

“ISSUED FOR TENDER”

**MECHANICAL & ELECTRICAL
SPECIFICATIONS**

September 19, 2025

**HUMBER RIVER HEALTH
ABAMU RENOVATIONS**



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Quasar Project No. HC-25-054

Project Manual Divisions and Sections bound herein are listed below under the name of the Designer-of-Record responsible for their preparation, under whose seal and authority seal each document so listed is issued for the purpose stated above.

Seals and signatures do not apply to documents not included herein, nor to documents prepared by the Owner or others, including (except as otherwise indicated) Documents in Division 00 – Procurement and Contracting Requirements, Geotechnical Reports, etc.

DISCIPLINE	SEAL AND SIGNATURE
PRIME CONSULTANT'S SEAL This seal governs all Documents and Sections of these Specifications, except Documents and Sections listed below.	
MECHANICAL CONSULTANT'S SEAL This Seal governs: Division 22 – Plumbing. Division 23 – Heating, Ventilating, and Air Conditioning.	
ELECTRICAL CONSULTANT'S SEAL This Seal governs: Division 26 – Electrical.	
The Consultant's seal does not apply to Sections or Documents prepared by other professionals, including the following: Division 00: All Documents Appendices to the Specifications	

End of Document

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1 General

1.01 Summary of Work

- .1 Work Covered by Contract Documents
 - .1 Work of this Contract comprises [replacement of corridor and stairwell lighting, and addition of occupancy and photocell lighting control sensors for the Administration Building] at [Facility name], located at [address], [City, ON], further identified as the site.
 - .2 [The facility is owned by [Insert Owner's Name].
 - .3 [Quasar Consulting Group Inc.] is acting as Prime Consultant.
- .2 The following is not intended to be an all-encompassing scope of work:
 - .1 [Removal and disposal of existing lighting fixtures, as indicated.]
 - .2 [Supply and installation of new LED luminaires, as indicated.]
 - .3 [Modifications to the existing electrical distribution to integrate new lighting and controls equipment.]

1.02 Work Restrictions

- .1 [Construction shall occur in the period between the end of fall exams, and the start of the winter term.]
- .2 Access to site for construction will commence on [December 21, 2017.]
- .3 Contractor is responsible to expedite submittals to ensure products are available to site within the required lead time period.
- .4 Work must be completed by [January 5, 2018.]

1.03 Cutting and Patching

- .1 Approvals
 - .1 Submit written request in advance of cutting or alteration which affects:
 - .1 Structural integrity of any element of project.
 - .2 Efficiency, maintenance, or safety of any operational element.
 - .3 Visual qualities of sight-exposed elements.
 - .4 Work of Owner or separate contractor.
- .2 Inspection
 - .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
 - .2 After uncovering, inspect conditions affecting performance of Work.
 - .3 Beginning of cutting or patching means acceptance of existing conditions.
- .3 Execution
 - .1 Perform cutting, fitting, and patching to complete the Work.

- .2 Remove and replace defective and non-conforming work.
- .3 Provide openings in non-structural elements of Work for penetrations of electrical work.
- .4 Perform Work to avoid damage to other work.
- .5 Prepare proper surfaces to receive patching and finishing.
- .6 Cut rigid materials using power saw or core drill. Pneumatic or impact tools are not allowed.
- .7 Restore Work with new products in accordance with Contract Documents.
- .8 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .9 At penetration of fire-rated wall, ceiling, or floor construction, completely seal voids with fire-rated material of full thickness of construction element.
- .10 Refinish surfaces to match adjacent finishes; for continuous surfaces refinish to nearest intersection; for an assembly, refinish entire unit.

1.04 Duties of the Contractor

- .1 The Contractor shall assume the responsibilities and duties including but not limited to the ones described below:
 - .1 Superintendence
 - .1 Provide full time, on-site, superintendent personnel and supporting staff with proven experience in projects of similar value and complexity.
 - .2 Site superintendent shall have over-all authority to speak for and represent the Contractor.
 - .2 Coordination
 - .1 Coordinate the Work with all the sub-trades involved to ensure that the Work will be carried out on schedule and in proper sequence.
 - .2 Take complete responsibility for all remedial work that results from failure to coordinate any aspect of the electrical work prior to its installation.
 - .3 Take responsibility for the delivery of equipment necessary to complete the Work in accordance with the approved schedule.
 - .3 Staffing and Scheduling
 - .1 Within seven days after the award of the Contract, the Contractor shall provide to the Owner's representative the following information:
 - .1 Appointment of official representatives in the project.
 - .2 Schedule of Work.
 - .3 Delivery schedule for specified equipment.
 - .4 Requirements for temporary facilities, site signs, storage, and the like.
- .2 Work Completion Meeting

- .1 Prior to application for Substantial Performance of the Work, the Contractor shall participate in the take-over meeting. Agenda is to include the following:
 - .1 Review of outstanding deficiencies.
 - .2 Submission of maintenance manuals, warranties, and as-built drawings.
- .3 [Applications for incentives under the saveONenergy program.]

1.05 Submittals

- .1 Shop Drawings and Product Data
 - .1 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connection, explanatory notes, and other information necessary for completion of Work.
 - .2 Adjustments made on shop drawings by the Consultant are not intended to change Contract Price.
 - .3 Make changes in shop drawings as the Consultant may require.
 - .4 Submit three copies of product data sheets or brochures for requirements requested in Specification Sections and as the Consultant may reasonably request where shop drawings will not be prepared due to standardized manufacture of product.
- .2 Samples
 - .1 Submit for review, samples in duplicate as requested in respective Specification Sections.
 - .2 Deliver samples prepaid to Consultant's business address.
- .3 Record Drawings
 - .1 After award of the Contract, the Consultant will provide a set of transparency drawings for purpose of maintaining record drawings. Accurately and neatly record deviations from Contract Documents caused by site conditions and changes ordered by the Consultant.
 - .2 Record locations of concealed components of mechanical and electrical services.
 - .3 Identify drawings as "Project Record Copy". Maintain in new condition and make available for inspection on site by the Consultant.
 - .4 On completion of Work and prior to final inspection, submit record documents to the Consultant.

1.06 Quality Control

- .1 Inspection
 - .1 The Owner and the Consultant shall have access to the work area at all times.
 - .2 Give timely notice requesting inspection if Work is designated for special tests, inspections, or approvals by the Consultant's instructions, or law of place of Work.
 - .3 If Contractor covers, or permits to be covered, work that has been designated for special tests, inspections, or approvals before such is made, the Contractor is to uncover such work, have inspections or tests satisfactorily completed, and make good such work.

1.07 Construction Facilities and Temporary Controls

- .1 Installation and Removal

- .1 Provide construction facilities and temporary controls in order to execute Work expeditiously. Remove such from site after use.
- .2 Hoarding
 - .1 Erect hoarding to enclose area of construction leaving one side of corridor, (outside of hoarding), open for passage; to protect public, workers, public and private property from injury or damage.
 - .2 Provide hoarding as detailed to underside of ceiling, protecting public and private property from injury or damage. Provide lockable gates within hoarding for access to site by workers and equipment.
- .3 Dust Tight Screens
 - .1 Provide dust tight screens or partitions to localize dust generating activities and for protection of workers, finished areas of Work, and public.
 - .2 Maintain and relocate protection until such work is complete.
- .4 Site Storage/Loading
 - .1 Confine the work and operations of employees to limits indicated by Contract Documents. Do not unreasonably encumber premises with products.
 - .2 Do not load or permit to be loaded any part of the work area with a weight or force that will endanger the Work.
- .5 Facilities
 - .1 Office space and telephone will not be provided by the Owner.
- .6 Water Supply
 - .1 The Owner will provide a continuous supply of potable water for construction use.
 - .2 Arrange for connection with appropriate utility company and pay costs for installation, maintenance and removal.
 - .3 The Owner will pay for utility charge at prevailing rates.
- .7 Tools, Equipment and Materials Storage
 - .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment, and materials, (within hoarding or site office).
 - .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.
- .8 Project Cleanliness
 - .1 Maintain the work area in tidy condition, free from accumulation of waste products, and debris.
 - .2 Remove waste material and debris from site and deposit in waste container at end of each working day.
 - .3 Clean interior areas prior to start of finish work, maintain areas free of dust and other contaminants outside of hoarding during construction as well as inside of the hoarding during finishing operations.

1.08 Material and Equipment

- .1 Product and Material Quality
 - .1 Products, materials, equipment, and articles referred to as products throughout Specifications incorporated in the Work shall be new, not damaged or defective, and of best quality compatible with Specifications for purpose intended. If requested, furnish evidence as to type, source, and quality of products provided.
 - .2 Defective products will be rejected regardless of previous inspections. Inspection does not relieve responsibility but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
 - .3 Should any dispute arise as to quality or fitness of products, decision rests strictly with the Consultant based upon requirements of Contract Documents.
- .2 Storage, Handling, and Protection
 - .1 Handle and store products in manner to prevent damage, adulteration, deterioration, and soiling and in accordance with manufacturer's instructions when applicable.
 - .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seals and labels intact.
 - .3 Store products subject to damage from weather in weatherproof enclosures.
- .3 Manufacturer's Instructions
 - .1 Unless otherwise indicated in Specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
 - .2 Notify the Consultant in writing of conflicts between Specifications and manufacturer's instructions, so that the Consultant may establish course of action.
 - .3 Improper installation of erection of products, due to failure in complying with these requirements, authorizes the Consultant to require removal and reinstallation at no increase in Contract Price.
- .4 Workmanship
 - .1 Workmanship shall be best quality, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Consultant if required Work is such as to make it impractical to produce required results.
 - .2 Do not employ any unfit person or anyone unskilled in their required duties.
 - .3 Decisions as to quality or fitness of workmanship in cases of dispute rest solely with Consultant, whose decision is final.

1.09 Project Closeout

- .1 Final Cleaning
 - .1 When the Work is Substantially Performed, remove surplus products, tools construction machinery, and equipment not required for performance of remaining work.
 - .2 Remove waste materials and debris from site at regularly scheduled times or dispose of as directed by the Consultant. Do not burn waste materials on site.
 - .3 Leave work area broom clean before inspection process commences.

- .2 Inspection and Takeover Procedures
 - .1 Prior to application for certificate of Substantial Performance, carefully inspect the Work and ensure it is complete, that major and minor construction deficiencies are complete, defects are corrected, and building is clean and in condition for occupancy. Notify Consultant in writing, of satisfactory completion of the Work and request an inspection.
 - .2 During Consultant inspection, a list of deficiencies and defects will be tabulated. Correct same.
 - .3 When Consultant considers deficiencies and defects have been corrected and it appears requirements of the Contract have been performed, make application for certificate of Substantial Performance.

1.10 Laws, Notices, Permits, and Fees

- .1 Unless reference is made in the Contract Documents to other standards, all Work shall conform to or exceeds the minimum applicable standards of the Ontario Building Code (OBC) or the governing Jurisdictional Authorities.
- .2 Comply with codes, by-laws, and regulations of authorities having jurisdiction over the place of the Work. Codes and regulations form an integral part of the Contract Documents.
- .3 Conform to the latest published requirements of the OBC, together with all related supplements. If a conflict should arise between specific sections of the Code, follow the most stringent requirements.
- .4 The Owner shall apply and pay for the building permit. The Contractor shall pick up the building permit from the municipal department having jurisdiction at the place of Work.
- .5 Obtain and pay for all other permits, inspections, deposits, and certificates of inspection as part of the Work.
- .6 Arrange for inspection, testing, and acceptance of the Work required by the authorities having jurisdiction. Be responsible for necessary preparations, provisions, and pay associated costs. It is the responsibility of the Contractor to schedule notifications and inspections required by the authorities having jurisdiction such that notifications can be properly received and that inspections can be properly undertaken without causing a delay in the Work. The Contractor, at no additional cost to the Owner, shall be responsible for any delay in the Work caused by failure to properly schedule required notifications and inspections. The Contractor shall be present at each site inspection by an inspector.

1.11 Discrepancies and Clarifications

- .1 Advise Consultant of discrepancies discovered in requirements of the Contract Documents and request clarification in written form.
- .2 Advise Consultant when clarifications are required pertaining to meaning or intent of requirements of Contract Documents and request clarification form Consultant in written form.
- .3 Do not proceed with related work until written clarification is provided by Consultant.
- .4 Failure to notify Consultant shall result in Contractor incurring responsibility for resulting deficiencies and expense at no additional cost to the Owner.
- .5 Written instructions issued by the Consultant for the purpose of clarification, implicitly supersede applicable and relevant aspects of the Contract Documents irrespective of whether these Documents are explicitly or specifically cited in clarification requests or clarification instructions.

1.12 Setting Out the Work

- .1 Assume full responsibility for and execute complete layout of the Work to required locations, lines and elevations.
- .2 Arrange meeting with Consultant to discuss critical setting out assumptions for the Work and establish limiting conditions for setting out the Work. Consultant shall chair and prepare minutes of meeting and prepare and submit sketches regarding understanding of key setting out principals.

1.13 Documents at the Place of Work

- .1 Maintain at the Place of work, one copy of each of the following:
- .2 Contract Documents including Drawings, Specifications, addenda, and other modifications to the Contract.
- .3 'Reviewed' or 'Reviewed as Modified' shop drawings.
- .4 Construction and submittal schedules.
- .5 Supplemental Instructions, proposed Change Orders, Change Orders and Change Directives.
- .6 Field test reports.
- .7 Consultant's field reviews.
- .8 Reports by authorities having jurisdiction.
- .9 Building and other applicable permits, and related permit Documents.
- .10 Daily logs including start and finish date of each part of the Work.
- .11 As-built drawings recording as-built conditions, instructions, changes for structure, equipment, wiring, plumbing and the like.

1.14 Overloading

- .1 Protect the existing building from loads which may cause permanent deformation.
- .2 Protect the Work from loads which may cause permanent deformation.

1.15 Protecting Installed Work

- .1 Protect surfaces of completed work exposed to view from staining. Disfigurement and all other damage by restriction of access or by use of physical means suitable for the material and surface location.
- .2 Keep concrete floors and finishes free from oils, grease or other material likely to damage or discolour them or affect bond of applied finishes.
- .3 Protect finished flooring from pedestrian traffic with minimum reinforced kraft paper temporary protection, secured in place and with joints sealed by reinforced pressure sensitive tape. Maintain protection in place until contract completion.
- .4 Protect finished flooring from continuing construction work and delivery of products with plywood panels of minimum 6 mm thickness with joints between panels sealed with reinforced pressure sensitive tape. Maintain protection in place until work and delivery are complete.
- .5 Make good or replace damaged material to the satisfaction of the Consultant.

- .6 Damaged work shall be made good by trades which performed original work, but at the expense of those who caused the damage.
- .7 Protect work and existing property. If damaged, repair or replace. Take all necessary reasonable precautions to guard site, premises, materials, and public when supervised Work is in progress, and at all other times.

1.16 Trademarks and Labels

- .1 Trademarks and labels, including applied labels, shall not be visible in finished work in finished areas, unless otherwise indicated by the Consultant.
- .2 The exceptions to this requirement are trademarks and labels which are essential to identify materials, systems, assemblies and equipment for maintenance and replacement purposes and for life safety, fire resistance and temperature rise ratings.

1.17 Waste Audits and Plans for Waste Reduction

- .1 Comply with requirements of jurisdictional authorities.
- .2 Deliver to nearest appropriate depot, materials accepted for recycling by the municipality having jurisdiction over the place of Work, including but not limited to cardboard, paper, plastic, aluminium, steel, and glass. Deliver to nearest appropriate depot scrap and excess gypsum wallboard for recycling for this material. Include the costs for this work in the Contract Price.

1.18 Interferences

- .1 Co-ordinate placement of equipment to ensure that components will be properly accommodated within spaces provided prior to commencement of the Work
- .2 Take complete responsibility for remedial work that results from failure to coordinate aspect of the Work prior to its fabrication/installation
- .3 Ensure that accesses and clearance required by jurisdictional authorities and/or for easy maintenance of equipment are provided in layout of equipment and services.

1.19 Security

- .1 Be responsible for security of the place of work and materials, from time the Work commences until completion.
- .2 Provide and maintain signs, hoardings guardrail, barriers, warning lights, and other protection as required by authorities having jurisdiction for safety of the place of work. Be responsible for adequacy of protection.

1.20 Smoking Policy

- .1 Smoking in the Owner's premises is prohibited.
- .2 Smoking within 25 m of the existing or completed buildings is prohibited.

1.21 Examination of Site

- .1 Examine the site and be aware of all conditions affecting the Work. No claims will be entertained at any time which would properly have been avoided by a thorough examination of the site.

1.22 Site Conditions

- .1 Existing known conditions of the site are shown on the Drawings. No responsibility is assumed by the Owner for the accuracy of this information.

1.23 Examination Before Execution of Work

- .1 Make good defects in the Work on which further execution of the Work depends.
- .2 Verify dimensions of prepared work before fabrication of the Work.
- .3 Do not proceed with the execution of the Work unless the work which is to receive it and site conditions are satisfactory. Commencement of all Work of all sections shall imply that prepared work and site conditions are satisfactory.

1.24 Exits, Entries, and Parking

- .1 Vehicle access and parking will be assigned by the Owner.

1.25 Construction Safety

- .1 Include all provisions such as fences, barricades, bracing supports, storage facilities, sanitation facilities, fire protection, standpipes, electrical supply, temporary heat, steam supply, ventilation, construction equipment with its supports and guards, stairs, ramps, platforms, runways, ladders, scaffolds, guardrails, temporary flooring, rubbish chutes, walkway lighting, and morality lighting, all as required by the Occupational Health and Safety Act, and amendments thereto and the Fire Code Ontario Regulation 388/97 as well as all other applicable regulations of jurisdictional authorities.

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.01 Definitions

- .1 In this Section "Substitution" means a Product, a manufacturer, or both, not originally specified in Contract Documents by proprietary name but proposed for use by Contractor in place of a Product, a manufacturer, or both, specified by proprietary name.

1.02 Substitution Procedures

- .1 Contractor may propose a Substitution wherever a Product or manufacturer is specified by proprietary name(s), unless there is accompanying language indicating that Substitutions will not be considered.
- .2 Contractor may propose a Substitution wherever a Product or manufacturer is specified by proprietary name(s) and accompanied by language such as "or equal", "or approved equal", or other similar words. Do not construe such language as an invitation to unilaterally provide a Substitution without Consultant's prior acceptance in writing. Do not order or install any Substitution without a Supplemental Instruction or Change Order.
- .3 Provided a proposed Substitution submission includes all of the information specified in this Section under Submission Requirements for Proposed Substitutions, Consultant will promptly review and accept or reject the proposed Substitution.
- .4 Consultant may accept a Substitution if satisfied that:
 - .1 the proposed substitute Product is the same type as, is capable of performing the same functions as, interfaces with adjacent work the same as, and meets or exceeds the standard of quality, performance and, if applicable, appearance and maintenance considerations, of the specified Product,
 - .2 the proposed substitute manufacturer has capabilities comparable to the specified manufacturer, and
 - .3 the Substitution provides a benefit to Owner.
- .5 If Contractor fails to order a specified Product or order a Product by a specified manufacturer in adequate time to meet Contractor's construction schedule, Consultant will not consider that a valid reason to accept a Substitution.
- .6 If Consultant accepts a Substitution and subject to Owner's agreement, the change in the Work will be documented in the form of either a Supplemental Instruction or Change Order as specified in Section 01 26 00 – Contract Modification Procedures.
- .7 If a Substitution is accepted in the form of a Supplemental Instruction or Change Order, Contractor shall not revert to an originally specified Product or manufacturer without Consultant's prior written acceptance.

1.03 Submission Requirements for Proposed Substitutions

- .1 Include with each proposed Substitution the following information:
 - .1 Identification of the Substitution, including product name and manufacturer's name, address, telephone numbers, and web site.
 - .2 Reason(s) for proposing the Substitution.
 - .3 A statement verifying that the Substitution will not affect the Contract Price and Contract Time or, if applicable, the amount and extent of a proposed increase or decrease in Contract Price and Contract Time on account of the Substitution.

- .4 A statement verifying that the Substitution will not affect the performance [or warranty] of other parts of the Work.
- .5 Manufacturer's Product literature for the Substitution, including material descriptions, compliance with applicable codes and reference standards, performance and test data, compatibility with contiguous materials and systems, and environmental considerations.
- .6 Product samples as applicable.
- .7 A summarized comparison of the physical properties and performance characteristics of the specified Product and the Substitution, with any significant variations clearly highlighted.
- .8 Availability of maintenance services and sources of replacement materials and parts for the Substitution, as applicable, including associated costs and time frames.
- .9 If applicable, estimated life cycle cost savings resulting from the Substitution.
- .10 Details of other projects and applications where the Substitution has been used.
- .11 Identification of any consequential changes in the Work to accommodate the Substitution and any consequential effects on the performance of the Work as a whole. A later claim for an increase to the Contract Price or Contract Time for other changes in the Work attributable to the Substitution will not be considered.

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.01 Administrative

- .1 Submit specified submittals to Consultant for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in the Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time or for Product substitutions or other deviations from the Drawings and Specifications.
- .2 Where required by authorities having jurisdiction, provide submittals to such authorities for review and approval.
- .3 Do not proceed with Work affected by a submittal until review is complete.
- .4 Present Shop Drawings, Product data, and samples in SI metric units. Where items or information is not produced in SI Metric units, converted values are acceptable.
- .5 Review submittals, provide verified field measurements where applicable, and affix Contractor's review stamp prior to submission to Consultant. Contractor's review stamp represents that necessary requirements have been determined and verified, and that the submittal has been checked and coordinated with requirements of the Work and Contract Documents.
- .6 Verify field measurements and that affected adjacent work is coordinated.
- .7 Submittals not meeting specified requirements will be returned with comments.
- .8 Reproduction of construction Drawings to serve as background for Shop Drawings is not permitted.
- .9 Do not propose Substitutions or deviations from Contract Documents via Shop Drawing, Product data and sample submittals.

1.02 Shop Drawings and Product Data

- .1 Indicate Products, methods of construction, and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the Work.
- .2 Where Products attach or connect to other Products, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross-references to Drawings, Specifications and other already reviewed Shop Drawings.
- .3 Accompany submittals with a transmittal information including:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification of each submittal item and quantity.
 - .5 Other pertinent data.
- .4 Shop Drawing submittals shall include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:

- .1 Subcontractor.
- .2 Supplier.
- .3 Manufacturer.
- .4 Contractor's stamp, date, and signature of Contractor's authorized representative responsible for Shop Drawing review, indicating that each Shop Drawing has been reviewed for compliance with Contract Documents and, where applicable, that field measurements have been verified.
- .5 Details of appropriate portions of the Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationships to other parts of the Work.
- .5 Product data submittals shall include material safety data sheets (MSDS) for all controlled Products.
- .6 Submit electronic copy of Shop Drawings where specified in the technical Specifications.
- .7 Submit electronic copy of Product data sheets or brochures where specified in the technical Specifications.
- .8 Where a submittal includes information not applicable to the Work, clearly identify applicable information and strike out non-applicable information.
- .9 Supplement standard information to include details applicable to Project.
- .10 Allow 5 Working Days for Consultant's review of each submittal.
- .11 If upon Consultant's review no errors or omissions are discovered, or if only minor corrections are required as indicated, submittal will be returned and fabrication or installation of Work may proceed.
- .12 If upon Consultant's review significant errors or omissions are discovered, a so noted copy will be returned for correction and resubmission. Do not commence fabrication or installation.
- .13 Consultant's notations on submittals are intended to ensure compliance with Contract Documents and are not intended to constitute a change in the Work requiring change to the Contract Price or Contract Time. If Contractor considers any Consultant's notation to be a change in the Work, promptly notify Consultant in writing before proceeding with the Work.
- .14 Resubmit corrected submittals through same procedure indicated above, before any fabrication or installation of the Work proceeds. When resubmitting, notify Consultant in writing of any revisions other than those requested by Consultant.

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.01 Section Includes

- .1 Safety requirements and adherence.

1.02 Related Requirements

- .1 Section 01 31 00 – Project Management and Coordination.
- .2 Section 01 33 00 – Submittal Procedures.
- .3 This section describes requirements applicable to all Sections within Division 02 to Division 49.

1.03 References

- .1 Province of Ontario: Occupational Health and Safety Act, Regulation and Code R.S.O -1990.

1.04 Safety Plan

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to commencing any site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Construction Manager may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.05 Responsibility

- .1 The Prime Contractor is responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial, and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.
- .3 Should any unforeseen or peculiar safety-related factor, hazard, or condition become evident during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations of Province having jurisdiction. Advise Construction Manager verbally and in writing.

1.06 Submittals

- .1 Make submittals in accordance with Section 01 33 00.
- .2 Submit site-specific Health and Safety Plan: Within seven (7) days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
 - .1 Results of site-specific safety hazard assessment.
 - .2 Results of safety and health risk or hazard analysis for site tasks and operation found in work plan.
- .3 Submit two (2) copies of Contractor's authorized representative's work site health and safety inspection reports to Construction Manager and authority having jurisdiction weekly.
- .4 Submit copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.

- .5 Submit copies of incident and accident reports.
- .6 Submit Material Safety Data Sheets (MSDS) to [General Contractor] [Construction Manager].
- .7 [General Contractor] [Construction Manager] will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within ten (10) days after receipt of plan. Revise plan as appropriate and resubmit plan to Construction Manager within five (5) days after receipt of comments from Construction Manager.
- .8 [General Contractor] [Construction Manager]'s review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .9 Medical Surveillance: Where prescribed by legislation, regulation, or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Construction Manager.
- .10 On-site Contingency and Emergency Response Plan: Address standard operating procedures to be implemented during emergency situations.
- .1 File Notice of Project with Owner prior to commencement of Work.

1.07 Safety Activities

- .1 Perform site specific safety hazard assessment related to project.
- .2 Schedule and administer Health and Safety meeting with Construction Manager prior to commencement of Work.
- .3 Perform Work in accordance with Section 01 41 00 and this section.

1.08 Health and Safety Coordinator

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Coordinator. Health and Safety Coordinator must:
 - .1 Have minimum two (2) years of site-related working experience specific to activities associated with electrical installations.
 - .2 Have working knowledge of occupational safety and health regulations.
 - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
 - .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
 - .5 Be on site during execution of Work and report directly to and be under direction of Registered Occupational Hygienist or site supervisor.

1.09 Posting of Documents

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

1.10 Correction of Non-Compliance

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by [General Contractor] [Construction Manager].
- .2 Provide [General Contractor] [Construction Manager] with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Construction Manager may stop Work if non-compliance of health and safety regulations is not corrected.

1.11 Project/Site Conditions

- .1 Work at site will involve contact with:
 - .1 Live electrical parts.

1.12 Work Stoppage

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

1.13 Fire Protection

- .1 Provide and maintain temporary fire protection equipment during performance of Work required by insurance companies having jurisdiction and governing codes, regulations, and bylaws.
- .2 Burning rubbish and construction waste materials is not permitted on site.
- .3 Maintain placed or installed fire resistive construction, fireproofing, firestopping to protect the portions of the Work during construction.

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.01 Section Includes

- .1 Laws, notices, permits, and fees.
- .2 Discovery of hazardous materials.

1.02 Related Requirements

- .1 Section 01 35 43 – Environmental Procedures.
- .2 This section describes requirements applicable to all Sections within Division 02 to Division 49.

1.03 Laws, Notices, Permits and Fees

- .1 The laws of the Place of the Work shall govern the Work.
- .2 The Owner shall obtain and pay for the building permit, permanent easements, and rights of servitude. The Contractor shall be responsible for permits, licenses, or certificates necessary for the performance of the Work which were in force at the date of executing the Agreement.
- .3 Give the required notices and comply with the laws, ordinances, rules, regulations or codes which are or become in force during the performance of the Work and which relate to the Work, to the preservation of the public health and to construction safety.
- .4 If the Contractor knowingly performs or allows work to be performed that is contrary to any laws, ordinances, rules, regulations or codes, the Contractor shall be responsible for and shall correct the violations thereof; and shall bear the costs, expenses, and damages attributable to the failure to comply with the provisions of such laws, ordinances, rules, regulations or codes. Determine detailed requirements of authorities having jurisdiction.
- .5 Pay construction damage deposits levied by municipality in connection with the issuance of a building permit.

1.04 Hazardous Material Discovery

- .1 Asbestos: If material resembling asbestos is encountered in course of demolition work, immediately stop work and notify Construction Manager.

1.05 Personnel Smoking

- .1 Comply with regulatory and Owner imposed smoking restrictions during execution of the Work.

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.01 Section Includes

- .1 Quality assurance criteria.

1.02 Related Requirements

- .1 Section 01 45 00 – Quality Control.
- .2 This section describes requirements applicable to all Sections within Division 02 to Division 49.

1.03 Quality Assurance

- .1 Provide testing organization services as specified in Section 01 45 00.
- .2 Testing organization: Current member in good standing of their respective professional or industry organization and certified to perform specified services.
- .3 Comply with applicable procedures and standards of the certification sponsoring association.
- .4 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.
- .5 Qualifications:
 - .1 Provide adequate workforce training through meetings and demonstrations.
 - .2 Have someone on site with deconstruction experience throughout project for consultation and supervision purposes.

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.01 Section Includes

- .1 Inspection and testing, administrative and enforcement requirements.
- .2 Equipment and system adjust and balance.

1.02 Related Requirements

- .1 Section 01 43 00 – Quality Assurance.
- .2 This section describes requirements applicable to all Sections within Division 02 to Division 49.

1.03 Inspection by Authority

- .1 Allow Authorities Having Jurisdiction access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .2 Give timely notice requesting inspection whenever portions of the Work are designated for special tests, inspections or approvals, either when described in the Contract Documents or when required by law in the Place of the Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

1.04 Review by Construction Manager

- .1 Construction Manager may order any part of Work to be reviewed if Work is suspected to be not in accordance with Contract Documents.

1.05 Independent Inspection Agencies

- .1 Independent Inspection and Testing Agencies will be engaged by Construction Manager for purpose of inspecting and testing portions of Work. Cost of such services will be borne by Owner.
- .2 Provide equipment required for executing inspection and testing by appointed agencies.
- .3 Employment of inspection and testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and testing to ascertain full degree of defect. Correct defect and irregularities as advised by Construction Manager at no cost to Owner. Pay costs for retesting and re-inspection.

1.06 Access to Work

- .1 Allow inspection and testing agencies access to Work, off site manufacturing and fabrication plants.
- .2 Co-operate to provide reasonable facilities for such access.

1.07 Procedures

- .1 Notify appropriate agency and Construction Manager in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.

- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.08 Rejected Work

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

1.09 Reports

- .1 Submit four (4) copies of inspection and test reports to Construction Manager.
- .2 Provide copies to manufacturer or fabricator of material being inspected or tested.

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.01 Section Includes

- .1 Product quality, availability, storage, handling, protection, and transportation.
- .2 Product substitution procedures.
- .3 Manufacturer's instructions.
- .4 Quality of Work, coordination, and fastenings.
- .5 Existing facilities.

1.02 Related Requirements

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 25 00 – Substitution Procedures.
- .3 This section describes requirements applicable to all Sections within Division 02 to Division 49.

1.03 Terminology

- .1 New: Produced from new materials.
- .2 Re-newed: Produced or rejuvenated from an existing material to like-new condition to serve a new or existing service.
- .3 Defective: A condition determined exclusively by the Consultant.

1.04 Product Quality

- .1 Products, materials, equipment, parts, or assemblies (referred to as Products) incorporated in Work: New, not damaged or defective, of best quality (compatible with specification requirements) for purpose intended. If requested, provide evidence as to type, source and quality of Products provided.
- .2 Defective Products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective Products at own expense and be responsible for delays and expenses caused by rejection.
- .3 Should any dispute arise as to quality or fitness of Products, decision rests strictly with Consultant.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .5 Permanent labels, trademarks and nameplates on Products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.05 Availability

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

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

1.06 Storage and Protection

- .1 Store and protect Products in accordance with manufacturers' instructions.
- .2 Store with seals and labels intact and legible.
- .3 Store sensitive Products in weather tight, climate controlled, enclosures in an environment favourable to Product.
- .4 For exterior storage of fabricated Products, place on sloped supports above ground.
- .5 Cover Products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of Products.
- .6 Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- .7 Provide equipment and personnel to store Products by methods to prevent soiling, disfigurement, or damage.
- .8 Arrange storage of Products to permit access for inspection. Periodically inspect to verify Products are undamaged and are maintained in acceptable condition.

1.07 Transportation and Handling

- .1 Transport and handle Products in accordance with manufacturer's instructions.
- .2 Promptly inspect shipments to ensure that Products comply with requirements, quantities are correct, and Products are undamaged.
- .3 Provide equipment and personnel to handle Products by methods to prevent soiling, disfigurement, or damage.

1.08 Product Changes

- .1 Change in Product(s): Submit request for substitution or alternative in accordance with Section 01 25 00.

1.09 Existing Utilities

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

1.10 Manufacturer's Instructions

- .1 Unless otherwise indicated in specifications, install or erect Products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.
- .2 Notify Consultant in writing, of conflicts between specifications and manufacturer's instructions, so that Consultant may establish course of action.

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

1.11 Quality of Work

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

1.12 Coordination

- .1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.13 Concealment

- .1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation, inform Consultant if there is interference. Install as directed by Consultant.

1.14 Remedial Work

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

1.15 Location of Fixtures

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

1.16 Fastenings

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.17 Fastenings - Equipment

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use Type 304 or 316 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.18 Protection of Work in Progress

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

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.01 Section Includes

- .1 Field engineering survey services to measure and stake site.
- .2 Recording of subsurface conditions found.
- .3 Survey services to determine measurement inverts for the Work.
- .4 Requirements and limitations for cutting and patching the Work.

1.02 Related Requirements

- .1 Section 01 25 00 – Substitution Procedures.
- .2 This section describes requirements applicable to all Sections within Division 02 to Division 49.

1.03 References

- .1 Owner's identification of existing survey control points and property limits.

1.04 Submittals

- .1 Submit name and address of Surveyor to Consultant.
- .2 On request of Consultant, submit documentation to verify accuracy of field engineering work.
- .3 Submit certificate signed by surveyor certifying [and noting] those elevations and locations of completed Work that conform [and do not conform] with Contract Documents.

1.05 Qualifications of Surveyor

- .1 Qualified registered land surveyor, licensed to practise in the Place of the Work, acceptable to [Consultant] [Owner].

1.06 Survey Reference Points

- .1 Existing base horizontal and vertical control points are designated on Drawings.
- .2 Locate, confirm and protect control points prior to starting site Work. Preserve permanent reference points during construction.
- .3 Make no changes or relocations without prior written notice to Consultant.
- .4 Report to Consultant when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
- .5 Require surveyor to replace control points in accordance with original survey control.

1.07 Survey Requirements

- .1 Establish [two] permanent bench marks on site, referenced to established bench marks by survey control points.
- .2 Record locations, with horizontal and vertical data in Project Record Documents.
- .3 Establish lines and levels, locate and lay out, by instrumentation.
- .4 Stake for grading, fill [and topsoil] placement [and landscaping features].

- .5 Stake slopes [and berms].
- .6 Establish pipe invert elevations.
- .7 Stake batter boards [for foundations].
- .8 Establish foundation [column locations] and floor elevations.
- .9 Establish lines and levels for mechanical and electrical work.

1.08 Subsurface Conditions

- .1 Promptly notify Consultant in writing if discovered surface or subsurface conditions at Place of Work differ materially from those indicated in Contract Documents.
- .2 Advise the Consultant of a reasonable assumption of probable conditions when determined.
- .3 After prompt investigation, should Consultant determine that conditions do differ materially, instructions will be issued for changes in Work.

1.09 Examination

- .1 Inspect existing conditions, including elements or adjacent Work subject to irregularities, damage, movement, including Work during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of the Work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.

1.10 Preparation

- .1 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .2 Provide protection from elements for areas which may be exposed by uncovering work; maintain excavations free of water.

1.11 Existing Services

- .1 Before commencing work, establish location and extent of service lines in area of Work and notify Consultant of findings.
- .2 Remove abandoned service lines within [2] metres of structures. Cap or seal lines at cut-off points as directed by Consultant.

1.12 Location of Equipment and Fixtures

- .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3 Inform Consultant of impending installation and obtain approval for actual location.
- .4 Submit field drawings to indicate relative position of various services and equipment when required by Consultant.

1.13 Survey Record

- .1 Maintain a complete, accurate log of control and survey work as it progresses.
- .2 On completion of foundations and major site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of Work.
- .3 Record locations of maintained, re-routed and abandoned service lines.

End of Section

1 General

1.01 Summary

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

1.02 Manufacturer's Instructions

- .1 Install, erect, or apply Products in strict accordance with manufacturer's instructions.
- .2 Notify Consultant, in writing, of conflicts between Contract Documents and manufacturer's instructions where, in Contractor's opinion, conformance with Contract Documents instead of the manufacturer's instructions may be detrimental to the Work or may jeopardize the manufacturer's warranty.
- .3 Do not rely on labels or enclosures provided with Products. Obtain written instructions directly from manufacturers.
- .4 Provide manufacturer's representatives with access to the Work at all times. Render assistance and facilities for such access so that manufacturer's representatives may properly perform their responsibilities.

1.03 Fastenings – General

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials.
- .2 Prevent electrolytic action and corrosion between dissimilar metals and materials by using suitable non-metallic strips, washers, sleeves, or other permanent separators to avoid direct contact.
- .3 Use non-corrosive fasteners and anchors for securing exterior work.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Do not use fastenings or fastening methods that may cause spalling or cracking of material to which anchorage is made.

1.04 Fastenings – Equipment

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Bolts shall not project more than one diameter beyond nuts.

1.05 Fire Rated Assemblies

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

1.06 Location of Fixtures, Outlets, and Devices

- .1 Consider location of fixtures, outlets, and devices indicated on Drawings as approximate.
- .2 Locate fixtures, outlets, and devices to provide minimum interference, maximum usable space, and as required to meet safety, access, maintenance, acoustic, and regulatory, including barrier free, requirements.

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

1.07 Protection of Completed Work and Work in Progress

- .1 Adequately protect parts of the Work completed and in progress from any kind of damage.
- .2 Promptly remove, replace, clean, or repair, as directed by Consultant, work damaged as a result of inadequate protection.
- .3 Do not load or permit to be loaded any part of the Work with a weight or force that will endanger the safety or integrity of the Work.

1.08 Remedial Work

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

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.01 Section Includes

- .1 Requirements and limitations for cutting and patching of Work.

1.02 Related Requirements

- .1 Section 01 25 00 – Substitution Procedures: Product options and substitutions.
- .2 Section 01 32 00 – Construction Progress Documentation: Submittals and scheduling.
- .3 Section 01 61 00 – Common Product Requirements.
- .4 Individual Product Specification Sections:
 - .1 Cutting and patching incidental to work of the section.
 - .2 Advance notification to other sections of openings required in Work of those sections.
 - .3 Limitations on cutting structural members.

1.03 Submittals

- .1 Submit written request in advance of cutting or alteration which affects:
 - .1 Structural integrity of any element of Project.
 - .2 Integrity of weather exposed or moisture resistant element.
 - .3 Efficiency, maintenance, or safety of any operational element.
 - .4 Visual qualities of sight exposed elements.
 - .5 Work of Owner or separate contractor.
- .2 Include in request:
 - .1 Identification of Project.
 - .2 Location and description of affected Work.
 - .3 Necessity for cutting or alteration.
 - .4 Description of proposed Work and Products to be used.
 - .5 Alternatives to cutting and patching.
 - .6 Effect on work of Owner or separate contractor.
 - .7 Written permission of affected separate contractor.
 - .8 Date and time work will be executed.

2 Products

2.01 Materials

- .1 Primary Products: Those required for original installation.

- .2 Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 25 00.

3 Execution

3.01 Examination

- .1 Examine existing conditions prior to commencing Work, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering existing Work, assess conditions affecting performance of work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.

3.02 Preparation

- .1 Provide temporary supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
- .2 Provide protection from elements for areas which may be exposed by uncovering work.
- .3 Maintain excavations free of water.

3.03 Cutting

- .1 Execute cutting and fitting including excavation and fill to complete the Work.
- .2 Uncover work to install improperly sequenced work.
- .3 Remove and replace defective or non-conforming work.
- .4 Remove samples of installed work for testing when requested.
- .5 Provide openings in the Work for penetration of electrical work.
- .6 Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- .7 Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.

3.04 Patching

- .1 Execute patching to complement adjacent Work.
- .2 Fit Products together to integrate with other Work.
- .3 Execute work by methods to avoid damage to other Work, and which will provide appropriate surfaces to receive patching and finishing.
- .4 Employ original installer to perform patching for weather exposed and moisture resistant elements, and sight-exposed surfaces.
- .5 Restore work with new Products in accordance with requirements of Contract Documents.
- .6 Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .7 At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material to full thickness of the penetrated element.

