schedules.

1.18 **COOPERATION BETWEEN TRADES**

1.18.1 Cooperate and coordinate with other trades as required for satisfactory and expeditious completion of work. Take field dimensions relative to work. Fabricate and erect work to suit field dimensions and field conditions. Pay cost of extra work caused by and make up time lost as result of failure to provide necessary cooperation information or items to be fixed to or built-in, in adequate time.

1.19 **COOPERATE WITH OWNER'S STAFF**

1.19.1 Maintain close cooperation with Owner's staff. The Owner will determine the times during which work may be carried out in certain areas. If the work cannot be completed in the allowed time, the Contractor may be required to clean up the area and finish the work at some future time.

1.19.2 Shutdowns will be scheduled during unoccupied times. Include any overtime wages due to conditions stipulated above in the Bid Price.

1.19.3 Provide seven day's minimum notice, in writing, prior to any interruptions of service or restriction of use of any service.

1.19.4 Provide all phase testing, as required, prior to disconnecting existing and connecting new to avoid damage to equipment.

1.19.5 The Owner's operations must take precedence over Contractors' operations at all times. Interruptions due to noise, drilling, etc., will not be allowed without Owner's prior approval.

1.19.6 Include any overtime wages due to conditions stipulated above in the Bid Price.

1.20 **EXAMINATION OF DAMAGED DEVICES**

1.20.1 Report all damaged, defective and non-functioning devices and equipment shown for reinstallation or relocation to the Consultant prior to removal and storage. All devices and equipment will be assumed to be fully functional unless reported otherwise prior to removal.

1.20.2 Devices and equipment damaged during removal, storage or reinstallation will be replaced at no cost to the Owner.

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal as defined in Clause “Material and Equipment”.

2.2 **CONCRETE**

2.2.1 Use concrete in accordance with the requirements of Division 3 unless specified or shown otherwise. Use red pigmentation when used as mechanical protection for electrical equipment.

2.3 **FIRESTOPPING**

2.3.1 Use only service penetration firestop components and assemblies tested in accordance with CAN.ULC S115 “Fire Tests of Firestop Systems” and listed in most recent ULC “List of Equipment and Materials” or by another recognized independent testing and certification agency acceptable to the Consultant.

2.3.2 Pipe sleeves through fire separations requiring a rating are to be installed as per firestopping manufacturer's recommendations, as some firestopping manufacturers do not allow pipe sleeves within their approved system. Confirm pipe sleeve compatibility prior to starting work on site.

2.3.3 The following manufacturers of the above equipment will be considered equal subject to requirements of Clause "Material and Equipment":

Hilti
Tremco

2.4 **ACCESS DOORS**

2.4.1 Access doors to be flush to edge of frame, concealed continuous hinge with screwdriver operated cam latch. Non fire-rated door construction to be minimum 14 gauge, with 16 gauge frame. Fire-rated door construction to be a minimum 20 gauge insulated door with 16 gauge frame. Insulation thickness to provide required rating.

2.4.2 Size doors to allow adequate operating/maintenance clearance for devices. Doors to be a minimum 600 mm x 600 mm (24″ x 24″) for body entry, and 300 mm x 300 mm (12″ x 12″) for hand entry, unless noted otherwise. Use the following access doors:

Masonry Walls	Acudor UF-5000
Drywall Walls	Acudor DW-5040
Drywall Ceilings	Acudor BP58, match ceiling thickness
Fire-Rated	Acudor FW-5050/FB-5060 to match fire separation
Wet Areas,	Acudor UF-5000 (stainless)

2.4.3 The following manufacturers of the above equipment will be considered equal subject to requirements of Clause “Material and Equipment”:

Adam
Ancon LeHage
E. H. Price

2.5 **SPRINKLER PROOF EQUIPMENT**

2.5.1 This building will be fully sprinklered. Use sprinkler proof electrical equipment to prevent the sprinkler system water from entering electrical equipment for all surface mounted equipment.

2.6 **IDENTIFICATION NAME LABELS**

2.6.1 Provide white lamacoid identification labels with black uppercase lettering, minimum 14 pt Arial or Helvetica typeface, for identification of all MCCs, switchboards, distribution panels, panelboards, transformers and transfer switches.

2.6.2 Submit a complete list of nameplate wording for review by Consultant prior to installation.

2.6.3 Warning plates are to be red with white letters, minimum 14 pt Arial or Helvetica typeface, as indicated on drawings.

3 Execution

3.1 **GENERAL**

3.1.1 Instruct and supervise other Sections doing related work.

3.1.2 Supply the measurements of equipment to other Sections to allow for necessary openings to be left in the work of other Sections.

3.1.3 Install conduit, which is to be concealed, neatly and close to building structure so that the necessary furring can be kept as small as possible.

3.1.4 Carry out all work in accordance with the latest regulations of the Ontario Electrical Safety Code and all applicable Municipal, Provincial and Federal Codes and Regulations. In no instance, however, is the standard established by the Drawings and Specifications, to be reduced by any of the Codes referred to above.

3.1.5 Install all ceiling components in direct accordance with reflected ceiling plans.

3.1.6 Electrical Drawings show approximate locations for wall-mounted devices. Clarify exact location and mounting height with Consultant prior to roughing-in.

3.1.7 All serviceable equipment installed on the roof (including receptacles) to be installed minium 3 m (10'-0") from roof edge unless otherwise noted on Drawings.

3.2 **STORAGE OF MATERIALS**

3.2.1 Provide proper weatherproof storage for the protection of materials and equipment on site. Blank off openings in all equipment until required for use. Consultant may require materials which are not properly stored to be discarded and removed from the site.

3.3 SUPPORTS AND BASES

3.3.1 Provide structural work required for installation of equipment provided under this Division.

3.3.2 Set all floor-mounted equipment on concrete bases at least 100 mm (4″) high. Size concrete equipment bases to suit the equipment actually supplied and in accordance with the Shop Drawings of such equipment. Do not start concrete work until anchor bolts and other embedded parts required for the complete installation, as well as Shop Drawings, are available at the site.

3.3.3 Extend existing concrete bases as required for replacement or new equipment. Match existing height.

3.3.4 For new concrete bases or pads on existing floors, first scrape and remove existing floor finish. Scarify existing floor so that new concrete adheres to it. Dowel new pads to new and existing floors.

3.3.5 Provide all brackets and supports required in steel stud walls. All conduits and equipment must be supported on brackets or supports attached to steel studs. Do not support materials or equipment from wall sheathing.

3.3.6 Provide independent support; brackets and unistrut structures where required to install electrical equipment; disconnect switches, splitters, panels, etc:

- in areas where the equipment is located on walls/columns that are not suitable for direct installation.
- When installation away from structural building elements is called for.
- When it is necessary to elevate the electrical equipment to ensure code compliance or ergonomical operator access.

3.3.7 For all supports of suspended or wall hung electrical equipment, provide structural drawings stamped and signed by a structural engineer holding a P.Eng. designation and registered in the Province of Ontario. This engineer is to submit proof of professional liability insurance. Equipment to be supported from the bottom.

3.3.8 Do not mount starters, VFD's, etc. on building equipment.

3.3.9 Do not suspend luminaires greater than 11.3kg (25 lbs), cable tray, conduit racks, etc from metal roof deck. Provide supports as required to suspend from roof joists.

3.3.10 Provide lintels for double-width and adjacent tubs and multiple conduits running in parallel, where located in block and poured walls.

3.4 CONCRETE INSERTS

3.4.1 General

3.4.1.1 Anchors for the support of conduits and equipment from the underside of suspended structural concrete systems may be by cast-in-place inserts placed prior to the pouring of concrete or by the use of inserts placed in holes drilled after the forms are stripped.

3.4.1.2 The safe load capacity of concrete anchors is affected by a number of variables such as specific anchor type, embedment, spacing between individual anchors, edge distances, direction of loading, concrete strength and "prying action". Refer to the manufacturer's recommendations for each specific insert proposed, including any dynamic or vibratory loads.

3.4.1.3 Be responsible for the proper selection and installation of inserts, including number, type, spacing and accurate placement to provide the necessary safe load capacity and satisfactory long term performance.

3.4.2 **Installation of Inserts in Hardened Concrete:**

3.4.2.1 Use inserts placed in pre-drilled holes. Do not use powder driven inserts or self-drilling inserts. Before drilling holes, accurately locate all reinforcing bars in the affected areas using an electro-magnetic locator.

3.4.2.2 Do not drill through or otherwise damage reinforcing bars. If reinforcing is encountered, the inserts must be relocated. Ensure that hole diameter, depth of penetration, spacing, etc., are in strict accordance with the insert manufacturer's recommendations for the specific insert type and load condition.

3.4.2.3 Due to the relatively close spacing of reinforcing bars in the bottom of many of the beams and girders, the preferred location of drilled-in-place anchors in beams and girders is into the sides of these members, rather than upwards into the bottom.

3.4.2.4 Inserts to be zinc plated female concrete anchors. Nylon or plastic anchors are not acceptable.

3.4.3 Concrete screws without anchors are not acceptable.

3.5 **FIRESTOPPING**

3.5.1 Provide a listed firestop system in accordance with the Ontario Building Code to seal around all conduits, electrical wires and cables, and other similar electrical services which penetrate part of a building assembly required to have a fire resistance rating or a fire separation. Refer to Architectural Drawings and Specifications Section “Firestopping and Smoke Seals” for building assembly and fire separation types and locations.

3.5.2 For all penetrations through fire separations required to have a fire resistance rating, use firestop systems with an F rating not less than the fire resistance rating for the fire separation. This includes the sealing of any sleeves provided for future uses. Provide an FT rating where required by the Ontario Building Code. For all penetrations through a Service Room floor, provide a minimum W rating - Class 1 in addition to the fire resistance rating.

3.5.3 All firestopping must be thoroughly reviewed by the Technical Representative of the systems manufacturer on site before any firestopping is concealed and submit a report of compliance with the rating requirements. Technical Representative to complete 3 destructive tests to confirm compliance with ULC listing, minimum one floor test and one wall test, third test to be Contractor’s choice. Contractor to replace fire stopping system after destructive test has been completed. Submit a copy of the report to the Consultant. Report to include as a minimum, confirmation fire stopping shop drawings were used during review, locations where destructive testing was

completed, confirmation all fire stopping locations were reviewed and installed systems meet the manufacturer requirements.

3.5.4 Provide instruction wall labels on both sides of wall for all thru-wall penetrations using FlameStopper. Locate adjacent to penetration as required to be visible from standing position.

3.6 CUTTING AND PATCHING

3.6.1 Flash holes through walls and roof to make weatherproof.

3.6.2 Do not cut or drill holes through floors, roof or structural members before obtaining permission from the Consultant.

3.6.3 For penetrations through walls not required to have a fire rating, seal all spaces between pipe or pipe and surrounding wall construction with a fire-rated foam sealant. Use 3M Fire Barrier, Metacaulk, or Dow Fire Stop UL Classified fire rated foam sealants. Do this as the work progresses, to avoid leaving inaccessible holes at completion of the job. For penetrations through parts of the building assembly required to have a fire resistance rating or acting as a fire separation, see Clause “Firestopping” in this Section.

3.6.4 Before drilling holes through floors or roof slabs, accurately locate and note sizes for each required hole. Get approval of Consultant before any cutting is started.

3.6.5 Where conduits are required to pass through existing walls, floors, and roof, cut and patch the necessary openings.

3.6.6 Where recessed electrical equipment is removed or replaced with equipment of a smaller size, patch openings to match existing wall material.

3.6.7 Where wiring devices (switches, receptacles, etc) are removed from drywall walls, remove device box and patch opening to match existing wall.

3.6.8 Where wiring devices (switches, receptacles, etc) are removed from poured concrete or block walls, remove device and provide blank coverplate.