- .8 Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

3.05 Cutting, Patching, and Remedial Work

- .1 Coordinate and perform the Work to ensure that cutting and patching work is kept to a minimum.
- .2 Perform cutting, fitting, patching, and remedial work [including excavation and fill,] to make the affected parts of the Work come together properly and complete the Work.
- .3 Perform cutting, patching, and remedial work using competent and qualified specialists familiar with the Products affected, in a manner that neither damages nor endangers the Work.

End of Section

1 General

1.01 Section Includes

- .1 Adjusting products and equipment required by all specification sections for this Project.

1.02 Related Requirements

- .1 Section 01 74 00 – Cleaning and Waste Management.
- .2 Section 01 75 16 – Startup Procedures.
- .3 This section describes requirements applicable to all sections within Division 02 to Division 49.

1.03 Purpose

- .1 Testing adjusting and balancing of operating systems will be performed in contract by an agency that will be selected by the Owner and consigned to this Contract:
- .2 Prior to start of balancing, the Contractor is to ensure systems are:
 - .1 piped, ducted, wired and wireless services and systems, including components and equipment forming part thereof,
 - .2 manually and mechanically operated, including components and equipment forming any part,
 - .3 testing, adjusting and balancing will not be started until after all static checks have been completed for the system being balanced and signed off on the commissioning report forms,
 - .4 Contractor to ensure systems are operated at designated times, under conditions required for proper testing, adjusting, and balancing,
 - .5 report any deficiencies or defects which may affect the balancing or noted during testing, adjusting and balancing, which cannot be promptly corrected.

2 Products – Not Used

3 Execution

3.01 Preparation

- .1 Prepare each system and item of equipment for testing, adjusting and balancing.
- .2 Verify that each system and equipment installation is complete and in functional operation.
- .3 Verify appropriate ambient conditions.

3.02 Testing

- .1 Tests will be conducted to confirm compliance with requirements of Contract Documents. Take corrective action as necessary.

3.03 Adjusting

- .1 Adjust operating Products and equipment to ensure smooth and unhindered operation.
- .2 Provide equipment required to ensure proper, efficient and safe operation of all equipment including belts and sheaves.

3.04 Balancing

- .1 Cooperate with, and assist the balancing agent to ensure that the various parts of system are in a proper state of equilibrium.

End of Section

1 General

1.01 Section Includes

- .1 Starting equipment in preparation for adjusting and commissioning.
- .2 To bring the facility to a fully operational state, free of deficiencies, in the most efficient and timely manner achievable.
- .3 Contractor's and Owner's responsibilities during each of the following successive sub phases of facility start-up:
 - .1 Contractor start-up which leads to Interim Acceptance of the Work.
 - .2 Performance Testing which leads to Practical Completion of the Work.

1.02 Related Requirements

- .1 Section 01 75 00 – Starting and Adjusting.
- .2 Section 01 91 13 – General Commissioning Requirements.
- .3 This section describes requirements applicable to all sections within Division 02 to Division 49.

1.03 Starting Systems

- .1 Coordinate schedule for start-up of various equipment and systems.
- .2 Notify Consultant seven days prior to start-up of each item.
- .3 Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.
- .4 Verify tests, metre readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- .5 Verify that wiring and support components for equipment are complete and tested.
- .6 Execute start-up under supervision of applicable [manufacturer's representative] [Contractors' personnel] in accordance with manufacturers' instructions.
- .7 When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- .8 Submit a written report in accordance with Section 01 33 00 and Section 01 78 00 that equipment or system has been properly installed and is functioning correctly.

1.04 Start-Up Report

- .1 Commissioning agent will provide start up report forms (check sheets) with the exception of controls.
- .2 Contractor to develop, complete and provide the report forms for all control points, software and hardware.
- .3 Submit completed report forms to commissioning agent for review within ninety (90) days of award of contract.
- .4 Commissioning agent will assemble completed report forms into a commissioning manual on the following subjects:

- .1 Each mechanical system (except for controls).
- .2 Each electrical system.
- .5 Refer to Owner for a sample of the commissioning report form.
- .6 Include manufacturer's equipment start-up reports and test certificates as an appendix to the commissioning manual.
- .7 The commissioning manual will be kept on site for use by appropriate contractors and the commissioning agent.
 - .1 Maintain this manual current.
 - .2 Maintain a schedule for work of the commissioning agent in conjunction with the commissioning schedule.
- .8 The report forms are divided into three parts:
 - .1 Technical data.
 - .2 Static checks.
 - .3 Operational checks.
- .9 Contractor is to complete each part prior to verification by the commissioning agent.
- .10 Contractor is responsible for completing the report forms as follows and as indicated on the attached sample:
 - .1 Technical Data
 - .1 Specified: Commissioning Agent
 - .2 Shop Drawing: Contractor
 - .3 Installed: Contractor
 - .4 Verified: Commissioning Agent
 - .5 Date/Checked By: Contractor to sign when all shop drawing and installed information is completed.
 - .2 Static Checks
 - .1 Confirmation of Completion: Contractor to confirm all items listed are completed prior to verification by the commissioning agent.
 - .2 Date / Checked By: Contractor to sign when the installation of the equipment and or systems are complete and ready for the commissioning agent to verify.
 - .3 Operational Checks
 - .1 Operational checks will be performed by the commissioning agent using the balancing report and control=s forms.

1.05 Submissions

- .1 Advise Commissioning Agent of report forms required for equipment and systems but not yet supplied by the commissioning agent.

- .2 Provide a sample of manufacturer's start-up forms for equipment or systems not included.
- .3 Submit and completed and verified commissioning manual to the Owner with all data entered and sign-offs, prior to Substantial Completion of the Work.

1.06 Contractor Start Up

- .1 Contractor to perform the following during start-up:
 - .1 Start equipment and systems.
 - .2 Test, adjust and balance equipment and systems as specified in Section 01 75 00.
 - .3 Demonstrate equipment and systems as specified in their applicable section.
- .2 Complete and submit start-up reports including:
 - .1 Contractor's system and equipment start up reports.
 - .2 Manufacturers' equipment startup reports.
- .3 Review Contract Documents and inspect the Work to ensure completeness of the Work and compliance with requirements of Contract Documents.
- .4 Correct Contract deficiencies and defects identified as a result of the foregoing and as may be identified by the owner.
- .5 Execute and complete approved Change Orders.
- .6 Perform other work and activities required for fulfillment of prerequisites to Interim Acceptance of the Work.
- .7 Commissioning Agent will perform the following during start-up:
 - .1 Perform preliminary interim inspections as necessary.
 - .2 Witness manufacturers' equipment start-up.
 - .3 Verify starting, testing, adjusting, and balancing by Contractor.
 - .4 Provide start-up reports for all systems and equipment and review and approve Contractor start-up reports.
 - .5 Cooperate in systems and equipment demonstration and instruction.
 - .6 Initiate Change Orders as required.
 - .7 Verify correction of Contract deficiencies and defects by Contractor.
 - .8 Verify execution of Change Orders performed by Contractor.
 - .9 Perform other activities related to Substantial Completion of the Work as specified in Section 01 77 00.
- .8 The following will be performed to an on-going cycle of:
 - .1 Owner's inspections.
 - .2 Documentation of results.

- .3 Diagnosis of problems.
- .4 Correction of Contract Deficiencies and execution of Change Orders as required.
- .5 Verification of results.

1.07 Performance Testing

- .1 Performance testing will be performed by the Commissioning Agent and:
 - .1 completed prior to Substantial Completion,
 - .2 completed when all systems have been balanced and tested and are operating to the satisfactory of the Commissioning Agent, and
- .2 Contractor to perform the following during Performance Testing:
 - .1 Correct Contract deficiencies and defects previously outstanding and those identified during performance testing.
 - .2 Execute Change Orders.
- .3 The following will be performed to an on-going cycle of:
 - .1 Performance testing.
 - .2 Documentation of results.
 - .3 Diagnosis of problems.
 - .4 Correction of Contract deficiencies, defects and execution of Change Orders as required.
 - .5 Verification of results.

1.08 Seasonal Constraints

- .1 Notwithstanding requirements in this section, additional separate cycles of Contractor start-up, performance testing and fine tuning may be necessitated at a later time on equipment and systems whose full operation is dependent on seasonal conditions.
- .2 Contractor's responsibilities with respect to later facility start-up activities are specified in this section.

1.09 Partial Utilization of Work

- .1 When partial utilization of the Work is required, the applicable requirements specified in this section apply to the part(s) of the Work to be utilized.

1.10 Third Party Testing

- .1 Third party independent testing will be carried out for the following prior to substantial completion:
- .2 Architectural:
 - .1 Roofing.
 - .2 Radiation Protection.
 - .3 Materials testing.
 - .4 Asphalt testing.

- .5 Thermal scans.
- .6 Building envelope testing.
- .3 Mechanical:
 - .1 Medical gas testing.
- .4 Electrical:
 - .1 Power Distribution.
- .5 Structural:
 - .1 Steel Deck.
 - .2 Concrete testing.
 - .3 Soil testing.
 - .4 Weld testing.
 - .5 Structural testing.
- .6 Cooperate with independent testing agencies to enable thorough and detailed testing of all systems and equipment.

End of Section

1 General

1.01 Inspection and Declaration

- .1 Contractor's Inspection: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Owner and Consultant in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
 - .2 Request Owner and Consultant's Inspection.
- .2 Owner and Consultant's Inspection: Owner, Consultant, and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor to correct Work accordingly.
- .3 Completion: submit written certificate that following have been performed:
 - .1 Work has been completed and inspected for compliance with Contract Documents.
 - .2 Defects have been corrected and deficiencies have been completed.
 - .3 Equipment and systems have been tested, adjusted, and are fully operational.
 - .4 Certificates required by Fire Commissioner have been submitted.
 - .5 Operation of systems have been demonstrated to Owner's personnel.
 - .6 Work is complete and ready for final inspection.
- .4 Final Inspection: when items noted above are completed, request final inspection of Work by Departmental Representative and Contractor. If Work is deemed incomplete by Departmental Representative, complete outstanding items and request re-inspection.

1.02 Prerequisites to Final Payment

- .1 After Ready-for-Takeover of the Work and before submitting an application for final payment in accordance with the General Conditions of Contract:
 - .1 Correct or complete all remaining defective, deficient, and incomplete work.
 - .2 Remove from the Place of the Work all remaining surplus Products, Construction Equipment, and Temporary Work.
 - .3 Perform final cleaning and waste removal necessitated by the Contractor's work performed after Ready-for-Takeover, as specified in Section 01 74 00 – Cleaning and Waste Management.

1.03 Cleaning

- .1 In accordance with Section 01 74 00.

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.01 Section Includes

- .1 Inspections and declarations.
- .2 Closeout submittals.
- .3 Operation and maintenance manual format.
- .4 Contents each volume.
- .5 Recording actual site conditions.
- .6 As-built documents and samples.
- .7 As-built drawings.
- .8 Final survey.
- .9 Warranties and bonds.

1.02 Related Requirements

- .1 Document 00 64 01 – Request for Electronic Files Form.
- .2 Section 01 33 00 – Submittal Procedures.
- .3 Section 01 32 19 – Submittals Schedule.
- .4 Section 01 45 00 – Quality Control.
- .5 Section 01 79 00 – Demonstration and Training.
- .6 This section describes requirements applicable to all Sections within Division 02 to Division 49.

1.03 References

- .1 Professional Engineers Ontario – Use of the Professional Engineer's Seal.

1.04 Definitions

- .1 As-built drawings – Drawings prepared by the Contractor incorporating all changes in the work and using field information. As-built drawings are not sealed by the Consultant.
- .2 Record drawings – Sealed drawings prepared by the Consultant incorporating all changes in the work, and all changes reviewed and verified in detail. As-built drawings may become record drawings after the detailed site review by the Consultant.

1.05 Inspections and Declarations

- .1 Contractor's Inspection: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Consultant in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
 - .2 Request Consultant's Inspection.

- .2 Consultant's Inspection: Consultant and Contractor will perform inspection of Work to identify defects or deficiencies. Correct defective and deficient Work accordingly.
- .3 Completion: submit written certificate that following have been performed:
 - .1 Work has been completed and inspected for compliance with Contract Documents.
 - .2 Defects have been corrected and deficiencies have been completed.
 - .3 Equipment and systems have been tested, adjusted and balanced and are fully operational.
 - .4 Certificates required by authorities having jurisdiction have been submitted.
 - .5 Operation of systems have been demonstrated to Owner's personnel.
 - .6 Work is complete and ready for Final Inspection.
- .4 Final Inspection: when items noted above are completed, request final inspection of Work by Owner, Consultant, and Contractor. If Work is deemed incomplete by Owner and Consultant, complete outstanding items and request re-inspection.
- .5 Declaration of Substantial Performance: when Owner and Consultant consider deficiencies and defects have been corrected and it appears requirements of Contract have been substantially performed, make application for Substantial Performance of the Work.
- .6 Commencement of Warranty Periods: the date of Substantial Performance of the Work shall be the date for commencement of the warranty period.
- .7 Commencement of Lien Periods: the date of publication of the certificate of Substantial Performance of the Work shall be the date for commencement of the lien period, unless required otherwise by the lien legislation applicable at the Place of the Work.
- .8 Final Payment: When Owner and Consultant consider final deficiencies and defects have been corrected and it appears requirements of Contract have been completed, make application for final payment.
- .9 Payment of Hold-back: After issuance of certificate of Substantial Performance of the Work, submit an application for payment of hold-back amount.

1.06 Closeout Submittals

- .1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .2 Copy will be returned after final inspection, with Consultant's comments.
- .3 Revise content of documents as required prior to final submittal.
- .4 Two (2) weeks prior to Substantial Performance of the Work, submit to the Consultant, four (4) final copies of operating and maintenance manuals in Canadian English.
- .5 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .6 If requested, furnish evidence as to type, source and quality of products provided.
- .7 Defective products will be rejected, regardless of previous inspections. Replace defective products at own expense.
- .8 Pay costs of transportation.

1.07 Operation and Maintenance (O&M) Manual

- .1 Format: organize data in the form of an instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 mm x 279 mm with spine and face pockets.
- .3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.
- .4 Cover and spine: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by systems, under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: Manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .9 Provide a USB flash drive with a digital copy of all documents included as hard copies in O&M manual. All files to be in searchable PDF format.
- .10 Provide 1:1 scaled CAD files in *.dwg AutoCAD on USB flash drive.

1.08 Contents – Each Volume

- .1 Table of Contents: provide title of project;
 - .1 date of submission;
 - .2 names, addresses, and telephone numbers of Consultant and Contractor with name of responsible parties; and
 - .3 schedule of products and systems, indexed to content of volume.
- .2 For each product or system, list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00.
- .4 Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Certificate of Acceptance: Relevant certificates issued by authorities having jurisdiction, including code compliance certificate, and life safety systems performance certificate.
 - .1 Electrical Safety Authority Inspection Certificate.
- .6 Training: Refer to Section 01 79 00.

1.09 Recording Actual Site Conditions

- .1 Record information on set of black line opaque drawings, and within the Project Manual, provided by Consultant.

- .2 Annotate with coloured felt tip marking pens, maintaining separate colours for each major system, for recording changed information.
- .3 Record information concurrently with construction progress. Do not conceal Work of the Project until required information is accurately recorded.
- .4 Contract drawings and shop drawings: legibly mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 References to related shop drawings and modifications.
- .5 Specifications: legibly mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, and field test records, as required by individual specifications sections.

1.10 As-Built Documents and Samples

- .1 In addition to requirements in General Conditions, maintain at the site for Consultant one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to the Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
- .2 Store as-built documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.
- .3 Label as-built documents and file in accordance with section number listings in List of Contents of the Project Manual. Label each document "AS-BUILT DOCUMENTS" in neat, large, printed letters.

- .4 Maintain as-built documents in clean, dry, and legible condition. Do not use as-built documents for construction purposes.
- .5 Keep as-built documents and samples available for inspection by Consultant.

1.11 As-Built Drawings

- .1 Complete and submit Document 00 64 01 to the Consultant for AutoCAD drawing release.
- .1 Employ a competent computer draftsman to electronically transfer the marked up information from the red line drawings to the CAD files supplied by the Consultant.
- .2 Mark revised documents as "AS-BUILT DRAWINGS".
 - .1 Include all revisions, with special emphasis on electrical (as-installed conduit routing).
 - .2 Contractor to provide a stamp on all CAD drawings indicating "AS-BUILT", name of contractor, and date.
 - .3 Use Consultant's CTB plot style file to plot drawings in hard copy and to PDF as detailed in this Section. Include CTB file on delivered digital media.
- .3 Submit completed record documents to Consultant on a USB flash drive, accompanied by three (3) hard copy sets.
- .4 Ensure as-built drawings are submitted to Consultant prior to Substantial Performance of the Work.

1.12 Final Survey

- .1 Submit final site survey certificate, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.
- .2 Inaccurate or neglectful information shall become a liability of the Contractor.

1.13 Warranties and Bonds

- .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
- .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten (10) days after completion of the applicable item of work.
- .4 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.
- .5 Verify that documents are in proper form, contain full information, and are notarized.
- .6 Co-execute submittals when required.
- .7 Retain warranties and bonds until time specified for submittals.

2 Products – Not Used

3 Execution – Not Used

End of Section

1 General

1.01 Section Includes

- .1 As-built drawings.

1.02 Related Requirements

- .1 Document 00 64 01 – Request for Electronic Files Form.
- .2 This section describes requirements applicable to all Sections within Division 02 to Division 49.

1.03 References

- .1 Professional Engineers Ontario – Use of the Professional Engineer's Seal. March 2022.

1.04 Definitions

- .1 As-built drawings – Drawings prepared by the Contractor incorporating all changes in the work and using field information. As-built drawings are not sealed by the Consultant.
- .2 Record drawings – Sealed drawings prepared by the Consultant incorporating all changes in the work, and all changes reviewed and verified in detail. As-built drawings may become record drawings after the detailed site review by the Consultant.

1.05 Recording Actual Site Conditions

- .1 Record information on set of black line opaque drawings, and within the Project Manual, provided by Consultant.
- .2 Annotate with coloured felt tip marking pens, maintaining separate colours for each major system, for recording changed information.
- .3 Record information concurrently with construction progress. Do not conceal Work of the Project until required information is accurately recorded.
- .4 Contract drawings and shop drawings: legibly mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 References to related shop drawings and modifications.
- .5 Specifications: legibly mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.

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

1.06 As-Built Drawings

- .1 Complete and submit Document 00 64 01 to the Consultant for AutoCAD drawing release.
- .2 Employ a competent computer draftsman to electronically transfer the marked up information from the red line drawings to the CAD files supplied by the Consultant.
- .3 Follow the conventions of the layering system when adding new layers or information. Confirm exactly layering standard used with the Consultant, i.e. U.S. National CAD Standard, PWGSC, etc.
- .4 Mark revised documents as "AS-BUILT DRAWINGS".
 - .1 Include all revisions, with special emphasis on electrical (as-installed conduit routing).
 - .2 Contractor to provide a stamp on all CAD drawings indicating "AS-BUILT", name of contractor, and date.
 - .3 Use Consultant's CTB plot style file to plot drawings in hard copy and to PDF as detailed in this Section. Include CTB file on delivered digital media.
- .5 Submit completed record documents to Consultant on a CD-ROM, accompanied by three (3) hard copy sets.
- .6 Ensure as-built drawings are submitted to Consultant prior to Substantial Performance of the Work.

2 Products – Not Used

3 Execution – Not Used

End of Section

September 19, 2025

1 General

1.01 Section Includes

- .1 Procedures for preparation of integrated systems testing and coordination of all sub-trades in the execution of this testing to ensure life safety systems meet code requirements.

1.02 Related Requirements

- .1 Division 08 – Openings.
- .2 Division 14 – Conveying Equipment.
- .3 Division 21 – Fire Suppression.
- .4 Division 23 – Heating, Ventilating, and Air Conditioning.
- .5 Division 26 – Electrical.
- .6 Section 28 46 13 – Fire-Alarm Systems.
- .7 This section describes requirements applicable to all Sections within Division 02 to Division 49.

1.03 References

- .1 CAN/ULC-S1001-11, Integrated Systems Testing of Fire Protection and Life Safety Systems.
- .2 2024 Ontario Building Code.

1.04 Submittals

- .1 The Integrated Testing Report shall include all documentation described in Subsection 7.3 of CAN/ULC-S1001. This includes:
 - .1 The Integrated Testing Plan.
 - .2 Integrated Testing Forms.
 - .3 Integrated Testing Forms for Re-tests.
 - .4 Documentation required by Section 5.3 of CAN/ULC-S1001.

1.05 Closeout Submittals

- .1 The Integrated Testing Report shall be provided to the following:
 - .1 The Consultant.
 - .2 The Owner.
 - .3 Municipal fire inspector as requested.
- .2 Maintain a copy of the CAN/ULC-S1001 functional test report on site.

1.06 Qualifications

- .1 Integrated Testing Coordinator:
 - .1 Must have all licenses and certifications required by contractual obligations, as well as those required by federal, provincial, and other regulations.

- .2 Must have the competencies listed in CAN/ULC-S1001.
- .3 Must prepare an Integrated Testing Plan.
- .4 Must provide the Integrated Testing Plan to the professional designers for review/acceptance prior to the test.
- .5 Collect the required pre-test documentation (e.g. confirmation from designers/installers/verifiers that systems are ready for testing, confirmation that building occupants have been notified and that safety measures are in place, etc.).
- .6 Determine what previous testing of the systems can be accepted to avoid duplication of testing.
- .7 Determine which parties are required to participate in the Integrated Systems Test.
- .8 Implement the Integrated Testing Plan (perform the tests) and record the results to show proper integration (ensure re-testing is performed as needed).
- .9 Compile all the documentation into an Integrated Testing Report and provide it to the building owner, Authority Having Jurisdiction (as required), and keep a copy on the building site.

2 Products – Not Used

3 Execution

3.01 Responsibility

- .1 The Mechanical Contractor is responsible for hiring an Integrated Testing Coordinator and coordinating integrated systems testing to meet the requirements of CAN/ULC-S1001. Time is to be allocated in the construction schedule for these tests, and the Mechanical Contractor is to ensure that the key sub-trades are a part of this testing.
- .2 Pre-requisites for integrated systems testing are individual verification reports such as fire alarm verification report, sprinkler sign off, elevator sign off, fire/smoke/life safety fan balancing reports, and others.
- .3 The intent is not to replicate the tests of each device, but to test the operation of the life safety system as a whole. Examples include but are not limited to the following:
 - .1 Fan shutdown on duct smoke detector.

3.02 Examples from CAN/ULC-S1001 of Systems that Require Integrated Testing

- .1 HVAC:
 - .1 Smoke control systems.
 - .2 Confirm and document that the air handling unit disengages when fire or smoke is detected. Preventing the conveyance of smoke, ash, particulates, or the fire itself through the air system substantially strengthens a building resilience in an emergency, and protects personnel.

3.03 Site Tests and Inspections

- .1 In accordance with CAN/ULC-S1001.

- .2 Coordinate all subtrades and installers to ensure presence by required trades during the CAN/ULC-S1001 functional testing.

End of Section

1 General

1.01 Section Includes

- .1 Alteration project procedures.
- .2 Removal of designated building equipment and fixtures.
- .3 Removal of designated construction.
- .4 Disposal of materials.
- .5 Identification of utilities.

1.02 Related Requirements

- .1 Section 01 11 00 – Summary of Work:
 - .1 Work sequence.
 - .2 Owner's continued occupancy.
 - .3 Alteration Project Procedures, re-installation of removed and stored products.
- .2 Section 01 56 00 – Temporary Barriers and Enclosures: Temporary enclosures, dust control barricades, security at Owner occupied areas, and cleanup during construction.
- .3 Section 01 73 00 – Execution: Project record documents.

1.03 Scheduling

- .1 To Section 01 32 00 – Construction Progress Documentation.

1.04 Alteration Project Procedures

- .1 Employ skilled and experienced installer to perform alteration work.
- .2 Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity.
- .3 Remove, cut, and patch Work in a manner to minimize damage and to provide means of restoring Products and finishes to original or specified condition.
- .4 Refinish existing visible surfaces to remain in renovated rooms and spaces, to renewed condition for each material, with a neat transition to adjacent finishes.
- .5 Where new Work abuts or aligns with existing, provide a smooth and even transition. Patch Work to match existing adjacent Work in texture and appearance.
- .6 When finished surfaces are cut so that a smooth transition with new Work is not possible, terminate existing surface along a straight line at a natural line of division and submit recommendation to Consultant for review.
- .7 Patch or replace portions of existing surfaces which are damaged, lifted, discoloured, or showing other imperfections.
- .8 Finish surfaces as specified in individual Product sections.

1.05 Action Submittals

- .1 Section 01 33 00: Procedures for submittals.
- .2 Shop Drawings: Indicate demolition and removal sequence and location of salvageable items; location and construction of temporary work.

1.06 Closeout Submittals

- .1 Section 01 78 00: Procedures for submittals.
- .2 Project Record Documents: Accurately record actual locations of capped utilities, and subsurface obstructions.

1.07 Regulatory Requirements

- .1 Conform to applicable code for demolition work, dust control, and products requiring electrical disconnection and re-connection.
- .2 Obtain required permits from authorities.
- .3 Do not close or obstruct egress width to any building or site exit.
- .4 Do not disable or disrupt building fire or life safety systems without three (3) days prior written notice to Owner.
- .5 Conform to procedures applicable when hazardous or contaminated materials are discovered.

1.08 Site Conditions

- .1 Conduct demolition to minimize interference with adjacent and occupied building areas.
- .2 Cease operations immediately if structure appears to be in danger and notify Consultant. Do not resume operations until directed.

2 Products

2.01 Materials

- .1 As specified in Product sections; match existing Products and work for patching and extending work.

3 Execution

3.01 Preparation

- .1 Provide, erect, and maintain temporary barriers at locations indicated.
- .2 Erect and maintain weatherproof closures for exterior openings.
- .3 Erect and maintain temporary partitions to prevent spread of dust, odours, and noise to permit continued Owner occupancy.
- .4 Protect existing materials which are not to be demolished.
- .5 Notify affected utility companies before starting work and comply with their requirements.
- .6 Provide appropriate temporary signage including signage for exit or building egress.

3.02 Demolition

- .1 Disconnect, remove, cap, and identify designated utilities within demolition areas.
- .2 Demolish in an orderly and careful manner. Protect existing supporting structural members.
- .3 Remove demolished materials from site except where specifically noted otherwise. Do not burn or bury materials on site.
- .4 Remove materials as Work progresses. Upon completion of Work, leave areas in clean condition.
- .5 Remove temporary Work.

End of Section

1 General

1.01 Section Includes

- .1 This Section specifies stone fibre board insulation for general board insulation applications.

1.02 Related Requirements

- .1 Section 07 21 16 – Blanket Insulation.
- .2 Section 07 92 00 – Joint Sealants.
- .3 Section 09 21 16 – Gypsum Board Assemblies.

1.03 Reference Standards

- .1 ASTM International (ASTM).
 - .1 ASTM C165 - [2012], Standard Test Method for Measuring Compressive Properties of Thermal Insulations.
 - .2 ASTM C356 - [2010], Standard Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat.
 - .3 ASTM C411 - [2011], Standard Test Method for Hot-Surface Performance of High-Temperature Thermal Insulation.
 - .4 ASTM C518 - [2010], Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - .5 ASTM C612 - [2010], Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .6 ASTM C665 - [2011], Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - .7 ASTM C795 - [2013], Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .8 ASTM C1104/C1104M - [2000(2006)], Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
 - .9 ASTM C1338 - [2008], Standard Test Method for Determining Fungi Resistance of Insulation Materials and Facings.
 - .10 ASTM E96/E96M - [2010], Standard Test Methods for Water Vapor Transmission of Materials.
 - .11 ASTM E136 - [2011], Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.
- .2 Factory Mutual Global Inc. (FM).
 - .1 FM 4473-[2005], Specification Test Standard for Impact Resistance Testing of Rigid Roofing Materials by Impacting with Freezer Ice Balls.
- .3 Underwriters' Laboratories of Canada (ULC).
 - .1 CAN/ULC S102-[2010], Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

- .2 CAN/ULC S702-[2009], Amended 2012], Standard for Thermal Insulation Mineral Fibre for Buildings, Includes Amendment 1.
- .3 CAN/ULC S114-[2005], Standard Method of Test for Determination of Non-Combustibility in Building Materials.
- .4 ULC Fire Resistance Directory W605 [2012], Fire Resistance Ratings, 1 Hour Assembly – Interior Surface.
- .5 ULC Fire Resistance Directory W606 [2012], Fire Resistance Ratings, 2 Hour Assembly – Interior Surface.
- .6 ULC Fire Resistance Directory W610 [2012], Fire Resistance Ratings, 1 Hour Assembly - Interior and Exterior Surfaces.
- .7 ULC Fire Resistance Directory W611 [2012], Fire Resistance Ratings, 2 Hour Assembly - Interior and Exterior Surfaces.

1.04 Administrative Requirements

- .1 Co-ordination: Co-ordinate work of this Section with roofing or deck work and with work of other trades for proper time and sequence to avoid construction delays.
- .2 Pre-installation Meeting: Convene pre-installation meeting after Award of Contract and before starting work of this Section to verify project requirements, substrate conditions and coordination with other building sub-trades, and to review manufacturer's written installation instructions.
 - .1 Ensure meeting agenda includes review of methods and procedures related to insulation installation including co-ordination with related work.
 - .2 Record meeting proceedings including corrective measures and other actions required to ensure successful completion of work and distribute to each attendee within 1 week of meeting.

1.05 Action and Informational Submittals

- .1 Make submittals in accordance with Contract Conditions and Section 01 33 00.
- .2 Product Data: Submit product data including manufacturer's literature for insulation materials and accessories, indicating compliance with specified requirements and material characteristics.
 - .1 Submit list on insulation manufacturer's letterhead of materials and accessories to be incorporated into Work.
 - .2 MSDS report.
 - .3 Include product name.
 - .4 Include preparation instructions and recommendations, installation methods, and storage and handling requirements.
 - .5 Include contact information for manufacturer and their representative for this Project.
- .3 Samples:
 - .1 Submit 100 mm by 100 mm minimum sample of insulation in thickness used on Project.
- .4 Test Reports:
 - .1 Submit evaluation service reports or other independent testing agency reports showing compliance with specified performance characteristics and physical properties.

- .5 Field Reports: Submit manufacturer's field reports within 3 days of each manufacturer representative's site visit and inspection.
- .6 Insulation Installer Qualifications:
 - .1 Submit letter verifying insulation installer's experience with work similar to work of this Section.

1.06 Closeout Submittals

- .1 Operation and Maintenance Data: Supply maintenance data for insulation materials for incorporation into manual specified in Section 01 78 00.
- .2 Record Documentation: In accordance with Section 01 78 00.
 - .1 List materials used in insulation work.
 - .2 Warranty: Submit warranty documents specified.

1.07 Quality Assurance

- .1 Board Insulation Installer Quality Assurance: Work experience of 5 years minimum with work similar to work of this Section.

1.08 Delivery, Storage, and Handling

- .1 Delivery and Acceptance Requirements:
 - .1 Deliver material in accordance with Section 01 61 00.
 - .2 Deliver materials and accessories in insulation manufacture's original packaging with identification labels intact and in sizes to suit project.
 - .3 Ensure insulation materials are not exposed to moisture during delivery.
 - .4 Replace wet or damaged insulation materials.
- .2 Storage and Handling Requirements: Store materials off ground in dry location and protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
 - .1 Store in original packaging until installed.
- .3 Packaging Waste Management:
 - .1 Remove waste packaging materials from site and dispose of packaging materials at appropriate recycling facilities.
 - .2 Collect and separate for disposal paper and plastic material in appropriate on-site storage containers for recycling.

1.09 Warranty

- .1 Project Warranty: Refer to Contract Conditions for project warranty provisions.
- .2 Manufacturer's warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and not intended to limit other rights Owner may have under Contract Conditions.
- .3 Warranty period: 1 year commencing on Date of Substantial Performance of Work.

2 Products

2.01 Manufacturer

- .1 Manufacturer: ROXUL INC.
420 Bronte Street South, Suite 105, Milton, Ontario, L9T 0H9
Phone: 905-878-8474, Toll Free: 1-800-265-6878, e-mail: contactus@roxul.com, URL: www.rspect.com.

2.02 Description

- .1 Faced non-combustible, semi-rigid, mineral wool insulation board to ASTM C612.

2.03 Performance Criteria

- .1 General purpose board insulation: To ASTM C612, Type IVA.
 - .1 Fire performance:
 - .1 Non-combustibility: To CAN/ULC-S114.
 - .2 Surface Burning Characteristics: To CAN/ULC-S102.
 - .1 Flame spread unfaced: 5.
 - .2 Smoke developed unfaced: 10.
 - .2 Thermal resistance (RSI value/25.4 mm at 24°C: [0.72] m²·K/W to ASTM C518.
 - .3 Water vapour permeance:
 - .1 Unfaced; [1715] ng/Pa·s·m² maximum.
 - .2 With PSP facing: [575] ng/Pa·s·m² maximum.
 - .4 Moisture sorption: 0.03% to ASTM C1104/C1104M.
 - .5 Dimensional stability: 0.35% maximum linear shrinkage at 650°C to ASTM C356.
 - .6 Fungi resistance: Passed to ASTM C1338.
 - .7 Corrosive resistance:
 - .1 Steel to ASTM C665: Pass.
 - .2 Stainless steel to ASTM C795: Conforms.
 - .8 Density: 64 kg/m³ to ASTM C612.

- .9 Acoustical performance sound absorption coefficients to ASTM C423.

Sound Absorption Coefficients at Frequencies							
Thickness (mm)	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	NRC
25	0.07	0.32	0.77	1.04	1.05	1.05	0.80
37	0.18	0.48	0.96	1.09	1.05	1.05	0.90
50	0.26	0.68	1.12	1.10	1.03	1.04	1.00
76	0.63	0.95	1.14	1.01	1.03	1.04	1.05
100	1.03	1.07	1.12	1.04	1.07	1.08	1.10

2.04 Materials

- .1 Non-combustible, rigid, mineral wool fire rated insulation board to ASTM C612, Type IVA.
- .1 Compressive resistance:
- .1 At 10%: 4.3 kPa to ASTM C165.
- .2 At 25%: 10.8 kPa to ASTM C165.
- .2 Size: 610 mm by 1219 mm.
- .3 Thickness: 25 mm.
- .4 Acceptable Material: ROXUL INC., ROCKBOARD 40 [with [RFF] [White Polypropylene] [Black Mat] Facer].

2.05 Accessories

- .1 Mechanical fasteners in accordance with insulation manufacturer's written recommendations.
- .1 Foundation insulation board: 40 mm concrete nails with 19 mm washers.
- .2 Foundation Sealing Compound: Bitumen sealing compound in accordance with Section 07 92 00.
- .3 Adhesive: All-purpose construction adhesive in accordance with insulation manufacturer's written recommendations.
- .4 Facings: Use only facings in accordance with insulation manufacturer's written recommendations as follows:
- .1 RFF facer: Aluminum foil with fiberglass reinforcement to ASTM.
- .1 Acceptable material: ROXUL INC., RFF FACER.

2.06 Source Quality Control

- .1 Ensure insulation components and accessories are supplied or approved in writing by single manufacturer.

2.07 Product Substitutions

- .1 Substitutions: No substitutions permitted.

3 Execution

3.01 Installers

- .1 Use only installers with 5 years minimum experience with work similar to work of this Section.

3.02 Examination

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for insulation installation in accordance with manufacturer's written recommendations.
 - .1 Visually inspect substrate in presence of the Consultant.
 - .2 Ensure surfaces are free of snow, ice, frost, grease, and other deleterious materials.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Consultant.
- .2 Start of insulation installation indicates installer's acceptance of substrate installation conditions.

3.03 Installation

- .1 General:
 - .1 Install insulation in accordance with manufacturer's written recommendations.
 - .2 Install insulation to maintain continuity of thermal protection to building elements and spaces.
 - .3 Fit insulation closely around electrical boxes, pipes, ducts, frames, and other objects in or passing through insulation.
 - .4 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of chimneys and vents.
 - .5 Do not enclose insulation before inspection and receipt of Consultant's written approval.
- .2 Installation of Insulation Board:
 - .1 Install insulation board using mechanical fasteners in accordance with insulation manufacturer's written recommendations.
 - .2 Attach insulation board with 40 mm concrete nails and seal with bitumen sealing compound.
 - .3 Seal joints with acoustical joint sealant in accordance with Section 07 92 00.
- .3 Vapour Barrier.
 - .1 Seal all joints with aluminum foil tape to manufacturer's instructions.

3.04 Field Quality Control

- .1 Field Inspection: Coordinate field inspection in accordance with Section 01 45 00.
- .2 Manufacturer's Services:
 - .1 Coordinate manufacturer's services with Section 01 45 00.

- .1 Have manufacturer review work involved in handling, installation, protection, and cleaning of insulation and accessories, and submit written reports in acceptable format to verify compliance of Work with Contract conditions.
- .2 Manufacturer's Field Services: Provide manufacturer's field services consisting of product use recommendations and periodic site visits for product installation review in accordance with manufacturer's instructions.
 - .1 Report any inconsistencies from manufacturer's recommendations immediately to the Consultant.
- .3 Schedule site visits to review work at stages listed:
 - .1 After delivery and storage of drainage sheet and accessories, and when preparatory work on which Work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.
 - .4 Obtain reports within three days of review and submit immediately to the Consultant.

3.05 Cleaning

- .1 Progress Cleaning: Perform cleanup as work progresses in accordance with Section 01 74 00.
 - .1 Leave work area clean at end of each day.
- .2 Final Cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment [in accordance with Section 01 74 00.
- .3 Waste Management:
 - .1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.
 - .2 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.06 Protection

- .1 Protect installed products and accessories from damage during construction.
- .2 Repair damage to adjacent materials caused by insulation installation.

End of Section

1 General

1.01 Section Includes

- .1 This Section specifies stone fibre batt and blanket thermal insulation and stone fibre batt and blanket acoustical insulation.

1.02 Related Requirements

- .1 Section 07 21 13 – Board Insulation.
- .2 Section 07 84 00 – Firestopping.
- .3 Section 07 92 00 – Joint Sealants.
- .4 Section 09 21 16 – Gypsum Board Assemblies.

1.03 Reference Standards

- .1 ASTM International (ASTM).
 - .1 ASTM C165 - 2007, Standard Test Method for Measuring Compressive Properties of Thermal Insulations.
 - .2 ASTM C167 - 2009, Standard Test Method for Thickness and Density of Blanket or Batt Thermal Insulations.
 - .3 ASTM C356 - 2010, Standard Test Method for Linear Shrinkage of Preformed High-Temperature Thermal Insulation Subjected to Soaking Heat.
 - .4 ASTM C423 - 2009a, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
 - .5 ASTM C518 - 2010, Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - .6 ASTM C553 - 2011, Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - .7 ASTM C612 - 2010, Standard Specification for Mineral Fiber Block and Board Thermal Insulation.
 - .8 ASTM C665 - 2011, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
 - .9 ASTM C795 - 2008, Standard Specification for Thermal Insulation for Use in Contact with Austenitic Stainless Steel.
 - .10 ASTM C1104/C1104M - 2000(2006), Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation.
 - .11 ASTM E90 - 2009, Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
 - .12 ASTM E136 - 2011, Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.
 - .13 ASTM E413 - 2010, Classification for Rating Sound Insulation.
 - .14 ASTM E1050 - 2012, Standard Test Method for Impedance and Absorption of Acoustical Materials Using a Tube, Two Microphones and a Digital Frequency Analysis System.

- .2 Underwriters' Laboratories of Canada (ULC).
 - .1 CAN/ULC S702-2009 Amended 2012, Standard for Thermal Insulation Mineral Fibre for Buildings, Includes Amendment 1.
 - .2 CAN/ULC S114-2005, Standard Method of Test for Determination of Non-Combustibility in Building Materials.
 - .3 CAN/ULC S115-2005, Standard Method of Test of Firestop Systems.
 - .4 CAN/ULC S102-2010, Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
- .3 Underwriters' Laboratories (UL).
 - .1 UL 181 - 2005, Factory-Made Air Ducts and Connectors.

1.04 Administrative Requirements

- .1 Co-ordination: Co-ordinate work of this Section with roofing or deck work and with work of other trades for proper time and sequence to avoid construction delays.

1.05 Action and Informational Submittals

- .1 Make submittals in accordance with Contract Conditions and Section 01 33 00.
- .2 Product Data: Submit product data including manufacturer's literature for insulation materials and accessories, indicating compliance with specified requirements and material characteristics.
 - .1 Submit list on insulation manufacturer's letterhead of materials and accessories to be incorporated into Work.
 - .2 MSDS report.
 - .3 Include product name.
 - .4 Include preparation instructions and recommendations, installation methods, and storage and handling requirements.
 - .5 Include contact information for manufacturer and their representative for this Project.
- .3 Samples:
 - .1 Submit 140 mm x 190 mm minimum sample of insulation in thickness used on Project.
- .4 Test Reports:
 - .1 Submit evaluation service reports or other independent testing agency reports showing compliance with specified performance characteristics and physical properties.
- .5 Field Reports: Submit manufacturer's field reports within 3 days of each manufacturer representative's site visit and inspection.
- .6 Insulation Installer Qualifications:
 - .1 Submit letter verifying insulation installer's experience with work similar to work of this Section.

1.06 Closeout Submittals

- .1 Operation and Maintenance Data: Supply maintenance data for insulation materials for incorporation into manual specified in Section 01 78 00.
- .2 Record Documentation: In accordance with Section 01 78 00.
 - .1 List materials used in insulation work.
 - .2 Warranty: Submit warranty documents specified.

1.07 Quality Assurance

- .1 Batt and Blanket Insulation Installer Quality Assurance: Work experience of five years minimum with work similar to work of this Section.

1.08 Delivery, Storage, and Handling

- .1 Delivery and Acceptance Requirements:
 - .1 Deliver material in accordance with Section 01 61 00.
 - .2 Deliver materials and accessories in insulation manufacture's original packaging with identification labels intact and in sizes to suit project.
 - .3 Ensure insulation materials are not exposed to moisture during delivery.
 - .4 Replace wet or damaged insulation materials.
- .2 Storage and Handling Requirements: Store materials off ground in dry location and protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
 - .1 Store in original packaging until installed.
- .3 Packaging Waste Management:
 - .1 Separate and recycle waste packaging materials in accordance with Section 01 74 19.
 - .2 Remove waste packaging materials from site and dispose of packaging materials at appropriate recycling facilities.

1.09 Warranty

- .1 Project Warranty: Refer to Contract Conditions for project warranty provisions.
- .2 Manufacturer's warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to and not intended to limit other rights Owner may have under Contract Conditions.
- .3 Warranty period: One year commencing on Date of Substantial Performance of Work.

2 Products

2.01 Manufacturers

- .1 Roxul Inc.
420 Bronte Street South, Suite 105, Milton, Ontario, L9T 0H9
Phone: 905-878-8474, Toll Free: 1-888-364-3577, e-mail: contactus@roxul.com, URL: www.roxul.com.

2.02 Description

- .1 Non-combustible, lightweight, semi-rigid stone wool batt insulation, to CAN/ULC-S702 Type 1, that provides fire resistance to CAN/ULC-S114 and a sound control to ASTM E423.

2.03 Performance Criteria

- .1 Acoustical and fire batt insulation for walls and floors to CAN/ULC S702, Type 1.

- .1 Fire performance:

- .1 Non-combustibility: To CAN/ULC S114.
- .2 Surface Burning Characteristics: To CAN/ULC S102.
 - .1 Flame spread: 0.
 - .2 Smoke developed: 0
- .3 Smoulder resistance: 0.09% to CAN/ULC S129.

- .2 Acoustical Performance:

- .1 Airborne sound transmission loss: To ASTM E90.
- .2 Rating sound insulation: To ASTM E413.
- .3 Sound absorption co-efficients: To ASTM E423.

Sound Absorption Co-efficiencies at Frequencies							
Thickness (mm)	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	NRC
25	0.14	0.25	0.65	0.90	1.01	1.01	0.70
38	0.18	0.44	0.94	1.04	1.02	1.03	0.85
50	0.28	0.60	1.09	1.09	1.05	1.07	0.95
76	0.52	0.96	1.18	1.07	1.05	1.05	1.05
102	0.86	1.11	1.20	1.07	1.08	1.07	1.10

- .4 Impedance and absorption of acoustic materials: To ASTM E1050.
- .3 Air erosion velocity: 5.08 m/s maximum to UL 181.
- .4 Thermal resistance: To ASTM C518.
- .5 Corrosive resistance: To ASTM C665, Corrosive to steel - Pass.
- .6 Stainless steel stress corrosion: To ASTM C795.
- .7 Density: To ASTM C167, 45 kg/m3.

2.04 Materials

- .1 Non-combustible, lightweight, semi-rigid stone wool batt insulation to CAN/ULC S702, Type 1, that provides fire resistance to ASTM E136 and a sound control to ASTM E90 and ASTM E423.
 - .1 Thickness: 76 mm (3").

- .2 Acceptable Material: Roxul Inc., Roxul AFB.

2.05 Accessories

- .1 Mechanical fasteners in accordance with insulation manufacturer's written recommendations.
- .2 Acoustical sealant in accordance with Section 07 92 00.
- .3 Firestopping materials in accordance with Section 07 84 00.

2.06 Source Quality Control

- .1 Ensure insulation components and accessories are supplied or approved in writing by single manufacturer.

3 Execution

3.01 Installers

- .1 Use only installers with five years minimum experience with work similar to work of this Section.

3.02 Examination

- .1 Verification of Conditions: Verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for insulation installation in accordance with manufacturer's written recommendations.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Ensure surfaces are free of snow, ice, frost, grease and other deleterious materials.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.
- .2 Start of insulation installation indicates installer's acceptance of substrate installation conditions.

3.03 Installation

- .1 Install insulation in accordance with manufacturer's written recommendations.
- .2 Install insulation to maintain continuity of thermal protection to building elements and spaces.
- .3 Do not compress insulation to fit into spaces.
- .4 Co-ordinate installation of firestopping insulation with Section 07 84 00.
- .5 Fit insulation closely around electrical boxes, pipes, ducts, frames and other objects in or passing through insulation.
- .6 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and minimum 50 mm from sidewalls of chimneys and vents.
- .7 Seal joints with acoustical joint sealant in accordance with Section 07 92 00.
- .8 Do not enclose insulation until before inspection and receipt of Consultant's written approval.

3.04 Field Quality Control

- .1 Field Inspection: Coordinate field inspection in accordance with Section 01 45 00.

3.05 Cleaning

- .1 Progress Cleaning: Perform cleanup as work progresses in accordance with Section 01 74 00.
 - .1 Leave work area clean at end of each day.
- .2 Final Cleaning: Upon completion, remove surplus materials, rubbish, tools, and equipment in accordance with Section 01 74 00.
- .3 Waste Management:
 - .1 Collect recyclable waste and dispose of or recycle field generated construction waste created during construction or final cleaning related to work of this Section.
 - .2 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.06 Protection

- .1 Protect installed products and accessories from damage during construction.
- .2 Repair damage to adjacent materials caused by insulation installation.

End of Section

1 General

1.01 Section Includes

- .1 Fire rated and non-fire rated access doors and frame units.

1.02 Related Requirements

- .1 Section 20 05 00 – Common Work Results for Mechanical.
- .2 Section 26 05 00 – Common Work Results for Electrical.

1.03 References

- .1 UL/ULC Fire Resistance Directory.

1.04 Action Submittals

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for access door components and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Shop Drawings:
 - .1 Submit catalogue details for each type of door illustrating profiles, dimensions, and methods of assembly.
 - .2 If access door is to be installed in a fire rated assembly, shop drawing to indicate the rating.
- .4 Before commencing installation of work, coordinate with other trades and prepare on a set of reflected ceiling plans and wall elevations, complete layouts of access doors. Submit these layouts for Consultant's review and show exact sizes and locations of such access doors. Locate and arrange the work to suit.

1.05 Closeout Submittals

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data:
 - .1 Submit operation and maintenance data for cleaning and maintenance of finishes for incorporation into manual.
 - .2 Submit manufacturer's ordering information for additional keys.
- .3 At time of instruction of Owner's operating staff, hand-over and obtain signed receipt for four sets of each type of key used to lock access doors in secure areas.

1.06 Delivery, Storage, and Handling

- .1 Deliver, store and handle materials in accordance with Section 01 61 00, and with manufacturer's written instructions.
- .2 Delivery and acceptance requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Store and protect access doors from nicks, scratches, and blemishes.

- .4 Leave protective coatings in place until final cleaning of building.

2 Products

2.01 Manufacturers

- .1 Acudor Acorn.
- .2 Baird – ABCO.
- .3 Mifab.
- .4 Stelpro - Type 700.
- .5 Watts Water Technologies (Canada) Inc.

2.02 Access Doors

- .1 Construction:
 - .1 Access doors shall be flush to edge of frame, concealed continuous hinge with screwdriver operated cam latch.
 - .2 Steel, prime coated, flush mounted with 180 degree opening door, round safety corners, concealed hinges, plaster lock and anchor straps.
 - .3 Rounded safety corners, concealed hinges, screwdriver latch, anchor straps, able to open 180 degrees.
 - .4 Door construction to be minimum 14 gauge with 16 gauge frame.
 - .5 Fire-rated door construction to be a minimum 20 gauge insulated door with 16 gauge frame. Insulation thickness to provide required rating.
 - .6 Provide for plaster surfaces recessed 16 gauge prime painted steel door and welded metal lath, ready to take plaster.
 - .7 Provide for tiled surfaces, recessed type 16 gauge primed steel doors to suit type of tile used.
 - .8 Provide other access doors of welded 12 gauge steel, factory prime coated, flush type.
- .2 Materials:
 - .1 Tiled or marble surfaces: stainless steel with [brushed satin] [polished] finish.
 - .2 Other areas: prime coated steel.
 - .3 Constructed of stainless steel in areas finished with tile or marble surfaces.
 - .4 Constructed of stainless steel with neoprene gasketed door in damp and high humidity areas.
 - .5 Latching:
 - .6 Fitted with screwdriver operated latches.
 - .7 In areas subject to security risks (Public Corridors, Public Washrooms, etc.), fitted with keyed cylinder locks with similar keys.
- .3 Fire Ratings:

- .1 When access doors are required to be located in fire rated walls, floor and ceilings, provide ULC tested and labelled units rated in accordance with the structures being penetrated i.e. 3/4 hour, 1 hour, 2 hour.
- .4 Minimum dimensions (or as indicated otherwise on drawings):
 - .1 600 mm by 600 mm (24 in by 24 in) for personnel entry.
 - .2 450 mm by 450 mm (18 in by 18 in) for hand entry.
 - .3 300 mm by 300 mm (12 in by 12 in) for viewing only.
 - .4 Size doors to allow adequate operating/maintenance clearance for devices.
 - .5 Access doors shall be, wherever possible, of a standard size for each application.
- .5 Example products based on Acudor Acorn:
 - .1 Concealed plaster: PS-5010.
 - .2 Concealed drywall: DW-5015.
 - .3 Existing drywall: DW-5040.
 - .4 Fire-rated: FW-5050/FB-5060 to match assembly.

2.03 Exclusions

- .1 Lay-in tile ceilings: use unobtrusive identification locators.

3 Execution

3.01 Examination

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for access door installation in accordance with manufacturer's written instructions.
- .2 Lay-in type ceiling tiles, properly marked, with lamacoid label on adjacent ceiling carrying channel, may serve as access panels. Where ceiling tiles are required to be clipped, provide the appropriate access clips.
- .3 Before commencing installation of work, coordinate with other trades and prepare on a set of reflected ceiling plans and wall elevations, complete layouts of access doors. Submit these layouts for Consultant's review and show exact sizes and locations of such access doors. Locate and arrange the work to suit.
- .4 Confirm exact access door dimensions and locations with the Consultant prior to ordering and prior to commencing installation. Arrange work to suit.

3.02 Installation

- .1 Access doors are to be installed by the trade responsible for the particular type of construction in which the doors are required.
- .2 Provide access doors for [new and existing] concealed valves, dampers, junction boxes, equipment, etc.
- .3 Provide access doors wherever equipment, valves, dampers, control devices, junction boxes, pull boxes, etc., are concealed behind walls or inaccessible ceilings.

- .4 Provide access doors to give access to all valves, cleanouts, strainers, duct access doors, and other mechanical devices which may need maintenance or repair which are concealed in inaccessible construction.
- .5 Access doors shall match wall and ceiling finishes.
- .6 Access doors in gypsum ceiling shall be recessed type.
- .7 Locate access doors within view of equipment and ensure equipment is accessible for operating, inspecting, adjusting, servicing without using special tools.
- .8 Supply access doors, and make arrangements and pay for installation by trade in whose work they occur.
- .9 Size and locate access doors in applied tile, block, or in glazed or unglazed structural tile to suit joint patterns.
- .10 Access doors in ceilings, where acoustic tile is applied to plaster or gypsum board, to be dish type designed to receive tile insert.
- .11 Access doors are not required in removable ceilings. Provide coloured marking devices after completion of ceilings, at one corner of each panel below point requiring access. Colour code markers to show service or device above.
- .12 Provide access doors at locations where equipment requires inspection, service, maintenance, or adjustment, including by not limited to the following:
 - .1 Expansion joints.
 - .2 Plumbing cleanouts.
 - .3 Dampers.
 - .4 Fire dampers.
 - .5 Air valves.
 - .6 Air terminal units.
 - .7 Valves.
 - .8 Heating or cooling coils.
 - .9 Junction and pull boxes for power wiring or control wiring.
 - .10 Any concealed electrical devices.

3.03 Protection

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by access door installation.

End of Section

1 General

1.01 Section Includes

- .1 This Section specifies products, criteria and characteristics, and methods and execution that are common to one or more Sections of Mechanical Divisions. It is intended as a supplement to each Section and is to be read accordingly.

1.02 References

- .1 Division 00 and Division 01 apply to and are a part of each Mechanical Division:
 - .1 Division 20 – Common Mechanical Requirements;
 - .2 Division 21 – Fire Suppression;
 - .3 Division 22 – Plumbing;
 - .4 Division 23 – Heating, Ventilating, and Air Conditioning;
 - .5 Division 25 – Integrated Automation.
- .2 The provisions of this Section also apply to the following sections:
 - .1 Section 08 31 00 – Access Doors and Panels.
 - .2 Section 10 44 16 – Fire Extinguishers.

1.03 Submittals

- .1 Submit shop drawings/product data sheets for:
 - .1 pressure gauges and thermometers;
 - .2 electric motors (submit with equipment they are associated with).
- .2 Submit weight loads for selected equipment (upon request).
- .3 Submit copy of architectural reflected ceiling plan drawings and elevation drawings to indicate proposed access door locations.
- .4 Submit a list of equipment identification nameplates indicating proposed wording and sizes.
- .5 Submit a list of pipe and duct identification colour coding and wording.
- .6 Submit a proposed valve tag chart and a list of proposed valve tag numbering and identification wording.
- .7 Submit drawings indicating size and location of required sleeves, recesses and formed openings in poured or precast concrete work.
- .8 Submit any other submittals specified in this Section or other Sections of Mechanical Divisions.

1.04 Maintenance Material Submittals

- .1 As specified in Part 2 of this Section, submit a spare belt set, tagged, and identified, for each belt driven piece of equipment.

2 Products

2.01 Firestopping and Smoke Seal Materials

- .1 Firestopping and smoke seal system materials for mechanical penetrations through fire rated construction are specified in Section 20 05 17 – Sleeves and Sleeve Seals for Mechanical Piping, and work is to be done as part of mechanical work unless otherwise specified in Division 07.

2.02 Access Doors

- .1 Refer to Section 08 31 00.
- .2 Provide all access doors required for Mechanical work unless otherwise specified in Division 08. Coordinate consistency of look and finish of access doors on project with each Division of Work. Coordinate exact requirements with General Trades Contractor.
- .3 Access doors to be rust resistant steel door panels, with concealed hinges and positive locking and self-opening screwdriver operated lock. Wall type frame to be suitable for wall installation and have integral keys for plaster walls. Doors in tile wall to be stainless steel and in ceilings to be suitable for plaster covering with only frame joint showing. Other doors to be prime painted steel.
- .4 Size access doors to suit the concealed work for which they are supplied, and wherever possible they are to be of standard size for all applications, but in any case they are to be minimum 300 mm x 300 mm (12" x 12") for hand entry and 600 mm x 600 mm (24" x 24") for body entry.
- .5 Lay-in type tiles, properly marked, may serve as access panels. Coordinate marking of ceiling tiles with the Consultant. Panels in glazed tile walls to be 12 gauge, 304 alloy stainless steel, No. 4 finish, with recessed frame secured with stainless steel counter-sunk flush head screws.
- .6 Panels in plaster surfaces to have dish-shaped door and welded metal lath, ready to take plaster. Provide a plastic grommet for door key access.
- .7 Other access doors to be welded 12 gauge steel, flush type with concealed hinges, lock and anchor straps, complete with factory prime coat. Submit to Consultant for review, details of non-standard door construction details.
- .8 Access doors in fire rated ceilings, walls, partitions, structures, etc., to be ULC listed and labelled and of a rating to maintain fire separation integrity.
- .9 Where access doors are located in surfaces where special finishes are required, they are to be of a recessed door type capable of accepting finish in which they are to be installed so as to maintain final building surface appearance throughout.
- .10 Manufacturers:
 - .1 SMS.
 - .2 Bauco.
 - .3 Acudor.

2.03 Flexible Piping Connectors

- .1 Double wall stainless steel flexible connectors for piping connections to vibration isolated equipment, each selected by manufacturer to suit the application. Shop drawings or product data sheets must indicate construction and performance requirements that suit the application.
- .2 Manufacturers:
 - .1 Hyspan Precision Products Inc.;

- .2 Senior Flexonics Ltd.;
- .3 The Metraflex Co.

3 Execution

3.01 General Piping and Ductwork Installation Requirements

- .1 Unless otherwise specified, locate, and arrange horizontal pipes and ducts above or at ceiling on floors, arranged so that under consideration of all other work in area, maximum ceiling height and/or usable space is maintained. If required to maintain ceiling heights, reroute and/or resize ductwork, with Consultant's approval.
- .2 Unless otherwise specified, install work concealed in finished spaces, and concealed to degree possible in partially finished and unfinished spaces. Refer to and examine Architectural drawings and room finish schedules to determine finished, partially finished, and unfinished areas. Walls which are painted are considered finished.
- .3 Install pipes and ducts parallel to building lines and to each other.
- .4 Neatly group and arrange exposed work.
- .5 Locate work to permit easy access for service or maintenance as required and/or applicable. Locate valves, dampers and any other equipment which will or may need maintenance or repairs and which are to be installed in accessible construction so as to be easily accessible from access doors. Where valves, dampers and similar piping or ductwork accessories occur in vertical services in shafts, pipe spaces or partitions, locate accessories at floor level.
- .6 Make connections between pipes of different materials using adapters suitable for application. Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe.
- .7 Comply with equipment and material manufacturer's installation instructions unless otherwise specified herein or on drawings, and unless such instructions contradict governing codes and regulations.
- .8 Carefully clean ducts, pipe and fittings prior to installation. Temporarily cap or plug ends of pipe, ducts and equipment which are open and exposed during construction.
- .9 Install piping and ductwork which are to be insulated so that they have sufficient clearance to permit insulation and finish to be applied continuously and unbroken around pipe or duct, except for ductwork at fire barriers, in which case insulation will be terminated at each side of the duct fire damper.
- .10 Inspect surfaces and structure prepared by other trades before performing work. Verify surfaces or structure to receive work has no defects or discrepancies which could result in poor application or cause latent defects in installation and workmanship. Report defects in writing. Installation of work will constitute acceptance of such surfaces as being satisfactory.
- .11 Any ferrous piping that exhibits in excess of 5% surface rust, either inside or outside or both, is to be wire brush cleaned to bare metal and coated with suitable primer. Steel pipe, fittings and accessories are to be free of corrosion and dirt when work is complete or prior to being concealed from view. Where dirt is evident, clean piping prior to being concealed.
- .12 For factory applied finishes, repaint or refinish surfaces damaged during shipment and installation. Quality of repair work is to match original finish. This requirement also applies to galvanized finishes.
- .13 Where mechanical work is located in high humidity areas where ferrous metal products will be subject to corrosion and protection for such products is not specified, provide finishes on products to protect against corrosion or provide products which will not corrode in the environment, i.e. aluminium ductwork, copper or stainless steel pipe, etc.

- .14 Provide screwed unions or flanges in piping connections to equipment and in regular intervals in long (in excess of 12 m (40')) piping runs to permit removal of sections of piping.
- .15 Unless otherwise specified and except where space limitations do not permit, piping elbows are to be long radius. Eccentric reducers are to be installed with straight side at top of piping.

3.02 Pipe Joint Requirements

- .1 Do not make pipe joints in walls or slabs.
- .2 Ream piping ends prior to making joints.
- .3 Properly cut threads in screwed steel piping and coat male threads only with Teflon tape or paste, or an equivalent thread lubricant. After pipe has been screwed into fitting, valve, union, or piping accessory, not more than 2 pipe threads are to remain exposed.
- .4 Site bevel steel pipe to be welded or supply mill bevelled pipe. Remove scale and oxide from bevels and leave smooth and clean. Use factory made welding tees or welding outlet fittings for piping branches off mains. Do not use shop or site fabricated fittings unless written approval has been obtained.
- .5 Welded joints are to be made by CWB certified licensed journeyman welders qualified in accordance with CSA B51, Boiler Pressure Vessel and Pressure Piping Code, and who are in possession of a proper certificate of qualification for each procedure to be performed. Each weld is to be identified with the welder's identification symbol, and welds are not to be concealed until they have been inspected and approved. Electrodes are to be in accordance with CSA W48 Series, Electrodes, and requirements of CAN/CSA W117.2, Safety in Welding, Cutting and Allied Processes are to be followed.
- .6 Unless otherwise specified, make flanged joints with Garlock 5500 or equivalent gasket materials to suit the application, and bolts and nuts. Bolts are not to be longer than length necessary to screw nut up flush to the end of bolt. Bolts used for flanged connections in piping with a working pressure of 690 kPa (100 psi) and greater are to be ASTM A-193 Grade B-7, with heavy hexagon nuts to ASTM A-194 CL-2H. Provide suitable washers between each bolt head and flange and between each nut and flange.
- .7 A random check of bolted flanged connections will be made to verify flanged connections are properly mated with no shear force acting on bolts. Supply labour to disconnect and reconnect selected flanged joints. If improperly mated joints are found, remove and reinstall affected piping so flanges mate properly. If improperly mated joints are found, additional joints will be checked, and you will be responsible for the repair of any other improper joints discovered.
- .8 Unless otherwise specified make soldered joints in copper piping using flux suitable for and compatible with type of solder being used. Clean the outside of pipe end and inside of fitting, valve, or similar accessory prior to soldering.
- .9 Install mechanical joint fittings and couplings in accordance with manufacturer's instructions.
- .10 Grooves are to be rolled. Make arrangements with coupling and fitting manufacturer for shop and/or site instructions and demonstrations as required, and adhere to manufacturer's instructions with respect to pipe grooving, support, type of gasket required, anchoring and guiding the grooved piping system.
- .11 If pressure crimped couplings and fittings are used, ensure gaskets are fully compatible with piping fluid, and valves and piping accessories are suitable. Use only fitting manufacturer supplied crimping equipment. Comply with manufacturer's latest published specification, instructions, and recommendations with respect to pipe, coupling, and fitting preparation and installation, and support, anchoring and guiding of the piping system.
- .12 Solvent weld PVC piping in 2 parts, primer stage and cementing stage, in accordance with manufacturer's recommendations, ASTM D2855, and CSA requirements.

- .13 Install PVC piping with gasketed joints in accordance with manufacturer's current published specifications, instructions and recommendations, and CSA requirements.

3.03 Duct Openings

- .1 Duct openings, air inlet and outlet openings, fire damper and similar openings will be provided in new poured concrete work, masonry, drywall and other building surfaces by trade responsible for particular construction in which opening is required.
- .2 Size openings for fire dampers to suit damper arrangement with folding blade out of air stream.
- .3 For duct openings except where fire dampers are required, pack and seal space between duct or duct insulation and duct opening as specified above for pipe openings in non-fire rated construction.

3.04 Sleeve and Formed Opening Location Drawings

- .1 Prepare and submit for review, drawings indicating size and location of required sleeves, recesses and formed openings in poured or precast concrete work.
- .2 Such drawings are to be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum, and are to take into account structural items such as grade beams, column caps, and column drop slabs.
- .3 Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Contract.

3.05 Installation of Pipe Escutcheon Plates

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

3.06 Supply of Access Doors

- .1 Supply access doors to give access to mechanical work which may need maintenance or repair but which is concealed in inaccessible construction, except as otherwise specified herein or on drawings.
- .2 Before commencing installation of mechanical work, coordinate with other trades and prepare on a set of reflected ceiling plans and wall elevations, complete layouts of access doors. Submit these layouts for Consultant's review and show exact sizes and locations of such access doors. Locate and arrange mechanical work to suit.
- .3 Access doors will be installed by trade responsible for particular type of construction in which doors are required. Supply access doors to trade installing same at proper time.
- .4 Wherever possible, access doors to be of a standard size for each application. Confirm exact dimensions and minimum size restrictions with the Consultant prior to ordering.
- .5 Group piping and ductwork to ensure minimum number of access doors is required.
- .6 Coordinate with Electrical Contractor and General Trades Contractor to ensure access doors on project are provided by a single manufacturer, installed as part of work of General Trades Contractor and work involving both mechanical and electrical services should, where possible, be accessible from common access door. Coordinate work to ensure common location access doors are not supplied by both Mechanical Divisions and Electrical Divisions.

3.07 Installation of Valves

- .1 Generally, valve locations are indicated or specified on drawings or specified in Sections of the Specification where valves are specified, however, regardless of locations shown or specified, following requirements apply:
 - .1 provide shut-off valves to isolate systems, at base of vertical risers, in branch take-offs at mains and risers on floors, to isolate equipment, to permit work phasing as required, and wherever else required for proper system operation and maintenance;
 - .2 install shut-off valves with handles upright or horizontal, not inverted, and located for easy access;
 - .3 unless otherwise specified, provide a check valve in discharge piping of each pump;
 - .4 valve sizes are to be same as connecting pipe size;
 - .5 valves are to be permanently identified with size, manufacturer's name, valve model or figure number and pressure rating, and wherever possible, valves are to be product of same manufacturer;
 - .6 for valves in insulated piping, design of valve stem, handle and operating mechanism is to be such that insulation does not have to be cut or altered in any manner to permit valve operation.

3.08 Finish Painting of Mechanical Work

- .1 Finish paint exposed mechanical work as specified and/or scheduled in accordance with requirements of Division 09.
- .2 Touch-up paint damaged factory applied finishes on mechanical work products.

3.09 Pipe Leakage Testing

- .1 Before piping has been insulated or concealed, and before equipment, fixtures and fittings have been connected, test piping for leakage.
- .2 Tests are to be witnessed by the Consultant and/or Owner's representative, and, where required, representatives of governing authorities. Give ample notice of tests in writing and verify attendance. Have completed test report sheets dated and signed by those present to confirm proper test results.
- .3 When circumstances prevent scheduled tests from taking place, give immediate and adequate notice of cancellation to all who were scheduled to attend.
- .4 Gravity Drainage and Vent Piping
 - .1 Test piping in accordance with local governing building code.
 - .2 After fixtures and fittings are set and pipes are connected to building drain or drains, turn on water into pipe, fixtures, fittings and traps in order to detect any imperfect material or workmanship. Perform a smoke test if required by local governing authorities.
- .5 Pumped Drainage Piping
 - .1 Test piping with cold water at a pressure of 1-½ times normal working pressure and maintain pressure for a minimum of 2 hours.
- .6 Domestic Water Piping

- .1 Test piping with cold water at a pressure of 1-½ times normal working pressure and maintain pressure for a minimum of 2 hours.
- .7 Sprinkler System Piping
 - .1 Test system piping in accordance with requirements of NFPA No. 13, "Installation of Sprinkler Systems", and in accordance with any additional requirements of governing authorities.
- .8 Standpipe System Piping
 - .1 Test system piping in accordance with requirements of NFPA No. 14, "Standpipe and Hose Systems", and in accordance with any additional requirements of governing authorities.
- .9 CO2 Fire Extinguishing System Piping
 - .1 Test system piping in accordance with requirements of NFPA No. 12, "Standard on Carbon Dioxide Extinguishing Systems", and in accordance with any additional requirements of governing authorities.
- .10 Clean Agent Fire Extinguishing System Piping
 - .1 Test system piping in accordance with requirements of NFPA No. 2001, "Standard on Clean Agent Extinguishing Systems", and in accordance with any additional requirements of governing authorities.
- .11 Heat Transfer (HVAC) System Piping
 - .1 Test piping with cold water at a pressure of 1035 kPa (150 psi) for a minimum of 2 hours.
- .12 Steam and Condensate Piping
 - .1 Test piping with cold water for a minimum of 2 hours at following pressures:
 - .1 0 kPa to 105 kPa (0 psi to 15 psi) low pressure piping – 690 kPa (100 psi);
 - .2 110 kPa to 690 kPa (16 psi to 100 psi) medium pressure piping – 1035 kPa (150 psi);
 - .3 greater than 690 kPa (100 psi) high pressure piping – 1380 kPa (200 psi).
- .13 Natural Gas Piping
 - .1 Test piping in accordance with requirements of CAN/CSA B149.1 and any additional requirements of local governing authorities.
 - .2 After completion of the verification test, locate required tag stating results of the verification test at the point of entry of gas main into building, affixed to the pipe in a secure manner.
 - .3 Check piping joints and connections for leaks with a water/soap solution while piping is under pressure.
- .14 Propane Gas Piping
 - .1 Test piping in accordance with requirements of CAN/CSA B149.2 and any additional requirements of local governing authorities.
 - .2 After completion of the verification test, locate required tag stating results of the verification test at the point of entry of gas main into building, affixed to the pipe in a secure manner.
 - .3 Check piping joints and connections for leaks with a water/soap solution while piping is under pressure.

- .15 Compressed Air Piping
 - .1 Test piping with dry compressed air or nitrogen at 690 kPa (100 psi) for a minimum of 2 hours.
 - .2 Test piping joints with a water-soap solution while piping is under pressure to detect leaks.
- .16 Fuel Oil Piping
 - .1 Test piping (not tanks) with dry compressed air or nitrogen for a minimum period of 2 hours at 1035 kPa (150 psi).
 - .2 Check piping joints and connections for leaks with a water/soap solution while piping is under pressure.
- .17 Gasoline Piping
 - .1 Test piping (not tanks) with dry compressed air or nitrogen for a minimum period of 2 hours at 1035 kPa (150 psi) in accordance with TSSA requirements.
 - .2 Check piping joints and connections for leaks with a water/soap solution while piping is under pressure.
- .18 Refrigerant Piping
 - .1 Test refrigerant piping for leakage and dehydrate in accordance with requirements of Chapter 18 of ASHRAE Handbook - Fundamentals.
- .19 Control Air Piping and Tubing
 - .1 Test control air piping and tubing with dry compressed air or nitrogen before concealing and again before connection of instruments.
 - .2 Rough-in test pressure is to be 345 kPa (50 psi) maintained over 24 hours with a pressure drop not to exceed 35 kPa (5 psi).
 - .3 Test joints for leaks with a soap solution.
 - .4 Finish test is to be 205 kPa (30 psi) with a permissible loss of 7 kPa (1 psi) over a 4 hour period. Prior to connecting instruments, blow systems clean and dry, and test component connections for leaks with a water/soap solution.
- .20 Pure Water Piping
 - .1 When piping has been properly flushed and cleaned, test at 690 kPa (100 psi) for 2 hours with only distilled water or filtered dry compressed air. If distilled water is used, drain system when testing is complete.
- .21 Following requirements apply to all testing:
 - .1 ensure piping has been properly flushed, cleaned and is clear of foreign matter prior to pressure testing;
 - .2 temporarily remove or valve off piping system specialties or equipment which may be damaged by test pressures prior to pressure testing systems, and flush piping to remove foreign matter;
 - .3 when testing is carried out below highest level of the particular system, increase test pressure by the hydrostatic head of 7 kPa (1 psi) for every 600 mm (24") below the high point;
 - .4 include for temporary piping connections required to properly complete tests;

- .5 piping under test pressure is to have zero pressure drop for length of test period;
- .6 tighten leaks found during tests while piping is under pressure. If this is impossible, remove and refit piping and reapply test until satisfactory results are obtained;
- .7 where leaks occur in threaded joints in steel piping, no caulking of these joints will be allowed under any conditions;
- .8 tests are to be done in reasonably sized sections so as to minimize number of tests required;
- .9 in addition to leakage tests specified above, demonstrate proper flow throughout systems including mains, connections and equipment, as well as proper venting and drainage, and include for any necessary system adjustments to achieve proper conditions.

3.10 Interruption to and Shut-Down of Mechanical Services and Systems

- .1 Coordinate shut-down and interruption to existing mechanical systems with Owner. Generally, shut-downs may be performed only between the hours of 12:00 midnight Friday until 6:00 a.m. Monday morning, unless otherwise specified in Division 01. Include for costs of premium time to perform work during nights, weekends or other times outside of normal working hours, which may be necessary to comply with stipulations specified herein this Article. Services for operation of existing non-renovated areas of building are to be maintained.
- .2 Upon award of a Contract, submit a list of anticipated shut-down times and their maximum duration.
- .3 Prior to each shut-down or interruption, inform Owner and the Consultant in writing 5 working days in advance of proposed shut-down or interruption and obtain written consent to proceed. Do not shut-down or interrupt any system or service without such written consent. Shutdowns of some essential services may require additional advance notification time.
- .4 Perform work associated with shut-downs and interruptions as continuous operations to minimize shut-down time and to reinstate systems as soon as possible, and, prior to any shut-down, ensure materials and labour required to complete the work for which shut-down is required are available at site.
- .5 Pipe freezing shall be used to connect new piping to existing piping. Alternative methods may be proposed, if site conditions are evaluated and permit, and are approved by the Consultant.
- .6 Where existing isolation valves do not hold, pipe freezing shall be used to connect new piping to existing piping.

3.11 Mechanical Service Requirements for Floating Floor Slabs

- .1 Where mechanical services are required to be installed in or through a vibration isolated floating slab, install such services so as not to transmit any vibration to base slab on which floating floor slab is placed.
- .2 Wherever possible, arrange mechanical work to avoid penetrating a floating floor slab.

3.12 Excavation and Backfill Work

- .1 Unless otherwise specified in Division 31, provide all excavation and backfill associated with the mechanical scope of work.
- .2 Before commencement of excavation for work, determine in consultation with Consultant, Owner, Municipality and utilities, presence, if any, of existing underground services at site. Engage local utilities to locate and mark out such services. Ensure trades concerned are aware of their presence.
- .3 Be responsible for any damage done to underground services caused by neglect to determine and mark out location of such services prior to excavation work commences.

- .4 Where Work falls under jurisdiction of local governing utility, confirm requirements and comply with utility requirements.
- .5 Unless otherwise specified in Division 31, provide excavation, backfill and related work required for mechanical work. Obtain a copy of soil test report if available from the Consultant. Depth of excavations must accommodate local governing requirements and local standard practices to compensate for local frost levels of Place of the Work.
- .6 Inverts and locations of existing site services may have been site surveyed and approximate location may be shown on drawings. Confirm inverts and locations are correct, prior to commencing excavation and contact Utilities to accurately locate their services. Where discrepancies are found, immediately inform Consultant, and await a direction. Grade bottom of trench excavations as required.
- .7 In firm, undisturbed soil, lay pipes directly on soil, unless otherwise directed.
- .8 Before backfilling, arrange for inspection of work by the Consultant. Do not backfill work unless reviewed with the Consultant. Failure to do so prior to backfilling will require re-excavating work and re-backfill at no additional cost to Owner.
- .9 Unless otherwise specified, backfill trenches within building with clean sharp sand in individual layers of maximum 150 mm (6") thickness compacted to a density of 100% Standard Proctor. Hand compact first layers up to a compacted level of minimum 300 mm (12") above top of pipe. Hand or machine compact the balance up to grade.
- .10 Unless otherwise specified, backfill trenches outside the building (not under roads, parking lots or traffic areas), up to a compacted level of 450 mm (18") thick above the pipe, hand compacted to a density of 95% Standard Proctor, using granular "A" gravel. Backfill the balance in 150 mm (6") layers with approved excavated material, compacted to 95% Standard Proctor density.
- .11 Unless otherwise specified, backfill trenches outside building under roads, parking lots or traffic areas with crushed stone or granular "A" gravel in layers not exceeding 150 mm (6") thickness, compacted to 100% Standard Proctor density up to grade level.
- .12 Provide minimum 1.37 m (4.5') of cover for underground piping subject to freezing and located outside building.
- .13 Provide minimum 450 mm (18") of cover for underground piping subject to freezing and located inside building.
- .14 After first lift of backfill has been compacted, mark entire path of pipe using continuous 75 mm (3") wide detectable identified marking tape equal to SMS Ltd. D-UGMT.
- .15 Unless otherwise directed in Division 02 and/or Division 31, store and dispose of excavated materials as follows:
 - .1 during progress of contract, place material as directed in such a manner to minimize damage or disfigurement of ground and which in no way impedes progress of work;
 - .2 separately place surplus topsoil and subsoil as directed; leave site clean and unencumbered.
- .16 Perform pumping as required to keep excavations free of water.
- .17 Engage services of independent soils testing agency to test final backfill compaction density of each backfilled location. Compact backfill to satisfaction of testing agency and in accordance with Specification. Submit a copy of testing agency's report to the Consultant for review.
- .18 Fill depressions to correct grade level with appropriate material, after an adequate period has passed to reveal any settlement. Use maximum possible compaction. Pay costs required to make good damages caused by settlement.

- .19 Coordinate requirements for final surface toppings (concrete, asphalt, pavers, grass sod, etc.) with General Contractor.

3.13 Cutting, Patching and Core Drilling

- .1 Unless otherwise provided by General Trades, perform cutting, patching, and core drilling of existing building required for installation of mechanical work. Perform cutting in a neat and true fashion, with proper tools and equipment to Consultant's approval. Patching is to exactly match existing finishes and be performed by tradesmen skilled in particular trade or application. Work is subject to review and acceptance by the Consultant.
- .2 Criteria for cutting holes for additional services:
 - .1 cut holes through slabs only; no holes to be cut through beams;
 - .2 cut holes 150 mm (6") diameter or smaller only; obtain approval from Structural Consultant for larger holes;
 - .3 keep at least 100 mm (4") clear from beam faces;
 - .4 space at least 3 hole diameters on centre;
 - .5 for holes that are required closer than 25% of slab span from supporting beam face, use cover meter above slab to clear slab top bars;
 - .6 for holes that are required within 50% of slab span, use cover meter underside of slab to clear slab bottom bars;
 - .7 submit sleeving drawings indicating holes and their locations for Structural Consultant's review.
- .3 Do not cut or drill any existing work without approval from Owner and Consultant. Be responsible for damage done to building and services caused by cutting or drilling.
- .4 Where pipes pass through existing construction, core drill an opening. Size openings to leave 12 mm (½") clearance around pipes or pipe insulation.
- .5 Prior to drilling or cutting an opening, determine, in consultation with Consultant and Owner, and by use of non-destructive radar scan (magnetic scan) of slab or wall, presence of any existing services and reinforcement bars concealed behind building surface to be cut and locate openings to suit. Coring is not permitted through concrete beams or girders.
- .6 Where drilling is required in waterproof slabs, size opening to permit snug and tight installation of a pipe sleeve sized to leave 12 mm (½") clearance around pipe or pipe insulation. Provide a pipe sleeve, constructed of Schedule 40 galvanized steel pipe with a flange at one end and of a length to extend 100 mm (4") above slab, in opening. Secure flange to the underside of slab and caulk void between sleeve and slab opening with proper non-hardening silicone base caulking compound to produce a water-tight installation.
- .7 Firestop and seal openings in fire rated construction. Do not leave openings open overnight unless approved by Owner and Consultant.

3.14 Packing and Sealing Core Drilled Pipe Openings

- .1 Pack and seal void between pipe opening and pipe or pipe insulation for length of opening as follows:
 - .1 non-fire rated interior construction – pack with mineral wool and seal both ends of opening with non-hardening silicone base caulking compound to produce a water-tight seal;

- .2 exterior walls above grade – pack with mineral wool and seal both ends of sleeves water-tight with non-hardening silicone base caulking compound unless mechanical type seals have been specified;
- .3 exterior walls below grade (and any other wall where water leakage may be a problem) – seal with link type mechanical seals as specified.

3.15 Flashing for Mechanical Work Penetrating Roof

- .1 Unless otherwise specified in Division 07, perform required flashing work, including counter-flashing, for mechanical work penetrating and/or set in roof.
- .2 Perform flashing work in accordance with requirements of drawing details and/or requirements specified in Division 07.

3.16 Cleaning Mechanical Work

- .1 Refer to cleaning requirements specified in Division 01.
- .2 Clean mechanical work prior to application for Substantial Performance of the Work.
- .3 Include for vacuum cleaning interior of air handling units and ductwork systems.

3.17 Connections to Other Equipment

- .1 Carefully examine Contract Documents during bidding period and include for mechanical work piping and/or ductwork connections to equipment requiring such connections.

3.18 Seismic Restraint Anchor Points for Equipment

- .1 Where mechanical equipment requires seismic restraint, it is to be complete with manufacturer designed and rated seismic restraint anchor points and attachments, certified by equipment manufacturers, so equipment may be bolted down or restrained in the field.
- .2 Equipment to be restrained must be designed such that the strength and anchorage of its internal components exceed force level; used to restrain and anchor the equipment to the supporting structure.