3.6.9 Include the cost of all cutting and patching in the Lump Sum Contract Price for the work of Division 16.

3.6.10 Remove and replace ceiling where necessary to complete the work of this Division unless this work is specifically included in another Division.

3.6.11 All cutting and patching to be done by the trade specializing in the materials to be cut.

3.7 PAINTING

3.7.1 Touch up minor damage to finish on equipment supplied with factory applied baked enamel finish. Completely refinish items suffering damage which, in the opinion of the Consultant, is too extensive to be remedied by touchup.

3.7.2 Paint both sides and edges of plywood backboards for electrical and communications equipment before installing equipment. Use one coat fire retardant primer and two coats fire retardant paint.

3.7.3 Paint disconnect switch or breaker for fire alarm and exit light systems in red enamel. Use one coat of primer and one finish coat.

3.7.4 Where walls are cut and patched for electrical work, paint walls to match existing. For walls less than 9.3m^2 (100 sq ft), paint entire wall. For walls larger than 9.3m^2 (100 sq ft), paint area of patch. Painting to be completed by painting contractor.

3.7.5 Refer to Section 01010 “General Provisions” for painting of exposed conduit, walls, floors and ceilings.

3.7.6 Include the cost of all painting in the Lump Sum Contract Price for the work of Divisions 16.

3.8 ACCESS DOORS

3.8.1 Supply access doors wherever equipment, junction boxes, life safety devices, etc., are concealed behind walls or inaccessible ceilings. All devices installed requiring periodic maintenance to be made accessible. Doors will be installed by the trade specializing in the materials receiving access doors.

3.9 IDENTIFICATION

3.9.1 Colour code control wiring consistently throughout the installation and generally match colour coding of internal wiring of pre-wired components. Match existing colour coding in use on site. Verify with Owner prior to installation.

3.9.2 All branch circuits shall be:

Phase A - red
Phase B - black
Phase C - blue

3.9.3 Identify all disconnects, starters, and other control equipment with lamacoid nameplates indicating the equipment controlled and all panels, transformers, etc identifying equipment name.

3.9.4 Lamacoid labels to be mechanically attached with self-tapping screws or rivets. Lamacoid labels attached using adhesive methods are not acceptable.

3.9.5 Identify the panel and circuit number for each wiring device with self-adhesive label on the coverplate. Use clear tape with black 14 pt Arial or Helvetica typeface. Locate labels for receptacles on front of coverplate and labels for switches on rear of coverplate.

3.9.6 Identify all pull boxes, junction boxes or octagon boxes located in the ceiling cavity with the exact use of the box, including circuits contained within. Felt pen is acceptable.

3.9.7 Provide nameplate identifying equipment type, identification number, service and area served on each panelboard, MCC and transformer. Contractor is to complete a TVDSB Asset Tag Information Form for new and/or replaced piece of equipment. A sample copy of the form is attached in Appendix "A". A list of all equipment that require asset tags are listed in Appendix "B". The information gathered on these forms is required to be transferred electronically onto TVDSB's Ebase system.

3.9.8 Where equipment is concealed above accessible ceilings, indicate location using coloured-coded marking devices, approved by Consultant, fastened to the ceiling components.

3.10 LOCKS AND KEYS

3.10.1 Where locked panelboards, control panels, terminal cabinets, etc., are specified, use a separate key pattern for each system with all locks in each system common to one key. Provide seven keys of each pattern to the Owner on a 25 mm (1″) key ring. Submit one set of keys with manuals.

3.11 TESTING

3.11.1 All systems must be thoroughly tested before arrangements are made for the final demonstration in the presence of the Owner's staff. Systems to be tested are:

1. Emergency Lighting
2. Lighting Control Systems
3. Security and Access Control Systems
4. Voice / Data Cabling
5. PA / Intercom Systems

3.11.2 For the following systems, the manufacturer's Testing Representative must be present for the test period and submit a Certificate of Operation to the Consultant:

1. Fire Alarm

3.11.3 At the completion of the work, demonstrate operation of all systems to the Owner's representative and the Consultant. Promptly rectify any malfunction found.

3.12 TEMPORARY ELECTRICAL FACILITIES FOR CONSTRUCTION

3.12.1 Temporary electrical power is available at the site. Cooperate with owner for use of this power.

3.12.2 Tie in at one location only, as directed. Distribute temporary power from this location.

3.12.3 Arrange and pay for the cost of inspection of the temporary service.

3.12.4 Notify the monitoring company and Owner each and every time a part of the fire alarm system is shut down and reactivated.

3.12.5 Completely remove all temporary facilities when they are no longer required.

3.12.6 Provide fixed temporary lighting for open areas, stairwells and each enclosed room. In open areas and enclosed rooms use 150W A21 lamps, or equivalent, at spacings not exceeding 7.5m. In staiwells use one 100W A21 lamp, or equivalent, at each landing. Lighting to be on dedicated circuits.

3.12.7 Temporary lighting stipulated in this Section, do not include provisions for higher intensity lighting required for a specific operation (concrete finishing, plastering, etc.). This will be the responsibility of the specific trade requiring the higher intensity.

3.12.8 Provide minimum two 120V 20A GFCI receptacles, on dedicated circuits, per 150 m² construction area.

3.12.9 Temporary power requirements stipulated in this Section, do not include provisions for electric space heating, electric welders, or any other item of equipment which requires either a 3 phase supply or connection to a single phase circuit rated in excess of 20 amperes. Any trade using equipment which falls into above categories is to be responsible for providing additional facilities required for such equipment, including any increased sizing. This Division is responsible to see the connection to the temporary system is safe.

3.12.10 Use non-metallic sheathed cable, Type NMW-10, #12 AWG, manufactured in accordance with CSA Spec. C22.2 No. 38, for all temporary lighting branch circuit wiring.

3.12.11 **Temporary Fire Alarm Devices**

3.12.11.1 Notify the local Fire Department and Owner each and every time a part of the fire alarm system is shut down and reactivated.

3.12.11.2 Provide new temporary hard wired fire alarm detectors, pull stations and notification appliances within the construction area.

3.12.11.2.1 Provide one 135°F rate-of-rise heat detector for every 465 m² (5000 ft²) of floor area.

3.12.11.2.2 Provide smoke detectors in all temporary corridors spaced maximum 10m (30 ft).

3.12.11.2.3 Provide a manual pull station at every exit/entrance to the construction area.

3.12.11.2.4 Provide one surface mounted bell for every 560 m² (6000 ft²) of floor area.

3.12.11.3 Use #14 AWG, AC-90 cable for temporary wiring to devices.

3.12.11.4 Connect devices to dedicated fire alarm zones, grouped on a floor-by-floor basis. Provide zone cards as required to suit existing fire alarm panel.

3.12.11.5 Completely verify temporary fire alarm devices any time temporary devices are added, removed or relocated.

3.12.11.6 Once the permanent fire alarm system is operational completely remove all temporary devices and wiring. Turn devices over to the Owner.

3.13 **EQUIPMENT SCHEDULE**

3.13.1 Equipment Schedules are as shown on Drawings.

3.13.2 In general, the motor or item numbers shown in the Equipment Schedules coincide with those numbers shown for Mechanical Trades.

3.14 GROUNDING

3.14.1 Ground all components of the Electrical system in accordance with the requirements of Section 10 of the Ontario Electrical Safety Code latest edition and the Inspection Authority.

3.14.2 Provide a separate green ground conductor in all raceways.

3.14.3 Ground secondary neutrals of transformers to building ground conductor.

3.14.4 Where attached to equipment, conduits, cabinets, etc., use suitable approved solderless lugs, compression connectors. No soldered or split bolt type connections are to be used on grounding circuits at any point.

3.14.5 All compression connectors, lugs, etc., used in grounding circuits in any location are to have bolts, nuts, etc., of silicone bronze alloy equal to “Everdur” metal.

3.14.6 Clean all surfaces to which bus or cable are to be bolted, of all paint, rust, etc., and work to a bright, flat surface.

3.14.7 Conduit expansion joints and telescoping sections or metal raceways not thoroughly bonded otherwise, are to be provided with approved bonding jumpers or not less than #8 AWG stranded bare copper.

3.14.8 Provide a separate #14 green ground wire for all isolated ground receptacles.

3.15 START-UP SERVICES

3.15.1 Provide the services of a qualified person to be on call and available to the site within one hour, for 2 weeks after work of this Contract is taken over by the Owner. Assist Owner's staff to become familiar with the system operation.

3.16 MAINTENANCE OF EXISTING SERVICES

3.16.1 Take every precaution to locate and protect existing services so that no interruption occurs. If any existing service is damaged due to the work of this Division, arrange and pay for repair. Bear any costs due to interruption of existing services.

3.16.2 Be responsible for maintaining continuity of existing services, and for programming work so that the Owners can carry out their normal business uninterrupted, with the exception of scheduled shutdowns for connection to or rerouting of existing services, at a time agreed to by the Owners, on weekdays, over weekends or after normal working hours.

3.16.3 Permission from the Owner is required before making any connections to or rerouting of existing services. Give seven days prior notice to the Consultant and Owner.

3.17 PROTECTING AND MAKING GOOD

3.17.1 Be responsible for protection of Owner's property, as well as finished and unfinished work, from damage due to execution of work under this Contract. Repair damage resulting from failure to provide such protection to the satisfaction of the Consultant, at no expense to the Owner.

3.17.2 Attach and fasten fixture and fittings in place in safe, sturdy, secure manner so that they cannot work loose or fall or shift out of position during occupancy of building, as the result of vibrating or other causes in normal use of building.

3.17.3 Coordinate and cooperate with other trades, taking into account existing installations, to assure best arrangement of equipment in available space. For critical locations, prepare interference and installation drawing showing work of various sections as well as existing installations, for approval before commencing work.

3.17.4 All new equipment shall be delivered to site wrapped in plastic and removed only after room is thoroughly cleaned and painted, if applicable. Where existing or new equipment must be operational throughout construction in adjacent spaces, ensure door sweeps are installed and mechanical ventilation systems are fully operational. Provide filters with minimum filtration rate of 10 micron (MERV 5) on all make-up air and supply ducts. Ensure filters are regularly changed to maintain adequate airflow.

3.18 REMOVAL OF EXISTING MATERIAL AND EQUIPMENT

3.18.1 Remove existing material and equipment where shown or specified. Equipment such as Fire Alarm devices, and any other special devices are to be turned over to the Owner. Relocate these items to a designated storage site as directed by Owner. Other material and equipment which is removed becomes the property of the Contractor, and must be immediately removed from the site.

3.19 LOAD BALANCE

3.19.1 Measure phase current to distribution panels and MCCs with normal loads operating at time of acceptance.

3.19.2 Submit, at completion of work, a report listing phase and neutral currents on panelboards, dry-core transformers and motor control centre, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

3.20 REBATES AND INCENTIVES

3.20.1 Provide all invoices and proof of purchase documentation to Owner as requested for application by Owner for rebates and incentives. All incentives will be paid to the Owner.

3.21 CASH ALLOWANCES

3.21.1 Refer to Section 01020 for cash allowances carried by the General Contractor.

3.21.2 Include in the Base Bid price, cash allowances of:

3.21.2.1 $3,000.00 to cover the cost of unforeseen electrical deficiencies. Submit Electrical Safety Authority Inspection deficiencies to the Consultant.

3.21.3 Any amounts in excess of the cash allowances will be paid by the Owner. Return any unused portions of the cash allowances in full to the Owner.

3.22 **DEFICIENCY REVIEW**

3.22.1 The Electrical Contractor shall confirm in writing that the work is complete and ready for inspection. The Consultant will schedule a site visit to review the work and provide a written deficiency list. Once deficiencies have been corrected, the Electrical Contractor shall confirm in writing to the Consultant that all deficiencies have been corrected. The Consultant will schedule a second site visit to review the correction of noted deficiencies. Should any noted deficiencies be found to be still outstanding, the Electrical Contractor shall correct them and again notify the Consultant in writing. Charges to the Electrical Contractor may result from repeat visits after the second visit.