3.19 Installation of Flexible Connectors

- .1 Provide flexible connectors in piping connections to seismically restrained equipment, where applicable, and wherever else shown.
- .2 Provide flexible connectors in piping connections to vibration isolated equipment.

3.20 Fan Noise Levels

- .1 Submit sound power levels with fan shop drawings/product data, with levels measured to AMCA 300 and calculated to AMCA 301.

3.21 Equipment and System Manufacturer's Certification

- .1 When equipment/system installation is complete, but prior to start-up procedures, arrange and pay for equipment/system manufacturer's authorized representative to visit site to examine installation, and after any required corrective measures have been made, to certify in writing to the Consultant that equipment/system installation is complete and in accordance with equipment/system manufacturer's instructions.

3.22 System Startup

- .1 When installation of equipment/systems is complete but prior to commissioning, perform start-up for equipment/systems as specified in mechanical work Sections in accordance with following requirements:
 - .1 Submit a copy of each equipment/system manufacturer's start-up report sheet to the Consultant for review, and incorporate any comments made by the Consultant.
 - .2 Under direct on-site supervision and involvement of equipment/system manufacturer's representative, start-up equipment/systems, make any required adjustments, document procedures, leave equipment/systems in proper operating condition, and submit to the Consultant complete set of start-up documentation sheets signed by manufacturer/supplier and Contractor.
 - .3 Commission interconnected life safety systems in accordance with CAN/ULC-S1001-11 and provide written report for Consultant's review.

End of Section

1 General

1.01 Section Includes

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

2 Products – Not Used

3 Execution

3.01 Disconnection and Removal of Existing Mechanical Work

- .1 Where indicated on drawings, disconnect, and remove existing mechanical work, including hangers, supports, insulation, etc. Disconnect at point of supply, remove obsolete connecting services and make system safe. Cut back obsolete piping behind finishes and cap water-tight unless otherwise specified.
- .2 Scope and extent of demolition or revision work is only generally indicated on drawings. Estimate scope, extent and cost of work at site during bidding period site visit(s). Claims for extra costs for demolition work not shown or specified but clearly visible or ascertainable at site during bidding period site visits will not be allowed.
- .3 If any re-design is required due to discrepancies between mechanical drawings and site conditions, notify the Consultant who will issue a Site Instruction. If, in the opinion of the Consultant, discrepancies between mechanical drawings and actual site conditions are of a minor nature, required modifications are to be done at no additional cost.
- .4 Where existing mechanical services extend through, or are in an area to serve items which are to remain, maintain services in operation. Include for rerouting existing services concealed behind existing finishes and which become exposed during renovation work, so as to be concealed behind new or existing finishes.
- .5 Unless otherwise specified, remove from site and dispose of existing materials which have been removed and are not to be relocated or reused.

End of Section

1 General

1.01 Section Includes

- .1 This Section specifies requirements that are common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly. Where requirements of this Section contradict requirements of Division 00 or Division 01, conditions of Division 00 or Division 01 to take precedence.
- .2 Be responsible for advising product vendors of requirements of this Section.

1.02 Related Requirements

- .1 Division 00 and Division 01 apply to and are a part of this Section.

1.03 Definitions

- .1 "concealed" – means hidden from normal sight in furred spaces, shafts, ceiling spaces, walls and partitions.
- .2 "exposed" – means work normally visible, including work in equipment rooms, service tunnels, and similar spaces.
- .3 "finished" - means when in description of any area or part of an area or a product which receives a finish such as paint, or in case of a product may be factory finished.
- .4 "provision" or "provide" (and tenses of "provide") – means supply and install complete.
- .5 "install" (and tenses of "install") – means secure in position, connect complete, test, adjust, verify, and certify.
- .6 "supply" – means to procure, arrange for delivery to site, inspect, accept delivery, and administer supply of products; distribute to areas; and include manufacturer's supply of any special materials, standard on site testing, initial start-up, programming, basic commissioning, warranties, and manufacturers' assistance to Contractor.
- .7 "delete" or "remove" (and tenses of "delete" or "remove") – means to disconnect, make safe, and remove obsolete materials; patch and repair/finish surfaces to match adjoining similar construction; include for associated re-programming of systems and/or change of documentation identifications to suit deletions, and properly dispose of deleted products off site unless otherwise instructed by Owner and reviewed with the Consultant.
- .8 "BAS" – means building automation system; "BMS" – means building management system; "FMS" – means facility management system; and "DDC" means direct digital controls; references to "BAS", "BMS", "FMS" and "DDC" generally mean same.
- .9 "governing authority" and/or "authority having jurisdiction" and/or "regulatory authority" and/or "Municipal authority" – means government departments, agencies, standards, rules and regulations that apply to and govern work and to which work must adhere.
- .10 "OSHA" and "OHSA" – stands for Occupational Safety and Health Administration and Occupational Health and Safety Act, and wherever either one is used, they are to be read to mean local governing occupational health and safety regulations that apply to and govern work and to which work must adhere, regardless if Project falls within either authority's jurisdiction.
- .11 "Mechanical Divisions" – refers to Division 20, Division 21, Division 22, Division 23, Division 25, and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Mechanical Contractor, unless otherwise noted.

- .12 "Electrical Divisions" – refers to Division 26, Division 27, Division 28, and other Divisions as specifically noted, and which work as defined in Specifications and/or on drawings is responsibility of Electrical Contractor, unless otherwise noted.
- .13 "Consultant" – means person, firm or corporation identified as such in Agreement or Documents, and is licensed to practice in Place of the Work, and has been appointed by Owner to act for Owner in a professional capacity in relation to the Work.
- .14 Wherever words "indicated", "shown", "noted", "listed", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean product referred to is "indicated", "shown", "listed", or "noted" on Contract Documents.
- .15 Wherever words "reviewed", "satisfactory", "as directed", "submit", or similar words or phrases are used in Contract Documents they are understood, unless otherwise defined, to mean that work or product referred to is "reviewed by", "to the satisfaction of", "submitted to", etc., Consultant.

1.04 Documents

- .1 Documents for bidding include but are not limited to issued Drawings, Specifications and Addenda.
- .2 Specification is arranged in accordance with CSI/CSC 49 Divisions of MasterFormat.
- .3 Drawings and Specifications are portions of Contract Documents and identify labour, products and services necessary for performance of work and form a basis for determining pricing. They are intended to be cooperative. Perform work that is shown, specified, or reasonably implied on the drawings but not mentioned in Specification, or vice-versa, as though fully covered by both.
- .4 Review Drawings and Specifications in conjunction with documents of other Divisions and, where applicable, Code Consultant's report.
- .5 Unless otherwise specifically noted in Specifications and/or on Drawings, Sections of Mechanical Divisions are not intended to delegate functions nor to delegate work and supply of materials to any specific trade, but rather to generally designate a basic unit of work, and Sections are to be read as a whole.
- .6 Drawings are performance drawings, diagrammatic, and show approximate locations of equipment and connecting services. Any information regarding accurate measurement of building is to be taken on site. Do not scale Drawings, and do not use Drawings for prefabrication work.
- .7 Drawings are intended to convey the scope of work and do not show architectural and structural details. Provide, at your cost, offsets, fittings, transformations and similar products required as a result of obstructions and other architectural and/or structural details but not shown on Drawings.
- .8 Locations of equipment and materials shown may be altered, when reviewed by the Consultant, to meet requirements of equipment and/or materials, other equipment or systems being installed, and of building, all at no additional cost to Contract.
- .9 Specification does not generally indicate specific number of items or amounts of material required. Specification is intended to provide product data and installation requirements. Refer to schedules, Drawings (layouts, riser diagrams, schematics, details) and Specification to provide correct quantities. Singular may be read as plural and vice versa.
- .10 Starter/motor control centre (MCC)/variable frequency drive (VFD) schedule drawings are both mechanical and electrical, and apply to work of Mechanical Divisions and Electrical Divisions. Be responsible for reviewing starter, MCC, VFD, and motor specification requirements prior to Bid submission. Confirm and coordinate exact scope of work and responsibility of work between Mechanical Divisions and Electrical Divisions.

- .11 Drawings and Specifications have been prepared solely for use by party with whom Consultant has entered into a contract and there are no representations of any kind made by the Consultant to any other party.
- .12 In the case of discrepancies between the drawings and specifications, documents will govern in order specified in "General Conditions", however, when scale and date of drawings are same, or where discrepancy exists within specification, most costly arrangement will take precedence.

1.05 Metric and Imperial Measurements

- .1 Generally, both metric and imperial units of measurement are given in Sections of Specification governed by this section. Measurement conversions may be generally "soft" and rounded off. Confirm exact measurements based on application. Where measurements are related to installation and onsite applications, confirm issued document measurements with applicable local code requirements, and/or as applicable, make accurate measurements onsite. Where significant discrepancies are found, immediately notify Consultant for direction.

1.06 Examination of Documents and Site

- .1 Carefully examine Documents and visit site to determine and review existing site conditions that will or may affect work, and include for such conditions in Bid Price.
- .2 Report to Consultant, prior to Bid Submittal, any existing site condition that will or may affect performance of work as per Documents. Failure to do so will not be grounds for additional costs.
- .3 Upon finding discrepancies in, or omissions from Documents, or having doubt as to their meaning or intent, immediately notify Consultant, in writing.

1.07 Work Standards

- .1 Where any code, regulation, bylaw, standard, contract form, manual, printed instruction, and installation and application instruction is quoted it means, unless otherwise specifically noted, latest published edition at time of submission of Bids adopted by and enforced by local governing authorities having jurisdiction. Include for compliance with revisions, bulletins, supplementary standards or amendments issued by local governing authorities.
- .2 Where regulatory codes, standards and regulations are at variance with Drawings and Specification, more stringent requirement will apply unless otherwise directed by Owner and reviewed with the Consultant.
- .3 Supplementary mandatory specification and requirements to be used in conjunction with project include but are not limited to following:
 - .1 Air-Conditioning, Heating and Refrigeration Institute (AHRI);
 - .2 Air Movement and Control Association (AMCA);
 - .3 American Iron and Steel Institute (AISI);
 - .4 American National Standards Institute (ANSI);
 - .5 American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., (ASHRAE);
 - .6 American Society of Mechanical Engineers (ASME);
 - .7 American Society of Testing and Materials (ASTM);
 - .8 American Water Works Association (AWWA);
 - .9 Associated Air Balance Council (AABC);

- .10 Building Industry Consulting Services, International (BICSI);
- .11 Canadian Gas Association (CGA);
- .12 Canadian General Standards Board (CGSB);
- .13 Canadian Standards Association (CSA);
- .14 Electrical and Electronic Manufacturers Association of Canada (EEMAC);
- .15 Electrical Safety Authority (ESA);
- .16 Electronic Industries Association (EIA);
- .17 Factory Mutual Systems (FM);
- .18 Illuminating Engineering Society (IES);
- .19 Institute of Electrical and Electronic Engineers (IEEE);
- .20 International Standards Organization (ISO);
- .21 Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS);
- .22 National Building Code of Canada (NBC);
- .23 National Electrical Manufacturers Association (NEMA);
- .24 National Environmental Balancing Bureau (NEBB);
- .25 National Fire Protection Association (NFPA);
- .26 National Standards of Canada;
- .27 NSF International;
- .28 Occupational Health and Safety Act (OHSA);
- .29 Ontario Building Code (OBC);
- .30 Ontario Electrical Safety Code (OESC);
- .31 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA);
- .32 Technical Standards and Safety Authority (TSSA);
- .33 Thermal Insulation Association of Canada (TIAC);
- .34 Underwriters' Laboratories of Canada (ULC);
- .35 Workplace Hazardous Materials Information System (WHMIS);
- .36 Material Safety Data Sheets by product manufacturers;
- .37 Local utility inspection permits;
- .38 Codes, standards, and regulations of local governing authorities having jurisdiction;
- .39 Additional codes and standards listed in Trade Sections;
- .40 Owner's standards.

- .4 Provide applicable requirements for barrier free access in accordance with latest edition of local governing building code.
- .5 Where any governing Code, Regulation, or Standard requires preparation and submission of special details or drawings for review they are to be prepared and submitted to appropriate authorities. Be responsible for costs associated with these submittals.
- .6 Unless otherwise specified, install equipment in accordance with equipment manufacturer's recommendations and instructions, and requirements of governing Codes, Standards, and Regulations. Governing Codes, Standards, and Regulations take precedence over manufacturer's instructions.
- .7 Work is to be performed by journeyperson tradesmen who perform only work that their certificates permit, or by apprentice tradesmen under direct on site supervision of experienced journeyperson tradesman. Journeyperson to apprentice ratio is not to exceed ratio determined by the Board as stated in Ontario College of Trades and Apprenticeship Act or local equivalent governing body in Place of the Work.
- .8 Journeyperson tradesmen are to have a copy of valid trade certificates available at site for review with the Consultant at any time.
- .9 Experienced and qualified superintendent is to be on-site at times when work is being performed.
- .10 Coordinate work inspection reviews and approvals with governing inspection department to ensure that construction schedule is not delayed. Be responsible for prompt notification of deficiencies to the Consultant and submission of reports and certificates to the Consultant.
- .11 Properly protect equipment and materials on site from damage due to elements and work of trades, to satisfaction of Owner and reviewed with the Consultant. Equipment and materials are to be in new condition upon Substantial Performance of the Work.
- .12 Mechanical piping system work, including equipment, must comply in all respects with requirements of local technical standards authorities and CSA B51, Boiler, Pressure Vessels and Pressure Piping Code. Where required, mechanical work products must bear a CRN number.
- .13 Electrical items associated with mechanical equipment are to be certified and bear stamp or seal of a recognized testing agency such as CSA, UL, ULC, ETL, etc., or bear a stamp to indicate special electrical utility approval.

1.08 Permits, Certificates, Approvals, and Fees

- .1 Contact and confirm with local authorities having jurisdiction including utility providers, requirements for approvals from such authorities. Obtain and pay for permits, certificates, and approvals required to complete Work.
- .2 Be responsible for ensuring that authorities having jurisdiction which require on-site inspection of work, have ample notification to perform inspection, with sufficient lead time to correct deficiencies in a manner that will not impede schedule of completion of Work. If any defect, deficiency or non-compliant is found in work by inspection, be responsible for costs of such inspection, including any related expenses, making good and return to site, until work is passed by governing authorities.
- .3 Obtain and submit to Consultant, approval/inspection certificates issued by governing authorities to confirm that Work as installed is in accordance with rules and regulations of local governing authorities and are acceptable.
- .4 Include in each copy of operating and maintenance instruction manuals, copies of approvals and inspection certificates issued by regulatory authorities.

1.09 Requirements for Contractor Retained Engineers

- .1 Professional engineers retained to perform consulting services with regard to Project work, i.e. seismic engineer, fire protection engineer or structural engineer, are to be members in good standing with local Association of Professional Engineers, and are to carry and pay for errors and omissions professional liability insurance in compliance with requirements of governing authorities in Place of the Work.
- .2 Retained engineer's professional liability insurance is to protect Contractor's consultants and their respective servants, agents, and employees against any loss or damage resulting from professional services rendered by aforementioned consultants and their respective servants, agents, and employees in regards to the Work of this Contract.
- .3 Unless otherwise specified in Division 00 or Division 01, liability insurance requirements are as follows:
 - .1 coverage is to be a minimum of \$1,000,000.00 CDN inclusive of any one occurrence;
 - .2 insurance policy is not to be cancelled or changed in any way without insurer giving Owner minimum thirty days written notice;
 - .3 liability insurance is to be obtained from an insurer registered and licensed to underwrite such insurance in the Place of the Work;
 - .4 retained consultants are to ascertain that sub-consultants employed by them carry insurance in the form and limits specified above;
 - .5 evidence of the required liability insurance in such form as may be required is to be issued to Owner, Owner's Consultant, and Municipal Authorities as required prior to commencement of aforementioned consultant's services.

1.10 Workplace Safety

- .1 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials. Submit WHMIS MSDS (Material Safety Data Sheets) for products where required, and maintain one copy at site in a visible and accessible location available to personnel.
- .2 Comply with requirements of Occupational Health and Safety Act and other regulations pertaining to health and safety, including worker's compensation/insurance board and fall protection regulations. When working in confined spaces, comply with requirements of Occupational Health and Safety Act - Ontario Regulation 632, "Confined Spaces" and any other applicable Ministry of Labour requirements.
- .3 If at any time during course of work, hazardous materials other than those identified in Documents and pertaining to Project Scope of Work, are encountered, or suspected that were not identified as being present and which specific instructions in handling of such materials were not given, cease work in area in question and immediately notify Consultant. Comply with local governing regulations with regards to working in areas suspected of containing hazardous materials. Do not resume work in affected area without approval from Owner and reviewed with the Consultant.

1.11 Planning and Layout of Work

- .1 Base installation layout, design, terminations, and supply of accessories, on Contract Documents with specific coordination with reviewed shop drawings.
- .2 Plan, coordinate, and establish exact locations and routing of services with affected trades prior to installation such that services clear each other as well as other obstructions. Generally, order of right of way for services to be as follows:
 - .1 piping requiring uniform pitch;

- .2 piping 100 mm (4") dia. and larger;
 - .3 large ducts (main runs);
 - .4 cable tray and bus duct;
 - .5 conduit 100 mm (4") dia. and larger;
 - .6 piping less than 100 mm (4") dia.;
 - .7 smaller branch ductwork;
 - .8 conduit less than 100 mm (4") dia.
- .3 Unless otherwise shown or specified, conceal work in finished areas, and conceal work in partially finished and/or unfinished areas to extent made possible by the area construction. Install services as high as possible to conserve headroom and/or ceiling space. Notify Consultant where headroom or ceiling space appears to be inadequate prior to installation of work.
- .4 Do not use Contract Drawing measurements for prefabrication and layout of piping, sheet metal work and such other work. Locations and routing are to generally be in accordance with Contract Drawings, however, prepare layout drawings for such work. Use established bench marks for both horizontal and vertical measurements. Confirm inverts, coordinate with and make allowances for work of other trades. Accurately layout work, and be entirely responsible for work installed in accordance with layout drawings. Where any invert, grade, or size is at variance with Contract Drawings, notify Consultant prior to proceeding with work.
- .5 Prepare plan and interference drawings (at a minimum drawing scale of 1:50 or 1/4"=1' 0") of work for coordination with each trade Contractor. Arrange for preparation of detailed section drawings of ceiling spaces of corridors and any other congested areas. Sections are to be cross referenced with plan drawings so that trades may make use of section drawings. Section drawings to indicate lateral and elevation dimensions of major services within ceiling space. Lateral dimensions are to be from grid lines and elevations from top of floor slab. Obtain from Consultant, engineering drawings for this use. Contractors' interference drawings are to be distributed among other Trade Contractors. Submit drawings to the Consultant for review. Failure of General Contractor to prepare and coordinate overall interface drawings of trades does not relieve respective Division Contractor of responsibility to ensure that work is properly planned and coordinated.
- .6 Carry out alterations in arrangement of work that has been installed without proper coordination, study, and review, even if in accordance with Contract Documents, in order to conceal work behind finishes, or to allow installation of other work, without additional cost. In addition, make necessary alterations in other work required by such alterations, without additional cost.
- .7 Shut-off valves, balancing devices, air vents, equipment, and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.
- .8 Be responsible for making necessary changes, at no additional cost, to accommodate structural and building conditions that were missed due to lack of coordination.

1.12 Scheduling

- .1 Include for any and all scheduling, coordination, and construction phasing to suit project, specified in Division 01 and/or as indicated on the drawings. Review exact phasing requirements with Consultant prior to start of Work.
- .2 [Phasing and scheduling of Work is required in order to maintain existing building operations. Include costs (including costs for "off hours" work) for scheduling, co-ordination, and construction phasing to suit

this project as specified in Division 01 and on drawings. Review phasing requirements with the Consultant prior to start of Work.]

- .3 [Protect existing areas above, below, and adjacent areas of Work from any debris, noise, or interruptions to existing services to satisfaction of Owner and reviewed with the Consultant. Maintain in operation existing services to these areas to allow Owner to continue use of these areas. If services that are required to be maintained run through areas of renovations, provide necessary protection to services or reroute, in coordination with Owner and Consultant. Include for required premium time work to meet these requirements.]
- .4 [Work being performed within occupied spaces and work affecting surfaces adjacent to occupied spaces may need to be performed after regular business hours. For areas where spaces are used by Owner on a 24 hours basis or over various hours, coordinate hours of work with Owner on a regular basis to suit Owner's schedule. Execute work at times confirmed with and agreed to by Owner and reviewed with the Consultant, so as not to inconvenience Owner's occupation or in any way hinder Owner's use of building. Include for required premium timework to meet these requirements.]
- .5 Project partial occupancy permits may be required throughout project. Provide for each partial permit, required local governing authority certificate and any other testing/verification certificates for systems.

1.13 Coordination

- .1 Review Contract Documents and coordinate work with work of each trade. Coordination requirements are to include but not be limited to following:
 - .1 requirements for openings, sleeves, inserts and other hardware necessary for installation of work;
 - .2 concrete work such as housekeeping pads, sumps, bases, etc., required for work, and including required dimensions, operating weight of equipment, location, etc.;
 - .3 depth and routing of excavation required for work, and requirements for bedding and backfill;
 - .4 wiring work required for equipment and systems but not specified to be done as part of mechanical work, including termination points, wiring type and size, and any other requirements.
- .2 Ensure materials and equipment are delivered to site at proper time and in such assemblies and sizes so as to enter into building and be moved into spaces where they are to be located without difficulty.
- .3 Wherever possible, coordinate equipment deliveries with manufacturers and/or suppliers so equipment is delivered to site when it is required, or so it can be stored within building, subject to available space as confirmed with Owner and reviewed with Owner, and protected from elements.
- .4 Ensure proper access and service clearances are maintained around equipment, and, where applicable, access space for future equipment removal or replacement is not impeded. Comply with code requirements with regards to access space provision around equipment. Remove and replace any equipment which does not meet this requirement.
- .5 Where work is to be integrated, or is to be installed in close proximity with work of other trades, coordinate work prior to and during installation.

1.14 Products

- .1 Be responsible for ordering of products (equipment and materials) in a timely manner in order to meet project-scheduling timelines. Failure to order products to allow manufacturers sufficient production/delivery time to meet project-scheduling timelines is an unacceptable reason to request for other suppliers or substitutions.
- .2 Provide Canadian manufactured products wherever possible or required and when quality and performance is obtainable at a competitive price. Products are to be supplied from manufacturer's

authorized Canadian representative, unless otherwise noted. Unless otherwise specified, products are to be new and are to comply with applicable respective Canadian standards. References to UL listings of products to include requirements that products are to be also Underwriters Laboratories of Canada (ULC) listed for use in Canada. Products are to meet or exceed latest ANSI/ASHRAE/IES 90.1 standards, as applicable. Do not supply any products containing asbestos materials or PCB materials.

- .3 Systems and equipment of this Project are to be "State of the Art" and be most recent and up to date series/version of product that is available at time of shop drawing review process. Products that have been stored or "on shelf" for an extended period of time will not be accepted. Software is to be of latest version available and be provided with updates available at time of shop drawing review process. Systems are to be designed such that its software is backwards compatible. Future upgrades are not to require any hardware replacements or additions to utilize latest software.
- .4 Products scheduled and/or specified have been selected to establish a performance and quality standard, and, in some instances, a dimensional standard. In most cases, base specified manufacturers are stated for any product specified by manufacturer's name and model number. Where manufacturers are listed, first name listed is base specified company. Bid Price may be based on products supplied by any of manufacturers' base specified or named as acceptable for particular product. If manufacturers are not stated for a particular product, base Bid Price on product supplied by base specified manufacturer.
- .5 Documents have been prepared based on product available at time of Bidding. If, after award of Contract, and if successful manufacturer can no longer supply a product that meets base specifications, notify Consultant immediately. Be responsible for obtaining other manufacturers product that complies with base specified performance and criteria and meets project timelines. Proposed products are subject to review and consideration by the Consultant and are considered as substitutions subject to a credit to Contract. In addition, if such products require modifications to room spaces, mechanical systems, electrical systems, etc., include required changes. Such changes are to be submitted in detail to the Consultant for review and consideration for acceptance. There will be no increase in Contract Price for revisions. Above conditions supplement and are not to supersede any specification conditions with regards to substitutions or failure to supply product as per issued documents.
- .6 Listing of a product as "acceptable" does not imply automatic acceptance by the Consultant and/or Owner. It is responsibility of Contractor to ensure that any price quotations received and submittals made are for products that meet or exceed specifications included herein.
- .7 If products supplied by a manufacturer named as acceptable are used in lieu of base specified manufacturer, be responsible for ensuring that they are equivalent in performance and operating characteristics (including energy consumption if applicable) to base specified products. It is understood that any additional costs (i.e. for larger starters, larger feeders, additional spaces, etc.), and changes to associated or adjacent work resulting from provision of product supplied by a manufacturer other than base specified manufacturer, is included in Bid Price. In addition, in equipment spaces where equipment named as acceptable is used in lieu of base specified equipment and dimensions of such equipment differs from base specified equipment, prepare, and submit for review accurately dimensioned layouts of rooms affected, identifying architectural and structural elements, systems and equipment to prove that equipment in room will fit properly meeting design intent. There will be no increase in Contract Price for revisions.
- .8 In addition to manufacturer's products base specified or named as acceptable, other manufacturers of products may be proposed as substitutions to the Consultant for review and consideration for acceptance, listing in each case a corresponding credit for each substitution proposed. However, base Bid Price on products base specified or named as acceptable. Certify in writing to the Consultant that proposed substitution meets space, power, design, energy consumption, and other requirements of base specified or acceptable product. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally, or architecturally, required by acceptance of proposed substitution. Consultant has sole discretion in accepting any such proposed substitution of product. Indicate any proposed substitutions in areas provided on Bid Form. Do not order such products until they are accepted in writing by the Consultant.

- .9 Where products are listed as "or approved equal", certify in writing that product to be used in lieu of base specified product, at least meets space, power, design, energy consumption, and other requirements of base specified product and is equivalent or better than base specified product. When requested by the Consultant, provide full design detail drawings and specifications of proposed products. Acceptance of these "or approved equal" products is at sole discretion of the Consultant. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally, or architecturally, required by acceptance of approved equal product. There must be no increase in Contract price due to Consultant's rejection of proposed equivalent product.
- .10 Whenever use of product other than base specified product is being supplied, ensure corresponding certifications and product information (detailed catalogue and engineering data, fabrication information and performance characteristics) are submitted to the Consultant for review. Failure of submission of these documents to the Consultant in a timely manner to allow for review will result in base specified product to be supplied at Consultant's discretion, at no additional cost to Contract.
- .11 Products supplied by a manufacturer/supplier other than a manufacturer listed as acceptable may be considered for acceptance by the Consultant if requested in writing with full product documentation submitted, a minimum of 10 working days prior to Bid closing date.
- .12 Any proposed changes initiated by Contractor after award of Contract may be considered by the Consultant at the Consultant's discretion, with any additional costs for such changes if accepted by Owner and reviewed with the Consultant, and costs for review, to be borne by Contractor.
- .13 Whenever use of product other than based specified products or named as acceptable is being supplied, time for process of submission of other products and Consultant's review of products will not alter contract time or delay work schedule.

1.15 Shop Drawings

- .1 At start-up meeting, review with the Consultant products to be included in shop drawing submission. Prepare and submit list of products to the Consultant for review.
- .2 Submit electronic copies of shop drawings unless otherwise directed by the Consultant. Coordinate exact requirements with the Consultant.
- .3 Submit for review, drawings showing detail design, construction, and performance of equipment and materials as requested in Specification. Submit shop drawings to the Consultant for review prior to ordering and delivery of product to site. Include minimally for preparation and submission of following, as applicable:
 - .1 product literature cuts;
 - .2 equipment data sheets;
 - .3 equipment dimension drawings;
 - .4 system block diagrams;
 - .5 sequence of operation;
 - .6 connection wiring schematic diagrams;
 - .7 functionality with integrated systems.
- .4 Each shop drawing or product data sheet is to be properly identified with project name and product drawing or specification reference. Shop drawing or product data sheet dimensions are to match dimension type on drawings.

- .5 Where any item of equipment is required by Code or Standard or By-Law to meet a specific energy efficiency level, or any other specific requirement, ensure this requirement is clearly indicated on submission.
- .6 Ensure proposed products meet each requirement of Project. Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS". Include company name, submittal date, and sign each copy. Shop drawings that are received and are not endorsed, dated and signed will be returned to be resubmitted.
- .7 Consultant to review shop drawings and indicate review status by stamping shop drawing copies as follows:
 - .1 "REVIEWED" or "REVIEWED AS NOTED" (appropriately marked) – If Consultant's review of shop drawing is final, Consultant to stamp shop drawing;
 - .2 "RETURNED FOR CORRECTION" – If Consultant's review of shop drawing is not final, Consultant to stamp shop drawing as stated above, mark submission with comments, and return submission. Revise shop drawing in accordance with Consultant's notations and resubmit.
- .8 Following is to be read in conjunction with wording on Consultant's shop drawing review stamp applied to each and every shop drawing or product data sheet submitted:
 - .1 "THIS REVIEW BY CONSULTANT IS FOR SOLE PURPOSE OF ASCERTAINING CONFORMANCE WITH GENERAL DESIGN CONCEPT. THIS REVIEW DOES NOT MEAN THAT CONSULTANT APPROVES DETAILED DESIGN INHERENT IN SHOP DRAWINGS, RESPONSIBILITY FOR WHICH REMAINS WITH CONTRACTOR. CONSULTANT'S REVIEW DOES NOT RELIEVE CONTRACTOR OF RESPONSIBILITY FOR ERRORS OR OMISSIONS IN SHOP DRAWINGS OR OF CONTRACTOR'S RESPONSIBILITY FOR MEETING REQUIREMENTS OF CONTRACT DOCUMENTS. BE RESPONSIBLE FOR DIMENSIONS TO BE CONFIRMED AND CORRELATED AT JOB SITE, FOR INFORMATION THAT PERTAINS SOLELY TO FABRICATION PROCESSES OR TO TECHNIQUES OF CONSTRUCTION AND INSTALLATION, AND FOR COORDINATION OF WORK OF SUB-TRADES."
- .9 Submit each system and each major component as separate shop drawing submissions. Submit together, shop drawings for common devices such as devices of each system are to be submitted together.
- .10 Obtain shop drawings for submission from product manufacturer's authorized representatives and supplemented with additional items specified herein.
- .11 Do not order product until respective shop drawing review process has been properly reviewed with the Consultant.
- .12 Where extended warranties are specified for equipment items, submit specified extended warranty with shop drawing submittal.
- .13 Applicable mechanical equipment has been selected to meet energy efficiency requirements of ANSI/ASHRAE/IES 90.1, Energy Standards for Buildings, and shop drawings/product data submittals for such equipment must indicate compliance with this Standard or they will be returned for correction and re-submittal.

1.16 Equipment Loads

- .1 Supply equipment loads (self-weight, operating weight, housekeeping pad, inertia pads, etc.) to the Consultant, via shop drawing submissions, prior to construction.
- .2 Where given choice of specific equipment, actual weight, location, and method of support of equipment may differ from those assumed by the Consultant for base design. Back-check equipment loads, location, and supports, and include necessary accommodations.

- .3 Where supporting structure consists of structural steel framing, it is imperative that equipment loads, location, and method of support be confirmed prior to fabrication of structural steel. Review locations of equipment with the Consultant prior to construction.

1.17 Openings

- .1 Supply opening sizes and locations to the Consultant to allow verification of their effect on design, and for inclusion on structural drawings where appropriate.
- .2 No openings are permitted through completed structure without written approval from Owner and reviewed with the Consultant. Show required openings on a copy of structural drawings. Identify exact locations, elevations, and size of proposed openings and submit to the Consultant for review, well in advance of doing work.
- .3 Prior to leaving site at end of each day, walk through areas of work and check for any openings, penetrations, holes, and/or voids created under scope of work of project, and ensure that any openings created under scope of work have been closed off, fire-stopped and smoke-sealed. Unless directed by Owner and reviewed with the Consultant, do not leave any openings unprotected and unfinished overnight.

1.18 Scaffolding, Hoisting and Rigging

- .1 Unless otherwise specified or directed, supply, erect and operate scaffolding, rigging, hoisting equipment and associated hardware required for work, and subject to approval from Owner and reviewed with the Consultant.
- .2 Immediately remove from site scaffolding, rigging and hoisting equipment when no longer required.
- .3 Do not place major scaffolding/hoisting equipment loads on any portion of structure without approval from Owner and reviewed with the Consultant.

1.19 Changes in the Work

- .1 Whenever Consultant proposes in writing to make a change or revision to design, arrangement, quantity, or type of work from that required by Contract Documents, prepare and submit to the Consultant for review, a quotation being proposed cost for executing change or revision.
- .2 Quotation is to be a detailed and itemized estimate of product, labour, and equipment costs associated with change or revision, plus overhead and profit percentages and applicable taxes and duties.
- .3 Unless otherwise specified in Division 00 or Division 01, allowable maximum percentages for overhead and profit are to be 7% and 5% respectively.
- .4 Unless otherwise specified in Division 00 or Division 01, following additional requirements apply to all quotations submitted:
 - .1 when change or revision involves deleted work as well as additional work, cost of deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from cost of additional work before overhead and profit percentages are applied to additional work;
 - .2 material costs are not to exceed those published in the latest edition of Allpriser price guide, less 20%;
 - .3 mechanical material labour unit costs are to be in accordance with Mechanical Contractors Association of America Labor Estimating Manual, less 25%;
 - .4 electrical material labour unit costs are to be in accordance with National Electrical Contractors Association Manual of Labor Units at difficult level, less 25%;

- .5 costs for journey person and apprentice labour must not exceed prevailing rates at time of execution of Contract and must reflect actual personnel performing work;
 - .6 cost for site superintendent must not exceed 10% of total hours of labour estimated for change or revision, and change or revision must be such that site superintendent's involvement is necessary;
 - .7 costs for rental tools and/or equipment are not to exceed local rental costs;
 - .8 overhead percentage will be deemed to cover quotation costs other than actual site labour and materials, and rentals;
 - .9 quotations, including those for deleted work, to include a figure for any required change to Contract time.
-
- .5 Quotations submitted that are not in accordance with requirements specified above will be rejected and returned for re-submittal. Failure to submit a proper quotation to enable Consultant to expeditiously process quotation and issue a Change Order will not be grounds for any additional change to Contract time.
 - .6 Make requests for changes or revisions to work to Consultant in writing and, if Consultant agrees, will issue Notice of Change.
 - .7 Do not execute any change or revision until written authorization for the change or revision has been obtained from the Consultant.

1.20 Progress Payment Breakdown

- .1 Prior to submittal of first progress payment draw, submit a detailed breakdown of work cost to assist Consultant in reviewing and approving progress payment claims.
- .2 Payment breakdown is subject to Owner's approval and Consultant's review. Progress payments will not be processed until an approved breakdown is in place. Breakdown is to include one-time claim items such as mobilization and demobilization, insurance, bonds (if applicable), shop drawings and product data sheets, commissioning including testing, adjusting and balancing, system testing and verification, and project closeout submittals.
- .3 Indicate equipment, material and labour costs for site services (if applicable) and indicate work of each trade in same manner as indicated on progress draw.

1.21 Notice for Required Field Reviews

- .1 Whenever there is a requirement for the Consultant to perform a field review prior to concealment of any work, to inspect/re-inspect work for deficiencies prior to Substantial Performance of the Work, for commissioning demonstrations, and any other such field review, give minimum 5 working days' notice in writing to the Consultant.
- .2 If Consultant is unable to attend a field review when requested, arrange an alternative date and time.
- .3 Do not conceal work until the Consultant advises that it may be concealed.
- .4 When Consultant is requested to perform a field review and work is not ready to be reviewed, reimburse Consultant for time and travel expenses.

1.22 Preliminary Testing

- .1 When directed by the Consultant, promptly arrange, pay for, and perform site tests on any piece of equipment or any system for such reasonable lengths of time and at such times as may be required to

prove compliance with Specification and governing Codes and Regulations, prior to Substantial Performance of the Work.

- .2 When, in Consultant's opinion, tests are required to be performed by a certified testing laboratory, arrange and pay for such tests.
- .3 These tests are not to be construed as evidence of acceptance of work, and it is agreed and understood that no claim for delays or damage will be made for injury or breakage to any part or parts of equipment or system due to test where such injuries or breakage were caused by faulty parts and/or workmanship of any kind.
- .4 When, in Consultant's opinion, tests indicate that equipment, products, etc., are defective or deficient, immediately remove such equipment and/or products from site and replace them with acceptable equipment and/or products, at no additional cost.

1.23 Provisions for Systems/Equipment Used During Construction

- .1 Permanent building mechanical systems are not to be used for temporary heating or cooling purposes during construction.

1.24 Temporary Services

- .1 Coordinate with Prime Contractor, requirements for temporary services including but not limited to temporary heating, cooling, and water. Unless otherwise noted, provide required services in compliance with requirements of local governing building code and local governing inspection authorities.
- .2 Maintain fire protection of areas which may include fire watch during temporary shutdowns of existing systems, in accordance with requirements of local governing code and local governing authorities.

1.25 Maintaining Equipment Prior to Acceptance

- .1 Maintain equipment in accordance with the manufacturer's printed instructions prior to start-up, testing and commissioning.
- .2 Employ a qualified millwright to check and align shafts, drives, and couplings on all base mounted split coupled motor driven equipment.
- .3 Where equipment lubrication fittings are not easily accessible, extend the fittings to accessible locations using copper or aluminium tubing.
- .4 All filters are to be new upon Substantial Performance of the Work. This is in addition to any spare filters specified.

1.26 Record Documentation

- .1 Drawings for this project have been prepared on a CAD system using [AutoCAD] [Revit] software of release version reviewed with the Consultant. For purpose of producing record "as built" drawings, copies of Contract Drawings can be obtained from the Consultant.
- .2 As work progresses at site, clearly mark in red in a neat and legible manner on a set of bound white prints of Contract Drawings, changes, and deviations from routing of services and locations of equipment shown on Contract Drawings, on a daily basis. Changes and deviations include those made by addenda, change orders, and site instructions. Use notes marked in red as required. Maintain white print red line as-built set at site for exclusive use of recording as-built conditions, keep set up-to-date at all times, and ensure set is always available for periodic review. As-built set is also to include the following:
 - .1 dimensioned location of inaccessible concealed work;
 - .2 locations of control devices with identification for each;

- .3 for underground piping and ducts, record dimensions, invert elevations, offsets, fittings, cathodic protection and accessories if applicable, and locate dimensions from benchmarks to be preserved after construction is complete;
 - .4 for fire protection systems, record actual locations of equipment, sprinkler heads, and valves, drains, and test locations, and deviations of pipe routing and sizing from that shown on the drawings;
 - .5 location of piping system air vents;
 - .6 location of concealed services terminated for future extension and work concealed within building in inaccessible locations.
-
- .3 Before applying for a Certificate of Substantial Performance of the Work, update a clean copy of Contract Drawing set in accordance with marked up set of "as-built" white prints including deviations from original Contract Drawings, thus forming an "as-built" drawing set. Submit "as-built" site drawing prints to the Consultant for review. Make necessary revisions to drawings as per Consultant's comments, to satisfaction of the Consultant.
 - .4 Use final reviewed "as-built" drawing set to provide CAD files of drawings thus forming true "as-built" set of Contract Drawings. Identify set as "Project Record Copy". Load digital copies of final reviewed by the Consultant as-built drawings onto USB type flash drive. Provide 2 complete sets of "as-built" drawings on separate USBs. Submit "as-built" sets of white prints and USBs to Consultant.
 - .5 Submitted drawings are to be of same quality as original Contract Drawings. CAD drawing files are to be compatible with [AutoCAD] [Revit] software release version confirmed with the Consultant.
 - .6 Unless otherwise noted in Division 00 or Division 01, failure to maintain accurate record drawings will incur additional 5% holdback on progress claims until drawings are brought up to date to satisfaction of Owner and reviewed with the Consultant.
 - .7 For projects with phased turnover of project (refer to Division 01), review with the Consultant completeness of as-built drawings prior to turn over of an area. Interim as-built drawings to be made available to Owner's maintenance personnel.
 - .8 Where part of the Mechanical Scope of Work, retain and pay for services of a land surveyor registered in Place of the Work to measure, verify, and record size, location, invert elevation and pitch of buried piping services, and, when complete, transfer survey work to as-built drawings.