3.22.2 The Electrical Contractor is required to complete all work above ceilings and allow time for deficiency reviews and correction of noted deficiencies in a timely manner in order to accommodate the current Construction Schedule. This includes time for reinspection as required prior to concealing (drywall enclosures, drywall ceilings and acoustic tile ceilings) of any service. The Electrical Contractor will be responsible for uncovering any concealed services for inspection.

3.23 **LIST OF ELECTRICAL SUBCONTRACTORS AND MANUFACTURERS**

3.23.1 In the Bid documents, name the Subcontractors and Manufacturers for the items listed below. Use only one name for each item. See Clause “Material and Equipment”. Where the name of a manufacturer is not entered on the Bid Form, the Contractor will be required to use the base specified manufacturer.

3.23.2 **Subcontractors**

Fire Alarm System
Data Wiring
PA System
Security System

3.23.3 **Manufacturers**

Disconnect Switches
Emergency Lighting / Exit Signs
Fire Alarm Devices
Luminaires (by Type)
Occupancy Sensors
Panelboards
Security System
Structured Wiring
Wiring Devices

END OF SECTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 16001, “Electrical General Provisions”.

1.2 **DESCRIPTION OF SYSTEM**

1.2.1 Provide all new wiring and raceways. Where possible, conceal all wiring and raceways above ceilings, in walls and partitions. See Section 16001, “Electrical General Provisions”.

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal as defined in Clause “Material and Equipment”.

2.1.2 All outlet boxes, wiring devices, equipment and accessories must be C.S.A. approved and be designed for the application intended.

2.2 **RACEWAYS**

2.2.1 Use E.M.T. in concealed locations in concrete block walls, drywall partitions and for main and branch circuit wiring above corridor ceiling spaces.

2.2.2 Use minimum 1/2″ (16 mm) conduit for power wiring and 3/4″(21 mm) conduit for motor circuits.

2.2.3 Refer to Section 16700 for communication raceways.

2.2.4 Use set screw steel couplings and connectors. Use raintight steel couplings and connectors complete with “O” rings, where exposed to sprinklers.

2.2.5 Use red conduit for Fire Alarm wiring concealed above ceilings, in concrete walls and in mechanical and electrical rooms.

2.2.6 For new devices on existing block or poured concrete walls exposed in finished areas, provide metallic single compartment raceway and appropriate bases.

2.2.7 Use conduit expansion coupling for expansion joint crossing.

2.2.8 Use flexible metal conduit for all final connections to motors and other equipment subject to vibration or which has adjustable mountings. Minimum size 1/2″ (16 mm).

2.2.9 Use rigid PVC underground and in concrete floors, unless otherwise noted. Provide marking tape for underground installations in accordance with Ontario Electrical Safety Code.

2.2.10 For exterior above grade installations, use rigid aluminum conduits and fittings. All boxes and conduit bodies shall be die-cast, copper-free aluminum with aluminum covers and neoprene gaskets.

2.2.11 Fasten all raceways with approved supports. Use clamps and all mounting hardware of the same material as the conduit or compatible material to prevent galvanic corrosion.

2.3 CONDUCTORS

2.3.1 Aluminum conductors are NOT permitted on this project.

2.3.2 Use minimum copper #12 AWG RW-90XLPE **stranded** for branch circuiting and receptacle wiring.

2.3.3 Use RWU-90XLPE wire in all below grade locations.

2.3.4 Use minimum size of #14 AWG RW-90XLPE for control wiring.

2.3.5 Use RWU-90XLPE-1000 volt rated cables from Variable Frequency Drives to motors.

2.3.6 Type AC-90 cable may be used for final drops (maximum 2 m [6.5′]) to lighting fixtures and devices in accessible ceiling spaces. **DO NOT USE AS MAIN BRANCH WIRING FROM PANELBOARDS OR FOR BRANCH CIRCUIT WIRING (i.e. RECEPTACLES, ETC.).**

2.3.7 For wiring to heating equipment, recessed lighting fixtures or where body of fluorescent fixture is used as raceway, use conductors with high temperature insulation of type approved by Electrical Safety Authority.

2.3.8 Use all wire and cable insulation rated 600 volts minimum unless specified otherwise.

2.4 OUTLET BOXES

2.4.1 Use only masonry approved boxes in concrete and masonry construction.

2.4.2 Use 100 mm (4″) square or utility type boxes for surface-mounted boxes and 100 mm (4″) octagonal boxes for ceiling outlet boxes. Use multi-gang boxes for grouped devices. Use wrap-around covers for utility boxes. Use cast aluminium FS type boxes where surface mounted in finished areas.

2.4.3 Use flush-mounted boxes complete with adjustable ears, extension rings and plate rings as required. Do not use shallow or narrow boxes.

2.4.4 Provide FS type boxes c/w rain tight fittings where surface mounted in service rooms or where exposed to sprinklers.

2.5 WIRING DEVICES

2.5.1 Use specification grade wiring devices, types and ratings shown on the Drawings.

2.5.2 Switched receptacles to be black. Use red devices for receptacles\switches fed from emergency circuits.

2.5.3 Confirm colour of wiring devices and plates with Consultant prior to ordering.

2.5.4 **Receptacles**

2.5.4.1 125 volt 20 amp white U-ground Duplex Receptacle (CSA 5-20R)
Hubbell Catalogue No. HBL-5352-W

2.5.4.2 125 volt 20 amp white self-testing GFCI Duplex Receptacle (CSA 5-20R)
Hubbell Catalogue No. GFST20W

2.5.5 **Switches**

2.5.5.1 125 volt 20 amp white single pole switch
Hubbell Catalogue No. HBL-1221-W

2.5.5.2 125 volt 20 amp white three way switch
Hubbell Catalogue No. HBL-1223-W

2.5.6 **Cover Plates**

2.5.6.1 In general, use 302 stainless steel face plates for all flush-mounted devices and die-cast face plates for all surface-mounted devices.

2.5.6.2 All receptacles exposed to weather to have die-cast aluminum duplex gasketted spring door in-use covers.

2.5.7 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause “Material and Equipment”:

Cooper
Hubbell
Leviton
Pass & Seymour

2.6 **DISCONNECT SWITCHES**

2.6.1 Unless specified otherwise, fused or unfused disconnect switches to be conditionally hp rated, heavy duty type with visible break industrial safety switches in general purpose or weatherproof enclosures as required.

2.6.2 For 120V mechanical equipment, provide Hubbell Cat. #B100 toggle switch complete with lockable cover.

2.6.3 For equipment above ceilings such as fans and heat pumps single phase and three phase 30A and below: Hubbell Cat # HBL1372 disconnect switch with aluminum housing or equivalent to be approved by Consultant.

2.6.4 For exterior roof mounted equipment single phase and three phase 30A and below: Hubbell Cat # HBL13R series NEMA 3R disconnect switch with aluminum housing. Or equivalent to be approved by Consultant.

2.6.5 The door to be mechanically interlocked with the operating handle to prevent it from being opened when the switch is in the “ON” position. The handle is to be capable of being padlocked in the “OFF” or “ON” position.

2.6.6 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause “Material and Equipment”:

Eaton
Schneider
Siemens

3 Execution

3.1 **GENERAL**

3.1.1 Unless shown otherwise, the minimum size of all raceways and conductors to be in accordance with the Ontario Electrical Safety Code.

3.2 **CONDUIT INSTALLATION**

3.2.1 Conceal all conduits except in equipment rooms, unfinished area, and where specifically noted. Flush mount all devices, starters, etc., in finished areas. Install all exposed conduits parallel to building walls and partitions.

3.2.2 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

3.2.3 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

3.2.4 Run parallel or perpendicular to building lines.

3.2.5 Run conduits in flanged portion of structural steel. Do not pass conduits through structural members except as indicated.

3.2.6 Group conduits wherever possible on suspended surface channels.

3.2.7 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers. Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

3.2.8 Horizontal runs of conduit will not be permitted in walls unless noted otherwise.

3.2.9 In any case, horizontal runs must be located above level of door or transom frames in area.

3.2.10 Vertical conduits must be supported at each floor slab and at the top and bottom of each riser.

3.2.11 Conduits must be supported from building structure. Provide independent unistrut under obstructions such as ductwork for support as required. Support unistrut from structural members. Do not secure to underside of metal pan roof deck.

3.2.12 Conduit placement should follow the following priority:

- Below grade
- In walls or partitions
- In ceiling cavity
- Exposed

3.2.13 Maintain continuity of ground through all connection points. Use sealer lubricant on all threaded connections embedded in concrete, buried in ground or exposed outdoors.

3.2.14 Leave all conduit systems finished complete with outlet boxes, coverplates, bushings, caps, nylon fish wire, etc. Provide bushings for all sleeves.

3.3 CONDUCTORS

3.3.1 Join #8 AWG and larger conductors with compression connectors properly sized. On #10 AWG and smaller, relaxed wing-nut type connectors may be used. Ideal Industries 451, 452 or 453.

3.3.2 Size conductors for a maximum of 2% voltage drop from the supplying panel to the furthest outlet in the circuit. In calculating voltage drop, use 80% of overcurrent rating or design load where known, whichever is less.

3.3.3 Draw wiring into raceways only after all other work that may cause injury to the wire is completed. Use only wiring lubricants that do not shorten insulation life. Use continuous lengths for feeders to panels and large equipment. Do not splice without permission from Consultant.

3.4 GROUNDING

3.4.1 Ground all components of the Electrical system in accordance with the requirements of Section 10 of the Electrical Safety Code latest edition and the Inspection Authority.

3.4.2 **Provide a separate ground conductor in all raceways.**

3.4.3 Ground secondary neutrals of transformers to building ground conductor.

3.4.4 Where attached to equipment, conduits, cabinets, etc., use suitable approved solderless lugs, compression connectors. No soldered or split bolt type connections are to be used on grounding circuits at any point.

3.4.5 All compression connectors, lugs, etc., used in grounding circuits in any location are to have bolts, nuts, etc., of silicone bronze alloy equal to “Everdur” metal.

3.4.6 Clean all surfaces to which bus or cable are to be bolted, of all paint, rust, etc., and work to a bright, flat surface.

3.4.7 Conduit expansion joints and telescoping sections or metal raceways not thoroughly bonded otherwise, are to be provided with approved bonding jumpers or not less than #8 AWG stranded bare copper.

3.4.8 Provide a separate #14 green ground wire for all outlets connected to a GFCI circuit breaker.

3.5 OUTLET BOXES

3.5.1 Support all boxes independently of the conduits running to them. Use flush boxes in areas where concealed conduit is used.

3.5.2 Check the Drawings to ensure that no outlets are roughed-in at inaccessible locations, where built-in furniture, counters, etc., are to be installed. In such locations, install the outlets above and clear of the trim by approximately 100 mm (4″) unless shown otherwise on the Drawings.

3.5.3 **DO NOT INSTALL OUTLET BOXES OF ANY SYSTEM BACK TO BACK**. Offset as necessary to prevent sound transmission between areas.

3.6 WIRING DEVICES

3.6.1 Install light switches on lock jamb side of the door as finally hung. Check door swing before roughing-in. Install switches with the “ON” position up. Locate switch as close as practical to door jamb but not closer than 1″. Coordinate location with built-in and Owner supplied equipment and furnishings.

3.6.2 When two or more devices are grouped together, mount under a common coverplate unless shown otherwise.

3.6.3 Mount light switches at height as indicated on Drawings.

3.6.4 Mount duplex receptacles 25 mm (1″) above a countertop backsplash to bottom of device coverplate.

END OF SECTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 16001, “Electrical General Provisions” and Section 16100, “Basic Materials and Methods”.

1.2 **DESCRIPTION OF WORK**

1.2.1 Provide breakers to suit existing panelboards.

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal.