1.27 Operation and Maintenance Data

- .1 For each item of equipment for which a shop drawing is required (except for simple equipment), supply indexed copies of equipment manufacturers' operating and maintenance (O&M) instruction data manuals. Consolidate each copy of data as a PDF file on a USB drive. Consolidated O&M manual PDF to include:
 - .1 front cover: project name; wording – "Mechanical Systems Operating and Maintenance Manual"; and date;
 - .2 introduction sheet listing Consultant, Contractor, and Subcontractor names, street addresses, telephone and fax numbers, and e-mail addresses;
 - .3 equipment manufacturer's authorized contact person name, telephone number and company website;
 - .4 Table of Contents sheet, and corresponding index tab sheets;
 - .5 copy of each "REVIEWED" or clean, updated "REVIEWED AS NOTED" shop drawing or product data sheet, with manufacturer's/supplier's name, telephone and fax numbers, email address, company website address, and email address for local source of parts and service; when shop

drawings are returned marked "Reviewed As Noted" with revisions marked on shop drawing copies, they are to be revised by equipment supplier to incorporate comments marked on "Reviewed" shop drawings and a clean updated copy is to be included in operating and maintenance manuals;

- .6 Operating data is to include:
 - .1 pressure test reports, and certificates issued by governing authorities;
 - .2 description of each system and its controls;
 - .3 control schematics for equipment/systems including building environmental controls;
 - .4 wiring and connection diagrams;
 - .5 if applicable, BAS architecture and all required operating data;
 - .6 description of operation of each system at various loads together with reset schedules and seasonal variances;
 - .7 operation instruction for each system and each component;
 - .8 description of actions to be taken in event of emergencies and/or equipment failure;
 - .9 valve tag schedule, and flow diagrams to indicate valve locations.
- .7 Maintenance data is to include:
 - .1 operation and trouble-shooting instructions for each item of equipment and each system;
 - .2 schedules of tasks, frequency, tools required, and estimated task time;
 - .3 recommended maintenance practices and precautions;
 - .4 complete parts lists with numbers.
- .8 Performance data is to include:
 - .1 equipment and system start-up data sheets;
 - .2 equipment performance verification test results, and final commissioning report;
 - .3 final testing, adjusting and balancing reports.
- .9 copies of warranties;
- .10 items requested specifically in Section Articles.
- .2 Operating and maintenance instructions are to relate to job specific equipment supplied under this project and related to Owner's building. Language used in manuals is to contain simple practical operating terms and language easy for in-house maintenance staff to understand how to operate and maintain each system.
- .3 Before applying for a Certificate of Substantial Performance of the Work, assemble one copy of O&M Manual and submit to the Consultant for review prior to assembling remaining copies. Incorporate Consultant's comments into final submission.

1.28 Commissioning

- .1 After successful start-up and prior to Substantial Performance of the Work, commission the mechanical work. Commissioning work is the process of Contractor demonstrating to Owner and Consultant, for purpose of final acceptance, by means of successful and documented functional performance testing, that systems and/or subsystems are capable of being operated and maintained to perform in accordance with requirements of Contract Documents, as further described below.
 - .1 Retain services of a testing, adjusting, and balancing agency to perform testing and balancing of mechanical system air/fluid flows and capacities, prior to operational performance testing. Refer to Section 20 05 93 – Testing, Adjusting, and Balancing for Mechanical Systems.
 - .2 Test, adjust and operate equipment and systems after start-up but before functional performance testing, to confirm operations are in accordance with requirements of Contract Documents. Verify modes and sequences of control and monitoring, interlocks, and responses to emergency conditions. Complete commissioning data sheets to document successful operational performance testing.
 - .3 Repeat successful operational performance testing with completed commissioning data sheet documentation in the presence of Consultant and Owner to validate and verify equipment and systems are complete in all respects, function correctly, and are ready for acceptance.
 - .4 Submit final commissioning data sheets, TAB reports as specified in Section 20 05 93 – Testing, Adjusting, and Balancing for Mechanical Systems, project closeout documents, and other required submittals.

1.29 Warranty

- .1 Unless otherwise specified in Division 00 and Division 01, warrant mechanical work to be in accordance with Contract Documents and free from defects for a period of 1 year from date of issue of a Certificate of Substantial Performance of the Work.
- .2 Where equipment includes extended warranty period, e.g., 5 years, first year of warranty period is to be governed by terms and conditions of warranty in Contract Documents, and remaining years of warranty are to be direct from equipment manufacturer and/or supplier to Owner. Submit signed and dated copies of extended warranties to the Consultant.
- .3 Warranty to include parts, labour, travel costs and living expenses incurred by manufacturer's authorized technician to provide factory authorized on-site service.
- .4 Repair and/or replace any defects that appear in Work within warranty period without additional expense to Owner. Be responsible for costs incurred in making defective work good, including repair or replacement of building finishes, other materials, and damage to other equipment. Ordinary wear and tear and damage caused wilfully or due to carelessness of Owner's staff or agents is exempted.
- .5 Do not include Owner deductible amounts in warranties.
- .6 It is understood that warranties are to commence from time of Substantial Performance of the Work, regardless of what is noted within following Sections of Specification. Be responsible for providing whatever "bridging" or additional extended warranty period is required from time that material is purchased until this time.
- .7 Visit building during warranty period with Owner representatives. Owner to organize these visits. At these meetings, Owner representatives are to review performance of systems. If performance is satisfactory, then no further action needs to be taken. If unsatisfactory, then correct deficiencies, as directed by Owner representatives, to satisfaction of Owner's representatives. These site visits to occur:
 - .1 once during 1st month of building operation;

- .2 once during 3rd month of building operation;
- .3 once between 4th and 10th month in a season opposite to 1st and 3rd month visits.

1.30 Closeout Submittals

- .1 Prior to application for Substantial Performance of the Work, submit required items and documentation specified, including following as applicable to the project:
 - .1 Operating and Maintenance Manuals;
 - .2 as-built record drawings and associated data;
 - .3 extended warranties for equipment as specified;
 - .4 operating test certificates, i.e. Sprinkler Test Certificate;
 - .5 final commissioning report and TAB report;
 - .6 identified keys for equipment and/or panels for which keys are required, and other items required to be submitted;
 - .7 other data or products specified.

1.31 Instructions to Owner

- .1 Refer to equipment and system operational and maintenance training requirements specified in Division 01.
- .2 Train Owner's designated personnel in aspects of operation and maintenance of equipment and systems as specified. Demonstrations and training are to be performed by qualified technicians employed by equipment/system manufacturer/supplier. Supply hard copies of training materials to each attendee.
- .3 Unless where specified otherwise in trade Sections, minimum requirements are for manufacturer/suppliers of each system and major equipment, to provide minimum two separate sessions each consisting of minimum 4 hours on site or in factory training (at Owner's choice), of Owner's designated personnel (for up to 6 people each session), on operation and maintenance procedures of system.
- .4 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Use Operating and Maintenance Manuals during training sessions. Training modules include but are not limited to:
 - .1 Operational Requirements and Criteria – equipment function, stopping and starting, safeties, operating standards, operating characteristics, performance curves, and limitations;
 - .2 Troubleshooting – diagnostic instructions, test and inspection procedures;
 - .3 Documentation – equipment/system warranties, and manufacturer's/supplier's parts and service facilities, telephone numbers, email addresses, and the like;
 - .4 Maintenance – inspection instructions, types of cleaning agents to be used as well as cleaning methods, preventive maintenance procedures, and use of any special tools;
 - .5 Repairs – diagnostic instructions, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory.
- .5 Before instructing Owner's designated personnel, submit to the Consultant for review preliminary copy of training manual and proposed schedule of demonstration and training dates and times. Incorporate Consultant's comments in final copy.

- .6 Obtain in writing from the Consultant list of Owner's representatives to receive instructions. Submit to Consultant prior to application for Certificate of Substantial Performance of the Work, complete list of systems for which instructions were given, stating for each system:
 - .1 date instructions were given to Owner's staff;
 - .2 duration of instruction;
 - .3 names of persons instructed;
 - .4 other parties present (manufacturer's representative, consultants, etc.).
- .7 Obtain signatures of Owner's staff to verify they properly understood system installation, operation, and maintenance requirements, and have received operating and maintenance instruction manuals and "as-built" record drawings.
- .8 Submit to the Consultant copy of electronic version of training materials and include in operating and maintenance manuals submission.

1.32 Final Inspection

- .1 Submit to Consultant, written request for final inspection of systems. Include written certification that:
 - .1 deficiencies noted during job inspections have been completed;
 - .2 field quality control procedures have been completed;
 - .3 systems have been tested and verified, balanced, and adjusted, and are ready for operation;
 - .4 maintenance and operating data have been completed and submitted to, reviewed with the Consultant and accepted by Owner;
 - .5 tags and nameplates are in place and equipment identifications have been completed;
 - .6 clean-up is complete;
 - .7 spare parts and replacement parts specified have been provided and acknowledged by the Consultant;
 - .8 as-built and record drawings have been completed and submitted to and reviewed with the Consultant and accepted by Owner;
 - .9 Owner's staff has been instructed in operation and maintenance of systems;
 - .10 commissioning procedures have been completed.

2 Products – Not Used

3 Execution

3.01 Cleaning

- .1 During construction, keep site reasonably clear of rubbish and waste material resulting from work on a daily basis to the satisfaction of Owner and Consultant. Before applying for a Certificate of Substantial Performance of the Work, remove rubbish and debris, and be responsible for repair of any damage caused as a result of work.

- .2 Clean equipment and devices installed as part of this project.

End of Section

1 General

1.01 Section Includes

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

1.02 Submittals

- .1 At least 4 weeks prior to work commencing, submit a sample of each type of firestop and smoke seal system in applied form, for approval. Identify each system with manufacturer's name and type, ULC designation, and proposed use. After samples are reviewed, work is to conform to reviewed samples.
- .2 Submit a product data sheet and a WHIMIS sheet for each firestopping and smoke seal product.
- .3 Submit for review, full company name and experience of proposed firestopping and smoke seal system applicator.
- .4 Sleeve and Formed Opening Location Drawings
 - .1 Prepare and submit for review, drawings indicating size and location of required sleeves, recesses and formed openings in poured or precast concrete work.
 - .2 Such drawings are to be completely and accurately dimensioned and relate sleeve, recesses, and formed openings to suitable grid lines and elevation datum, and are to take into account structural items such as grade beams, column caps, and column drop slabs.
 - .3 Begin to prepare such drawings immediately upon notification of acceptance of bid and award of Contract.

1.03 Closeout Submittals

- .1 Submit a letter of proper firestopping and smoke seal certification as specified in Part 3 of this Section.

1.04 Quality Assurance

- .1 Applicator is to have a minimum of 3 years of successful experience on projects of similar size and complexity, and applicator's qualifications are to be reviewed by the Consultant.
- .2 Comply with firestopping and smoke seal product manufacturer's recommendations regarding suitable environment conditions for product installation.

2 Products

2.01 Pipe Sleeves

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

2.02 Firestopping and Smoke Seal Materials

- .1 Ensure all sealant and fire stopping is low VOC type in accordance with LEED.

- .2 Asbestos-free elastomeric materials tested, listed and labelled by ULC in accordance with CAN/ULC-S115 and CAN/ULC-S101 for installation in ULC designated firestopping and smoke seal systems to provide a positive fire, water and smoke seal, and a fire-resistance rating (flame, hose stream and temperature) not less than fire resistance rating of surrounding fire rated construction.
- .3 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with firestopping manufacturer's recommendations and ULC tested assembly.
- .4 Pipe insulation forming part of a fire and smoke seal assembly is specified in Section entitled Mechanical Insulation.
- .5 Manufacturers:
 - .1 A/D Fire Protection Systems "FIREBARRIER";
 - .2 Tremco Inc. Fire Protection Systems Group "TREMSTOP";
 - .3 3M Canada;
 - .4 Hilti (Canada) Ltd. Firestop Systems;
 - .5 Specified Technologies Inc.

2.03 Waterproofing Seal Materials

- .1 Modular, mechanical seal assemblies consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and pipe sleeve or wall opening, assembled with stainless steel bolts and pressure plates and designed so when bolts are tightened the links expand to seal the opening watertight. Select seal assemblies to suit pipe size and sleeve size or wall opening size.
- .2 Manufacturers:
 - .1 Thunderline Corp. (Power Plant Supply Co.) "LINK SEAL" Model S-316;
 - .2 The Metraflex Co. "MetraSeal" type ES.

2.04 Pipe Escutcheon Plates

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

3 Execution

3.01 Installation of Pipe Sleeves

- .1 Where pipes pass through concrete and/or masonry surfaces provide pipe sleeves as follows:
 - .1 in poured concrete slabs – unless otherwise specified, minimum 16 gauge flanged galvanized steel or, where permitted by governing authorities, factory fabricated plastic sleeves;
 - .2 in concrete or masonry walls – Schedule 40 galvanized steel pipe or Class 4000 cast iron pipe.
- .2 Sleeves in waterproofed slabs or walls are to be lengths of Schedule 40 mild galvanized steel pipe with a waterstop plate in accordance with drawing detail. Provide waterproof sleeves in following locations:
 - .1 in mechanical room floor slabs, except where on grade;

- .2 in slabs over mechanical, fan, electrical and telephone equipment rooms or closets;
- .3 in floors equipped with waterproof membranes;
- .4 in roof slab;
- .5 in waterproof walls.
- .3 Size sleeves, unless otherwise specified, to leave 12 mm ($\frac{1}{2}$ ") clearance around pipes, or where pipe is insulated, a 12 mm ($\frac{1}{2}$ ") clearance around pipe insulation.
- .4 Pack and seal void between pipe sleeves and pipe or pipe insulation in non-fire rated construction for the length of sleeves as follows:
 - .1 pack sleeves in interior construction with mineral wool and seal both ends of sleeves with non-hardening silicone base caulking compound;
 - .2 pack sleeves in exterior walls above grade with mineral wool and seal both ends of sleeves water-tight with approved non-hardening silicone base caulking compound unless mechanical type seals have been specified;
 - .3 seal sleeves in exterior walls below grade (and any other wall where water leakage may be a problem) with link type mechanical seals as specified.
- .5 Where sleeves are required in masonry work, accurately locate and mark sleeve location, and hand sleeves to mason for installation.
- .6 Terminate piping for sleeves that will be exposed so sleeve is flush at both ends with building surface so sleeve may be completely covered by an escutcheon plate, except for sleeves in waterproof floors which are to terminate 100 mm (4") above finished floor.
- .7 "Gang" type sleeving will not be permitted.
- .8 Where sleeves are provided in non-fire rated construction for future piping, or where piping has been removed from existing sleeves, cap and seal both ends of sleeved opening.

3.02 Installation of Waterproof Mechanical Seals

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

End of Section

1 General

2 Products

2.01 Piping Hangers and Supports

- .1 Pipe hanger and support materials, including accessories, are to be, unless otherwise specified, in accordance with Manufacturers Standardization Society (MSS) Standard Practice Manual SP-58, Pipe hangers and Supports-Materials, Design and Manufacture, and where possible, MSS designations are indicated with each product specified below. Conform to following requirements:
 - .1 unless otherwise specified, ferrous hanger and support products are to be electro-galvanized;
 - .2 hangers and supports for insulated piping are to be sized to fit around insulation and insulation jacket.
- .2 Hangers and supports for horizontal suspended piping as follows:
 - .1 adjustable steel clevis hanger – MSS Type 1;
 - .2 adjustable swivel ring band hanger – MSS Type 10;
 - .3 adjustable roller hanger – MSS Types 41, 43, and/or 45, with MSS Type 39 steel protection saddle.
- .3 Supports for horizontal pipe on vertical surfaces as follows:
 - .1 steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170;
 - .2 heavy-duty steel pipe clip – MSS Type 26;
 - .3 single steel pipe hook – Myatt Fig. 156;
 - .4 epoxy coated steel pipe stays are not permitted.
- .4 Floor supports for vertical risers as follows:
 - .1 copper tubing riser clamp – MSS Type 8;
 - .2 heavy-duty steel riser clamp – MSS Type 8.
- .5 Supports for vertical piping on vertical surfaces as follows:
 - .1 steel offset pipe clamp – Anvil Fig. 103 or Myatt Fig. 170;
 - .2 heavy-duty steel pipe bracket or soil pipe bracket – MSS Type 26;
 - .3 extension split pipe clamp – MSS Type 12;
 - .4 epoxy coated steel pipe stays are not permitted.
- .6 Base support for vertical risers in excess of 6 m (20') high extending out from base mounted equipment is to consist of a base elbow support with flange.
- .7 For horizontal pipe on racks, Unistrut or equal galvanized steel pipe racks with pipe securing hardware as follows:
 - .1 standard galvanized steel U-bolts/clamps supplied by rack manufacturer;

- .2 adjustable roller chair – MSS Type 44 with MSS Type 39 steel protection saddle.
- .8 Special hangers and supports for various applications as follows:
 - .1 vibration isolated riser supports – black steel riser clamps as specified above, complete with neoprene–steel–neoprene sandwich type vibration isolation pads between clamp and floor;
 - .2 for groups of pipes having same slope – MSS Type 32 welded steel brackets, Anvil Fig. 46 universal trapeze assemblies, or Unistrut or equal support assemblies, all with U-bolts, clamps, etc., to secure pipes in place;
 - .3 for sections of piping connected to vibration isolated equipment – hangers and supports as specified above but complete with MSS Type 48 spring cushions;\
 - .4 for piping on new roofs – Lexcor "Flash-Tite" or Thaler Roofing Specialties Products Inc. "MERS" Series insulated aluminum support risers with diameter, height, securement method and flashing to suit the application, channel type aluminum cross members, and galvanized steel pipe hangers and supports conforming to MSS SP-58, complete with all required accessories;
 - .5 for glass drain and vent piping – special padded hangers supplied by pipe supplier;
 - .6 for plastic piping – generally as specified above but in accordance with pipe manufacturer's recommendations;
 - .7 for fire protection piping – generally as above but ULC listed and/or FM approved, and in accordance with Chapter requirements of NFPA Standard applicable to piping system;
 - .8 for bare horizontal copper piping – generally as above but factory vinyl coated to prevent direct copper/steel contact;
 - .9 for bare copper vertical piping – corrosion resistant ferrous clamps with flexible rubber gasket type material (not tape) to isolate pipe from clamp;
 - .10 insulation protection shields to and including 40 mm (1-½") dia. – MSS Type 40 galvanized steel shields with ribs to keep shield centred on hanger.
- .9 Hanger rods are to be electro-galvanized carbon steel (unless otherwise specified), round, threaded, to ASTM A36, complete with captive machine nuts with washers at hangers, sized to suit loading in accordance with Table 3 in MSS SP-58, but in any case, minimum 9.5 mm (3/8") diameter.
- .10 Manufacturers:
 - .1 E. Myatt & Co. Inc.;
 - .2 Anvil International Inc.;
 - .3 Empire Industries Inc.;
 - .4 Hunt Manufacturing Ltd.;
 - .5 Unistrut Canada Ltd.;
 - .6 Nibco Inc. "Tolco";
 - .7 Taylor Pipe Supports.

3 Execution

3.01 Installation of Fastening and Securing Hardware

- .1 Provide fastening and securing hardware required for mechanical work to maintain installations attached to structure or to finished floors, walls, and ceilings in a secure and rigid manner capable of withstanding dead loads, live loads, superimposed dead loads, and any vibration of installed products.
- .2 Use fasteners compatible with structural requirements, finishes and types of products to be connected. Do not use materials subject to electrolytic action or corrosion where conditions are liable to cause such action.
- .3 Where floor, wall or ceiling construction is not suitable to support loads, provide additional framing or special fasteners to ensure proper securement to structure that is to support the products. Provide reinforcing or connecting supports where required to distribute loading to structural components.
- .4 Obtain written consent before using explosive actuated fastening devices. If consent is obtained, comply with requirements of CAN/CSA Z166.1 and CAN/CSA Z166.2.
- .5 Do not attach fasteners to steel deck without written consent from the Consultant.

3.02 Installation of Pipe Hangers and Supports

- .1 Provide required pipe hangers and supports.
- .2 Provide any additional structural steel channels, angles, inserts, beam champs and similar accessories required for hanging or supporting pipe. Unless otherwise shown or specified, hang or support pipes from structure only.
- .3 For insulated pipe, size hanger or support to suit diameter of insulated pipe and install hanger or support on outside of insulation and insulation finish.
- .4 Support requirements for underground piping are as follows:
 - .1 support underground pipe, unless otherwise specified, on a well compacted bed of dry, natural, undisturbed earth free from rocks or protrusions of any kind, or on compacted material as specified;
 - .2 support underground service piping penetrating building exterior walls or foundations to prevent pipe damage if minor building settlement occurs;
 - .3 ensure bedding and supports for underground pipes are flat and true and allowances are made for pipe hubs, couplings, or other protrusions so no voids are left between pipe and bedding.
- .5 Unless otherwise shown or specified, hang and/or support horizontal pipe above ground by means of hangers and/or supports specified in Part 2 of this Section. Unless otherwise shown or specified, hangers for suspended pipe less than or equal to 25 mm (1") dia. are to be clevis type or adjustable ring type, and hangers for suspended pipe greater than or equal to 40 mm (1-½") dia. are to be adjustable clevis type.
- .6 Space hangers and supports in accordance with following:
 - .1 cast iron pipe – hang or support at every joint with maximum 2.4 m (8') spacing;
 - .2 plastic pipe – conform to pipe manufacturer's recommended support spacing;
 - .3 glass pipe – conform to pipe manufacturer's recommended support spacing and support requirements;

- .4 copper and steel pipe – hang or support at spacing in accordance with following schedule:

Pipe dia.	Max. Spacing Steel	Max. Spacing Copper
to 25 mm (1")	2.4 m (8')	1.8 m (6')
40 mm (1-½")	2.7 m (9')	2.4 m (8')
50 mm (2")	3.0 m (10')	2.7 m (9')
65 mm (2-½")	3.6 m (12')	3.0 m (10')
75 mm (3")	3.6 m (12')	3.0 m (10')
90 mm (3-½")	3.6 m (12')	3.6 m (12')
100 mm (4")	4.2 m (14')	3.6 m (12')
250 mm (10")	6.0 m (20')	
300 mm (12")	6.7 m (22')	

- .5 flexible grooved pipe/coupling joint piping – as above but with not less than one hanger or support between joints;
- .7 Where pipes change direction, either horizontally or vertically, provide a hanger or support on horizontal pipe not more than 300 mm (12") from elbow, and where pipes drop from tee branches, support tees in both directions not more than 50 mm (2") on each side of tee.
- .8 When pipes with same slope are grouped and a common hanger or support is used, space hanger or support to suit spacing requirement of smallest pipe in group and secure pipes in place on common hanger or support.
- .9 Provide roller hangers or supports for heat transfer piping greater than or equal to 150 mm (6") diameter and conveying a material 75°C (170°F) or greater to facilitate pipe movement due to expansion and contraction, and at each hanger or support tack weld a steel protection saddle to pipe to protect piping insulation.
- .10 Unless otherwise shown or specified, support vertical piping by means of supports specified in Part 2 of this Section, spaced in accordance with following:
- .1 support vertical pipes at maximum 3 m (10') intervals or at every floor, whichever is lesser;
- .2 for sections of vertical piping with a length less than 3 m (10'), support pipe at least once;
- .3 for vertical cast iron plain end pipe (mechanical joint type), secure riser or pipe clamp around pipe under a flange integral with pipe for vertical support purposes, or provide a length of hub and spigot pipe to facilitate proper support;
- .4 for vertical steel pipe risers in excess of 3 m (10'), weld shear lugs to pipe to carry load;
- .5 for vibration isolated piping risers, provide rubber-steel-rubber vibration isolation pads between riser clamps and floor.
- .11 Support piping on the roof as follows:
- .1 on new roof – supply manufactured roof supports as per Part 2 of this Section to accommodate piping involved and support spacing specified above, and hand supports to roofing trade on roof for installation as part of roofing work, then secure piping in place on supports.
- .12 Each hanger, support or securement for horizontal bare copper tubing is to be plastic coated to prevent direct contact between pipe and ferrous hanger. Each wall or floor clamp for vertical bare copper piping is

to be isolated from pipe by means of strips of flexible rubber inserts. Use of painted ferrous hangers and supports, including those painted with copper coloured paint, is not acceptable. Site application of tape or other types of isolation is not acceptable.

- .13 For insulated horizontal piping less than or equal to 40 mm (1-½") diameter, provide galvanized steel insulation protection shields between insulation and hanger or support. Install shields immediately after pipe is insulated.
- .14 Do not support piping from steel deck without written consent from Consultant.

3.03 Equipment Bases and Supports

- .1 Unless otherwise specified or required, set floor mounted equipment on minimum 100 mm (4") high reinforced concrete housekeeping pads 200 mm (8") clear of equipment on each side and end, or a minimum of 200 mm (8") from centreline of equipment anchor bolts to edge of the base, whichever is larger. Conform to following requirements:
 - .1 supply dimensioned drawings and equipment base templates, and provide anchor bolts for proper setting and securing of equipment on pads;
 - .2 place anchor bolts during concrete pour and be responsible for required levelling, alignment, and grouting of equipment;
 - .3 as a minimum, use wire mesh reinforcement, however, for pads for large heavy equipment, use reinforcement as per structural drawing details.
- .2 For equipment not designed for base mounting, where required, provide welded, cleaned and prime coat painted structural steel stands or supports conforming to following requirements:
 - .1 provide stands and supports, except those for small equipment, designed by a structural engineer registered in jurisdiction of the work, and submit stamped and signed design drawings with calculations as shop drawings for review;
 - .2 flange bolt steel stands to concrete housekeeping pads;
 - .3 seismically restrained stands and supports in accordance with applicable requirements.
- .3 Where indicated on mechanical drawings, provide welded, cleaned and prime coat painted structural steel platforms, designed by a structural engineer registered in the jurisdiction of the work, for service access to equipment. Submit stamped and signed design drawings with calculations as shop drawings for review. Conform to following requirements:
 - .1 platforms in accordance with OHSA requirements and adequately sized, braced, anchored, and, as required, seismically restrained;
 - .2 flooring equal to Fisher & Ludlow "Tru-Weld" Type 19-4, Borden type W/B (19-W-4), welded steel bar type grating;
 - .3 support legs constructed of welded Schedule 40 black steel pipe with welded steel cross-bracing, securely anchored and sway braced;
 - .4 safety guard rails, constructed from minimum 32 mm (1-¼") dia. Schedule 40 black steel pipe, for all platforms and complete with vertical stanchions at maximum 1.2 m (48") centres, top and intermediate horizontal railing, and toe plates at floor;
 - .5 vertical ladders constructed of Schedule 40 black steel pipe, 25 mm (1") dia. for equal height rungs, 40 mm (1-½") for stringers, anchored to floors and walls and sway braced as required;

- .6 ships ladders, used wherever space conditions permit, of welded steel construction, climbing at an approximate 60° angle, and complete with channel iron stringers, open grate equal height risers approximately 165 mm (6-½") wide and factory made by grating manufacturer, handrails, and suitable anchoring and support.

3.04 Concrete Work for Mechanical Equipment Bases and Pads

End of Section

1 General

1.01 Section Includes

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

1.02 Seismic Consultant

- .1 Retain and pay for services of an experienced Seismic Consultant who is a registered professional engineer licensed in the jurisdiction of the work and a member in good standing of a Professional Engineers Association in the jurisdiction of the work.
- .2 Seismic Consultant is to:
 - .1 determine proper seismic hazard level, design, recommend, and review proposed mechanical work seismic restraint shop, placement and securing drawings, and sign and stamp drawings prior to submittal for review as specified below;
 - .2 supervise installation of mechanical work seismic restraint and, when work is complete, certify in writing that seismic restraint work has been installed in accordance with signed, stamped and reviewed drawings;
 - .3 prepare and submit to Municipality and authorities having jurisdiction, on a form approved by Municipality and authorities having jurisdiction, at the beginning of seismic restraint work and when work is complete, original signed and sealed Letters of Assurance for design, installation, and field review of seismic restraint work.

1.03 Submittals

- .1 Obtain required equipment information and submit manufacturer's shop drawings/product data sheets for restraining devices and steel bases. Include placement data, and details of attachment to both equipment and structure meeting requirements of forces involved. Product data sheets and drawings are to be signed and stamped by Seismic Consultant referred to above.
- .2 If requested, submit samples of seismic restraint materials for review.

1.04 Closeout Submittals

- .1 Submit copies of Seismic Consultant's Letters of Assurance as specified above.
- .2 Submit copies of Seismic Consultant and seismic control manufacturer's certification letters as specified in Part 3 of this Section.

1.05 Quality Assurance

- .1 Seismic restraints are to be designed by a registered professional engineer as specified above, and are to be installed by qualified tradesmen under supervision of and to the approval of the design engineer.
- .2 Unless otherwise specified, seismic control and restraints are to be designed in accordance with Code requirements, ANSI/SMACNA Seismic Restraint Manual: Guidelines for Mechanical Systems, SMACNA/ASHRAE Service Restraint Applications CD-ROM, and the P.P.I.C. Manual Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems, all of which are to form a part of this Section.
- .3 Seismic control and restraints for fire protection piping and equipment are to be in accordance with NFPA requirements. When specified and/or required, design is also to include Factory Mutual requirements.

- .4 Restraint products must be tested in an independent testing laboratory, or certified by Seismic Consultant, to confirm restraint products meet requirements of this Section, i.e. dynamic ultimate limit load state as required by Code, "Fail Safe" design, etc. If particular tests are carried out to represent a restraint type, test is to be valid for the full load range of the restraint. Submit such tests or certification when requested.
- .5 Seismic control and restraint product manufacturers are to provide required assistance during installation, and, when installation is complete, submit written reports listing any deficiencies to the installation.

2 Products

2.01 General

- .1 Isolation, anchors, bolts, bases, restraints, etc., are to be designed to withstand without failure or yielding, the dynamic G load as specified in Code for the seismic zone in which building is located. Design loads are ultimate limit state loads (1.5 times working load) acting through the centre of gravity of the anchored or restrained equipment. "Fail Safe" designs are acceptable.
- .2 For both isolated and non-isolated floor mounted equipment, i.e. tanks, heat exchangers, boilers, etc., design and provide anchors and bolts to withstand, without failure or yielding, a dynamic ultimate limit state load as defined in Code, of the greater of 0.3 g (2.94 m/s²) or as required by Code, applied horizontally through the centre of gravity.
- .3 Where impact forces may be significant, use ductile materials.
- .4 Seismic restraining devices factory supplied with equipment are to meet requirements of this Section.

2.02 Manufacturers

- .1 Mason Industries Inc.;
- .2 Kinetics Noise Control;
- .3 Vibro-Acoustics Ltd;
- .4 Price Industries Inc.

2.03 Slack Cable Restraints

- .1 Aircraft cable galvanized slack cable restraints meeting current requirements of Building Code, sized to suit the application and complete with required cable ties, anchor hardware (selected for a load equal to twice the weight of the equipment), and similar connection accessories.

2.04 Anchor Bolts

- .1 Equal to Mason Industries type SAB seismic anchor bolts.

2.05 Flexible Piping Connections

- .1 Flexible piping connectors are to be supplied with seismic restraint materials. Where flexible connections are not specified with piping in other Sections they are to be equal to Mason Industries twin sphere, non-metallic connectors with hose lengths preset in strict accordance with manufacturer's instructions and to approval of Seismic Consultant, each rated for continuous operation at 1725 kPa at 87.7°C (250 psi at 190°F) or 1380 kPa at 121°C (200 psi at 250°F), and complete with:
 - .1 nylon tire cord reinforced EPDM body;
 - .2 ductile iron reinforcing ring and ductile iron screwed or flanged connections as required and to suit piping system operating pressure.

2.06 Vibration Isolation Products

- .1 Refer to Section 20 05 48.13 – Vibration Controls for Mechanical Systems.

3 Execution

3.01 Installation of Seismic Restraint Materials

- .1 Provide seismic restraint for mechanical equipment, piping, and ductwork, including diffusers, grilles, etc., as per requirements of current edition of Building Code and this Section of the Specification.
- .2 Following Mechanical Components Restraint Guide is to be used as a general guide only to establish appropriate restraint methods, hardware, and attachments, however, due to differences in construction, size, weight, and configuration of different manufacturer's equipment and variety of ways and means that equipment and components can be installed, specific restraint methods are to be confirmed in the field. Seismic restraint materials and methods are to be reviewed and approved by Seismic Consultant.
- .3 Mechanical Component Restraint Guide:

Item	Type of Restraint	Minimum no. of Restraints	Notes
In-line Pumps	SCR	2	Pipe mounted type pump
Pumps Non-Isolated	BTHP	4	Base mount type pump
Pumps Isolated	SNBR	4	Base mount type pump
Expansion Tanks	SCR	4	
D.H.W. Tanks	SCR	4	Attach to removable steel strap yoke
Glycol Tanks	SCR	4	Attach to removable steel strap yoke
Boilers			
- With Base	BTHP	4	
- Without Base	CSSB	4	
Chillers			
- Isolated	SNBR	4	
- Non-Isolated	BTHP	4	
Cooling Towers Closed Circuit Coolers			
- Isolated	SNBR	4	
- Non-Isolated	BTSLPR	4	
Heat Exchangers	BTHP	4	Bolt to custom support frame
Radiant Panels	SCR	4	Per panel section
Unit Heaters	TSR-SCR	4	
Force Flow Heaters	TSR-SCR	4	

Item	Type of Restraint	Minimum no. of Restraints	Notes
AHU's and A/C Units Free Standing			
- With Base	BTHP	4	
- Without base	CSSB	4	
AHU's and A/C Units Suspended			
- Isolated	SCR	4	
- Non-Isolated	SCR	4	
Packaged Rooftop Air Units (all types)			
On roof curb	BTRC	4	Roof curb bolted to roof.
Humidifiers	BTHP	4	Bolt unit to custom stand.
Electronic		4	Bolt stand to housekeeping pad or structure.
Fans – Suspended			
- Isolated	SCR	4	
- Non-Isolated	SCR	4	
Fans – Freestanding			
- Isolated	SNBR	4	
- Non-Isolated	BTHP	4	
Grilles, Registers, Diffusers	SCR	4	Where not bolted to duct (i.e. in tee-bar ceilings)
Airflow Control Valves	SCR	4	Where suspended
Air Compressor Receiver Sets			
- Isolated	BTHP	4	
- Non-Isolated			
Piping	SCR TSR	As required	As per Specification
Ductwork	SCR TSR	As required	As per Specification

.4 Legend

Legend	
SCR	Slack cable restraint (bolted to structure)
SNBR	Seismic snubber (bolted to structure)
TSR	Threaded support rod (bolted or clamped to structure)
BTSLPR	Bolt to sleeper (sleeper bolted to structure)
BTHP	Bolt to concrete housekeeping pad (pad to be keyed to structure)
CSSB	Custom steel shoe base (bolted to structure)
BTRC	Bolt to roof curb (roof curb bolted to roof structure)

- .5 Provide structural steel bases for equipment unless equipment manufacturer certifies direct attachment capabilities.
- .6 Space restraints under equipment so minimum distance between adjacent corner restraints is at least equal to the height of the centre of gravity of the equipment. Include the height of the centre of gravity on shop drawings, otherwise, design for increased forces on supports and submit design calculations with shop drawings. In particular, chillers are to meet this requirement.
- .7 Floor mounted isolated equipment is to be installed on 100 mm (4") high concrete housekeeping pads with at least 200 mm (8") clearance between drilled inserts and edges of pads. Ensure housekeeping pads are keyed to structure to resist seismic displacement.
- .8 Requirements pertaining to seismic control work are as follows:
- .1 execute seismic control and restraint work in accordance with drawing details, reviewed shop drawings, ANSI/SMACNA Seismic Restraint Manual, PIPC Manual: Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping Systems, and National Uniform Seismic Installation Guidelines (NUSIG);
 - .2 seismic control systems are to work in all directions;
 - .3 fasteners and attachment points are to resist same maximum load as the seismic restraint;
 - .4 drilled or power driven anchors and fasteners are not permitted;
 - .5 no equipment, equipment supports or mounts are to fail before failure of structure;
 - .6 supports of cast iron or threaded pipe are not permitted;
 - .7 seismic control measures are not to interfere with integrity of firestopping;
 - .8 equipment is to be bolted to structure, and bolts are to be fitted with isolation washers;
 - .9 number, size, type, and installation of anchor bolts are to be as recommended by anchor bolt manufacturer and seismic design consultant;
 - .10 where more than a 3 mm (1/8") differential exists between an anchor or attachment bolt diameter, an anchor and attachment point hole, or an isolator gap attachment bolt and equipment anchor attachment hole, pack air gap with Mason type 0.5 FastSteel reinforced epoxy putty;
 - .11 hung equipment and pipe hangers are to be fitted with a means of preventing upward movement, and non-isolated equipment and pipe hanger rods are to be fitted with oversized steel washers

- and nuts above and below hanger or equipment attachment point, locked tight to prevent uplift of equipment or hanger;
- .12 where suspended equipment hanger rod length exceeds 50 rod diameters between structure and equipment attachment point, reinforce rods with angle iron to prevent bending due to uplift forces;
 - .13 seismic control measures are not to jeopardize noise and vibration isolation systems, and 6 mm (¼") to 9 mm (3/8") clearance during normal operation of equipment and systems is to be provided between seismic restraint and equipment;
 - .14 where hold-down bolts for seismic restraint equipment penetrate roofing membranes coordinate with roofing trade for installation of pitch pockets/"gum cups" and sealing compound to maintain water-tight integrity of roof;
 - .15 where friction type clamps are used for support of equipment and connecting services, secure clamps to steel work by means of welding or other positive means to prevent slippage or loosening of clamps due to seismic forces.
- .9 Provide slack cable restraint assemblies for:
- .1 steam piping 32 mm (1-¼") dia. and larger;
 - .2 fuel gas, fuel oil, medical gas, compressed air and service piping 25 mm (1") dia. and larger;
 - .3 piping 32 mm (1-¼") dia. and larger located in boiler, fan, chiller, and similar equipment rooms;
 - .4 horizontal and vertical piping 65 mm (2-½") dia. and larger;
 - .5 ductwork and duct mounted equipment;
 - .6 isolated and non-isolated ceiling hung fans, tanks, equipment, etc.;
 - .7 generator exhaust system(s).
- .10 Installation requirements for slack cable restraints include following:
- .1 connect slack cable restraints to ceiling hung equipment in such a way that axial projection of wires passes through the centre of gravity of the equipment;
 - .2 orient restraint wires on ceiling hung equipment at approximately 90° to each other (in plan), and tie back to the ceiling slab at an angle not exceeding 45° to slab;
 - .3 install cables using appropriate grommets, shackles, and other hardware to ensure alignment of restraints and to avoid bending cables at connection points, and, where feasible, wrap cables directly around pipes as opposed to using collars;
 - .4 for piping systems, provide transverse slack cable restraints at a maximum spacing of 12.5 m (40'), and longitudinal restraints at 25 m (80') maximum spacing, or as limited by anchor/slack cable performance;
 - .5 for piping less than 250 mm (10") dia., reduce transverse restraint spacing to 6 m (20'), and note that smaller piping may be rigidly tied to larger piping for restraint, but not the reverse;
 - .6 vary adjacent spacing of restraints on a piping run by 10% to 30% to avoid coincident resonance;
 - .7 transverse bracing for one pipe section may also act as longitudinal bracing for piping connected perpendicular to it if bracing is installed within 600 mm (24") of elbow or tee, and if connected piping is same or smaller dia., and note that branch lines are not to be used to restrain main lines;

- .8 provide flexibility in piping joints or sleeves where piping penetrates building seismic or expansion joints;
- .9 wherever possible, support weight of vertical piping risers at a point or points above the centre of gravity of riser, and provide lateral guides at top and bottom of riser, and at intermediate points not to exceed the transverse spacing specified above for horizontal pipes, with guide clearance not exceeding 3 m (10');
- .10 install restraints at least 50 mm (2") clear of other equipment and services;
- .11 adjust restraint cables such that they are not visibly slack, or such that flexibility is approximately 40 mm (1-1/2") under thumb pressure for a 1.5 m (5') cable length, with an equivalent ratio for other cable lengths, and adjust clearance of cable strap/spacer piece restraints so as not to exceed 6 mm (0.23");
- .12 provide transverse and axial restraints within 4 m (12') of a vertical bend;
- .13 at steel trusses, connect to top chords at panel points and follow truss manufacturer's instructions;
- .14 diffusers and grilles mounted in t-bar ceilings or which are not positively secured to ductwork or structure are to be fitted with slack cable restraints to prevent them from falling in the event the ceiling t-bar grid is displaced;
- .15 do not bridge vibration isolators with slack cable restraints;
- .16 other approved restraint systems are conventional pipe guides, rigid restraint where piping passes through a block or concrete wall, or a cable strap and spacer piece attached to structure and used where piping is adjacent to a wall and conventional slack cable restraints cannot be used.

3.02 Installation of Flexible Piping Connectors

- .1 Supply flexible piping connectors for connections (including plumbing) to seismically restrained equipment. Hand connectors to appropriate piping trade at site for installation.

3.03 Site Inspection and Letters of Certification

- .1 When seismic control products have been installed, arrange for seismic control product manufacturer and Seismic Consultant to examine installation of seismic control products and to certify in writing (separate letters) that products have been properly installed in accordance with governing Codes and Regulations, and recommendations and instructions. Seismic Consultant is to apply his professional stamp to the letter.

End of Section

1 General

1.01 Section Includes

- .1 Nameplates.
- .2 Tags.
- .3 Pipe Markers.