2.1.2 This building will be fully sprinklered. Use sprinkler proof electrical equipment to prevent the sprinkler system water from entering electrical equipment for all surface mounted equipment.

2.1.3 Unless noted otherwise on the Drawings or in Specifications, user operated devices, display and controls shall be located between 125mm (5") and 1830mm (72") from bottom of floor mounted equipment.

2.2 **DISTRIBUTION EQUIPMENT**

2.2.1 **Distribution and Panelboard Circuit Breakers**

2.2.1.1 Unless noted otherwise on Drawings or panel schedules, circuit breakers are to be moulded case as rated below. Series rated breakers are not acceptable unless stated otherwise on the Drawings (ground fault breakers excluded).

2.2.1.2 Breakers are to be suitable for the panelboards provided. All breakers are to be bolted in place. Plug-in only type are not acceptable.

2.2.1.3 For 250V panelboards, main and branch breakers to be rated minimum 22,000 amperes RMS symmetrical at 208 or 240 volt.

2.2.1.4 For 600V panelboards, main and branch breakers to be rated minimum 22,000 amperes RMS symmetrical at 600 volt.

2.2.1.5 All circuit breakers smaller than 400A to be moulded case thermal-magnetic type providing inverse time-current tripping curves. Multi-pole breakers to have common-trip device with single handle.

2.2.1.6 All circuit breakers 400A and larger to have adjustable Long-time Short-time Instantaneous (LSI) solid state trip unit.

2.2.1.7 All 600V circuit breakers 1000A and larger, and all 208V circuit breakers 2000A and larger to have adjustable Long-time Short-time Instantaneous Ground Fault (LSIG) solid state trip unit. Each circuit breaker shall provide trip indication showing reason for trip (overload, short circuit, ground fault).

2.2.1.8 Shunt trip breakers to be 120V AC solenoid type. Electrically held shunt trip breakers are not acceptable.

2.2.1.9 Provide ground fault circuit interrupters breakers as indicated on Panel Schedules. Provide separate neutral conductors for each circuit. Unless noted otherwise, ground fault circuit interrupter breakers are Class A, Group 5mA.

2.2.1.10 Provide positive locking devices on the handles of breakers serving loads below. Trip units to remain free to function while locked in the ON position.

- exit signs
- emergency lighting and night light circuits
- Fire Alarm control panels
- Security System control panels
- CCTV and network equipment
- door hardware
- snow melting and heat tracing

2.2.1.11 Provide quantity of spare breakers as called for on the Panel Schedules or Drawings

2.2.2 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause “Material and Equipment”:

Eaton
Schneider
Siemens

3 Execution

3.1 **PANELBOARDS**

3.1.1 Provide new typewritten directories for all existing panelboards affected by work.

3.1.2 Contractor to provide updated schedules complete with room numbers. Trace out existing circuits as required.

3.1.3 Include room number and description of load for each breaker. For circuits serving mechanical equipment, indicate room number mechanical equipment serves. Coordinate on site with Division 15.

3.2 **ARC FLASH HAZARD WARNING LABELS**

3.2.1 Provide generic shock and arc flash warning labels on all new panelboards, MCC’s and disconnect switches and splitters in accordance with Ontario Electrical Safety Code 2-306.

3.2.2 Label shall be located so that it is clearly visible to persons before examination, adjustment, servicing, or maintenance of equipment. Locate label on the inside door of panelboards.

END OF SECTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 16001, “Electrical General Provisions” and Section 16100, “Basic Materials and Methods”.

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1 **Lighting Systems**

1.2.1.1 Nominal 120 volt A.C.

1.2.1.2 Branch circuit wiring from 120/208 volt, 3 phase, 4 wire panelboards.

2 Products

2.1 **GENERAL**

2.1.1 Use materials specified herein or approved equal.

2.1.2 Use the product of only one manufacturer for each type of luminaire.

2.1.3 Refer to Luminaire Schedule on Drawings.

2.2 **LED LUMINAIRES**

2.2.1 All LED luminaires must bear an approved certification mark as per Ontario Electrical Safety Code Bulletin 2-7-29. A UL certification mark without the ‘c' is not an approved certification mark.

2.2.2 **Luminaires designed for LED lamps with integral driver** as specified below shall adhere to LED lamp manufacturer guidelines, certification programs, and test procedures for thermal management to guarantee the minimum lamp life and lumen maintenance as specified below.

2.2.3 **Luminaires designed with integrated custom LED’s.** shall be as specified on drawings or approved equal meeting the following requirements:

2.2.3.1 Only products from manufacturers that have been in the lighting manufacturing business for minimum of 10 years will be considered.

2.2.3.2 Luminaires must be DLC Listed.

2.2.3.3 Modularity, shall be designed to allow for replacement of; driver, LED’s, without specialised tools and without removing luminaire from the ceiling.

2.2.3.4 Performance - LED luminaire with custom lamps must exceed LED lamp parameters specified below for efficacy and lumen maintenance by minimum 15%.

2.2.3.5 Lumen Maintenance - at least 70% of initial lumens for at least 50,000 hours.

2.2.3.6 Minimum luminous efficacy 50 lumens per watt (lm/W)

2.2.3.7 Warranty - Written warranty covering repair or replacement for a minimum of five (5) years from the date of purchase. Warranty must be included with maintenance manuals and have a toll-free (e.g., "800") number, or mailing address, or web site address for consumer complaint resolution and future LED replacement upgrade.

2.3 EXIT SIGNS

2.3.1 Signs to be suitable for wall and/or ceiling mounting and be provided with diffusers on the underside for down lighting and directional arrows in the face as indicated on the Drawings.

2.3.2 Signs to be green pictograms, Meeting CSA22.2 No. 141-10 with directonal pictograms and faces as shown on the drawings.

2.3.3 Provide an LED (light emitting diode) type light source, maximum 3 watts, 120/347 volt power supply.

2.3.4 Signs to meet CSA-C860-01 “Performance of Internally Lighted Exit Signs”.

2.3.5 Provide suitable clear acrylic guards as indicated on the Drawings.

2.3.6 Signs to be self-powered for 2 hours constructed from extruded, one-piece aluminum painted white, suitable for wall and/or ceiling mounting. To be Lumacell LA-3-W-S.

2.3.7 The following manufacturers will be considered as equal subject to the requirements of Clause “Material and Equipment”:

AimLite
Beghelli Luxnet
Emergi-lite
Lithonia
Lumacell
Lumaid
Stanpro
Uniglo

2.4 EMERGENCY LIGHTING

2.4.1 All floodlights to be 4 watt LED MR16 type. Units to be 12 volt with an 8 year minimum battery life expectancy, capable of producing 250 watts for 1/2 hour at 120 volt, rated in accordance with CSA Standard C22-2-141.

2.4.2 The following manufacturers will be considered equal subject to requirements of Clause "Material and Equipment":

AimLite
Beghelli Luxnet
Emergi-lite
Lithonia
Lumacell
Lumaid
Stanpro
Uniglo

2.5 **LUMINAIRE NOISE**

2.5.1 All ballasted luminaires are to be manufactured to reduce noise below room ambient noise level.

2.5.2 Any luminaire or group of luminaires which can be heard above ambient noise are to be quietened or replaced at no additional cost to the Contract.

2.6 **SPARE LUMINAIRES**

2.6.1 Provide a quantity of 1% spare luminaries (minimum 1) of each type used on project and turn over to Owner at Substantial Completion.

3 Execution

3.1 **INDOOR LIGHTING**

3.1.1 Install luminaires complete with the necessary accessories, conduit supports, ball aligners, hangers, mounting yokes, etc.

3.1.2 Check the type of ceilings before placing an order for luminaires.

3.1.3 Provide independent supports from slabs or steel above hung ceilings. Luminaires are not to be supported solely by the hung ceiling. Nylon inserts are not on approved fastening method for poured concrete. Do not secure to underside of metal pan roof deck.

3.1.4 Obtain revised locations from the Consultant when pipes or ductwork interfere with the proper mounting location of recessed luminaires before roughing-in conduit.

3.1.5 Take all necessary precautions to ensure that all luminaires, diffusers and lamps are left clean at the completion of the job.

3.1.6 Ensure that all luminaires including ballasts and lamps are in good working order at the completion of the job. Replace at no extra cost any defective or burned-out lamps.

3.2 **LUMINAIRES IN SUSPENDED CEILINGS**

3.2.1 Provide adequate additional chain hanger supports for all luminaires in suspended ceiling systems to approval of the Consultant, and in accordance with Ontario Electrical Safety Code Bulletin No. 30-4-4.1996.

3.2.2 All existing luminaires to be removed and reinstalled are to have new chain hangers provided.

3.2.3 Coordinate with the Architect and Ceiling Contractor to determine which ceilings have been designed and constructed to carry the weight of the luminaires, so the support chains can be eliminated.

3.2.4 Ensure all luminaires are mechanically secured to the ceiling system with manufacturer approved clips.

3.3 **LUMINAIRE SCHEDULE**

3.3.1 Refer to Drawings for luminaire type and description.

3.4 EMERGENCY LIGHTING

3.4.1 Test emergency for 1/2 hour and verify that the entire system is working properly. Contractor is to complete the Emergency Lighting Test Form and providing a line item for each and every device. A sample copy of the form is attached in Appendix `A'. Submit a letter and the completed form indicating each device has been tested, prior to occupancy. Letter to state the following: "The emergency lighting system has been tested for 1/2 hour and is working in accordance with the Drawings and Specifications".

3.5 REPLACEMENT LUMINAIRES

3.5.1 Prior to ordering new luminaires to replace existing, Contractor to verify voltage of existing luminaires.

3.6 EXIT SIGNS

3.6.1 Locate exit signs as required to prevent obstruction from view. Mount on walls where possible.

3.6.2 Mount exit signs as required to prevent plumbing, structural supports, etc from obstructing view of exit sign. Provide pendant mounts as required for ceiling mounted signs.

END OF SECTION

A P P E N D I X "A"

Emergency Lighting Test Form

Emergency Lighting Test Form			
Project Name	XYZ Project, City		
C+B Project #	####		
Contractor Name	Your Name Electric Ltd.		
Date of Test	Day, Month, Year		
Device Type	**Device Location**	**Source (Battery # or CCT#)**	**Test Duration (min.)**

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 16001, “Electrical General Provisions” and Section 16100, “Basic Materials and Methods”.

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1 **Stand Alone Lighting Control**

1.2.1.1 Provide stand alone lighting control devices as shown on plans and specified herein.

1.3 **SUBMITTALS**

1.3.1 Submit a lighting control sequence of operation schedule with shop drawings outlining control sequence for each type of room. Group rooms with identical sequence of operation and indicate room numbers.

1.3.2 Schedule to identify number of lighting zones, zone type (switching or dimming), auto-on operation (to preset lighting level if applicable), auto-off operation, daylight harvesting, work plane height and illumination as specified herein.

2 Products

2.1 **GENERAL**

2.1.1 Use materials specified herein or approved equal.

2.1.2 In general, switches and automatic wall switches to match wiring device colour. Faceplates for low-voltage switches to match wiring device faceplates. Refer to Section 16100.