1.02 References

- .1 ASME A13.1 – Scheme for the Identification of Piping Systems.

1.03 Submittals

- .1 Section 01 33 00: Submittals.
- .2 Submit list of wording, symbols, letter size, and colour coding for mechanical identification.
- .3 Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
- .4 Product Data: Provide manufacturers catalogue literature for each product required.
- .5 Samples: Submit two labels, tags samples to Consultant for approval.
- .6 Manufacturer's Installation Instructions: Indicate special procedures, and installation.

1.04 Closeout Submittals

- .1 Section 01 77 00: Project Closeout.
- .2 Record actual locations of tagged valves.

2 Products

2.01 Mechanical Work Identification Materials

- .1 Confirm with the Owner if an existing mechanical work identification system is in place and, if so, match accordingly.
- .2 If an existing mechanical work identification system is not in place, the following is to be used:
 - .1 Equipment nameplates are to be minimum 1.6 mm (1/16") thick 2-ply laminated coloured plastic plates, minimum 12 mm x 50 mm (½" x 2") for smaller items such as damper motors and control valves, minimum 25 mm x 65 mm (1" x 2-½") for equipment, and minimum 50 mm x 100 mm (2" x 4") for control panels and similar items. Additional requirements are as follows:
 - .1 unless otherwise specified or required, each nameplate is to be white, complete with bevelled edges and black engraved wording to completely identify equipment and its use with no abbreviations;
 - .2 wording is generally to be as per drawings, i.e. Fan EF-1, and is to include equipment service and building area/zone served, but must be reviewed prior to engraving;
 - .3 supply stainless steel screws for securing nameplates in place;

- .4 nameplates for equipment suspended above floor level or generally not within easy viewing from floor level are to be increased in size so as to be easily readable from floor level.
- .2 Valve tags are to be coloured, 40 mm (1-½") square, 2-ply laminated plastic with bevelled edges, red-white, green-white, yellow-black, etc., to match piping identification colour, each complete with a 3.2 mm (1/8") diameter by 100 mm (4") long brass plated steel bead chain, and four lines of engraved maximum size identification wording, i.e.:

VALVE V12 200 mm (8") CHILL. WATER NORMALLY OPEN

- .3 Standard pipe identification is to be equal to Smillie McAdams Summerlin Ltd., Brady or Primark Manufacturing Inc. vinyl plastic with indoor/outdoor type vinyl ink lettering and directional arrows, as follows:
- .1 for pipe less than or equal to 150 mm (6") diameter, coiled type snap-on markers of a length to wrap completely around pipe or pipe insulation;
- .2 for pipe larger than 150 mm (6") diameter, saddle type strap-on markers with 2 opposite identification locations and complete with nylon cable ties.
- .4 Identification wording and colours for pipe identification materials are to be as follows:

Pipe Service	Identification Colour	Legend
domestic cold water	green	DOM. COLD WATER
domestic hot water supply	green	DOM. HW SUPPLY
domestic hot water recirculation	green	DOM. HW RECIRC.
tempered domestic water	green	TEMP. DOM. WATER
chilled drinking water	green	CH. DRINK WTR.
storm drainage	green	STORM
sanitary drainage	green	SAN.
plumbing vent	green	SAN. VENT
acid sanitary drainage	yellow	ACID DRAIN
acid drainage vent	yellow	ACID VENT
fire protection standpipe	red	F.P. STANDPIPE
fire protection sprinklers	red	F.P. SPRINKLER
natural gas	to Code	to Code, c/w pressure
natural gas vent	to Code	to Code
propane gas	to Code	to Code, c/w pressure
propane gas vent	to Code	to Code
fuel oil supply	yellow	FUEL OIL SUPPLY
fuel oil return	yellow	FUEL OIL RETURN
fuel oil vent	yellow	FUEL OIL VENT

Pipe Service	Identification Colour	Legend
heating water supply	yellow	HTG. WTR. SUPPLY
heating water return	yellow	HTG. WTR. RETURN
heating water drain	yellow	HTG. WTR. DRAIN
glycol heating supply	yellow	GLY. HTG. SUPPLY
glycol heating return	yellow	GLY. HTG. RETURN
glycol heating drain	yellow	GLY. HTG. DRAIN
glycol heat reclaim return	yellow	GLY. HTG. RECLAIM R.
glycol heat reclaim supply	yellow	GLY. HTG. RECLAIM S.
heat pump geothermal loop – source side supply	green	GEO. LOOP SOURCE SUPPLY
heat pump geothermal loop – source side return	green	GEO. LOOP SOURCE RETURN
heat pump geothermal loop – load side supply	green	GEO. LOOP LOAD SUPPLY
Heat pump geothermal loop – load side return	green	GEO. LOOP LOAD RETURN
condenser water supply	green	COND. WTR. SUPPLY
condenser water return	green	COND. WTR. RETURN
chilled water supply	green	CH. WTR. SUPPLY
chilled water return	green	CH. WTR. RETURN
chilled water drain	green	CH. WTR. DRAIN
low pressure steam	yellow	kPa STEAM
medium pressure steam	yellow	kPa STEAM
high pressure steam	yellow	kPa STEAM
low pressure condensate	yellow	L.P. CONDENSATE
medium pressure condensate	yellow	M.P. CONDENSATE
high pressure condensate	yellow	H.P. CONDENSATE
pumped condensate	yellow	PUMPED CONDENSATE
steam vent	yellow	STEAM VENT
boiler feedwater	yellow	BLR. FEEDWATER
boiler blowdown	yellow	BLR. BLOW-OFF
refrigerant suction	yellow	REFRIG. SUCTION
refrigerant liquid	yellow	REFRIG. LIQUID
refrigerant hot gas	yellow	REFRIG. HOT GAS
diesel engine exhaust	yellow	ENGINE EXHAUST
gasoline	yellow	GASOLINE
distilled water	green	DISTILL. WATER

Pipe Service	Identification Colour	Legend
demineralized water	green	DEMIN. WATER
compressed air (< 700 kPa)	green	kPa COMP. AIR
compressed air (>700 kPa)	yellow	kPa COMP. AIR
control air	green	CONTROL AIR

- .5 Colours for pipe identification legends and directional arrows are to be as follows:

Identification Colour	Legend and Arrow Colour
yellow	black
green	white
red	white

- .6 Duct identification is to be custom made Mylar stencils with 50 mm (2") high lettering to accurately describe duct service, i.e. "AHU-1 SUPPLY", complete with a directional arrow, and coloured ink with ink pads and roller applicators. Ink colour is generally to be black but must contrast with lettering background.

3 Execution

3.01 Preparation

- .1 Degrease and clean surfaces to receive adhesive for identification materials.

3.02 Installation

- .1 Identify new exposed piping and ductwork as per Part 2 of this Section in locations as follows:
- .1 at every end of every piping or duct run;
 - .2 adjacent to each valve, strainer, damper and similar accessory;
 - .3 at each piece of connecting equipment;
 - .4 on both sides of every pipe and duct passing through a floor, wall or partition, unless otherwise specified;
 - .5 at 6 m (20') intervals on pipe and duct runs exceeding 6 m (20') in length;
 - .6 at least once in each room, and at least once on pipe and duct runs less than 6 m (20') in length.
- .2 Unless otherwise specified identify new concealed piping and ductwork as per Part 2 of this Section in locations as follows:
- .1 at points where pipes or ducts enter and leave rooms, shafts, pipe chases, furred spaces, and similar areas;
 - .2 at maximum 6 m (20') intervals on piping and ductwork above suspended accessible ceilings, and at least once in each room;
 - .3 at each access door location;
 - .4 at each piece of connected equipment, automatic valve, etc.

- .3 Provide an identification nameplate for equipment provided as part of this project, including items such as control valves, motorized dampers, instruments, and similar products. Secure nameplates in place, approximately at eye level if possible, with stainless steel screws unless such a practice is prohibitive, in which case use epoxy cement applied to cleaned surfaces. Locate nameplates in the most conspicuous and readable location.
- .4 Paint new natural and/or propane gas piping with primer and 2 coats of yellow paint in accordance with Code requirements. Identify piping at intervals as specified above.
- .5 Provide an identification nameplate for each motor starter or disconnect switch located in a motor control centre or on a motor starter panel, and on each individually mounted starter provided as part of mechanical work, and on each disconnect switch provided as part of the electrical work for motorized equipment provided as part of mechanical work.
- .6 For electrically traced mechanical work, identification wording is to include "ELECTRICALLY TRACED".
- .7 Tag valves and prepare a valve tag chart in accordance with following requirements:
 - .1 attach a valve tag to each new valve, except for valves located immediately at equipment they control;
 - .2 prepare a digital valve tag chart to list tagged valves, with, for each valve, the tag number, location, valve size, piping service, and valve attitude (normally open or normally closed);
 - .3 if an existing valve tag chart is available at site, valve tag numbering is to be an extension of existing numbering and new valve tag chart is to incorporate existing chart;
 - .4 include a copy of valve tag chart in each copy of operating and maintenance instruction manuals.
- .8 Where shut-off valves, control dampers, sensors, and similar items which will or may need maintenance and/or repair are located above accessible suspended ceilings, provide round coloured ceiling tacks in ceiling panel material, or stickers equal to Brady "Quick Dot" on ceiling grid material to indicate locations of items. Unless otherwise specified, ceiling tack or sticker colours are to be as follows:
 - .1 HVAC piping valves and equipment: yellow
 - .2 fire protection valves and equipment: red
 - .3 plumbing valves and equipment: green
 - .4 HVAC ductwork dampers and equipment: blue
 - .5 control system hardware and equipment: orange

End of Section

1 General

1.01 Section Includes

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

1.02 Definitions

- .1 "Agency" – means agency to perform testing, adjusting, and balancing work.
- .2 "TAB" – means testing, adjusting, and balancing to determine and confirm quantitative performance of equipment and systems and to regulate specified fluid flow rate and air patterns at terminal equipment, e.g., reduce fan speed, throttling, etc.
- .3 "hydronic systems" – includes heating water, chilled water, glycol-water solution, condenser water, and any similar system.
- .4 "air systems" – includes outside air, supply air, return air, exhaust air, and relief air systems.
- .5 "flow rate tolerance" – means allowable percentage variation, minus to plus, of actual flow rate values in Contract Documents.
- .6 "report forms" – means test data sheets arranged for collecting test data in logical order for submission and review, and these forms, when reviewed and accepted, should also form permanent record to be used as basis for required future testing, adjusting, and balancing.
- .7 "terminal" – means point where controlled fluid enters or leaves the distribution system, and these are supply inlets on water terminals, supply outlets on air terminals, return outlets on water terminals, and exhaust or return inlets on air terminals such as registers, grilles, diffusers, louvers, and hoods.
- .8 "main" – means duct or pipe containing system's major or entire fluid flow.
- .9 "submain" – means duct or pipe containing part of the systems' capacity and serving 2 or more branch mains.
- .10 "branch main" – means duct or pipe servicing 2 or more terminals.
- .11 "branch" – means duct or pipe serving a single terminal.

1.03 Submittals

- .1 Within 30 days of work commencing at site, submit name and qualifications of proposed testing and balancing agency in accordance with requirements of article entitled Quality Assurance below.
- .2 Submit sample test forms, if other than those standard forms prepared by Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB), are proposed for use.
- .3 Submit a report by Agency to indicate Agency's evaluation of mechanical drawings with respect to service routing and location or lack of balancing devices. Include set of drawings used and marked-up by Agency to prepare report.

1.04 Closeout Submittals

- .1 Submit a report by Agency after each site visit made by Agency during construction phase of this Project.
- .2 Submit a draft report, as specified in Part 3 of this Section.
- .3 Submit a final report, as specified in Part 3 of this Section.

- .4 Submit a testing and balancing warranty as specified in Part 3 of this Section.
- .5 Submit reports listing observations and results of post construction site visits as specified in Part 3 of this Section.

1.05 Quality Assurance

- .1 Employ services of an independent testing, adjusting, and balancing agency meeting qualifications specified below, to be single source of responsibility to test, adjust, and balance building mechanical systems to produce design objectives. Agency is to have successfully completed testing, adjusting, and balancing of mechanical systems for a minimum of 5 projects similar to this Project within past 3 years, and is to be certified as an independent agency in required categories by one of following:
 - .1 AABC – Associated Air Balance Council;
 - .2 NEBB – National Environmental Balancing Bureau.
- .2 NBCTA certification in lieu of the above noted organizations is not permitted.
- .3 Testing, adjusting, and balancing of complete mechanical systems is to be performed over entire operating range of each system in accordance with one of following publications:
 - .1 National Standards for a Total System Balance published by Associated Air Balance Council;
 - .2 Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems published by National Environmental Balancing Bureau;
 - .3 Chapter 37, Testing, Adjusting, and Balancing of ASHRAE Handbook HVAC Applications.

2 Products – Not Used

3 Execution

3.01 Scope of Work

- .1 Perform total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of fluid quantities of mechanical systems as required to meet design specifications and comfort conditions, and recording and reporting results.
- .2 Mechanical systems to be tested, adjusted, and balanced include:
 - .1 TAB of domestic water systems (all piping extended from Municipal main) is to include:
 - .1 domestic hot water recirculation piping;
 - .2 tempered water piping flows.
 - .2 TAB of swimming pool systems is to include all pool piping water flows.
 - .3 TAB of laboratory systems is to include flows through piping, fittings including bench work fittings, and associated equipment including special ventilation systems.
 - .4 TAB of medical gas systems is not part of TAB work and is specified in Section entitled Medical Gas Piping Systems.
 - .5 TAB of fuel oil system is to include supply and return oil flows as applicable, and is to be in accordance with requirements of CAN/CSA B139.

- .6 TAB of heating systems is to include piping and equipment fluid temperatures, flows and control, and if TAB is not done during heating season, a follow-up site visit during heating season will be required to confirm proper flows and temperatures, and any required system "fine tuning".
- .7 TAB of cooling systems is also to include piping and equipment fluid temperatures, flows and control, and if TAB is not done during cooling season, a follow-up site visit during cooling season will be required to confirm proper flows and temperatures, and any required system "fine tuning".
- .8 TAB of air handling systems is to include equipment and ductwork air temperatures, capacities, and flows.

3.02 Testing, Adjusting, and Balancing

- .1 Conform to following:
 - .1 as soon as possible after award of Contract, Agency is to carefully examine a set of mechanical drawings with respect to routing of services and location of balancing devices, and is to issue a report listing results of the evaluation;
 - .2 set of drawings examined by Agency is to be returned with evaluation report, with red line mark-ups to indicate locations for duct system test plugs, and required revision work such as relocation of balancing devices and locations for additional devices;
 - .3 after review of mechanical work drawings and specification, Agency is to visit site at frequent, regular intervals during construction of mechanical systems, to observe routing of services, locations of testing and balancing devices, workmanship, and anything else that will affect testing, adjusting, and balancing;
 - .4 after each site visit, Agency is to report results of site visit indicating date and time of visit, and detailed recommendations for any corrective work required to ensure proper adjusting and balancing;
 - .5 testing, adjusting, and balancing is not to begin until:
 - .1 building construction work is substantially complete and doors have been installed;
 - .2 mechanical systems are complete in all respects, and have been checked, started, adjusted, and then successfully performance tested.
 - .6 mechanical systems to be tested, adjusted and balanced are to be maintained in full, normal operation during each day of testing, adjusting, and balancing;
 - .7 obtain copies of reviewed shop drawings of applicable mechanical plant equipment and terminals, and temperature control diagrams and sequences;
 - .8 Agency is to walk each system from system "head end" equipment to terminal units to determine variations of installation from design, and system installation trades will accompany Agency;
 - .9 Agency is to check valves and dampers for correct and locked position, and temperature control systems for completeness of installation before starting equipment;
 - .10 wherever possible, Agency is to lock balancing devices in place at proper setting, and permanently mark settings on devices;
 - .11 Agency is to leak test ductwork as specified in Section entitled HVAC Air Distribution in accordance with requirements of SMACNA "HVAC Air Duct Leak Test Manual", coordinate work with work of aforementioned Sections, provide detailed sketch(es) to Sheet Metal Contractor and Consultant identifying ductwork not in accordance with acceptable leakage values specified in aforementioned Sections, and retest corrected ductwork;

- .12 Agency is to balance systems with due regard to objectionable noise which is to be a factor when adjusting fan speeds and performing terminal work such as adjusting air quantities, and should objectionable noise occur at design conditions, Agency is to immediately report problem and submit data, including sound readings, to permit an accurate assessment of noise problem to be made;
 - .13 Agency is to check supply air handling system mixing plenums for stratification, and where variation of mixed air temperature across coils is found to be in excess of $\pm 5\%$ of design requirements, Agency is to report problem and issue a detail sketch of plenum baffle(s) required to eliminate stratification;
 - .14 Agency is to perform testing, adjusting, and balancing to within $\pm 5\%$ of design values, and make and record measurements which are within $\pm 2\%$ of actual values;
 - .15 for air handling systems equipped with air filters, test and balance systems with simulated 50% loaded (dirty) filters by providing a false pressure drop;
 - .16 test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 2.8°C (5°F) wet bulb temperature of maximum summer design condition, and within 5.5°C (10°C) dry bulb temperature of minimum winter design condition, and take final temperature readings during seasonal operation.
- .2 Prepare reports as indicated below.
- .1 Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on AABC or NEBB forms. Draft reports may be hand written, but must be complete, factual, accurate, and legible. Organize and format draft reports in same manner specified for final reports and submit for review.
 - .2 Upon verification and approval of draft reports, prepare final reports organized and formatted as specified below. Use units of measurement (SI or Imperial) as used on Project Documents.
 - .3 Report forms are to be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Report forms complete with schematic systems diagrams and other data are to be consolidated in electronic format as a PDF. PDF file to be indexed and organized into sections, as it applies to the project, as follows:
 - .1 General Information and Summary;
 - .2 Air Systems;
 - .3 Hydronic Systems;
 - .4 Temperature Control Systems;
 - .5 Special Systems.
 - .4 Agency is to provide following minimum information, forms, and data in report:
 - .1 inside cover sheet to identify Agency, Contractor, and Project, including addresses, and contact names and telephone numbers and a listing of instrumentation used for procedures along with proof of calibration;
 - .2 remainder of report is to contain appropriate forms containing as a minimum, information indicated on standard AABC or NEBB report forms prepared for each respective item and system;

- .3 Agency is to include for each system to be tested, adjusted and balanced, a neatly drawn, identified (system designation, plant equipment location, and area served) schematic "as-built" diagram indicating and identifying equipment, terminals, and accessories;
- .4 Agency is to include report sheets indicating building comfort test readings for all rooms.
- .3 After final testing and balancing report has been submitted, Agency is to visit site with Contractor and Consultant to spot check results indicated on balancing report. Agency is to supply labour, ladders, and instruments to complete spot checks. If results of spot checks do not, on a consistent basis, agree with final report, spot check procedures will stop and Agency is to then rebalance systems involved, resubmit final report, and again perform spot checks with Contractor and Consultant.
- .4 When final report has been accepted, Contractor is to submit to Owner, in name of Owner, a certificate equal to AABC National Guaranty Certification or a NEBB Quality Assurance Program Bond, and in addition, Contractor is to submit a written extended warranty from Agency covering one full heating season and one full cooling season, during which time any balancing problems which occur, with exception of minor revision work done during scheduled site visits, will, at no cost, be investigated by Agency and reported on to Owner, and if it is determined that problems are a result of improper testing, adjusting, and balancing, they are to be immediately corrected without additional cost to Owner.

End of Section

1 General

1.01 Section Includes

- .1 This Section specifies insulation requirements common to Mechanical Divisions work Sections and it is a supplement to each Section and is to be read accordingly.

1.02 Definitions

- .1 "concealed" – means mechanical services and equipment above suspended ceilings, in non-accessible chases, in accessible pipe spaces, and furred-in spaces.
- .2 "exposed" – means exposed to normal view during normal conditions and operations.
- .3 "mineral fibre" – includes glass fibre, rock wool, and slag wool.
- .4 "domestic water" or "potable water" – means piping extended from building Municipal supply main.

1.03 Submittals

- .1 At least 4 weeks prior to insulation work commencing, submit a sample of each type of insulation (and insulation accessories and finish), in applied form, for review. Mount samples on a plywood board. Identify each product with manufacturer's name and insulation type, and proposed use of insulation. When sample board has been approved, mechanical insulation work is to conform to approved sample board.
- .2 Submit a product data sheet for each insulation system product.
- .3 Submit a fabrication drawing for each custom made cover to indicate material and fabrication details, and a 300 mm (12") square sample of proposed cover material.
- .4 Submit a colour chart for coloured lagging adhesive for canvas jacketed insulation.

1.04 Closeout Submittals

- .1 In accordance with Part 3 of this Section, submit a letter from fire rated duct wrap supplier to certifying duct wrap has been properly installed.

1.05 Quality Assurance

- .1 Mechanical insulation is to be applied by a licensed journeyman insulation mechanic, or by an apprentice under direct, daily, on-site supervision of a journeyman mechanic.
- .2 Do not apply insulation unless leakage tests have been satisfactorily completed.
- .3 Ensure surfaces to be insulated are clean and dry.
- .4 Ensure ambient temperature is minimum 13°C (55°F) for at least 1 day prior to application of insulation, and for duration of insulation work, and relative humidity is and will be at a level such that mildew will not form on insulation materials.
- .5 Company with sub-contract for mechanical insulation work is to be a member in good standing of Thermal Insulation Association of Canada.
- .6 Insulation materials must be stored on site in a proper and dry storage area. Any wet insulation material is to be removed from site.

2 Products

2.01 Fire Hazard Ratings

- .1 Unless otherwise specified, insulation system materials inside building must have a fire hazard rating of not more than 25 for flame spread and 50 for smoke developed when tested in accordance with CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.

2.02 Thermal Performance

- .1 Unless otherwise specified, thermal performance of insulation is to meet or exceed values given in Tables entitled Minimum Piping Insulation Thickness Heating and Hot Water Systems and Minimum Piping Insulation Thickness Cooling Systems, as stated in ANSI/ASHRAE/IES Standard 90.1 version referenced in Ontario Building Code.

2.03 Pipe Insulation Materials

- .1 Horizontal pipe insulation at hangers and supports are to be equal to Belform Insulation Ltd. "Koolphen K-Block" insulated pipe support inserts consisting of minimum 150 mm (6") long, pre-moulded, rigid, sectional phenolic foam insulation (of same thickness as adjoining insulation) with a reinforced foil and kraft paper vapour barrier jacket and a captive galvanized steel saddle.
- .2 Flexible foam elastomeric is to be closed cell, sleeve type, longitudinally split self-seal, foamed plastic pipe insulation with a water vapour transmission rating of 0.10 in accordance with ASTM E96, Procedure B, and required installation accessories.
 - .1 Manufacturers:
 - .1 Armacell AP/Armaflex SS;
 - .2 IK Insulation Group K-Flex "LS" Self-Seal Pipe Insulation.
- .3 Closed cell foamed glass is to be Owens Corning "FOAMGLASS", expanded, sectional, rigid sleeve type insulation with a liquid or vapour permeability rating (as per ASTM C240) of 0.00, and a factory applied "PITWRAP SSII" self-sealing jacket and protective metal cladding.
- .4 Premoulded mineral wool is to be rigid, sectional, sleeve type, non-combustible, longitudinally split mineral wool, or basalt pipe insulation with a reinforced vapour barrier jacket.
 - .1 Manufacturers:
 - .1 Roxul "Tecton 1200";
 - .2 IIG (Johns Manville Inc.) MinWool-1200;
 - .3 Paroc 1200.
- .5 Fire rated pre-moulded mineral wool is to be non-combustible, fire-rated, rigid, sectional, longitudinally split mineral wool or basalt pipe insulation with a reinforced vapour barrier jacket and compatible with CAN/ULC-S115 and CAN/ULC-S101 firestopping.
 - .1 Manufacturers:
 - .1 Roxul "Tecton 1200";
 - .2 IIG (Johns Manville Inc.) MinWool-1200;
 - .3 Paroc 1200.

- .6 Pre-moulded mineral fibre is to be rigid, sectional, sleeve type insulation to ASTM C547, with a factory applied vapour barrier jacket.
 - .1 Manufacturers:
 - .1 Johns Manville Inc. "Micro-Lok AP-T Plus";
 - .2 Knauf Fiber Glass "Pipe Insulation" with "ASJ-SSL" jacket;
 - .3 Manson Insulation Inc. "ALLEY K APT";
 - .4 Owens Corning "Fiberglas" Pipe Insulation.
- .7 Blanket mineral fibre is to be blanket type roll insulation to CGSB 51-GP-11M, 24 kg/m³ (1-½ lb/ft³) density, with a factory applied vapour barrier facing.
 - .1 Manufacturers:
 - .1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;
 - .2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;
 - .3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;
 - .4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.
- .8 Pre-moulded weatherproof jacketed mineral fibre is to be Knauf Insulation "Redi-Klad 1000" sectional, sleeve type pipe insulation with a self-sealing weather-proof jacket and a 100 mm (4") butt joint sealing strip with each section.

2.04 Barrier-Free Lavatory Piping Insulation Kits

- .1 Removable, flexible, reusable, white moulded plastic insulation kits for barrier-free lavatory drain piping and potable water supplies exposed under lavatory.
- .2 Manufacturers:
 - .1 Truebo "Lav-Guard 2" E-Z Series;
 - .2 Zeston "SNAP-TRAP";
 - .3 McGuire Manufacturing Co. Inc. "ProWrap".

2.05 Equipment Insulation Materials

- .1 Blanket mineral fibre is to be blanket type roll form insulation to ASTM C553, 24 kg/m³ (1-½ lb/ft³) density, with a factory applied vapour barrier facing.
 - .1 Manufacturers:
 - .1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;
 - .2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;
 - .3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;
 - .4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.

- .2 Semi-rigid mineral fibre board is to be roll form, moulded insulation to ASTM C1393, with a factory applied vapour barrier facing consisting of laminated aluminum foil and kraft paper.
 - .1 Manufacturers:
 - .1 Knauf Fiber Glass Pipe and Tank Insulation;
 - .2 Manson Insulation Inc. "AK FLEX";
 - .3 Johns Manville Inc. Pipe and Tank Insulation "Micro-Flex";
 - .4 Multi-Glass Insulation Ltd. "MULTI-FLEX MF";
 - .5 Owens Corning Pipe and Tank Insulation;
 - .6 Glass-Cell Fabricators Ltd. "R-Flex".
- .3 Semi-rigid mineral wool blanket is to be equal to Roxul "Enerwrap MA 960" flexible, black fibrous scrim faced mineral wool blanket insulation to ASTM C553.
- .4 Closed cell foamed glass is to be Owens Corning "FOAMGLAS" expanded, rigid board and block type insulation with a liquid or vapour permeability rating (as per ASTM C240) of 0.00.

2.06 Removable/Reusable Insulation Covers

- .1 Valve, etc. covers are to be NO SWEAT reusable insulation wraps with vapour barrier jacket and self-sealing ends and longitudinal seam, with a length to suit the application and an insulation thickness equal to adjoining insulation.
- .2 Custom manufactured equipment covers conforming to shape of item to be insulated, designed to be easily removable and replaceable to suit use and maintenance procedures of particular item, and to provide adequate personnel protection. Covers are to be complete with minimum 95 kg/m³ (6 lb/ft³) density ceramic fibre insulation sewn between minimum 542.5 g/m² (1.8 oz/ft²) weight silicone impregnated fibreglass fabric in a quilted pattern using double stitches made with Kelvar or Teflon coated fibreglass thread. Overlap flaps are to be secured using laces, snaps, or Velcro double stitched in place.
- .3 Manufacturers:
 - .1 Crossby Dewar Inc.;
 - .2 Insufab Systems Inc.;
 - .3 ADL Insulflex Inc.;
 - .4 Firwin Corp.;
 - .5 GlassCell Isofab Inc.

2.07 Ductwork System Insulation Materials

- .1 Rigid mineral fibre board is to be pre-formed board type insulation to ASTM C612, 48 kg/m³ (3 lb/ft³) density, with a factory applied reinforced aluminum foil and kraft paper facing.
 - .1 Manufacturers:
 - .1 Knauf Fiber Glass Insulation Board with FSK facing;
 - .2 Manson Insulation Inc. "AK BOARD FSK";

- .3 Johns Manville Inc. Type 814 "Spin-Glas";
 - .4 Owens Corning 703.
- .2 Semi-rigid mineral fibre board is to be roll form insulation to ASTM C1393, consisting of cut strips of rigid mineral board insulation glued to an aluminium foil and kraft paper facing.
 - .1 Manufacturers:
 - .1 Multi-Glass Insulation Ltd. "Multi-Flex MKF";
 - .2 Glass-Cell Fabricators Ltd. "R-FLEX";
 - .3 Owens Corning Pipe and Tank Insulation;
 - .4 Johns Manville Inc. Pipe and Tank Insulation.
- .3 Blanket mineral fibre is to be blanket type roll form insulation to ASTM C553, 24 kg/m³ (1-½ lb/ft³) density, 40 mm (1-½") thick, with a factory applied vapour barrier facing.
 - .1 Manufacturers:
 - .1 Johns Manville Inc. Microlite FSK Duct Wrap Type 150;
 - .2 Knauf Fiber Glass Blanket Insulation FSK Duct Wrap Type III;
 - .3 Manson Insulation Inc. ALLEY WRAP FSK Duct Wrap Type III;
 - .4 Certainteed Corporation Softtouch FSK Duct Wrap Type 150.

2.08 Fire Rated Duct Wrap

- .1 Flexible, non-combustible, blanket type mineral fibre duct wrap completely encapsulated in reinforced foil, suitable for installation with zero clearance to combustibles (for grease ducts), and ULC tested and listed (ULC Designs FRD-17 & 23 for ventilation ducts, ULC Design FRD-19 for kitchen exhaust/grease duct) to facilitate a 2 hour fire resistance rating (76 mm (3") thick) to kitchen grease exhaust duct in accordance with requirements of NFPA 96, and/or a 1 hour or 2 hour fire resistance rating (38 mm (1-½") thick) to ventilation or pressurization ductwork in accordance with requirements of ISO 6944.
- .2 Manufacturers:
 - .1 3M Fire Barrier Duct Wrap 615;
 - .2 CL4 Inc. "CL4Fire";
 - .3 Unifrax Corp. "FyreWrap Elite 1.5";
 - .4 Morgan Thermal Ceramics "FireMaster FastWrap XL".

2.09 Insulating Coatings

- .1 Equal to Robson Thermal Manufacturing Ltd. insulating coatings as follows:
 - .1 anti-condensation coating, "No Sweat-FX";
 - .2 thermal insulating coating, "ThermaLite".

2.10 Insulation Fastenings

- .1 Wire – minimum 15 gauge galvanized annealed wire.

- .2 Wire with Mesh – minimum 15 gauge galvanized annealed wire factory woven into 25 mm (1") hexagonal mesh.
- .3 Aluminium Banding – equal to ITW Insulation Systems Canada "FABSTRAPS" minimum 12 mm (½") wide, 0.6 mm (1/16") thick aluminium strapping.
- .4 Stainless Steel Banding – equal to ITW Insulation Systems Canada "FABSTAPS" 0.6 mm (1/16") thick, minimum 12 mm (½") wide type 304 stainless steel strapping.
- .5 Duct Insulation Fasteners – weld-on 2 mm (3/32") diameter zinc coated steel spindles of suitable length, complete with minimum 40 mm (1-½") square plastic or zinc plated steel self-locking washers.
- .6 Tape Sealant – equal to MACtac Canada Ltd. self-adhesive insulation tapes, types PAF, FSK, ASJ, or SWV as required to match surface being sealed.
- .7 Mineral Fibre Insulation Adhesive – clear, pressure sensitive, brush consistency adhesive, suitable for a temperature range of -20°C to 82°C (-4°F to 180°F), compatible with type of material to be secured, and WHMIS classified as non-hazardous.
- .8 Flexible Elastomeric Insulation Adhesive – Armacell "Armaflex" #520 air-drying contact adhesive.
- .9 Closed Cell Foamed Glass Insulation Adhesive – Pittsburgh Corning PC88 multi-purpose 2-component adhesive.
- .10 Lagging Adhesive – white, brush consistency, ULC listed and labelled, 25/50 fire/smoke rated lagging adhesive for canvas jacket fabric, suitable for colour tinting, complete with fungicide and washable when dry.
- .11 Screws – No. 10 stainless steel sheet metal screws.

2.11 Insulation Jackets and Finishes

- .1 Canvas Jacket Material – ULC listed and labelled, 25/50 fire/smoke rated, roll form, minimum 170 g (6 oz).
- .2 Roll Form Sheet and Fitting Covers – minimum 15 mm (1/2") thick white PVC, 25/50 fire/smoke rated tested in accordance with CAN/ULC-S102, complete with installation and sealing accessories.
 - .1 Manufacturers:
 - .1 Proto Corp. "LoSMOKE";
 - .2 The Sure-Fit System "SMOKE-LESS 25/50";
 - .3 Johns Manville Inc. "Zeston" 300.
- .3 Rigid Aluminium Jacket – equal to ITW Insulation Systems Canada "Lock-on" 0.406 mm (0.016") thick embossed aluminum jacket material to ASTM B209, factory cut to size and complete with polysurlyn moisture barrier and continuous modified Pittsburgh Z-Lock, butt straps with "Fabstraps" to weatherproof the end to end joints, and 2-piece epoxy coated pressed aluminum fittings with weather locking edges.
- .4 Stainless Steel Jacket – equal to ITW Insulation Systems Canada "Lock-on" 0.254 mm (0.010") thick type 304 embossed stainless steel jacket material to ASTM A240, factory cut to size and complete with moisture barrier and continuous modified Pittsburgh Z-Lock, butt straps with "Fabstraps" to cover end to end joints, and 2-piece pressed stainless steel fittings with weather locking edges.
- .5 Adhesive backed flexible aluminium is to be MFM Building Products Corp. "Flex-Clad 400" roll form sheet material with an aggressive rubberized asphalt adhesive backing, high density polyethylene reinforcement, and an embossed aluminum facing.

- .6 Heat resistant, trowel consistency thermal insulating and finishing cement to CAN/CGSB 51.12, and suitable for the application.
- .7 Foamed glass insulation protective coating is to be Pittsburgh Corning "PITTCOTE 300e" flexible acrylic latex weather barrier coating, white unless otherwise specified.
- .8 UV and moisture resistant flexible foam insulation with protective jacket equal to Armacell "ArmaFlex Shield".
- .9 Self adhesive multilayer jacketing - equal to 3M Ventureclad 1577CW. Multi-ply laminate flexible jacketing, acrylic adhesive, zero permeability vapor barrier, 480 N/mm tensile strength, 22N/25 mm peel adhesion strength, 15.2 kPa shear adhesion after 72 hours, 147 N puncture resistance, 0.2 mm thickness.

3 Execution

3.01 General Insulation Application Requirements

- .1 Unless otherwise specified, do not insulate following:
 - .1 factory insulated equipment and piping;
 - .2 heating piping within radiation unit enclosures, including blank filler sections of enclosures;
 - .3 heating piping in soffits and/or overhang spaces and connected to bare element radiation in spaces;
 - .4 branch potable water piping located under counters to serve counter mounted plumbing fixtures and fittings, except barrier-free lavatories;
 - .5 exposed chrome plated potable water angle supplies from concealed piping to plumbing fixtures and fittings, except barrier-free lavatories;
 - .6 heated liquid system pump casings, valves, strainers and similar accessories;
 - .7 heating system expansion tanks;
 - .8 fire protection pump casings;
 - .9 manufactured expansion joints and flexible connections;
 - .10 acoustically lined ductwork and/or equipment;
 - .11 factory insulated flexible branch ductwork;
 - .12 fire protection system water storage tanks;
 - .13 piping unions, except for unions in "cold" category piping.
- .2 Install insulation directly over pipes and ducts, not over hangers and supports.
- .3 Install piping insulation and jacket continuous through pipe openings and sleeves.
- .4 Install duct insulation continuous through walls, partitions, and similar surfaces except at fire dampers.
- .5 When insulating "cold" piping and equipment, extend insulation up valve bodies and other such projections as far as possible, and protect insulation jacketing from the action of condensation at its junction with metal.

- .6 Insulate, vapour seal, and finish seismic restraints, braces, anchors, hanger rods, and similar hardware directly connected to "cold" piping and/or equipment, for a distance of 300 mm (12") clear of adjacent pipe or equipment finish, to match piping and/or equipment insulation.
- .7 When insulating vertical piping risers 75 mm (3") diameter and larger, use insulation support rings welded directly above lowest pipe fitting, and thereafter at 4.5 m (14.7') centres and at each valve and flange. Insulate as per Thermal Insulation Association of Canada National Insulation Standards, Figure No. 9.
- .8 Where piping and/or equipment is traced with electric heating cable, ensure cable has been tested and accepted prior to application of insulation, and ensure cable is not damaged or displaced during the application of insulation.
- .9 Where existing insulation work is damaged as a result of mechanical work, repair damaged insulation work to Project work standards.
- .10 Where existing insulation is damaged or missing in area of work, repair and insulating piping and ductwork to project work standards.
- .11 Where mineral fibre rigid sleeve type insulation is terminated at valves, equipment, unions, etc., neatly cover exposed end of insulation with a purpose made PVC cover on "cold" piping, and with canvas jacket material on "hot" piping.
- .12 Carefully and neatly gouge out insulation for proper fit where there is interference between weld bead, mechanical joints, etc., and insulation. Bevel away from studs and nuts to permit their removal without damage to insulation, and closely and neatly trim around extending parts of pipe saddles.
- .13 Where thermometers, gauges, and similar instruments occur in insulated piping, and where access to heat transfer piping balancing valve ports and similar items are required, create a neat, properly sized hole in insulation and provide a suitable grommet in the opening.

3.02 Insulation for Horizontal Pipe at Hangers and Supports

- .1 At each hanger and support location for piping 50 mm (2") diameter and larger and scheduled to be insulated, except where roller hangers and/or supports are required, and unless otherwise specified, supply a factory fabricated section of phenolic foam pipe insulation with integral vapour barrier jacket and captive galvanized steel shield. Supply insulation sections to piping installers for installation as pipe is erected.
- .2 For 100 mm (4") diameter and larger heating system piping where roller type hangers and supports are provided, a steel saddle will be tack welded to pipe at each roller hanger or support location. Pack saddle voids with loose mineral wool insulation.