2.2 **LINE VOLTAGE OCCUPANCY SENSORS**

2.2.1 Provide a complete occupancy sensor control system in each room indicated completed with sensor, control wiring and mounting hardware as indicated and specified herein and in manufacturer installation manuals:

2.2.2 The following Sensors to be provided:

2.2.2.1 **DT-200 Dual Technology Sensor**

- 40 kHz frequency ultrasonic transmission
- Time delays: SmartSet (automatic), fixed (5, 10, 15, 20, or 30 minutes), walk-through, test-mode
- Sensitivity adjustment: SmartSet (automatic) or reduced sensitivity (for PIR sensitivity); ultrasonic sensitivity is variable with trimpot
- Built-in light level sensor (DT-200) – works from 2 to 200 foot candles
- Low voltage, momentary switch input for manual operation
- DT-I relay with N/O and N/C outputs; rated for 1 Amp at 24 VDC/VAC
- 2000 sq ft of walking motion mounted at 10 ft; 1000 sq ft of desktop motion

2.2.2.2 **DT-300 Dual Technology Ceiling Sensor**

- 40 kHz frequency ultrasonic transmission
- Advanced Signal Processing automatically adjusts detection threshold
- User-adjustable DIP switch time delay and sensitivity settings
- Isolated relay allows sensor to interface with building control systems
- Omni-directional transmission (360° coverage)
- Temperature and humidity resistant receivers
- Digital DIP switch time delay (15 seconds to 30 minutes)

2.2.3 Unless otherwise indicated, provide the following models according to the symbol type:

Type	Symbol	Wattstopper Cat. No.	Mounting
1		DT-200	wall at ceiling
2		DT-300	ceiling

2.2.4 Provide DT-355 dual technology line voltage ceiling sensors in storage and service rooms.

2.2.5 Provide wire guards over sensors where indicated, plated steel 5mm (1/4") wire suitable for flat wall or corner mounting.

2.2.6 All Occupancy Sensors to be from one manufacturer, UL and cUL listed and have five year warranty.

2.2.7 **Power Packs**

2.2.7.1 Power pack shall be self-contained transformer and relay module in a NEMA 1 plenum use acceptable enclosure.

2.2.7.2 Power pack shall have two isolated relays rated for 100,000 cycles capable of switching 20 amp load utilizing zero crossing circuitry to protect from effects of inrush current and increase life.

2.2.7.3 Power pack shall have a switch input for each relay output which accept three-wire momentary, two-wire momentary push-button, or maintained low voltage switches as well as 24 VDC voltage devices.

2.2.7.4 Power pack shall have 16mm thread nipple for mounting to junction boxes.

2.2.7.5 Power pack shall provide separate an independent inputs for occupancy sensor, photocell, time clock and load shed signal devices.

2.2.7.6 Power pack shall provide a 24 VDC 150 mA output, with the relay connected for powering other devices.

2.2.7.7 Power pack time input shall provide selectable control scenarios for: hold-ON, to keep lighting controlled by occupancy sensors ON during timed occupancy; ON-only, to allow switches to only turn lighting ON and not OFF during timed occupancy; auto-ON, to turn ON lighting loads at the beginning of timed occupancy; after hour shut-off, to provide local switch operation of lighting loads after hours and then shutting them off after a selectable override time period of 30 minutes, 1 hour, 2 hours, or 4 hours.

2.2.7.8 Power pack shall have a standard 5 year warranty and be UL and CUL listed.

2.2.7.9 To be Wattstopper BZ-150 or approved equal.

2.2.8 **Momentary Switches**

2.2.8.1 Provide momentary, low voltage switches as indicated on Drawings and specified here in. Switches to be multi-button or centre spring return toggle/decora type.

2.2.8.2 LVS-1-W Series Low Voltage Momentary toggle Switch

- 3 amp, 24 VAC/VDC rated
- Single-pole, double-throw centre off spring return.
- designed to fit conventional toggle switch openings
- Minimum 5 year warranty
- cUL listed

2.2.9 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause "Materials and Equipment":

Douglas
Sensor Switch
Wattstopper

2.3 **DIGITAL LIGHTING MANAGEMENT**

2.3.1 Provide a 100% digital lighting control system as shown on the drawings to meet space control requirements of AHSRAE/IESNA 90.1-2010. Provide occupancy/vacancy modes of operation. In general, provide two control circuits per lighting zone with one circuit configured in occupancy mode and other in vacancy mode.

2.3.2 Provide automatic shut-off of receptacles as shown on the drawings. Receptacles to be powered whenever spaces are occupied, regardless of overhead lighting.

2.3.3 System to be capable of adjustment, including programming and photosensors and occupancy sensor parameters, using software residing on a PC. Use of a handheld configuration tool may not be substituted for this programming ability. Room controllers to operate independent of programming PC.

2.3.4 All components to be self-configuring, digitally addressable, capable of ladderless configuration and will not have dip switches or potentiometers.

2.3.5 Provide native BACnet integration via hardware. Use of a software gateway is not acceptable.

2.3.6 Provide contact closure to BAS for occupancy status.

2.3.7 **Digital Room Controllers**

2.3.7.1 Provide digitally addressable two relay controllers. Controllers to be self-configuring, automatically binding the room loads to the connected control devices without commissioning or the use of any tools.

2.3.7.2 Housing to be plenum rated and complete with nipple to mount to standard junction box.

2.3.7.3 Room controllers to have three integral on/off zero-crossing relays rated for 20A at 120V with three 0-10V dimming outputs and three connections for digital lighting network connection.

2.3.7.4 Provide receptacle controllers for circuits as shown on the drawings.

2.3.7.5 WattStopper LMRC-210.

2.3.8 **Digital Switches**

2.3.8.1 Low voltage momentary pushbutton switches to be in 2 equal-sized button configuration, white and compatible with standard decorator wall plates. Buttons to be field replaceable without removing switch from wall. WattStopper LMSW-102.

2.3.8.2 Low voltage switches shown connected to dimming room controllers to be momentary pushbutton switches with one button configuration and LED bar graph showing relative light level of controlled load, white and compatible with standard decorator wall plates. WattStopper LMDM-101.

2.3.8.3 Buttons to be field replaceable without removing switch from wall.

2.3.8.4 Switches to have two connection ports for digital network through-wiring.

2.3.9 **Digital Occupancy Sensors**

2.3.9.1 Digital occupancy sensors to provide automatic switching for specified load connected to a room controller. Sensors shall be interchangeable without the need for rewiring.

2.3.9.2 Sensors to have two connection ports for digital lighting network.

2.3.9.3 Sensors to use dual technology (passive infrared and ultrasonic or microphonic) for occupancy detection. Sensors must be initially trigged by both detection technologies.

2.3.9.4 Digital occupancy sensors shall provide digital calibration for sensitivity (0-100%), time delay (1-30 minutes) and test mode.

2.3.9.5 Multiple occupancy sensors shall be able to be added to the digital lighting network without additional configuration.

2.3.9.6 Unless otherwise indicated, provide the following models according to the symbol type:

Type	Symbol	Wattstopper Cat. No.	Mounting
1		LMDX-100	wall at ceiling
2		LMDC-100	ceiling
3		LMDW-102-W	wall at switch height

2.3.10 **Digital Photosensors**

2.3.10.1 Digital photosensors to provide automatic switching or dimming daylight harvesting capabilities for specified load connected to a room controller. Photosensors shall be interchangeable without the need for rewiring.

2.3.10.2 Sensors to have one connection port for digital lighting network.

2.3.10.3 Sensors to have a operational range for wavelengths between 400nm and 700nm and less than 5% sensitivity for wavelengths outside of this range. Light level range shall be from 1-10,000 footcandles complete with a deadband between the ON and OFF setpoints that will prevent the lights from cycling after they turn off.

2.3.10.4 Adjustable head and a mounting bracket shall accommodate multiple mounting positions and building materials. The photosensor may be mounted on a ceiling tile, skylight light well or backbox.

2.3.10.5 Open loop digital photosensors to have an internal photodiode to measure light with a 60 degree cutoff to avoid unwanted light from the interior of the room.

2.3.10.6 WattStopper LMLS-500.

2.3.11 **Handheld Configuration Tool**

2.3.11.1 Provide two handheld configuration tools with two-way communication to allow complete configuration and reconfiguration of devices. Unit to have LED or LCD display and be capable of uploading and downloading all configuration settings.

2.3.12 Other manufacturers must meet all of the above requirements and must submit shop drawings to Consultant for review minimum six working days prior to close for compliance review. Equal manufacturers will be added via addendum.

2.3.13 The following manufacturers will be considered as equal, subject to the requirements of Clause “Material and Equipment”:

Acuity Brands Control
Wattstopper

3 Execution

3.1 **STAND ALONE LIGHTING CONTROL**

3.1.1 Program all occupancy sensors, where applicable, to SmartSet mode.

3.1.2 Program all occupancy sensors without SmartSet mode to a time delay of 20 minutes.

3.1.3 Demonstrate to consultant correct operation of occupancy and photo sensors.

3.1.4 Program all intelligent power packs for automatic ON operation of one circuit and manual ON operation of second circuit with automatic OFF operation for both circuits.

3.2 **ADDITIONAL SYSTEM COMPONENTS**

3.2.1 Demonstrate to consultant correct operation of shunt relays.

3.3 **DIGITAL LIGHTING MANAGEMENT**

3.3.1 Provide CMP rated Category 5e with RJ-45 connectors for all control wiring. Wiring in accessible ceiling space may be free run, supported by conduit for other systems. Do not attach cable to ceiling grid supports. In inaccessible ceilings and all walls, provide conduit and back boxes.

3.3.2 Digital lighting network cabling to be green throughout building. Contractor to ensure cabling colour is unique from other low voltage cabling (data, voice, BAS controls, etc).

3.3.3 Program all rooms for 50% automatic ON operation and 100% automatic OFF operation of all circuits. Programming to be in accordance with ASHRAE 90.1.

3.3.4 Adjust time delay so that controlled area remains lit for 5 minutes after occupant leaves area.

3.3.5 Provide assistance to BAS contractor as required to integrate, at minimum, occupancy status with BAS.

3.3.6 Upon completion of the installation, the system shall be commissioned by the manufacturer's factory authorized representative who will verify a fully functioning system. Provide Consultant and Owner ten working days written notice of system startup and adjustment date.

3.3.7 Adjust high trim level for luminaires to obtain the following maximum lighting levels at the work plane. Provide high trim percentage and measured illuminance at work plane for each room in maintenance manual.

Space	Work Plane Height	Illuminance
Classrooms	760 mm	30 fc
General Arts Classroom	760 mm	45 fc
Gymnasium	0 mm	50 fc
Learning Commons	760 mm	30 fc
Maker Space	910 mm	30 fc
Offices	760 mm	35 fc

3.3.8 Provide room-by-room documentation on the commissioning of the system including sensor parameters, time delays, sensitivities, daylighting setpoints, sequence of operation, (e.g. manual ON, Auto OFF. etc.) and load parameters (e.g. blink warning, etc.)

3.3.9 Resubmit updated sequence of operation schedule to include high trim setting for each lighting zone and measured illumination at work plane.

3.3.10 Upon completion of commissioning, the factory-authorized technician shall provide the proper training to the owner's personnel on the adjustment and maintenance of the system.

3.3.11 Thirty days from occupancy re-calibrate all sensor time delays and sensitivities to meet the Owner's specific requirements. Provide a detailed report to the Consultant of re-commissioning activity.

3.3.12 Turn handheld configuration tools over to Owner’s representative at end of construction. Provide signed letter from Owner confirming receipt, and include in electrical manuals.

END OF SECTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 The requirements of the Instructions to Bidders, the Contract Forms, the General Conditions as amended, and the Supplementary General Conditions as hereinbefore written will form a part of the following Specifications and the Contractor will consult them in detail for instructions governing the work.

1.1.2 Conform to the requirements of Section 16001, “Electrical General Provisions”.

1.2 **REFERENCES**

ANSI/EIA/TIA-569B -Commercial Building Standard for Telecommunications Pathways and Spaces

1.3 **DESCRIPTION OF SYSTEMS**

1.3.1 **Data Communication System**: Provide a system of empty conduits and boxes, outlets and wiring, as indicated on Drawings. All conduits are to be complete with nylon fishwire. Refer to Section 16710 for cabling details.

1.3.2 **Security System**: Provide a system of empty conduits and boxes, outlets and wiring, as indicated on Drawings. All conduits are to be complete with nylon fishwire. Refer to Section 16705 for cabling details.

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal.

2.2 **COMMUNICATION/SECURITY/ACCESS CONTROL SYSTEM CONDUIT**

2.2.1 Cables shall generally be installed in communication trays or conduit. All new conduit shall be thin wall EMT, sized for the cables required plus an additional 50% for future cables. Minimum conduit size shall be 3/4″.

2.2.2 In general, the following table shall be used for communication conduit fill:

Conduit Size	**3/4" 21mm**	**1" 27mm**	**1-1/4" 35mm**	**1-1/2" 41mm**	**2" 53mm**	**2-1/2" 63mm**	**3" 78mm**
Max UTP	2	3	6	7	14	17	20
Max Coax	2	4	6	9	17	26	38

2.2.3 Cables shall NOT be attached to pipe or conduit or ductwork, etc.

2.2.4 Conduit ends shall be provided with non-metallic bushings to provide a round edge, which will not abrade the cable jacket.

2.2.5 **Telephone/Data:** Provide single gang device wall boxes, complete with 21 mm (3/4″) conduit **up to the cable tray or J hook system**. Provide pull boxes and splice boxes as indicated, for every 30 m (100') fo conduit, and more than two 90° bends or equivalent.

2.2.5.1 Stainless Steel faceplates specified in Section 16710 do not fit in all device boxes. Confirm compatibility with Data contractor prior to rough-in.

2.2.6 **Fibre Optic Backbone:** All fibre optic backbone cables to be in conduit system. Conduits to be factory painted orange.

2.2.7 **Security/Access Control System:** Provide single gang device wall boxes, complete with 16 mm (3/4″) conduit **up to the cable tray or J hook system**. Provide pull boxes and splice boxes as indicated, for every 30 m (100') fo conduit, and more than two 90° bends or equivalent. All conduits to have pull strings from device wall boxes to cable tray.

2.2.8 PVC conduit is not allowed inside and will be removed at the contractor's expense.

3 Execution

3.1 **COMMUNICATION/SECURITY/ACCESS CONTROL SYSTEM CONDUIT**

3.1.1 Provide 20 mm (3/4″) conduit except as noted, from each wall outlet to accessible ceiling space. **Ensure end of conduit is fully accessible for cabling installers.**

3.1.2 Provide all conduits, outlet boxes and wiring for a complete system. Minimum size conduit to be 21 mm (3/4"), except where noted.

3.1.3 Where possible, run all conduit in the ceiling space and conceal all conduit within ceiling spaces, walls or partitions. Mount outlets at the same elevation above finished floor level as duplex receptacles or as noted on the floor plans.

3.1.4 Rigidly install all conduits, adequately supported and properly reamed at both ends. Join sections of conduits by approved couplings and conduit terminations at boxes, pull boxes, etc. using approved fittings.

3.1.5 The inside radius of bends not to be less than: Six times the internal diameter of conduits 50mm (2") and smaller.

3.1.6 Install conduits and boxes as per TIA/EIA-569-A.

3.1.7 Minimum size of pull boxes and splice boxes to be sized as per conduits and Tables 5, 2-2 and 5, 2-3 in TIA/EIA-569-A.

3.1.8 Conduits shall be grounded minimum at one end.

3.1.9 Conduit fill capacity shall not exceed 35%.

3.1.10 Cables and raceway shall maintain minimum 150mm (6″) separation from sources of heat such as steam or hot water pipes, vessels and fittings, which are insulated, and minimum 610mm (24″) from the same, which are uninsulated.

3.1.11 Pull wires must be provided in all conduits.

END OF SECTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 16001, “Electrical General Provisions”.

1.1.2 Products will comply with the latest edition of the following Standards:

CAN/ULC-S302-M91, Installation and Classification of Burglar Alarm Systems for Financial and Commercial Premises, Safes and Vaults
CAN/ULC-S303-M91, Local Burglar Alarm Units and Systems
CAN/ULC-S306-03, Intrusion Detection Units
CAN/ULC-S319-05, Electronic Access Control Systems
CAN/ULC-S525-99, Audible Signal Appliances

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1 **Security System**

1.2.1.1 Provide a complete hardwired Security System including conduits, devices and all necessary components, as recommended by manufacturers.

1.2.1.2 Provide keypads, door contacts, motion sensors and headend equipment.

1.3 **SUBMITTALS**

1.3.1 Submit Shop Drawings in accordance with the General Conditions of the Contract and as specified in this Section.

1.3.2 Provide a written description of the proposed system configuration augmented with block diagrams identifying the location of all system components and associated cable routings.

1.3.3 Provide lists of all off-the-shelf and custom equipment, including equipment quantities.

1.3.4 Provide the mechanical, electrical and environmental specifications for all listed equipment and cable.

1.3.5 Provide an overview of any equipment installation techniques which may deviate from the standards contained in this Section. Expose all such installation techniques for prior approval by the Consultant.

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal.

.2.1.2 Conductors in inaccessible ceiling spaces and partitions are to be installed in electrical metallic tubing in accordance with Specification Section 16700.

2.1.3 Conceal all wiring above finished suspended ceilings, except where otherwise noted.

2.1.4 Outlet boxes are to be code gauge, galvanized steel, of a depth necessary to accommodate the number of wires and the device contained therein.

2.2 **SECURITY SYSTEM**

2.2.1 **Detection Devices**

2.2.1.1 Quad element motion detector with digital motion detection (no analog detection) circuitry and shielded from EMI and RFI signals, 12 m x 12 m (40′ x 40′) range with 110° viewing angle, complete with form C relay and anti-tamper switch. Paradox DG65-C.

2.2.2 **Wiring**

2.2.3 All wiring to be a minimum 22 gauge four conductor, CMP rated, as per manufacturer's recommendations.

2.2.4 The following manufacturers of the above equipment will be considered equal subject to requirements of Clause “Material and Equipment”:

eMerg (IEI)

3 Execution

3.1 **GENERAL INSTALLATION**

3.1.1 Provide all necessary wiring, conduits, outlet boxes and devices for a complete system. Conceal all wiring.

3.1.2 Install all wiring to manufacturer's recommendations. Conceal all conduit within ceiling spaces, walls or partitions, where possible.

3.1.3 Submit complete detailed wiring diagrams with description of system upon completion as per Section 16100. Provide all required instructional support to permit correct use of system by staff members.

3.1.4 Coordinate with door hardware supplier all requirements for system components, door strikes, concealed door contacts in particular. Coordinate power and electrical parameters with the door hardware supplier.

3.1.5 Included in Base Bid for manufacturers representative to spend four hours on site for training Owner’s Staff on the operations, maintenance and setup of the access control system. Notify Consultant seven days in advance of scheduled training.

3.2 **SECURITY SYSTEM**

3.2.1 Provide all necessary programming with documentation and backup. Provide one installation manual, two programming worksheets, 10 sets of User manuals, and 20 quick reference cards. Provide hardware means of convenient backing up and restoring the system program.

3.2.2 Wire all detection devices using form C contact and end of line resistor to provide full supervision against open circuits. Where provided, wire NC tamper switch in series with end of line resistor to provide trouble at panel if activated.

3.2.2.1 **Motion Detectors**

3.2.2.1.1 On activation of a motion detector, the system panel will initiate an alarm signal.

3.2.2.1.2 On activation of a motion detector tamper switch, the system panel will initiate a trouble signal.

3.3 **VERIFICATION AND COMMISSIONING**

3.3.1 Verify system and all connected components operation, and provide written Certificate of Verification.

3.3.2 Notify Owner and Consultant minimum seven days in advance of scheduled verification.

3.3.3 Provide all necessary tools, ladders and equipment.

3.3.4 Ensure appropriate subcontractors, and manufacturer's representatives and security specialists are present for verification.

3.3.5 Visual verification: Objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:

3.3.5.1 Sturdiness of equipment fastening.

3.3.5.2 Non-existence of installation related damages.

3.3.5.3 Compliance of device locations with drawings and reviewed shop drawings.

3.3.5.4 Compatibility of equipment installation with physical environment.

3.3.5.5 Inclusion of all accessories.

3.3.5.6 Device and cabling identification.

3.3.5.7 Application and location of ULC approval decals.

3.3.6 Technical verification: Purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:

3.3.6.1 Measurements of coverage patterns

3.3.6.2 Connecting joints and equipment fastening.

3.3.6.3 Compliance with manufacturer's specification, product literature and installation instructions.

3.3.7 Operational verification: Purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:

3.3.7.1 Operation of each device individually and within its environment.

3.3.7.2 Operation of each device in relation with programmable schedule and or/specific functions.

END OF SECTION

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1 General

1.1 **CERTIFIED SYSTEM VENDOR**

1.1.1 Data Communications work as specified will be the responsibility of the Contractor and equipment Vendor to:

1.1.1.1 Provide a minimum 15 year complete system performance warranty.

1.1.1.2 Provide a certified CAT 6 compliant wiring system compliant wiring system for based on contract documents.

1.1.1.3 Perform the pulling of all voice and data system cables.

1.1.1.4 **ONLY** qualified technicians directly employed by the Contractor and Vendor trained technicians will terminate all cables (at both ends), test and perform cross-connects.

1.1.1.5 After completion, provide testing as per ANSI/EIA/TIA-568A Addendum 5 on all cable runs, and documentation of test results.

1.1.1.6 Provide and install equipment as specified herein.

1.1.1.7 Provide documentation of the installation.

1.1.1.8 Provide System Vendor Letter of Certification/Warranty upon completion of job, which will include the notification of a CAT 6 compliant performance level, the Certification/Warranty Number, the identification of the installation by the location and installation date.

1.1.2 Approved Certified System Vendors are required to provide a complete voice/data system including all cables, fibre optic cables, patch cable, outlet jacks, patch panels, fibre patch panels which meet compliance requirements.

1.1.3 The Contractor's technicians are to have extensive training by the Certified System Vendor on the installation, terminations, testing and verification of the Vendors complete CAT6 system.

1.1.4 The following manufacturers are considered as equal, subject to the requirements of Clause "Material and Equipment":

CAT 6: Hubbell or AMP

1.2 **PREAPPROVED CONTRACTORS**

1.2.1 AMP or Hubbell Certified System Vendors

1.3 **SUBMITTALS**

1.3.1 **Shop Drawings**

1.3.1.1 Supply Shop Drawings in accordance with Section 16001 "Electrical General provisions". Do work in accordance with reviewed Shop Drawings.

1.3.1.2 Submit complete cabling system layout for voice and data, cable routing summary and cable outlet designations.

1.3.1.3 All cabling to be CMP rated.

1.3.1.4 Submit detailed layout drawings for termination racks.

1.3.1.5 Manufacturer's data on all devices, cables, patch panel, etc.

1.3.1.6 Detail exact location of equipment indicating wiring raceways, pull, junction and terminal boxes.

2 Products

2.1 **HORIZONTAL DISTRIBUTION SYSTEM**

2.1.1 The Horizontal Distribution System delivers connectivity from the Patch panel in the LAN Room to the work area. Four pair CAT6 UTP CMP rated cables will be used for this purpose.

2.1.2 Horizontal cabling will be terminated within the LAN Room and at the Telecommunications outlet, using the products specified herein. Quantities must be determined by the cable system installer after review of the Drawings.

2.1.3 Provide horizontal cabling for analog phone outlets as shown on the drawings. Terminate on 110 punchdown block located in LAN Rooms.

2.2 **RACEWAY**

2.2.1 Refer to Section 16700 for raceway details.

2.3 **SYSTEM COMPONENTS**

2.3.1 **Jacks**: Provide suitable Cat 6 components to form an installed system.

2.3.1.1 **Jack Colours**

DATA: White
Smart Board Link: Orange
Phone: Black

2.3.1.2 Provide stainless steel flush mounted plates with label designations. Semtron FM-0E-AMP-LAB Series.

2.3.2 **Voice and Data Cable**: Provide cable solution to meet certification.

2.3.3 **Patch Panels**

2.3.3.1 ALL Patch Panels used must be of the same brand as the Cable and Modular Jack used. Patch panels must be installed in a specified location in a wall mounted rack or a wall bracket as required.