3.03 Pipe Insulation Requirements – Mineral Fibre

- .1 Insulate following pipe inside building and above ground with mineral fibre insulation of thickness indicated:
 - .1 domestic cold water piping, less than 100 mm (4") dia. – 25 mm (1") thick;
 - .2 domestic cold water piping, greater than or equal to 100 mm (4") dia. – 40 mm (1½") thick;
 - .3 domestic hot water piping, less than 40 mm (1½") dia. – 25 mm (1") thick;
 - .4 domestic hot water piping, greater than or equal to 40 mm (1½") dia. – 40 mm (1½") thick;
 - .5 tempered domestic water piping, supply and return, less than 40 mm (1½") dia. – 25 mm (1") thick;

- .6 tempered domestic water piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;
- .7 storm drainage piping from roof drains to the point where main vertical risers extend straight down, without offsets, and connect to horizontal underground mains – 25 mm (1") thick;
- .8 condensate drainage piping from fan coil unit or any other air conditioning system/unit drain pans to main vertical drain risers or to indirect drainage point – 25 mm (1") thick;
- .9 drainage piping from refrigerated drinking fountains to nearest 75 mm (3") dia. or larger drain pipe – 25 mm (1") thick;
- .10 chilled water piping, supply and return, less than 100 mm (4") dia. – 25 mm (1") thick;
- .11 chilled water piping, supply and return, greater than or equal to 100 mm (4") dia. – 40 mm (1-½") thick;
- .12 chilled glycol solution piping, supply and return, less than 100 mm (4") dia. – 25 mm (1") thick;
- .13 chilled glycol solution piping, supply and return, greater than or equal to 100 mm (4") dia. – 40 mm (1-½") thick;
- .14 hot water heating piping, supply and return, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;
- .15 hot water heating piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;
- .16 glycol solution heating or heat reclaim piping, supply and return, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;
- .17 glycol solution heating or heat reclaim piping, supply and return, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;
- .18 low pressure (to 140 kPa (20 psi)) steam piping, less than 100 mm (4") dia. – 65 mm (2-½") thick;
- .19 low pressure (to 140 kPa (20 psi)) steam piping, greater than or equal to 100 mm (4") dia. – 80 mm (3") thick;
- .20 medium pressure (140 kPa to 415 kPa (20 psi to 60 psi)) steam piping, less than 40 mm (1-½") dia. – 100 mm (4") thick;
- .21 medium pressure (140 kPa to 415 kPa (20 psi to 60 psi)) steam piping, greater than or equal to 40 mm (1-½") dia. – 112 mm (4-½") thick;
- .22 low pressure condensate piping, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;
- .23 low pressure condensate piping, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;
- .24 medium pressure condensate piping, less than 40 mm (1-½") dia. – 40 mm (1-½") thick;
- .25 medium pressure condensate piping, greater than or equal to 40 mm (1-½") dia. – 50 mm (2") thick;
- .26 boiler feedwater piping complete – 25 mm (1") thick;
- .27 boiler blowdown piping complete – 40 mm (1-½") thick;
- .28 chilled domestic cold water piping from remote water cooler(s) to drinking fountain(s) – 40 mm (1-½") thick;

- .29 piping indicated to be traced with electric heating cable – minimum 50 mm (2") thick;
- .30 drum drip(s) in dry zone standpipe and/or sprinkler system piping – 50 mm (2") thick;
- .31 air compressor set fresh air intake piping – 25 mm (1") thick;
- .32 heat pump equipment earthloop piping – 25 mm (1") thick.
- .2 Secure overlap flap of the sectional insulation jacket tightly in place. Cover section to section butt joints with tape sealant.
- .3 Insulate fittings with sectional pipe insulation mitred to fit tightly, and cover butt joints with tape sealant, or, alternatively, wrap fittings with blanket mineral fibre insulation to a thickness and insulating value equal to the sectional insulation, secure in place with adhesive and/or wire, and cover with PVC fitting covers.
- .4 Unless otherwise specified, insulate unions, valves, strainers, and similar piping system accessories in "cold" piping with cut and tightly fitted segments of sectional pipe insulation with joints covered with tape sealant, or, alternatively, wrap piping union, valve, strainer, etc., with blanket mineral fibre and cover with PVC covers as for paragraph above.
- .5 Terminate sectional insulation approximately 50 mm (2") from flange or coupling on each side of flange or coupling. Cover flange or coupling with a minimum 50 mm (2") thickness of blanket mineral fibre insulation wide enough to butt tightly to ends of adjacent sectional insulation. Secure blanket insulation in place and cover with a purpose made PVC coupling cover.
- .6 Drum drips in dry zone sprinkler and/or standpipe system piping will be traced with electric heating cable as part of electrical work, and are generally not shown on drawing(s). Confirm number and size of drum drips required with trade providing piping and include for insulation to suit. Wherever possible drum drips will be located in heated areas.
- .7 Take special care at concealed water rough-in piping at plumbing fixtures to ensure piping is properly insulated. If necessary due to space limitations, use 12 mm (½") thick sectional pipe insulation in lieu of 25 mm (1") thick insulation.
- .8 Insulate seismic restraint hardware such as hanger rods, braces, anchors, etc., directly connected to "cold" category piping and equipment for a distance of 300 mm (12") from piping or equipment with insulation and finish to match pipe or equipment insulation. Coat seismic restraint hardware for a distance of 300 mm (12") from the termination of insulation with Robson Thermal "NO-SWEAT-FX" water based anti-condensation coating.

3.04 Pipe Insulation Requirements – Mineral Wool

- .1 Insulate following pipe inside building and above ground with high temperature mineral wool insulation of thickness indicated:
 - .1 high pressure (above 415 kPa (60 psi)) steam piping, less than 40 mm (1-½") dia. – 100 mm (4") thick;
 - .2 high pressure (above 415 kPa (60 psi)) steam piping, greater than or equal to 40 mm (1-½") dia. – 115 mm (4-½") thick;
 - .3 high pressure condensate piping – 50 mm (2") thick;
 - .4 engine-generator set exhaust system piping – 75 mm (3") thick.
- .2 Generally, install insulation on piping as specified above for mineral fibre insulation.
- .3 Generally, install insulation on fittings as specified above for mineral fibre insulation but cover with canvas, not PVC fitting covers.

3.05 Pipe Insulation Requirements – Flexible Foam Elastomeric

- .1 Install flexible elastomeric pipe insulation in strict accordance with manufacturer's published instructions to suit the application, and using adhesive, joint sealants, and finish to produce a water-tight installation. Insulate following pipe with flexible elastomeric pipe insulation of thickness indicated:
 - .1 refrigerant piping inside and outside building – 25 mm (1") thick.

3.06 Pipe Insulation Requirements – Closed Cell Foamed Glass

- .1 Install closed cell foamed glass insulation in strict accordance with manufacturer's published instructions to suit the application, and using adhesive, joint sealants, and jacketing to produce a water-tight installation. Insulate following pipe with closed cell foamed glass of thickness indicated:
 - .1 piping located outside building and indicated to be heat traced – minimum 50 mm (2") thick.

3.07 Pipe Insulation Requirements – Fire Rated Insulation

- .1 Where pipe (inside building and above ground) which is to be insulated as specified above penetrates fire rated construction, provide fire-rated, non-combustible sectional insulation on portion of pipe in fire barrier and for a distance of 50 mm (2") on either side of fire barrier. Insulation thickness is to be as specified, but in any case minimum 25 mm (1").

3.08 Installation of Barrier Free Lavatory Insulation Kits

- .1 Provide manufactured insulation kits to cover exposed drainage and water piping under barrier free lavatories.

3.09 Equipment Insulation Requirements – Blanket Type Mineral Fibre

- .1 Insulate following equipment with mineral fibre blanket type insulation of thickness indicated:
 - .1 chilled water and/or domestic cold water pump casings – 40 mm (1-½") thick;
 - .2 roof drain sumps where inside the building – 25 mm (1") thick;
 - .3 water meter(s) – 40 mm (1-½") thick;
 - .4 top of radiant ceiling panels – per manufacturer's recommendation or minimum 50 mm (2") thick, whichever is greater.
- .2 Unless otherwise noted, wrap equipment to a thickness and insulating value equal to an equivalent thickness of rigid sectional pipe insulation. Laminate insulation in place with a full coverage of adhesive and secure with wire. Apply a jacket of insulation vapour barrier material secured in place with adhesive or sealant tape.
- .3 Cover roof drain sumps with purpose made PVC fitting covers.
- .4 Lay fibreglass blanket on radiant ceiling panels after testing is complete.

3.10 Equipment Insulation Requirements – Semi-Rigid Mineral Fibre

- .1 Insulate following equipment with semi-rigid mineral fibre board insulation of thickness indicated:
 - .1 refrigeration machine water chiller(s) and suction elbow(s) – 50 mm (2") thick;
 - .2 uninsulated domestic hot water storage tank(s) – 40 mm (1-½") thick;

- .3 shell and tube type heat exchangers – 40 mm (1-½") thick;
- .4 condensate receiver(s) – 40 mm (1-½") thick;
- .5 flash tanks – 40 mm (1-½") thick;
- .6 hot well tank – 40 mm (1-½") thick;
- .7 deaerating feedwater heater – 40 mm (1-½") thick;
- .8 blow-down tank – 40 mm (1-½") thick;
- .9 chilled water or chilled glycol solution storage tank – 50 mm (2") thick;
- .10 heating main air separator – 40 mm (1-½") thick;
- .11 chilled water expansion tank – 40 mm (1-½") thick.
- .2 Install insulation as required to fit shape and contour of equipment. Secure insulation in place with adhesive, and with aluminum straps on 450 mm (18") centres. Apply a 6 mm (¼") thick skim coat of insulating cement, then, when insulating cement has dried, apply a 6 mm (¼") thick coat of cement trowelled smooth.
- .3 For "cold" equipment, prime insulation with suitable sealer and apply a jacket of glass thread reinforced foil and kraft paper vapour barrier jacket material laminated in place with a full coverage of adhesive.
- .4 Provide removable and replaceable insulated metal covers for equipment with removable heads to permit heads to be removed and replaced without damaging adjacent insulation work.

3.11 Equipment Insulation Requirements – Semi-Rigid Mineral Wool

- .1 Insulate following equipment with calcium silicate equipment insulation of thickness indicated:
 - .1 engine-generator set exhaust system silencer(s) – 75 mm (3") thick;
 - .2 uninsulated boiler breeching where inside the building – 75 mm (3") thick.
- .2 Cut or mitre insulation (or use factory scored type insulation) to fit shape and contour of equipment and secure insulation in place with aluminum straps on 450 mm (18") centres. Point joints, mitres, scores and gaps with insulating cement. Apply a 12 mm (½") thick coat of insulating cement and trowel smooth.

3.12 Equipment Insulation Requirements – Removable/Reusable Type

- .1 Provide custom designed and manufactured removable and reusable insulation covers for following:
 - .1 plate type heat exchanger(s);
 - .2 150 mm (6") dia. and larger piping strainers, backflow preventers, etc.;
 - .3 diesel engine exhaust manifolds;
 - .4 150 mm (6") dia. and larger steam traps and similar equipment.
- .2 Provide "wrap type" removable and reusable insulation covers for "cold" circuit balancing valves, backflow preventers, and similar items, and for steam traps and similar items requiring service in piping less than 150 mm (6") dia.

3.13 Ductwork Insulation Requirements – Mineral Fibre

- .1 Insulate following ductwork systems inside building and above ground with mineral fibre insulation of thickness indicated:
 - .1 Outdoor air and combustion air intake ductwork, casings and plenums from fresh air intakes to and including mixing plenums or sections, or, if mixing plenums or sections are not provided, to first heating coil, or if both mixing plenums or sections and heating coil sections are not provided, and fresh air is not tempered, then the fresh air ductwork system complete – minimum 40 mm (1-½") thick as required;
 - .2 mixed supply air or preheated supply air casings, plenums and sections to and including the fan section where not factory insulated – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;
 - .3 supply air ductwork outward from fans, except for supply ductwork exposed in area it serves – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;
 - .4 exhaust discharge ductwork for a distance of 3 m (10') downstream (back) from exhaust openings to atmosphere, including any exhaust plenums within the 3 m (10') distance – minimum 25 mm (1") thick rigid board or minimum 40 mm (1-½") thick flexible blanket as required;
 - .5 any other ductwork, casings, plenums, or sections specified or detailed on drawings to be insulated – thickness as specified.
- .2 Provide rigid board type insulation for casings, plenums, and exposed rectangular ductwork. Provide blanket type insulation for round ductwork and concealed rectangular ductwork.
- .3 Liberally apply adhesive to surfaces of exposed rectangular ducts and/or casings. Accurately and neatly press insulation into adhesive with tightly fitted butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom and side surfaces. Secure and seal joints with 75 mm (3") wide tape sealant. Additional installation requirements as follows:
 - .1 at trapeze hanger locations, install insulation between duct and hanger;
 - .2 provide drywall type metal corner beads on edges of ductwork, casings and plenums in equipment rooms, service corridors, and any other area where insulation is subject to accidental damage, and secure in place with tape sealant.
- .4 Liberally apply adhesive to surfaces of concealed rectangular or oval ductwork, and wrap insulation around duct with a top butt joint and tight section to section butt joints. Provide pin and washer insulation fasteners at 300 mm (12") centres on bottom surfaces. Secure and seal joints with 75 mm (3") tape sealant. At each trapeze type duct hanger, provide a 100 mm (4") wide full length piece of rigid mineral fibre board insulation between duct and hanger.
- .5 Accurately cut sections of insulation to fit tightly and completely around exposed and concealed round or oval ductwork. Liberally apply adhesive to surfaces of duct, and wrap insulation around duct with a top butt joint and tight section to section butt joints. Seal joints with tape sealant. At duct hanger locations install insulation between duct and hanger. At each hanger location for concealed ductwork where flexible blanket insulation is used, provide a 100 mm (4") wide full circumference strip of semi-rigid board type duct insulation between duct and hanger.
- .6 Insulation application requirements common to all types of rigid ductwork are as follows:
 - .1 at duct connection flanges, insulate flanges with neatly cut strips of rigid insulation material secured with adhesive to side surfaces of flange with a top strip to cover exposed edges of the side strips, then butt the flat surface duct insulation up tight to flange insulation, or, alternatively, increase insulation thickness to depth of flange and cover top of flanges with tape sealant;

- .2 installation of fastener pins and washers is to be concurrent with duct insulation application;
- .3 cut insulation fastener pins almost flush to washer and cover with neatly cut pieces of tape sealant;
- .4 accurately and neatly cut and fit insulation at duct accessories such as damper operators (with standoff mounting) and pitot tube access covers;
- .5 prior to concealment of insulation by either construction finishes or canvas jacket material, patch vapour barrier damage by means of tape sealant.

3.14 Duct Wrap Requirements – Fire Rated Material

- .1 Provide blanket type fire rated duct wrap system material for following ductwork to produce fire rating indicated:
 - .1 kitchen exhaust ductwork from exhaust hood to masonry shaft – 2 hour rating;
 - .2 stairwell pressurization ductwork from fan to stairwell – 1 hour rating;
 - .3 Trauma Room and Operating Room supply and exhaust ductwork complete – 1 hour rating.
- .2 Install duct wrap material in accordance with ULC design requirements and supplier's/manufacturer's instructions.
- .3 Coordinate installation of duct wrap with installation of ductwork.
- .4 Arrange and pay for duct wrap supplier to examine completed duct wrap system at site. Submit a letter from supplier to certifying duct wrap system has been properly installed.

3.15 Application of Insulating Coatings

- .1 Apply, in accordance with manufacturer's instruction, insulating coatings to following bare metal surfaces:
 - .1 paint bare metal surfaces clear of "cold" piping and/or equipment insulation for a distance of from 300 mm (12") to 600 mm (24") clear of pipe or equipment insulation, with "No Sweat-FX" anti-condensation coating;
 - .2 paint bare metal surfaces associated with mechanical systems with an operating temperature 60°C (140°F) with "ThermaLite" insulating coating.
- .2 Apply coatings with a brush. Remove any splatter or excess coating from adjacent surfaces.

3.16 Insulation Finish Requirements

- .1 Unless otherwise shown and/or specified, jacket exposed mineral fibre insulation, and calcium silicate duct insulation work inside building with canvas secured in place with a full covering coat of lagging adhesive. Accurately cut canvas with scissors or a knife. Do not rip or tear canvas to size. Remove lagging adhesive splatter from adjacent uninsulated surfaces.
- .2 Unless otherwise shown or specified, jacket exposed mineral fibre insulation listed below with canvas jacket secured in place with a full covering coat of coloured lagging adhesive. Accurately cut canvas with scissors or a knife. Do not rip or tear canvas to size. Remove lagging adhesive splatter from adjacent surfaces. Insulated services to receive coloured lagging adhesive are as follows:
 - .1 Chilled Water Piping;
 - .2 Chilled Glycol Piping
 - .3 Condenser Water Piping;

- .4 Domestic Cold Water Piping;
 - .5 Domestic Hot Water Piping;
 - .6 Domestic Hot Water Recirculation Piping;
 - .7 High Temperature Heating Water Piping;
 - .8 High Temperature Heating Glycol Piping;
 - .9 Heating Water Piping;
 - .10 Condensate Drain Piping;
 - .11 Low Pressure Steam Piping;
 - .12 High Pressure Steam Piping;
 - .13 Indoor Ductwork;
 - .14 [].
- .3 Jacket exposed pipe insulation work inside building with white sheet PVC and fitting covers. Install sheet PVC and fitting covers tightly in place with overlapped circumferential and longitudinal joints arranged to shed water. Seal joints to produce a neat water-tight installation. Provide slip-type expansion joints where required by manufacturer's instructions.
- .4 Install rigid aluminum jacket material tightly in place with overlapped circumferential joints positioned to shed water and covered with butt straps supplied with the jacket. Provide aluminum jacket for following insulation:
- .1 Chilled Water Piping;
 - .2 Chilled Glycol Piping
 - .3 Condenser Water Piping;
 - .4 High Temperature Heating Water Piping;
 - .5 High Temperature Heating Glycol Piping;
 - .6 Heating Water Piping;
 - .7 Condensate Drain Piping;
 - .8 Refrigerant Piping;
 - .9 Outdoor Ductwork;
 - .10 [].
- .5 Install adhesive backed flexible aluminum to cleaned and primed metal surfaces which are between - 23°C and 74°C (-10°F and 165°F) in strict accordance with manufacturer's published instructions and details, including shingle type overlap joints to shed water, and use of a hand roller to concentrate pressure on seams. Provide adhesive backed flexible aluminum jacket for following insulation:
- .1 Chilled Water Piping;
 - .2 Chilled Glycol Piping

- .3 Condenser Water Piping;
- .4 High Temperature Heating Water Piping;
- .5 High Temperature Heating Glycol Piping;
- .6 Heating Water Piping;
- .7 Condensate Drain Piping;
- .8 Refrigerant Piping;
- .9 Outdoor Ductwork;
- .6 Install rigid stainless steel jacket material tightly in place with overlapped circumferential joints positioned to shed water and covered with butt straps supplied with jacket. Provide stainless steel jacket for following:
 - .1 Chilled Water Piping;
 - .2 Chilled Glycol Piping
 - .3 Condenser Water Piping;
 - .4 High Temperature Heating Water Piping;
 - .5 High Temperature Heating Glycol Piping;
 - .6 Heating Water Piping;
 - .7 Condensate Drain Piping;
 - .8 Refrigerant Piping;
 - .9 Outdoor Ductwork;
 - .10 [].
- .7 Apply 2 heavy coats of "PITTCOTE 300e" coating with 24 hr between coats to foamed glass insulation exposed above grade.
- .8 Apply 2 coats (with 24 hr between coats) of specified coating to flexible elastomeric insulation outside building.
- .9 Install 3M Ventureclad series [1577CW] on insulated ductwork and ensure supports are installed on the outside of the jacketing. Jacketing shall be finished as [Flat White] Provide necessary insulation and jacketing materials at the time of duct work installation. Do not penetrate jacketing or install jacketing around duct supports. Provide 24GA G90 38 mm x 38 mm steel angle to protect all corners of rectangular ductwork and install between insulation and jacketing. Steel angle shall be continuous on entire duct work run. Provide additional steel angle between jacketing and duct support. Ensure jacketing is continuous with minimum 75 mm (or as required by manufacturer) overlapping on all joints. Provide jacketing on the following duct work:
 - .1 Exposed exterior duct work including outdoor air intake duct work, plenums and casings installed outside;
 - .2 Exposed interior insulated duct work;
 - .3 Interior outdoor air intake duct work, plenums, and casings;

- .4 Single wall plenum casings (intake or exhaust) field insulated;
- .5 Wherever indicated on drawings;
- .10 Install 3M Ventureclad series [1577CW] on exposed piping and ensure supports are installed on the outside of the jacketing. Do not penetrate or install jacketing around pipe supports. Jacketing shall be finished as [Flat White] [Provide galvanized insulation shield between insulation and jacketing at support points. Ensure jacketing is continuous with minimum 75 mm (or as required by manufacturer) overlapping on all joints. Provide jacketing on the following piping:
 - .1 Chilled water;
 - .2 Chilled glycol;
 - .3 High Temperature Heating Water;
 - .4 High Temperature Heating Glycol;
 - .5 Heating Water;
 - .6 Heating glycol;
 - .7 Low pressure steam (<104 kPa);
 - .8 Low pressure steam (<104 kPa) condensate;
 - .9 Domestic cold water piping;
 - .10 Domestic hot water piping;
 - .11 Coil condensate drain piping;
 - .12 Wherever indicated on drawings.

End of Section

1 General

1.01 References

- .1 Domestic water piping and valves are to comply with following codes, regulations, and standards (as applicable):
 - .1 applicable local codes and regulations.
 - .2 CAN/CSA B64, Backflow Preventers and Vacuum Breakers.
 - .3 CAN/CSA B125.1, Plumbing Supply Fittings.
 - .4 CAN/CSA B125.3, Plumbing Fittings.
 - .5 CAN/CSA B137 Series, Thermoplastic Pressure Piping Compendium.
 - .6 NSF/ANSI 14, Plastics Piping System Components and Related Materials.
 - .7 NSF/ANSI 61, Drinking Water System Components – Health Effects.
 - .8 NSF/ANSI 372, Drinking Water System Components – Lead Content.

1.02 Submittals

- .1 Submit shop drawings/product data sheets for all products specified in Part 2 of this Section except for pipe, fittings, and chlorine solution.

1.03 Closeout Submittals

- .1 Submit laboratory water purity test results indicating chlorine residual prior to application for Substantial Performance of the Work.
- .2 Prior Substantial Performance of the Work, submit a minimum of 3 identified keys for key operated hydrants.
- .3 Submit signed test results and inspection and test log cards for each backflow preventer as specified in Part 3 of this Section.
- .4 Submit anchor drawing(s) to detail fabrication and installation of water piping anchors. Drawing(s) are to be prepared and stamped by a professional structural engineer registered and licensed in jurisdiction of the work.
- .5 As specified in Part 3 of this Section, submit a letter from anchor design engineer stating anchor installation has been examined at site and anchors are properly fabricated and installed.

2 Products

2.01 Pipe, Fittings, and Joints

- .1 Soft Copper
 - .1 Type "K" soft copper to ASTM B88, supplied in a continuous coil with no joints if possible, and complete with, if joints are required, compression type flared joint couplings.
- .2 Copper - Solder Joint
 - .1 Type "L" hard drawn seamless copper to ASTM B88, complete with copper solder type fittings to ASME/ANSI B16.18 and soldered joints using The Canada Metal Co. Ltd. "SILVABRITE 100" or

equal lead-free solder for cold water pipe, and 95% tin / 5% Antimony or "SILVABRITE 100" solder for other services.

.3 Copper - Pressure Coupled Joint

- .1 Type "L" hard drawn seamless copper to ASTM B88 with Viega "ProPress with Smart Connect feature" copper fittings with EDPM seals, and pressure type crimped joints made by use of manufacturer recommended tool.

2.02 Shut-Off Valves

.1 Ball Valves

- .1 Class 600, 4140 kPa (600 psi) WOG rated, lead-free, full port ball type valves, each complete with a forged brass body with solder ends, forged brass cap, blowout-proof stem, 304 stainless steel ball, "Teflon" or "PTFE" seat, and a removable lever handle. Valves in insulated piping are to be complete with stem extensions.

.2 Manufacturers:

- .1 Toyo Valve Co.
.2 Milwaukee Valve Co.
.3 Kitz Corporation.
.4 Apollo Valves.
.5 Watts Industries (Canada) Inc.

.2 Butterfly Valves - Flanged Joint

- .1 Non-corrosive, minimum 1200 kPa (175 psi) cold water pressure rated, resilient seated butterfly valves, each complete with a coated cast ductile iron lug type body, stainless steel shaft, bronze disc, and EPDM seat, and each suitable for domestic water bubble-tight dead end service with valve in position and either side of connecting piping removed. Butterfly valves to and including 100 mm (4") dia. are to be equipped with lever handles. Butterfly valves larger than 100 mm (4") dia. are to be equipped with worm gear operators.

.2 Manufacturers:

- .1 DeZurik #632L Series;
.2 Kitz Corporation Code #6122EL/EG;
.3 Toyo Valve Co. #918BESL/EG;
.4 Bray Valve and Controls Canada Series 31;
.5 Apollo Valves #141 Series;
.6 Watts Industries (Canada) Inc. #BF-03.

.3 Butterfly Valves – Grooved End

- .1 Equal to Victaulic Series 608N, for copper pipe rated to 300 psi and be both bi-directional and dead-end service capable to full rated pressure. Seat material shall be EPDM UL Classified in accordance with ANSI/NSF 61 for ambient +86°F and hot +180°F potable water service and ANSI/NSF 372.

- .2 Victaulic Series 461, for stainless steel pipe rated to 300 psi and be both bi-directional and dead-end service capable to full rated pressure. Seat material shall be EPDM UL Classified in accordance with ANSI/NSF 61 for ambient +86°F and hot +180°F potable water service and ANSI/NSF 372.

2.03 Check Valves

- .1 Horizontal
 - .1 Lead-free, Class 125, bronze, 1380 kPa (200 psi) WOG rated horizontal swing type check valves with solder ends.
 - .2 Manufacturers:
 - .1 Toyo Valve Co. Fig. 237A-LF;
 - .2 Milwaukee Valve Co. #UP1509;
 - .3 Kitz Corporation Code 823;
 - .4 Apollo Valves #61LF Series.
- .2 Vertical
 - .1 Equal to Kitz Corp. Code 826, lead-free, 1725 kPa (250 psi) WOG rated vertical lift check valve with soldering ends.

2.04 Drain Valves

- .1 Minimum 2070 kPa (300 psi) water rated, 20 mm ($\frac{3}{4}$ ") dia., straight pattern full port bronze ball valves, each complete with a threaded outlet suitable for coupling connection of 20 mm ($\frac{3}{4}$ ") dia. garden hose, and a cap and chain. Ball material to be 304 stainless steel.
- .2 Manufacturers:
 - .1 Toyo Valve Co.
 - .2 Dahl Brothers Canada Ltd.
 - .3 Kitz Corporation.
 - .4 Apollo Valves.
 - .5 Watts Industries (Canada) Inc.

2.05 Domestic Hot Water Piping Balancing Valves

- .1 Equal to Victaulic Series 76X Low Lead Balancing Valve, lead-free and compliant with NSF-61 and NSF-372 for use in potable water applications, automatic flow limiting balancing valve (+/-5% over rated operating pressure range), complete with removable flow cartridge.
- .2 Equal to Victaulic TA Series 78BL, solder or flange end type as required, ball valve style, lead-free and compliant with NSF-61 and NSF-372 for use in potable water applications, circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter.

2.06 Partition Stops

- .1 Equal to Dahl Brothers Canada Ltd. Fig. E2300 Series or equal lead-free partition stops with EDPM packing, slotted spindles, extension tubes, stainless steel access plates, and 3 identified keys.

2.07 Domestic Hot Water Thermostatic Mixing Valves

- .1 Lawler Manufacturing Co. Inc. 800 Series "High-Low Thermostatic Mixer" factory assembled rough bronze thermostatic mixing valve assembly complete with rotatable union end inlet piping with check stops and stainless steel strainer screens, union outlet piping with thermometer connection, all sized as shown, and following:
 - .1 mixing valve with liquid motor, stainless steel piston and liner, tamper-resistant control adjustment, and 3-way protection against runaway temperatures, thermal shock, and scalding;
 - .2 dial type thermometer conforming to requirement specified in Section 20 05 00 – Common Work Results for Mechanical;
 - .3 ball type outlet shut-off valve conforming to valve requirements specified in this section;
 - .4 surface wall mounting enamelled steel cabinet with hinged door, key lock, and permanent identification;
 - .5 recessed wall mounting type 304 stainless steel cabinet with a #4 finish, hinged door, key lock, and permanent identification.
- .2 Manufacturers:
 - .1 Lawler Manufacturing Co. Inc.;
 - .2 Leonard Valve Co.;
 - .3 Symmons Industries Inc.

2.08 Shock Absorbers

- .1 Type 304 stainless steel piping shock absorbers, each complete with a nesting type bellows and a casing of sufficient displacement volume to dissipate kinetic energy generated in piping system, and each sized to suit connecting water pipe and equipment it is provided for.
- .2 Manufacturers:
 - .1 Watts Industries (Canada) Inc. "SG" Series.
 - .2 Jay R. Smith 5000 Series "HYDROTROL";
 - .3 Zurn #Z1700 "SHOKTROL";
 - .4 Mifab "HAMMERGUARD" WHB Series;

2.09 Water Hammer Arrestors

- .1 Piston type, sealed, all stainless steel construction, pressurized water hammer arrestors suitable for either vertical or horizontal installation, each complete with a pressurized compression chamber, welded nesting-type expansion bellows surrounded by non-toxic mineral oil, and a male treaded nipple connection.
- .2 Manufacturers:
 - .1 Jay R. Smith 5000 Series;
 - .2 Precision Plumbing Products "SS" Series.

- .3 Piston type, sealed, pressurized water hammer arrestors suitable for either horizontal or vertical installation, each complete with a hard drawn copper body, "O"-ring piston seals, an air charge, and an inlet opening equal to diameter of pipe in which arrestor is required.
- .4 Manufacturers:
 - .1 Watts Industries (Canada) Inc. LF05 or LF15M2;
 - .2 Zurn #Z1260;
 - .3 Precision Plumbing Products Inc. SC Series;
 - .4 Mifab MWH Series.

2.10 Piping Expansion Compensators and Guides

- .1 Pressurized type, selected to withstand system pressure and to suit calculated movement from -5°C (23°F) to maximum operating temperature plus 25% safety factor, complete with stainless steel bellows and shroud, copper tube sweat type female ends, anti-torque device, and proper and suitable alignment guides for both sides of each compensator.
- .2 Manufacturers:
 - .1 Senior Flexonics Series HB;
 - .2 Hyspan Precision Products Series 8500.

2.11 Pipe Anchors

- .1 Welded structural black steel anchors of a design, size, and type to securely anchor pipe at point shown. Each anchor is to withstand 150% axial thrust, and is to be designed and detailed by a professional structural engineer registered and licensed in jurisdiction of the work. Submit anchor design and fabrication shop drawings, stamped by design engineer.

2.12 Lavatory Supply Fitting Tempering Valves

- .1 Equal to Powers "HydroGuard" Series 490, model LM490 12 mm (½") dia. or model LM491 20 mm (¾") dia. as required, each CSA B125 certified, forged brass, tamper-proof thermostatic mixing valves, adjustable for water supply between 29°C and 49°C (85°F and 120°F), sized to suit number of lavatories in grouping, and complete with a stop and check valve and a lockable handle.
- .2 Each mixing valve is to be complete with a stainless steel flush wall mounting cabinet with vandal-proof hinged door.

2.13 Air Vents

- .1 Equal to ITT Hoffman Specialty No. 78 cast brass, 1035 kPa (150 psi) rated, 20 mm (¾") straight water main vent valves, each tapped at the top for a 3.2 mm (1/8") safety drain connection.

3 Execution

3.01 Demolition

- .1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 Piping Installation Requirements

- .1 Provide required domestic water piping.

- .2 Piping, unless otherwise specified, is as follows:
 - .1 for pipe inside building and aboveground in sizes to 100 mm (4") dia. – Type "L" hard copper with solder joints.
 - .1 Option: Type "L" hard copper with pressure coupled mechanical joints.
 - .2 Option: Type "L" hard copper with grooved end mechanical joints.
 - .1 Grooved pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing. All couplings will meet Victaulic standards for visual inspection sizes 2" to 8". The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Install in accordance with manufacturer's latest recommendations. A Victaulic factory trained representative shall periodically visit the job site and review the installation for best practices. The installing Contractor shall correct any identified deficiencies. Victaulic product that has been examined and has not met the visual inspection criteria for proper installation must be corrected and re-examined by Victaulic prior to the completion of the project.
- .3 Lay pipes true to line and grade with bells upgrade. Fit sections together so that, when complete, pipe has a smooth and uniform invert. Keep pipe thoroughly clean so jointed compound will adhere. Inspect pipe for defects before being lowered into trench.
- .4 Slope piping so it can be completely drained.
- .5 Provide cast brass dielectric type adapters/unions at connections between ferrous and copper pipe or equipment.

3.03 Installation of Shut-Off and Check Valves

- .1 Refer to Part 3 of Section 20 05 00 – Common Work Results for Mechanical.
- .2 For shut off valves installed on solder joint copper piping up to and including 75 mm (3") diameter, provide ball type valves, and for flanged joints copper or stainless steel piping larger than 75 mm (3") diameter provide butterfly type valves.

3.04 Installation of Drain Valves

- .1 Provide a drain valve at the bottom of domestic water piping risers, at other piping low points, and wherever else shown.
- .2 Locate drain valves so they are easily accessible.

3.05 Installation of Domestic Hot Water Piping Balancing Valves

- .1 Provide balancing valves in domestic hot water recirculation piping where shown or required.
 - .1 for pipe 25 mm (3/4") dia. and less ground – equal to Victaulic Series 76X
 - .2 for pipe greater than 25 mm (3/4") dia. – equal to Victaulic TA Series 78BL
- .2 Locate each valve so it is easily accessible.

3.06 Installation of Partition Stops

- .1 Provide partition stops in domestic water piping to each group of suite washroom plumbing fixtures. Locate partition stops in piping near floor level in inconspicuous but accessible locations. Confirm exact locations prior to roughing-in.

3.07 Installation of Domestic Hot Water Thermostatic Mixing Valves

- .1 Provide a domestic hot water thermostatic mixing valve assembly and wall mount.
- .2 Adjust each valve to design requirements and check and test operation. Set maximum temperature limit stops.
- .3 Identify each valve and its water temperature delivery setting with an engraved nameplate.

3.08 Installation of Shock Absorbers

- .1 Provide accessible shock absorbers in make-up water piping to equipment.
- .2 Ensure size of each shock absorber is properly selected to suit size of water pipe and equipment pipe is connected to.
- .3 Install down stream of backflow preventor.

3.09 Installation of Water Hammer Arrestors

- .1 Provide accessible water hammer arrestors in domestic water piping in locations as follows:
 - .1 in headers at groups of plumbing fixtures;
 - .2 at top of risers;
 - .3 at ends of long horizontal runs of piping;
 - .4 in piping connecting solenoid valves or equipment with integral solenoid valves;
 - .5 wherever else shown or required by Code.
- .2 Install each unit in a piping tee either horizontally or vertically in the path of potential water shock in accordance with manufacturer's instructions and details.

3.10 Installation of Expansion Compensators, Guides, and Anchors

- .1 Provide expansion compensators in domestic water piping.
- .2 Ensure pipe ends are properly aligned. Provide alignment guides on each side of expansion compensators, properly secured to building structure.
- .3 Provide anchors to secure domestic water piping to structure. Locate anchors generally where shown but with exact locations to suit piping as installed and requirements of reviewed anchor shop drawings.
- .4 When installation of anchors is complete, arrange, and pay for anchor design engineer to visit site to review anchor installation. Submit a letter from design engineer confirming each anchor is properly installed.

3.11 Installation of Lavatory Supply Fitting Tempering Valves

- .1 Provide thermostatic water tempering valves for hot water supply to public washroom lavatory supply fittings. Conceal valves and piping.
- .2 Provide a flush wall mount panel for each valve. Confirm exact location prior to roughing-in.
- .3 Install in accordance with manufacturer's instructions and set mixing valves to deliver 32°C (90°F) tempered water.

3.12 Installation of Air Vents

- .1 Provide accessible air vents in domestic water piping to prevent air binding.
- .2 Extend copper indirect drain piping from top drain connection of each vent to nearest suitable drain.
- .3 Locate exact vent locations on as-built record drawings.

3.13 Flushing and Disinfecting Piping

- .1 Flush and disinfect all new and/or reworked domestic water piping after leakage testing is complete.
- .2 Isolate new piping from existing piping prior to flushing and disinfecting procedures.
- .3 Flush piping until all foreign materials have been removed and flushed water is clear. Provide connections and pumps as required. Open and close valves, faucets, hose outlets, and service connections to ensure thorough flushing.
- .4 When flushing is complete, disinfect the piping with a solution of chlorine in accordance with AWWA C601.
- .5 When disinfecting is complete, submit water samples to a certified laboratory for purity testing and, when testing indicates pure water in accordance with governing standards, submit a copy of test results and fill the systems.

End of Section

1 General

1.01 Submittals

- .1 Submit shop drawings/product data sheets for all products specified in this Section except pipe and fittings.

1.02 Closeout Submittals

- .1 Submit a copy of plumbing inspection certificate prior to application for Substantial Performance of the Work.
- .2 Submit letters from product manufacturers/suppliers to certify correct installation of products as specified in Part 3 of this section.
- .3 Record Drawings: Indicate inverts of new below grade sanitary and storm piping on as-builts drawings.

2 Products

2.01 Pipe, Fittings, and Joints

- .1 Copper - Solder Joint
 - .1 Type DWV hard temper to ASTM B306, with forged copper solder type drainage fittings and 50% lead - 50% tin solder joints.
- .2 Cast Iron
 - .1 Class 4000 cast iron pipe, fittings, and mechanical coupling joints to CAN/CSA B70.

2.02 Cleanouts

- .1 Horizontal Piping
 - .1 TY pipe fitting with an extra heavy brass plug screwed into the fitting.
- .2 Vertical Piping
 - .1 Bronze or copper cleanout tees in copper piping, each complete with a bronze ferrule, and, for cast iron piping, "BARRETT" type cast iron cleanout tees, each gas and water-tight and complete with a bolted cover.
- .3 Urinal(s)
 - .1 Wall access cleanout assemblies, each complete with a tapered plug, threaded brass insert, urethane rubber seal, and polished stainless steel access cover with vandal-proof stainless steel securing screw.
 - .2 Manufacturers:
 - .1 Watts Industries (Canada) Ltd. #CO-590-RD.
 - .2 Jay R. Smith #SQ4-1819;
 - .3 Zurn #ZSS-1666-1;
 - .4 Mifab #C1440-RD;

2.03 Floor Drains, Funnel Floor Drains, and Hub Drains

- .1 Unless otherwise specified or indicated, floor drains are to be vandal-proof drains in accordance with drawing symbol list, each complete with a cast iron body and a trap seal primer connection. Cast iron components are to be factory finished with latex based paint coating.
- .2 Floor drains in areas with a tile or sheet vinyl floor finish are to be as above but with a square grate in lieu of a round grate.
- .3 Manufacturers:
 - .1 Watts Industries (Canada) Ltd.;
 - .2 Jay R. Smith Manufacturing Co.;
 - .3 Zurn Industries Ltd.;
 - .4 Mifab Inc.

3 Execution

3.01 Demolition

- .1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 Drain and Vent Piping Installation Requirements

- .1 Provide required drainage and vent piping. Pipe, unless otherwise specified, as follows:
 - .1 for pipe inside building and aboveground in sizes less than or equal to 65 mm (2-½") dia. – type DWV copper;
 - .2 for pipe inside building and aboveground in sizes greater than or equal to 75 mm (3") dia. – Class 4000 cast iron;
- .2 Unless otherwise specified, slope horizontal drainage piping aboveground in sizes to and including 75 mm (3") dia. 25 mm (1") in 1.2 m (4'), and pipe 100 mm (4") dia. and larger 25 mm (1") in 2.4 m (8').
- .3 Install and slope underground drainage piping to inverts or slopes indicated on drawings to facilitate straight and true gradients between points shown. Verify available slopes before installing pipes.
- .4 Unless otherwise specified, slope horizontal branches of vent piping down to fixture or pipe to which they connect with a minimum pitch of 25 mm (1") in 1.2 m (4').
- .5 Extend vent stacks up through roof generally where shown but with exact locations to suit site conditions and in any case a minimum of 3 m (10') from fresh air intakes. Terminate vent stacks a minimum of 330 mm (13") above roof (including roof parapets) in vent stack covers. Where not shown on drawings, route vent piping from source to building exterior as required in order to satisfy local governing codes and authority. Coordinate vent routing with other building services and ensure there is no architectural impact.
- .6 Provide cast brass dielectric unions at connections between copper pipe and ferrous pipe or equipment.

3.03 Installation of Shut-Off and Check Valves

- .1 Provide a shut-off valve and a check valve in discharge piping of each drainage pump.
- .2 Locate valves so they are easily accessible without the use of ladders or other such devices.

3.04 Installation of Floor Drains, Funnel Floor Drains and Hub Drains

- .1 Provide floor drains, funnel floor drains and hub drains.
- .2 Coordinate location of floor drains, funnel floor drains and hub drains with equipment provided by Mechanical Division and Owner's supplied equipment. Install in accordance with manufacturer's instructions.
- .3 Equip each drain with a trap.
- .4 In equipment rooms and similar areas, exactly locate floor drains to suit location of mechanical equipment and equipment indirect drainage piping. In washrooms, exactly locate floor drains to avoid interference with toilet partitions.
- .5 Confirm exact location of drains prior to roughing in. Where floor drains occur in washrooms coordinate locations with toilet partition installations.
- .6 Temporarily plug and cover floor drains during construction procedures. Remove plugs and covers during final clean-up work and when requested, demonstrate free and clear operation of each drain. Replace any damaged grates, and refinish any areas of the drain where cast iron finish has been damaged or removed, including rusted areas.

End of Section

1 General

1.01 Section Includes

- .1 Plumbing fixtures and related components.

1.02 Submittals

- .1 Submit product data sheets (fixture cuts) for all plumbing fixtures and fittings, including accessories.
- .2 Product Data: Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports and indicate materials and finishes, dimensions, construction details, and flow-control rates for each type of fixture indicated.
- .3 Wiring Diagrams: Power, signal, and control wiring.
- .4 Submit fixture manufacturer's standard colour charts for all fixtures where colours are available but a particular colour is not specified.
- .5 [Submit proof of WaterSense labelling for all applicable plumbing fixtures in accordance with Section 01 35 66.]

1.03 Closeout Submittals

- .1 Operation and maintenance data.