2.3.3.2 Patch panels must provide 24 or 48 ports, according to need and be wired to T568A. Patch panels must be augmented with horizontal management panels (front) and rear cable support, to properly dress, terminate and manage the installed cables and provided patch cords**. All cabling is to be terminated in numerical order according to the School's room number system. (Example: 100, 101, 101A, 101B, 102-1, 102-2, 103...).** The front of each module must be capable of accepting 9 mm to 12 mm labels. Patch panels must be UL Listed and CSA certified.

2.3.4 Provide minimum 25% spare capacity on all new patch panels.

2.3.5 Provide dedicated patch panels for telephone outlets.

2.3.6 **Patch Cables**

2.3.6.1 All patch cables supplied must be of the same brand as the terminations and horizontal cable used. Patch Cords used at the telecommunication rack and at the workstation must be prefabricated stranded Cat 6, 24 AWG, 4 pair assemblies.

2.3.6.2 In the wiring closet, 6′ patch cords must be provided to cross-connect between the patch panels and network equipment. One patch cord per terminated outlet is to be provided. Six foot patch cords are to be labelled with Brady style numbers on both ends corresponding to the patch panel port number for which the cable is intended. As well, each workspace outlet to include one 10′ Cat 6 patch cord.

3 Execution

3.1 **INSTALLATION**

3.1.1 The Contractor will supply, install, test, document and certify the cable system according to this specification and must comply with able plant installation and termination procedures as specified in the CSA T529-95 Standard for horizontal and backbone copper and fibre-optic cabling systems as well as the manufacturer's CSV cable installation practices.

3.1.2 The Contractor will correct deficiencies at no cost to the Owner.

3.1.3 Base Wiring includes:

1. Cable
2. Jacks/Patch Panel
3. Distribution and Termination
4. Testing and Labelling
5. Patch Cables

3.2 **IMPLEMENTATION**

3.2.1 **Horizontal Cabling and Termination**

3.2.1.1 Within the LAN Room, horizontal cable terminations and rack installation will be as per Drawing Details and SCCDB specifications.

3.2.1.2 **The horizontal data cabling** will be terminated on Patch panels, mounted in 19″ standard racks within the LAN Room. Provide one dedicated data cable per telecommunications outlet (or as specified on Drawings). Horizontal data cable length to the farthest outlet will not exceed 90 m (295′) as specified in CAN/CSA-T529. All Data cabling is to be Category 6 CMP. CMR cable will not be permitted.

3.2.1.3 Provide sufficient vertical and horizontal wire managers on the rack for Patch Cord management.

3.2.1.4 Unused ports on faceplates will be filled with the appropriate blank insert.

3.2.1.5 Each 4 pair cable to be terminated in an eight position module. Data pin/pair assignment must meet T568A Standard.

3.2.1.6 All cable runs will be completed without splices.

3.2.2 Support cables using cable clamps or wiring harnesses. Utilize cable trays and/or cable hanger to manage cable in orderly fashion.

3.2.3 Route all cable in such a way as to ensure maximum separations from sources of EMI as defined in CAN/CSA T529. Do not run cables above light fixtures, motors, speakers, air diffusers or similar locations.

3.2.4 Designate all data and voice outlets as per Drawings and Specifications.

3.2.5 Place all exposed cabling in a neat and professional manner and route as per Specifications and Drawings. Comb and/or route cabling in such manner as to ensure bundled cabling is neat and parallel to other cables in bundle. Tie-wrap all exposed cable bundles at maximum of every 200 mm (8″).

3.2.6 Securely mount data and voice outlets at all work area locations using screws as opposed to self adhesive strips.

3.3 LABELLING

3.3.1 Labelling must conform to these following SCCDBS Standards:

3.3.1.1 Brady type labelling within 6″ of each end of the horizontal cable to be used to indicate room number behind the patch panel. Brady type labelling within 6″ of end of the horizontal cable to be used to indicate patch port number inside the receptacle box.

3.3.1.2 Labelling on the front coverplate of the outlet must be as follows: the word “DATA” and “PHONE” in capital letters, patch panel port number and closet number if more than one closet exists in the building.

3.3.1.3 Labelling on the label area of the patch panel using manufacturer supplied labelling material must indicate the room number and number of the drop within that room, if there is more than one.

3.3.1.4 All other labelling is to be done using mechanically printed labels on permanent self adhesive white labels with minimum 3/16″ height.

3.4 **TESTING**

3.4.1 All cables will be tested as per ANSI/EIA/TIA-568B. All test records will be completed by the CSV. All test instrumentation, test records, and labour required for the testing will be supplied by the CSV/Contractor.

3.4.2 All cable faults will be corrected by the CSV/Contractor at no cost to the Owner. Splicing of cable pairs is not permitted for the repair of any cables. If a cable is found to be defective, it must be replaced.

3.4.3 Provide test result documentation within two weeks of completion of cable installation.

3.4.4 Inform Consultant 10 working days before testing is carried out so that the Consultant can witness all tests. Rectify wiring deficiencies immediately.

3.4.5 Carry out testing only after installation and termination/labelling of communications cabling at; floor tiles, surface-mounted telecommunications outlets, wall-mounted telecommunications outlets after substantial completion.

3.4.6 All test results will be verified by SCCDBS IT staff prior to invoicing.

3.4.7 The completed installation will be inspected by SCCDBS IT staff prior to invoicing.

3.5 **DOCUMENTATION**

3.5.1 Provide complete documentation of the installation and testing.

3.5.2 Provide Vendor Certification upon completion of cable installation.

3.5.3 Provide records and AutoCAD Drawings complete with all jack locations and numbers (voice and data).

3.5.4 All documentation will be verified by SCCDBS IT staff prior to invoicing.

END OF SECTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 The requirements of the Instructions to Bidders, the Contract Forms, the General Provisions as hereinbefore written will form a part of the following Specifications and the Contractor will consult them in detail for instructions governing the work.

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1.1 Provide new wiring, speakers and intercom stations as indicated on the drawings.

1.2.1.2 Extend existing intercom as indicated on the drawings.

1.2.1.3 **A copy of the PA/Intercom software must be turned over to the Owner complete with all passwords, etc., required to make programming modifications to the system. Proprietary programming software will not be acceptable.**

2 Products

2.1 **MATERIALS**

2.1.1 Use materials specified herein or approved equal.

2.1.2 Conceal all wiring above finished suspended ceilings, except where otherwise noted.

2.1.3 **Handsets (phones)**

2.1.3.1 Where phone outlets are indicated on plans, provide black intercom system handset to match existing.

2.1.4 **Speaker Assemblies**

2.1.4.1 **Classroom Modules**: Provide AEG 86-7025L-15 speaker assembly, complete with white square baffle, 25/70 volt transformer and speaker. Provide McBride MCSW-1 call switch assembly with rocker selection of Call or Privacy, on MCWP13SW stainless steel single gang wall place, mounted on classroom control panel.

2.1.4.2 **Ceilings**: Provide AEG 86-7025L-11 speaker assembly, complete with white round baffle, 25/70 volt transformer and speaker. Unit to be installed in AEG E10 backbox in ceiling tiles.

2.1.5 The following manufacturers will be considered equal :

Telecor SL

3 Execution

3.1 **INTERCOM SYSTEM**

3.1.1 Provide a complete functioning intercom system as specified and as indicated on the Drawings.

3.1.2 Provide all conduits, outlet and wiring for a complete system. All cable to be CMP rated. CMR cable will not be permitted.

3.1.3 Cables to be colour coded to manufacturer's recommendation.

3.1.4 **Testing**

3.1.4.1 Entire system is to be installed and tested by a qualified sound technician.

3.1.4.2 Upon complete, test each station and provide a comprehensive room-by-room report to the Consultant.

3.1.4.3 Allow for a minimum of two hour's instruction of operation on two different occasions. (Total of four hours). First training session to be completed during the week before School starts, at a time suitable to the Users.

3.1.4.4 In addition to the above, provide a qualified person familiar with the operation of the system to assist the School Administration in the operation of the system between 0800 hours and 1000 hours on the first day of school.

END OF SECTION

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1 General

1.1 **GENERAL REQUIREMENTS**

1.1.1 Conform to the requirements of Section 16001, “Electrical General Provisions”.

1.2 **DESCRIPTION OF SYSTEMS**

1.2.1 **Fire Alarm System**

1.2.1.1 Supply and install all equipment and accessories to extend the existing electrically supervised, coded, zoned fire alarm system by Edwards as described herein and as shown on plans. Fire alarm devices are to be in accordance with the Ontario Building Code and associated standards.

2 Products

2.1 **NOTIFICATION APPLIANCES**

2.1.1 Provide suitable wire guards for all devices where indicated on the drawings.

2.1.2 **Horn:** Wall mounted horn devices are to have red housing with white “FIRE” lettering. Edwards G1RF-HD.

2.1.3 **Horn-strobes (Wall Mounted):** Wall mounted horn-strobe devices are to have red housing with white “FIRE” lettering with field selectable 15, 30, 75 or 110 candela, 1 Hz synchronized xenon high output strobe. Edwards G1RF-HDVM.

2.1.4 **Horn-strobes (Ceiling Mounted):** Ceiling horn-strobe devices are to have white housing with red “FIRE” lettering with field selectable 15, 30, 75 or 110 candela, 1 Hz synchronized xenon high output strobe. Edwards GCF-HDVM.

2.2 **PASSIVE GRAPHIC ANNUNCIATOR**

2.2.1 Provide passive graphic mounted adjacent to the main panel and annunciator panels. Graphic is to be minimum 410 mm x 410 mm (16″ x 16″) graphic outline of building, minimum five zone identification colour, mounted in a frame behind a acrylic faceplate with tamperproof screws of building identifying each zone.

2.2.2 The graphic is to be designed with each zone a different colour to the adjacent zone for easy identification. All zones are to be displayed and labelled same as annunciator. Location of fire alarm system panels to be shown on passive graphic.

2.2.3 In partially sprinklered buildings, identify areas that are sprinklered utilizing hatching.

2.2.4 Identify locations of supervised valves, flow switches and other fire suppression systems. Passive graphic, annunciator and field device identification tags must be displayed and labelled verbatim.

2.2.5 Floor plans to be shown in ‘track up’ orientation based upon location of passive graphic.

2.3 **WIRING**

2.3.1 Provide new wiring to conform with requirements of Ontario Electrical Safety Code Section 32, and applicable Codes and Standards. Size wiring in accordance with Class 2 requirements, but protected from mechanical injury or other injurious conditions such as moisture, excessive heat or corrosive action in accordance with Class 1 requirements.

2.3.2 General wiring with a floor area, conductors to be solid copper Securix II, Type 105°C PVC, 300 volt. Minimum size of any conductor: for alarm receiving circuits and remote annunciators, #16 AWG solid. Wire resistance in these circuits not to exceed 50 ohms. For audible signal circuits minimum #16 AWG solid. Voltage drop to any signal not to exceed 10%.

2.3.3 Conductors in multi-conductor cables to have allowable temperature rating of at least 105°C (200°F).

2.3.4 All conductors to be as per Ontario Electrical Safety Code and installed in metallic raceway.

2.3.5 Install conductors entirely independent of all other wiring and do not enter fixture, raceway, box or enclosure occupied by other wiring.

2.3.6 Splices will not be permitted unless otherwise indicated on the Drawings or specified. Where splices are necessary and approved by the Consultant, use approval metal contact electrical crimp type connectors.

2.3.7 All wiring must be clear of shorts, open and grounds on completion of work.

2.4 **MANUFACTURER**

2.4.1 The following manufacturers of the above equipment will be considered as equal subject to requirements of Clause “Materials and Equipment”:

Edwards

3 Execution

3.1 **FIRE ALARM SYSTEM INSTALLATION**

3.1.1 Fire alarm system installation to be in accordance with the latest edition of CAN/ULC S-524 “Standard for the Installation of Fire Alarm Systems”.

3.1.2 **Wiring**

3.1.2.1 Riser diagrams on drawings show general design intent. Obtain complete wiring diagrams from Fire Alarm manufacturer prior to rough-in.

3.1.2.2 Provide all wiring in conduit and in accordance with Fire Alarm equipment manufacturer's requirements.

3.1.2.3 Identify signal circuit, initiating circuit, auxiliary circuit and all other wiring at Fire Alarm control panel, annunciator, terminal boxes or elsewhere on completion of work with appropriate marking labels.

3.1.2.4 All conventional initiating wiring to be Class B.

3.1.2.5 Provide addressable loops as indicated. All addressable wiring to be Data Communications Link Style A (DCLA). Provide line isolation devices at every circuit/zone change and every fire separation crossing, per CAN/ULC-S524 which automatically opens circuit when line voltage drops to protect the rest of the loops on either side.

3.1.2.6 Addressable loops must have at least 30% spare capacity for addition of future devices. Do not exceed 140 devices total on any addressable loop.

3.1.2.7 All initiating and D.C. signal circuits extending from the fire alarm control to be current limited and protected, in accordance with Ontario Electrical Safety Code requirements.

3.1.2.8 The extended circuit wiring to each alarm receiving circuit or signal circuit is to be individually supervised with no common wiring.

3.1.2.9 Install all wiring in EMT metal conduit above ceilings, and surface in mechanical spaces, and in maintenance/storage spaces with exposed ceilings.

3.1.3 **Control Panels, Transponders and Annunciators**

3.1.3.1 Install the main control panel and annunciators as shown on the Drawings.

3.1.4 Passive graphic, annunciator and field device identification tags provided by Fire Suppression Contractor must be displayed and labelled verbatim.

3.1.4.1 Review zone identification with Fire Inspection Department prior to programming, labelling and manufacturing passive graphics.

3.1.5 **Devices**

3.1.5.1 Install detectors in accordance with CAN/ULC Standard S524 latest edition “Installation of Fire Alarm Systems”.

3.1.5.2 Location of devices shown on Drawings are approximate and must be adjusted to site conditions. If location of existing device to be replaced is not properly centred in individual rooms, adjust to suit.

3.1.6 Mount detectors on ceiling as per CAN/ULC Standard S524 standard unless otherwise specified herein, with the minimum and maximum distances as required for the respective type of detector, at the highest point where variations in ceiling height exist. Do not mount detectors on sides, on undersides, or less than 600 mm (20″) from walls, beams, joints, ducts, open web steel joists, bulkheads or any structure projecting below actual ceiling height and less than 450 mm (18″) from air handling or heating outlets.

3.1.7 Should interference from obstruction, lamp positions, air outlet or heat radiating surfaces be encountered in locating any detector where shown, locate the detector as near as possible to the indicated position, clear of obstacles, to the satisfaction of the Consultant, but maintain a clear space of 600 mm (24″) on the ceiling, below and around.

3.1.7.1 Duct detectors to be mounted in supply air ducts unless otherwise indicated on the Drawings.

3.1.7.2 Mount end of line resistors beside last device. Document location of end of line resistors and place inside fire alarm control panel and in maintenance manuals. Provide PTouch labels on end of line faceplates indicating circuits contained within.

3.1.8 Locate all addressable monitor modules adjacent to equipment being monitored.

3.1.9 Locate all addressable control modules for motors adjacent to starters/motor control centres or building automation control panels as site directed.

3.1.10 Locate all addressable control modules not controlling motors within 3' of device being controlled, where practicable.

3.1.11 **Ancillary Devices**

3.1.11.1 Provide independent addressable control modules for each ancillary device shutdown.

3.1.11.2 Verify operating voltage of door hold open devices and magnetic locks supplied by door hardware contractor for tie into new system. Provide necessary transformation or relays.

3.1.11.3 Unless specified otherwise, power door hold-open devices from nearest unswitched lighting circuit.

3.1.11.4 Shutdown of fans to occur at starter separate from building automation controls. Where single point connections are provided to mechanical equipment, connect to fire alarm shutdown contact on mechanical equipment control panel.

3.1.11.5 Door hold open devices and latch retraction hardware to be installed in accordance with Ontario Building Code clause 3.1.8.12.

3.1.11.6 Magnetic locks to be installed in accordance with Ontario Building Code clause 3.4.6.15(4).

3.2 VERIFICATION AND CERTIFICATION OF FIRE ALARM EQUIPMENT

3.2.1 The Contractor is to provide a full set of Electrical Drawings and Specifications to the fire alarm system representative prior to starting the verification of the fire alarm system. Failure to do so may require the entire fire alarm system to be reverified. Fire alarm system representative to review drawings and provide comments to Consultant prior to commencing verification.

3.2.2 All construction work must be complete before verification of fire alarm system is started. Any modifications to the fire alarm installation after the verification has been commenced will require the entire system to be reverified. Where partial occupancies occur, the fire alarm system for the area to be occupied (including control units) shall meet the requirements of this Standard. Upon system completion, those parts of the fire alarm system tested to this Standard shall be retested in accordance with the requirements of CAN/ULC-S536, Standard for the Inspection and Testing of Fire Alarm Systems, prior to the release of the Verification Report.

3.2.3 Fire alarm technician to review existing building prior to date of verification and review any existing conditions requiring repair. Submit report minimum one week before commencing verification. Consultant will review and issue appropriate instruction.

3.2.4 Where a field device is replaced, the device shall be verified in accordance with CAN/ULC-S537-04.

3.2.5 Testing of all flow switches is to be with actual water flow activation. Supervised valve switches and other supervisory zones to be tested by closing valves or replicating the abnormal condition.

3.2.6 The Contractor is to engage the services of the Fire Alarm manufacturer's representative to verify the fire alarm system in accordance with CAN/ULC-S537-04.

3.2.7 Test all voice communication systems throughout building. Adjust speaker taps as required to provide a minimum common intelligibility scale (CIS) score of 0.70. Evaluate each acoustically isolated space separately. Provide appropriate reports for review by Consultant. Reports to include room name and number, speaker tap wattage, SPL and CIS at no less than 2 locations per room.

3.2.8 During the period of inspection by the manufacturer's representative, make available to the manufacturer's representative as many electricians as designated by the manufacturer's representative to complete the verification within the specified time frame.

3.2.9 Contractor is to supply Consultant with a list of deficiencies indicating areas where installation deviates from ULC Standards or Ontario Building Code. This list will be reviewed and authorized or rejected by Consultant prior to acceptance of certificate.

3.2.10 **Inspection Certification:** On completion of the inspection and when all the above conditions have been complied with, the Contractor is to provide to the Consultant:

3.2.10.1 A verification report identical to Appendix C of CAN/ULC-S537 completed by the fire alarm manufacturer's technician. Document C1 from CAN/ULC-S537 must be signed and dated by the technician upon completion of the verification.

3.2.10.2 A certificate of verification confirming that the inspection has been completed showing the conditions upon which such inspection and certification have been rendered. Certificate must be free of conditions noted. No additional exceptions or conditions are acceptable.

3.2.10.3 Proof of liability insurance for the inspection.

3.2.10.4 A letter separate from the Verification Report stating “All door hold open devices, including latch retraction/release have been tested by the fire alarm verifier and are installed and working, in accordance with Ontario Building Code 3.1.8.12".

3.2.10.5 Provide ESA Inspection Certificate.

3.2.11 **Description of Fire Alarm System**

3.2.11.1 Upon completion of the project, provide to the Owner a copy of CAN/ULC-S536-13 Appendix E "Description of Fire Alarm System for Inspection and Test Procedures". Provide type written copy of this form and provide soft copy with maintenance manuals.

3.3 **FIRE WATCH - ALTERNATIVE MEASURES FOR OCCUPANT FIRE SAFETY**

3.3.1 In the event of any shutdown of fire protection equipment or part thereof, the Fire Department and building occupants/owner should be notified. Instructions should be posted as to alternate provisions or actions to be taken in case of an emergency. These provisions and actions should be acceptable to the Chief Fire Official and be in accordance with the accepted Fire Safety Plan.

3.3.2 An attempt to minimize the impact of inoperative equipment should be made (i.e. where portions of a sprinkler, fire alarm system and standpipe system are taken out of service, the remaining portions will be maintained). Assistance and direction for specific situations should be sought from the Fire Department and be in accordance with the accepted Fire Safety Plan.

3.3.3 Procedures to be followed in the event of shutdown of any part of a fire protection system are as follows:

3.3.3.1 Notify the Fire Department and the monitoring station. Give your name, address and a description of the work and when you expect it to be corrected. The Fire Department should be notified in writing of shutdowns longer than 24 h;

3.3.3.2 Post notices on all floors by elevators and at entrances, stating the work and when it is expected to be completed;

3.3.3.3 Unless noted otherwise in the Fire Safety Plan, have staff or other reliable person(s) patrol the affected area(s) at least once every hour; and

3.3.3.4 Notify the Fire Department, the fire signal receiving centre, and building occupants/owner when work has been completed and systems are operational.

3.4 **INSPECTION COSTS**

3.4.1 Include all costs involved with this inspection in the total Bid Price.

3.5 **TESTING**

3.5.1 Tests of the complete system in the presence of the Owner and the Consultant are to include:

3.5.1.1 Spot check of devices to ensure proper connections and supervision.

3.5.1.2 Operation of an alarm initiating device on each detection circuit is to verify the required operation of alarm devices, annunciators, etc.

3.5.1.3 Operation of all other alarm initiating devices in a convenient, silent method (buzzer, light, meter, etc.) are to ensure connection to the proper circuit and function of the device.

3.5.1.4 Live smoke or open flame are not to be used for testing.

3.5.1.5 Test each area in stages to match the Work Schedule.

3.5.1.6 Demonstrate to Consultant and Owner the operation of ancillary functions (ie maglock and door hardware release, elevator recall, etc).

3.5.2 Provide assistance to the Fire Inspection Department for testing a minimum of 25% of the installed field devices and up to 100% of sprinkler/ standpipe devices (supervised valves, flow switches, etc). Correct deficiencies and retest any devices or zones operating incorrectly as directed by the Fire Inspection Department.

3.5.3 **Integrated Systems Testing**

3.5.3.1 Provide Integrated Systems Testing as indicated in CAN/ULC-S1001-11 "Integrated Systems Testing of Fire Protection And Life Safety Systems.

3.5.3.2 Contractor to engage with Fire Alarm manufacturer at testing phase or a 3rd party commissioning type contractor to arrange for this work. In general, systems to be tested for proper integration with the fire alarm system are noted in CAN/ULC-S1001-11 and include but are not limited to elevators, cooking equipment fire suppression systems, hold-open devices, electromagnetic locks, smoke control systems, emergency generators, audio/visual and/or lighting controls, notification systems, sprinkler systems, standpipe systems, fire pumps, water supplies, water supply control valves, freeze protection systems, fixed fire suppression systems.

3.5.3.3 Contractor to provide to consultant for approval, all proposed testing procedures and proposed reports prior to commencing test.

3.5.3.4 Provide completed reports upon completion of fire alarm verification and submission of verification reports and certificate.

3.6 **TRAINING**

3.6.1 The Contractor shall provide 2 hours training for the complete operation of fire alarm system.

3.7 **SPARE PARTS**

3.7.1 Provide spare fire alarm system parts, including programming and verification, as follows (minimum of 2):

Automatic Initiation Devices	:	10% of each type installed
Manual Pull Stations	:	5% of units installed
Signal Appliances	:	5% of each type installed
Monitor Modules	:	10
Control Modules	:	10
Duct Detector Housing	:	2

3.7.2 Turn spare parts over to Owner at end of construction. Provide signed letter from Owner listing items and quantities of accessories confirming receipt, and include in electrical manuals.

END OF SECTION