2 Products

2.01 General Re: Plumbing Fixtures and Fittings

- .1 Fixtures and fittings, where applicable, are to be in accordance with requirements of CAN/CSA-B45 Series, General Requirements for Plumbing Fixtures, including supplements, ASME A112.1.18.1/CSA B125.1, Plumbing Supply Fittings, and CAN/CSA-B125.3, Plumbing Fittings.
- .2 Barrier-free fixtures and fittings are to be in accordance with governing Code requirements.
- .3 Unless otherwise specified, vitreous china, porcelain enamelled, and acrylic finished fixtures are to be white.
- .4 Unless otherwise specified, toilet seats are to be constructed with an anti-microbial compound to inhibit growth of bacteria on seat surface.
- .5 Unless otherwise specified, fittings and piping exposed to view are to be brass, chrome plated and polished.
- .6 Fittings located in areas other than private washrooms are to be vandal-resistant.
- .7 Fixture carriers are to be suitable in all respects for the fixture they support and construction in which they are located.
- .8 Floor flanges for floor mounted water closets are to be cast iron or brass, secured to floor to prevent movement and complete with a wax seal and brass or stainless steel bolts, nuts, and washers. Plastic floor flanges will not be acceptable.
- .9 Proper seal to mate with fixture carrier flange and produce a water-tight installation.
- .10 Exposed traps for fixtures not equipped with integral traps, such as lavatories, are to be adjustable chrome plated cast brass "P" traps with cleanouts, minimum #17 gauge chrome plated tubular extensions, and chrome plated escutcheons, all to suit fixture type and drain connection.

- .11 Concealed traps for fixtures not equipped with integral traps, such as counter sinks, are to adjustable cast brass with cleanout plugs, all to suit fixture type and drain connection.
- .12 Exposed supplies for fixtures which do not have supply trim/fittings with integral stops, i.e. lavatories, are to be solid chrome plated brass angle vales with screwdriver stops for public areas, wheel handle stops for private areas, flexible stainless steel risers, and stainless steel or chrome plated steel escutcheons, all arranged and sized to suit fixture.
- .13 Water piping as specified, complete with ball type shut-off valves as specified with water piping or Dahl Bros. Canada Ltd. ¼ turn Mini Ball Valves.
- .14 INTEGRAL COUNTERTOP SINKS:
 - (a) ALL COUNTERTOP SINKS SUPPLIED AND INSTALLED AS PART OF MILLWORK BY ARCHITECTURAL DIVISION.
 - (b) DIVISION 15000 CONTRACTOR TO COORDINATE FIXTURE LOCATIONS WITH ARCHITECTURAL DIVISION. ARCHITECTURAL DIVISION TO PROVIDE DRILLING FOR FIXTURES WHERE REQUIRED.
 - (c) COORDINATE MECHANICAL WORK WITH SINK MANUFACTURER. PROVIDE ALL ACCESSORIES REQUIRED TO MAKE A FULLY FUNCTIONING FIXTURE AS PER REQUIREMENTS.

2.02 Plumbing Fixtures and Fittings

- .1 Provide all necessary accessories and adapters for a fully functioning plumbing fixture as required. Coordinate with suppliers accordingly with site conditions.
- .2 Plumbing fixtures and fittings are to be in accordance with following:
 - .1 'IPAC' Sink Wall Hung Sink
 - .1 American Standard ICU Basin #9118.111.020, vitreous china with EverClean antimicrobial surface which inhibits the growth of stain and odor causing bacteria mold and mildew, sealed overflow , 65 mm (2-9/16") dia. Faucet perch, back of sink 93 mm (3-11/16") higher than faucet perch, offset grid drain included, integrated mounting brackets, p-trap with Saniguard coating provided.
 - .2 American Standard Selectronic #605B.193.002 Electronic 'No-Touch' - Plug-in faucet, chrome plated brass, 5.7 LPM (1.5 GPM) pressure compensating, laminar flow device in base of spout, 152 mm (6") rigid/swing gooseneck spout, infrared sensor, below deck solenoid valve with serviceable strainer filter, module control assembly with splash-proof junction box and mounting kit, below deck.
 - .3 American Standard plug in AC power supply #M950520-0070A, hard wired Transformer, 80-250 VAC/ 6 VDC.
 - .4 American Standard #605XTMV1070, point of use thermostatic water mixing valve, bronze body, temperature adjustment by using a hex wrench, 10 mm (3/8") inlets compression fittings with stainless steel 508 mm (20") flexible hoses and 13 mm (1/2") MNPT outlet connection, built-in checks, housed in 127 mm x 86 mm x 81 mm (5" x 3-3/8" x 3-3/16") enclosure. Set valve temperature at 46°C (114.8°F). Provide tee, adaptors, and flex. copper tubing to suit installation.
 - .5 McGuire #LFH165LKN3, chrome plated polished brass faucet supplies, heavy duty angle stops, 10 mm (3/8") I.P.S. Inlet x 76 mm (3") long rigid horizontal nipples, V.P. loose keys, escutcheons, and flexible braided stainless riser.
 - .6 Watts #CA-311 Carrier, mounted on concrete floor, universal steel hangar support plates with integral mounting brackets, heavy gauge epoxy coated steel offset uprights with welded feet, plated hardware.

- .2 'L-1' -Patient Washroom Sink – Counter integrated - Plug – In Electronic 'No-Touch' Faucet:
 - .1 Basin- by others.
 - .2 Whitehall ligature resistant sensor activated faucet 4" centerset- WH3375-SO-LKF, spray nozzle with 1.5 gpm laminar flow control, non aerated, c/w mixing valve, Electronic 'No Touch' Faucet, C.P., double hole 4" C.C., control insert in spout inlet, dual supply for hot and cold water service, concealed internal temperature control mixer, multiple field adjustable modes and ranges.
 - .3 Transformer Box Mount, 120/12 VAC./ 9VDC as required.
 - .4 McGuire #8902 'P' Trap, C.P., polished, cast brass adjustable body, 32 mm (1-¼") inlet, 38 mm (1-½") outlet with cleanout plug, seamless brass wall bend and escutcheon. Coordinate drain outlet of sink with architectural basin.
 - .5 McGuire #H165LKN5 Supplies, C.P., polished brass, rigid horizontal nipple 9.5 mm (3/8") x 127 mm (5") long I.P.S., heavy all brass angle stops, with V.P. loose key, escutcheons and flexible braided stainless risers.
 - .6 Coordinate with countertop supplier for required penetrations and mounting. Coordinate with architectural.
- .3 'S-1' -Kitchen Sink – Counter integrated - Manual:
 - .1 Basin- by others.
 - .2 Moen 7561 series single handle gooseneck faucet. Reflex pull down system, duralock connection, 68" braided hoses, flexible lines with 3/8" compression fittings, high arc spout, temperature controlled by 100deg arch, right side mounting, 1.0gpm csa-1251 ASME A112.18.1, ADA compliant. Provide mixing valve as required.
 - .3 McGuire #8902 'P' Trap, C.P., polished, cast brass adjustable body, 32 mm (1-¼") inlet, 38 mm (1-½") outlet with cleanout plug, seamless brass wall bend and escutcheon. Coordinate drain outlet of sink with architectural basin.
 - .4 McGuire #H165LKN5 Supplies, C.P., polished brass, rigid horizontal nipple 9.5 mm (3/8") x 127 mm (5") long I.P.S., heavy all brass angle stops, with V.P. loose key, escutcheons and flexible braided stainless risers.
 - .5 Coordinate with countertop supplier for required penetrations and mounting. Coordinate with architectural.
- .4 'S-2' -Nurses Sink – Counter integrated - Manual:
 - .1 Basin- by others.
 - .2 Zurn Z812B4-XL-FC1.5-140 Polished chrome-plated cast brass faucet body with integrated shanks, quarter turn ceramic discs cartridges and a 5-3/8" rigid spout. Unit is finished with a 1.5GPM laminar flow spout, mounting hardware, vandal -resistant. 4" center set with 4" handles.
 - .3 McGuire #8902 'P' Trap, C.P., polished, cast brass adjustable body, 32 mm (1-¼") inlet, 38 mm (1-½") outlet with cleanout plug, seamless brass wall bend and escutcheon. Coordinate drain outlet of sink with architectural basin.
 - .4 McGuire #H165LKN5 Supplies, C.P., polished brass, rigid horizontal nipple 9.5 mm (3/8") x 127 mm (5") long I.P.S., heavy all brass angle stops, with V.P. loose key, escutcheons and flexible braided stainless risers. Provide equivalent ½" where required.

- .5 Coordinate with countertop supplier for required penetrations and mounting. Coordinate with architectural.
- .5 'WC-1' Toilet - Floor Mounted - Vitreous China - Manual Concealed Flush Valve - Barrier-Free Design / Right Height:
 - .1 Zurn Z5665-BWL1-AM (16-3/4") HIGH' Toilet, floor mounted, vitreous China, bottom outlet toilet with siphon jet flushing action and elongated from rom with 1-1/2" spud. ADA compliant
 - .2 Zurn-Z600AV -HET– exposed quiet diaphragm-type chrome plated, flushometer valve with polished exterior c/w Zurn aqua vantage TPE, chloramine resistant, dual seal diaphragm with a clog resistant. ADA compliant.
 - .3 Centoco #820STS-01 Toilet Seat, elongated heavy duty anti-microbial solid plastic open front with cover, reinforced stainless steel check hinge, posts, washers and nuts.
 - .4 Provide floor flange, flange bolts and gasket.

2.03 Manufacturers

- .1 Subject to compliance with requirements, manufacturers that may be incorporated into the Work include, but are not limited to, following:
 - .1 Plumbing Brass:
 - .1 Sloan;
 - .2 Acorn Engineering;
 - .3 American Standard;
 - .4 Delta Commercial;
 - .5 Chicago Faucet.
 - .6 Zurn Industries.
 - .2 Drain Fittings, Angle Supplies, and Traps:
 - .1 McGuire;
 - .2 American Standard;
 - .3 Delta Commercial;
 - .4 Zurn Industries.
 - .3 Fixture Carriers:
 - .1 Watts Industries;
 - .4 Surgeon Scrub Sinks:
 - .1 Kindred Commercial;
 - .5 Thermostatic Mixing Valves:

- .1 Delta Commercial;
- .6 Electronic “No Touch” Faucets:
 - .1 Delta Commercial;
 - .2 Zurn Industries.

2.04 Caulking

- .1 General Electric Series SCS-1200 Silicone Construction Sealant or Dow Corning 780 silicone rubber sealant with primers as recommended by sealant manufacturer. Caulking colour(s) for coloured fixtures other than white, if any, will be selected by Consultant from sealant manufacturer’s standard colour range.
- .2 Caulking in Mental Health areas shall be pick proof.

3 Execution

3.01 Demolition

- .1 Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 Installation of Plumbing Fixtures and Fittings

- .1 Provide required plumbing fixtures and fittings.
- .2 Coordinate with existing site conditions prior to purchasing plumbing fixtures to ensure compatibility of installation
- .3 Where new fixtures and fittings are to be connected to existing piping, include for required piping revisions.
- .4 Connect plumbing fixtures and fittings with piping sized in accordance with drawing schedule. Refer to manufacturer’s published connection (rough-in) requirements. Where manufacturer requires piping connection larger than shown below, provide piping accordingly:

Fixture and/or Fitting	Drain Size mm (in)	Vent Size mm (in)	DHW size mm (in)	DCW size mm (in)	Temp Water Size mm (in)
Water Closets Flush Valve Type	100 (4)	38 (1-½)	-	25 (1)	-
Urinals	75 (3)	38 (1-½)	-	25 (1)	-
Lavatories	38 (1-½)	32 (1-¼)	12 (½)	12 (½)	-
Lavatories (Electronic Faucet)	38 (1-½)	32 (1-¼)	12 (½)	12 (½)	12 (½)
Hand Hygiene Sinks	38 (1-½)	32 (1-¼)	12 (½)	12 (½)	
Counter Sinks	38 (1-½)	32 (1-¼)	12 (½)	12 (½)	-

- .5 Confirm exact location of plumbing fixtures and trim prior to roughing-in. Refer to architectural plan and elevation drawings.

- .6 When installation is complete, check and test operation of each fixture and fitting. Adjust or repair as required.
- .7 For barrier-free fixtures, comply with mounting height and other requirements of governing Code(s).
- .8 For barrier-free water closets utilizing manual flush controls, controls to be installed so that it is operable from the transfer side of the fixture.
- .9 Supply templates for counter mounted fixtures and trim and hand to trades who will cut the counter. Ensure openings in counter are properly located.
- .10 Locate control panels for electronic faucets under lavatories and recessed into wall. Coordinate panel installations with electrical trade who will provide 115 volt power wiring to panels. Install flexible conduit (supplied with box) and extend cord from faucet through the flexible conduit to control box. Connect hot and cold water piping to mixing valve in each box, and tempered water piping from each mixing valve to faucet. Set mixing valve maximum temperature limit stops to 43°C (110°F) after domestic water systems (hot and cold) are complete. Ensure each programmable controller is properly programmed and water off after deactivation is set for 3 seconds.
- .11 For electronic flush valves, locate transformer in ceiling space above electronic units to be served. Coordinate locations with electrical trade who will provide 120 volt line supply to transformers. Provide low voltage wiring from transformers to each electronic flush valve terminal point. Electrical line supply and low voltage wiring is to be concealed and access to transformer must be provided for servicing.
- .12 Protect baths from damage during construction and finishing work. Unless otherwise specified, pack concealed voids under baths with batt type glass fibre insulation as baths are installed.
- .13 Protect shower bases from damage during construction and finishing work.
- .14 Confirm exact mixing valve and shower head locations prior to roughing-in.
- .15 Install refrigerated drinking fountains in accordance with manufacturer's instructions. Plug into a wall receptacle provided as part of electrical work. Coordinate receptacle installation with electrical trade on site.
- .16 For emergency showers, install so bottom of shower head is approximately 2 m (82") above floor, and approximately 400 mm (16") out from wall. Wall mount mixing valve approximately 1.5 m (5') above floor and adjacent shower head. Set valve temperature limit stop to 35°C (95°F). Ensure valve is open, and exposed piping is chrome plated or stainless steel.
- .17 Install eye wash fixtures in accordance with manufacturer's instructions. Ensure exposed piping is painted.
- .18 Wall mount mixing valves for emergency fixtures approximately 1.5 m (5') above floor and secure in place. Check and confirm valve operation and temperature of tempered water supply. Provide cabinets where shown. Identify each cabinet and hand 3 identified cabinet keys to Consultant prior to Substantial Performance of the Work.
- .19 Set mop service basins on floor over drain piping and connect to roughed-in service. Install wall supply trim and any accessories specified.

3.03 Caulking at Plumbing Fixtures and Fittings

- .1 Caulk around plumbing fixtures and fittings where they contact walls, floors, and any other building surface.
- .2 Clean areas/surfaces to be caulked and prime in accordance with sealant manufacturer's instructions. Where damage to a building surface may occur, mask surface to prevent damage and ensure a clean exact edge to caulking bead.

- .3 Apply caulking using a gun with proper size and shape of nozzle and force sealant into joints to ensure good surface contact and a smooth and even finished bead of sealant.
- .4 If joints have been masked sealant may be tooled in a continuous stroke to obtain complete void filling. Remove masking tape immediately after tooling and before sealant begins to skin.

End of Section

1 General

1.01 Submittals

- .1 Submit shop drawings/product data sheets for all products specified in this section except pipe and fittings. Appropriate CRN assigned to each component is to be clearly indicated on component shop drawing/product data sheet.
- .2 Submit, prior to work commencing on site, a detailed account of your proposed pipe joint brazing procedures including pre and post nitrogen purging.

1.02 Closeout Submittals

- .1 Prior to Substantial Performance of the Work, submit 5 identified replacement filters for each type of filter for equipment that requires a replaceable filter.
- .2 Submit written certification by equipment manufacturers/suppliers confirming that equipment is properly installed, has been tested, and is in proper operating condition, all as specified in Part 3 of this section.
- .3 Submit manufacturer's start-up reports as specified in Part 3 of this section.
- .4 For each zone valve box assembly and combination zone valve box and alarm, submit for review a typed list of rooms and areas with medical gas terminal units controlled by the zone valves.
- .5 Record drawings: indicate as-constructed location of all piping governed by this Section.
- .6 Training attendance records.

1.03 Maintenance Material Submittals

- .1 Submit 3 identified keys for cabinet/panel lockable doors prior to Substantial Performance of the Work.

1.04 Design Pressure and Temperature Requirements

- .1 System design pressures are as follows:
 - .1 oxygen, carbon dioxide, nitrous oxide, medical air:
 - .1 maximum system pressure, 380 kPa (55 psi);
 - .2 maximum pressure at terminal unit, 345 kPa (50 psi).
 - .2 nitrogen:
 - .1 maximum system pressure, 1400 kPa (200 psi).
 - .3 vacuum:
 - .1 maximum system vacuum, 54 kPa (15.94" Hg);
 - .2 maximum vacuum at terminal unit, 68 kPa (20.08" Hg).
- .2 Design temperature for all services will be ambient temperature.

1.05 Quality Assurance

- .1 Products and work must comply in all respects with requirements of CAN/CSA Z7396.1 and related Standards, and, where applicable, requirements of local governing authorities.

- .2 Contractor is responsible for registration, inspection, and/or approval for medical gas system work, as required, with local regulatory authority.
- .3 Medical gas systems work must be performed by journeyman plumber / pipefitter / steamfitter tradesmen completely familiar with requirements of CAN/CSA Z7396.1, and who are qualified and certified (with jurisdictional authority issued Certificate) for silver brazing with nitrogen backing without using flux in accordance with Clause 4.5 in Part 1 of CSA B51. Jurisdictional authority is the authority designated by the province of the work to perform oversight functions cited in Clause 4.5 in Part 1 of CSA B51.
- .4 Consultant reserves the right to ask for and review the Certificate of any tradesman, and only tradesmen with valid Certificates may work on the systems.

2 Products

2.01 General Re: Piping System Materials and Components

- .1 Pipe, fittings, and piping system components are to be factory washed and degreased. Pipe is to be capped. Fittings and components are to be packaged.
- .2 Piping system components to be site connected with piping are to be complete with factory installed, washed, degreased, and capped Type "K" hard copper piping stubs with joints silver brazed while the component and piping is full of nitrogen.

2.02 Manufacturers

- .1 Unless otherwise specified, acceptable medical gas system product manufacturers / suppliers are:
 - .1 Class 1 Inc.;
 - .2 Amico Corp.;

2.03 Pipe, Fittings and Joints

- .1 Aboveground
 - .1 Type "L" or type "K" (as specified in Part 3) hard temper copper tubing to ASTM B819, "Standard Specification for Seamless Copper Tube for Medical Gas Systems", complete with wrought copper, brass or bronze "Silver Braze" fittings and silver brazed joints made with Silvaloy 15 or equal brazing alloy conforming to ANSI/AWS Standard A5.8 Classification BcuP-5.
- .2 Underground
 - .1 Type "K" soft temper copper tubing to ASTM B88, factory cleaned and capped as for hard temper copper tubing, and supplied in a continuous length with no joints.

2.04 Shut-Off Valves

- .1 Full flow bronze body ball type valves, 4140 kPa (600 psi) rated, ¼ turn on-off from a fully closed to a fully open position, in-line serviceable, blow-out proof, factory pressure tested, and complete with a chrome plated brass or stainless steel ball depending on valve size, a double Teflon seal, a Teflon seat, O-ring packing, lever handle capable of locking in open or closed position, and colour coded permanent identification labels.

2.05 Zone Valve Boxes

- .1 Wall mounting enamelled steel zone valve boxes with anchor brackets, sized to suit number of valves in the box, designed for vertical ganging type installation and complete with shut-off valves as specified above (less the handle lock feature), securely mounted to the back of the box, and complete with:

- .1 stainless steel or matte finish extruded aluminium trim;
- .2 re-installable front panel or window with centre mounted pull ring and silk-screen bilingual wording to read "CAUTION: MEDICAL GAS CONTROL VALVE - CLOSE ONLY IN EMERGENCY";
- .3 gauge connection brazed onto the pipe stub at the downstream (patient) side of each valve assembly, with a 40 mm (1-½") diameter pressure (or vacuum) gauge conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical, and with ranges as follows:
 - .1 vacuum – 0 to 760 kPa (0 to 30" Hg);
 - .2 all other services – 0 to 700 kPa (0 to 100 psi).

2.06 Local Emergency Alarm Panel/Zone Valve Box Assemblies

- .1 Flush wall mounting combination zone valve box and local emergency alarm panels and zone valve box assemblies incorporating a zone valve box and an area alarm panel in one enclosure. Each assembly is to be complete with:
 - .1 enamelled steel box sized to suit the components installed, complete with adjustable steel mounting brackets to accommodate various wall thicknesses, an anodized aluminium frame, and pull-out removable window with silk-screen bilingual wording to read "CAUTION: MEDICAL GAS CONTROL VALVES - CLOSE VALVES ONLY IN EMERGENCY";
 - .2 ball type shut-off valves as specified in this section but less the handle lock feature, sized as shown, complete with tube extensions, and secured to the back of the box;
 - .3 gauge connection brazed onto the pipe stub at the downstream (patient) side of each valve assembly, with a 40 mm (1-½") diameter pressure (or vacuum) gauge conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical, and with ranges as follows:
 - .1 vacuum – 0 to 100 kPa (0 to 28.5" Hg);
 - .2 all other services – 0 to 700 kPa (0 to 100 psi).
 - .4 modular, microprocessor based, gas specific alarm units with large LED universal (psi, kPa, "Hg, Bar) pressure/vacuum displays, LED trend display, high and low alarms with dry contacts for connection to a master alarm panel, 90 dBA audible alarm with silence button and adjustable alarm reminder, alarm history recall, identified sensors with DISS connection located in the back box, and required remote monitoring hardware.

2.07 Scavenging Terminal Units

- .1 AGSS evacuation terminal units for low pressure gas scavenging, single, modular, recessed wall or ceiling mounted, surface mounted, or ceiling column mounted as shown, each complete with a permanently colour coded faceplate sealed behind a Lexan faceplate, a 20 mm (¾") diameter Type "L" inlet supply tube, and a 20 mm (¾") diameter and 30 mm (1-3/16") diameter taper fitting for connection to standard anaesthesia gas disposal tubing.

2.08 Nitrogen Control Panels

- .1 Flush wall mounting panel, factory tested and cleaned for nitrogen service, packaged for delivery, and complete with:
 - .1 #14 gauge extruded aluminium back box complete with plaster mounting flange, and inlet and outlet 9.5 mm (3/8") diameter Type "K" copper tubing with brass fittings;

- .2 2760 kPa (400 psi) rated flexible cross-over tubing complete with quick-connect fittings;
- .3 stainless steel front panel with black silk-screened labelling, and panel mounted components as follows:
 - .1 1750 kPa (250 psi) high flow self-relieving, adjustable, lockable pressure regulator;
 - .2 ¼ turn brass ball type inlet supply valve;
 - .3 50 mm (2") diameter 0 – 2100 kPa (0 to 300 psi) inlet and outlet pressure gauges conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical;
 - .4 cartridge style DISS nitrogen outlet.

2.09 Pressure and Vacuum Switches for Alarm Signals

- .1 Factory assembled and set (to suit site requirements) switches, each labelled for the intended service, each suitable for pipeline pressure, medical gas or vacuum involved, and alarm function, and each complete with a NEMA 4 housing, tamper-proof external adjustment, a gas specific DISS inlet, a 50 mm (2") diameter monitoring gauge in accordance with requirements specified in Section 20 05 00- Common Work Results for Mechanical, and instructions for field adjustment.

2.10 Local Emergency Alarm Panels

- .1 Modular, field expandable, 115 volt, solid-state, microprocessor controlled, electronic, flush wall mounting audio-visual alarm panels designed for constant monitoring of piping system pressure or vacuum as applicable, and initiation of an alarm function on any open circuit only. Each panel is to be complete with:
 - .1 minimum #18 gauge steel back box sized to suit gas service modules required and equipped with adjustable mounting brackets to accommodate different wall thicknesses, a 115 volt power connection terminal block, fused 24 volt secondary transformer, a motherboard for plug-in connection of modules, and matte finish extruded aluminium or equal trim;
 - .2 power module with green power on LED, audible alarm with silencing pushbutton, adjustable (2 to 60 minutes) alarm repeater;
 - .3 gas specific colour coded sensors and displays with an error message for incorrect connection, each equipped with a microprocessor, LED digital readout in switch selected psi or kPa to facilitate a constant indication of each service being measured, a bar graph trend indicator to indicate green "NORMAL", yellow "CAUTION", and red "HIGH" or "LOW" alarm condition;
 - .4 red alarm light which flashes and an audible alarm which sounds when an alarm condition occurs, and an "ALARM MUTE" pushbutton to silence audible alarm, however, panel will remain in alarm state until problem is rectified;
 - .5 "TEST" pushbutton to test all panel functions;
 - .6 dry contacts for remote monitoring of high and low alarms;
 - .7 gas specific DISS connection (DISS body with check valve and DISS nut and gland) for each sensor module, supplied loose for field installation;
 - .8 building automation system serial communications interface panel.

2.11 Master Alarm Panel

- .1 Modular, field expandable, 115 volt, solid state, electronic, microprocessor-based flush wall mounting audio-visual alarm panel designed for constant monitoring of piping system pressure or vacuum as applicable, and initiation of an alarm function on any open circuit only. Panel is to be complete with:
 - .1 minimum #18 gauge steel back box sized to suit gas service modules required and equipped with adjustable mounting brackets to accommodate different wall thicknesses, a 115 volt power connection terminal block, fused 24 volt secondary transformer, a motherboard for plug-in connection of modules, and matte finish extruded aluminium or equal trim;
 - .2 power module with green power on LED, and adjustable (2 to 30 minutes) alarm repeater;
 - .3 microprocessor-based, field adjustable modules, each capable of handling 10 functions, capable of field upgrading to interface with a building automation system or slave alarm, and supplied in quantities to connect alarms as follows:
 - .1 Oxygen System:
 - .1 Primary liquid level low.
 - .2 High line pressure.
 - .3 Reserve supply in use.
 - .4 Bulk supply main tank(s) liquid level low, and cylinder reserve supply low, or, for systems with secondary liquid tanks for reserve supply, bulk supply main tank(s) liquid level low, reserve supply liquid level low, and reserve supply head pressure low, as applicable.
 - .5 Low line pressure.
 - .2 Medical Air System:
 - .1 Med Air Lag/Failure.
 - .2 Med Air Transformer Failure.
 - .3 Med Air No Electrical Overload.
 - .4 Med Air PLC Failure.
 - .5 Dryer A Switching Failure Alarms.
 - .6 Dryer B switching Failure Alarms.
 - .7 Dryer Low Outlet Pressure Alarm.
 - .8 Med Air High Dew Point Alarm.
 - .9 Med Air High CO Alarm.
 - .10 Med Air High Temp Alarm.
 - .11 Med Air High Line Pressure.
 - .12 Med Air Low Line Pressure.
 - .13 Med Air Reserve In use.

- .14 Med Air Reserve Manifold Low.
 - .15 Med Air Check Malfunction.
 - .3 Vacuum System:
 - .1 Vac Lag/Failure (for each pump).
 - .2 Vac Transformer Failure.
 - .3 Vac Pump Electrical Overload.
 - .4 Vac High Temperature.
 - .5 Vac PLC Failure.
 - .6 Vac Low Line Pressure.
 - .4 Scavenging Vacuum System:
 - .1 Vac Lag/Failure (for each pump).
 - .2 Vac Transformer Failure.
 - .3 Vac Pump Electrical Overload.
 - .4 Vac High Temperature.
 - .5 Vac PLC Failure.
 - .6 Vac Low Line Pressure.
 - .5 Nitrous Oxide:
 - .1 High Line Pressure.
 - .2 Reserve Manifold in Use.
 - .3 Low Line Pressure.
 - .6 Nitrogen:
 - .1 High Line Pressure.
 - .2 Reserve Manifold in Use.
 - .3 Low Line Pressure.
 - .7 Carbon Dioxide:
 - .1 High Line Pressure.
 - .2 Reserve Manifold in Use.
 - .3 Low Line Pressure.
- .4 red alarm LED's which flash and an audible alarm buzzer in excess of 90 dB which sounds when an alarm condition occurs, and an "ALARM MUTE" pushbutton to silence audible alarm, however, panel will remain in alarm state until problem is rectified;
- .5 "TEST" pushbutton to test all panel functions;

- .6 dry contacts for remote monitoring of high and low alarms;
- .7 building automation system signal interface panel.

2.12 Terminal Units

- .1 DISS type, gas specific, non-interchangeable, modular, flush mounting terminal units, either singular or in groups as shown on drawings, each designed to accommodate mounting surface thickness variations of up to 12 mm ($\frac{1}{2}$ "), complete with a CRN and following:
 - .1 die-cast outlet box;
 - .2 cartridge type primary check valve and stainless steel ball type secondary check valve;
 - .3 chrome plated brass outlet body with permanently embossed gas identification nameplate with bilingual labelling, all sealed behind a protective cover with chrome plated trim;
 - .4 required centreline spacing between multiple terminal units;
 - .5 temporary protective covers, and standing pressure test caps.
- .2 Equipment Connection Terminal Units: DISS medical gas specific riser assemblies, factory cleaned and capped, complete with a protective dust cap, brass outlet body, Type "K" inlet supply tube and bulkhead mounting provision.

2.13 Diss Conversion Terminal Units

- .1 DISS conversion assemblies, each to suit type of existing outlet to be converted, and each complete with a primary check valve, secondary check valve, and faceplate as specified for new terminal units.

3 Execution

3.01 Demolition

- .1 Perform required medical gas system demolition work. For demolition requirements, refer to Section 20 05 05 – Selective Demolition for Mechanical.

3.02 General Re: Piping Installation

- .1 Perform pipe joint brazing work in accordance with CAN/CSA Z7396.1 and reviewed brazing procedures submitted to the Consultant prior to start of work.
- .2 Consultant reserves the right to cut-out and examine piping joints during course of the work or after work is complete, and if interior of cut-out sample and/or fittings are found to be contaminated with oxidation or any other material, piping will be considered unacceptable and must be cleaned or replaced.
- .3 Where low pressure connecting assemblies are used in retractable gas columns, articulating arms, or any other dispensing assembly, DISS body or terminal unit which is used to connect it to copper pipeline must be brazed to the piping system.
- .4 Refer to architectural drawing plans and elevations for exact locations of terminal units, zone valve boxes, alarm panels, and other such items.

3.03 Installation of Medical Gas System Piping

- .1 Provide required medical gas system piping. Unless otherwise shown or specified, vacuum piping is to be minimum 20 mm ($\frac{3}{4}$ ") diameter, and piping for all other services is to be minimum 12 mm ($\frac{1}{2}$ ") diameter.
- .2 Piping aboveground, unless otherwise specified, is to be Type "L" copper.

- .3 Underground piping, unless otherwise specified, is to be Type "K" soft copper supplied in coils of lengths to suit the application so as to eliminate or minimize underground joints. Install underground piping below frost line in protective piping a minimum of 3 pipe sizes larger than copper pipe. Protective piping under roadways and other paved areas is to be Schedule 80 rigid PVC. Protective piping in other areas is to be flexible polyethylene. Piping offsets and long sweep elbows in soft copper piping may be cold bent if no deformation or reduction of pipe diameter occurs. Properly bed polyethylene piping.
- .4 Provide threaded piping unions at piping connections to source equipment. Do not silver braze unions. Braze a male NPT adaptor on end of pipe, wrap Teflon tape onto the adaptor (2 threads back), and screw union as tight as possible by hand, then with proper wrenches for final tightening. Do not over tighten.
- .5 Perform pipe brazing operations in strict accordance with requirements of CAN/CSA Z7396.1.
- .6 Ensure tools used during erection of piping systems are kept clean and free from oil and grease.
- .7 Support piping by means of support materials specified in Section 20 05 00 – Common Work Results for Mechanical, in accordance with requirements of article entitled "Pipeline Supports" in CAN/CSA Z7396.1 and with support spacing in accordance with table entitled "Spacing of Piping Supports" in CAN/CSA Z7396.1.
- .8 Refer to Section 20 05 00 – Common Work Results for Mechanical. Identify piping system work, including valves, concealed and exposed, on a daily basis in accordance with requirements of CAN/CSA Z7396.1.
- .9 Install vacuum piping sloped to low points. Equip each low point, including the bottom of vertical risers, with drip pockets consisting of a full size pipe tee with one leg capped with a removable cap. Ensure drip points are accessible and indicated on as-built record drawings.
- .10 Provide DISS identified riser outlet piping connections in ceiling and/or wall spaces for connection to terminal outlets integral with manufactured equipment such as articulated arms (with riser plates) provided as part of this section of the work or as part of the work of other Divisions of the Specification. Terminal units will be pre-piped by equipment manufacturer to an accessible location. Carefully rough-in piping and coordinate equipment connections, particularly for flush mounted and/or ceiling mounted equipment.
- .11 Provide identified piping connections to ceiling columns and/or headwalls provided as part of this section or as part of the work of other Divisions.
- .12 Provide valved and capped connections for future extension. Clearly and permanently identify each capped connection and ensure they are exactly located on as-built record drawings.
- .13 In accordance with CAN/CSA Z7396.1, provide a full size branch tee with shut-off valve for each gas source (including vacuum) downstream of main isolation valve.
- .14 Perform revision/retrofit work as shown and in accordance with CAN/CSA Z7396.1.

3.04 Installation of Valves

- .1 Provide shut-off/isolation valves where shown and/or required by CAN/CSA Z7396.1. Shut-off valves, unless otherwise specified, are to be ball type.
- .2 Provide check valves where shown and/or required by CAN/CSA Z7396.1.
- .3 Ensure valves are located for easy access and operation.

3.05 Installation of Zone Valves and Boxes

- .1 Provide zone valves in zone valve boxes. Provide a service isolation valve in piping immediately upstream of each zone valve and on same floor.

- .2 Accurately install boxes with reference to wall finish, and confirm exact locations prior to roughing-in.
- .3 At each zone valve box location provide a typed, framed, and glazed list of all rooms and areas controlled by the zone valve. Submit lists and wording for review prior to framing and glazing.

3.06 Installation of Combination Zone Valve/Area Alarm Boxes

- .1 Provide combination zone valve box/area alarm assemblies. Provide a service isolation valve in piping immediately upstream of each zone valve and on same floor.
- .2 Accurately install boxes with reference to wall finish, and confirm exact locations prior to roughing-in.
- .3 At each zone valve box location provide a typed, framed, and glazed list of all rooms and areas controlled by the zone valve. Submit lists and wording for review prior to framing and glazing.

3.07 Installation of Scavenging Terminal Units

- .1 Provide medical gas scavenging terminal units and mount. Confirm exact locations prior to roughing-in. Refer to architectural drawings.
- .2 Connect each terminal unit assembly with copper tubing extended to zone valve boxes to vacuum pump set.
- .3 Connect scavenging terminal units (with flexible connectors) supplied with articulated arms as for scavenger terminal units specified above.

3.08 Installation of Pressure/Vacuum Switches

- .1 Provide pressure or vacuum switches, as applicable, and all required connection hardware for medical gas pressure or vacuum alarms. Install in piping tees in accessible locations. Refer to tables entitled "Alarm Requirements for Cylinder and Vessel-Based Supply Systems" and "Alarm Requirements for Mechanical Supply Systems" in CAN/CSA Z7396.1.
- .2 Adjust each switch in accordance with manufacturer's/supplier's instructions to suit site and system conditions.

3.09 Installation of Alarm Panels

- .1 Provide wall mounted medical gas pressure/vacuum alarm panels. Confirm exact panel locations prior to roughing-in. Refer to architectural drawings.
- .2 Provide required hardware and connect each panel with required medical gas/vacuum piping as applicable.
- .3 Carefully check panel pressure/vacuum readings and make any required adjustments.
- .4 When installation is complete, test each panel function, and make any adjustments and corrections necessary.

3.10 Installation of Terminal Units

- .1 Provide wall mounted medical gas terminal units, either singular or in groups as indicated. Leave temporary caps in place.
- .2 Confirm exact locations prior to roughing-in. Refer to architectural drawings.
- .3 Equip each terminal unit with a faceplate.

- .4 Supply medical gas terminal units for factory installation in consoles, headwalls, articulating arms, ceiling service columns, and other such manufactured assemblies, and ship terminal units to manufacturer's plant.

3.11 Installation of Conversion Kits for Existing Terminal Units

- .1 Provide conversion kits to convert existing quick-connect terminal units to DISS terminal units.
- .2 Ensure converted terminal units are certified as part of the system certification after being modified, all in accordance with CSA Z7396.1 requirements.

3.12 Piping System Leakage Testing

- .1 Refer to Section 20 05 00 – Common Work Results for Mechanical. Ensure governing authorities are informed well in advance of scheduled tests so they may witness tests as required.

3.13 Power and Control Wiring

- .1 Line voltage power wiring to equipment, unless otherwise specified, will be done as part of the electrical work.
- .2 Control and alarm wiring, unless otherwise specified, is to be installed in conduit as part of medical gas system work in accordance with electrical work wiring requirements, and manufacturer's/supplier's certified wiring schematics.
- .3 Generally, power wiring (part of electrical work) and control and alarm wiring (part of mechanical work) is to be as follows:

Equipment	Line Voltage Power Wiring	Control and/or Alarm Wiring
vacuum pump sets	to pre-wired integral panel c/w disconnect and starters	from control panel alarm contacts to master alarm panel as per Code
air compressor set	to pre-wired integral panel c/w disconnect and starters	from control panel alarm contacts to mater alarm panel as per Code
scavenging pump set	to pre-wired integral panel c/w disconnect and starters	from control panel alarm contacts to master alarm panel as per Code
desiccant dryer	115 volt to power and control panel	from control panel alarm contacts to master alarm panel
dew point monitor	115 volt to monitor enclosure	from enclosure alarm contacts to master alarm panel
simplex medical air reserve manifold		from Low Pressure alarm switch to master alarm panel
reserve air manifold check assembly	115 volt to terminal strip	alarm wiring from pressure switch to master alarm panel
medical air dual supply station assembly		connection of dew point sensor to dew point monitor, and Reserve In Use alarm wiring to master alarm panel

Equipment	Line Voltage Power Wiring	Control and/or Alarm Wiring
oxygen inlet check valve assembly		oxygen main service line high and low pressure switches (located downstream of inlet check valve assembly) wiring to master alarm panel
duplex manifolds	115 volt to cabinet	alarm wiring from cabinet to master alarm panel
local alarm panels	115 volt to panel	
combo zone valve and area alarm units	115 volt to panel	

3.14 System Startup

- .1 When installation of medical gas system equipment from source of supply up to but not including outlets is complete, and piping leakage testing is complete, but prior to certification as specified below, and in accordance with article entitled "Commissioning of Supply Systems" in CAN/CSA Z7396.1, arrange for equipment manufacturers/ suppliers to visit site for length of time necessary to:
 - .1 check installation of equipment, and recommend any required adjustments, which are to be done immediately;
 - .2 start-up equipment, test operation, recommend any required adjustments, which are to be done immediately, check and verify safeties, operational sequences, controls, and alarms to ensure they are operating properly, and to ensure equipment performs as intended;
 - .3 obtain a letter or letters from system manufacturers/suppliers to certify above requirements have been successfully completed, have the letter(s) signed by the system supplier, and submit to the Consultant.

3.15 Medical Gas System Certification

- .1 When equipment start-up and certification as specified above is complete, notify Owner and Consultant that the systems are ready for certification as per CAN/CSA Z7396.1.
- .2 Arrange for system installer to be part of the certification team.
- .3 Should Owner's Certification Agency be delayed by your default or by the fact that you are not ready for the certification procedure, or if scheduled certification is cancelled with less than 2 days' notice because systems are not ready, you will be responsible for all costs for Certification Agency to repeat the tests, remain on site longer than could reasonably be expected, or reschedule tests, as applicable.
- .4 Owner's Certification Agency will make interim site visits during construction to review medical gas system work. Cooperate with and reasonably assist the Agency, and immediately correct any deficient work reported by the Agency.

3.16 Training

- .1 Include for 2 site training sessions for a minimum of 6 people for 8 hours per session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

End of Section

1 General

1.01 Submittals

- .1 Submit shop drawings/product data sheets for all products specified in this section except piping and unions.

1.02 Closeout Submittals

- .1 Submit with delivery of each unit a copy of factory inspection and test report, and include a copy of each report with O&M Manual project closeout data.
- .2 Prior to Substantial Performance of the Work, submit a spare seal flush line filter for each pump equipped with a seal flush line.

1.03 Quality Assurance

- .1 Pump motors are to comply with requirements of Section 20 05 00 – Common Work Results for Mechanical.

2 Products

2.01 Pipe, Fittings, and Joints

- .1 Black Steel - Screwed Joint
 - .1 Mild black carbon steel, Grade B, ASTM A53, complete with Class 125 cast iron threaded fittings to ANSI/ASME B16.4, and screwed joints.
- .2 Black Steel - Welded Joint
 - .1 Mild black carbon steel, Grade B, ASTM A53, mill or site bevelled, complete with factory made seamless carbon steel butt welding fittings to ASTM A234, Grade WPB, with long sweep pattern elbows unless otherwise specified, and welded joints.
- .3 Soft Copper Pipe
 - .1 Type "L" seamless soft copper to ASTM B77.
- .4 Hard Copper - Solder Joint
 - .1 Type "L" hard drawn seamless copper to ASTM B88, complete with wrought copper fittings to ANSI B16.22, and 95% tin / 5% Antimony solder joints.

2.02 Piping Unions

- .1 Screwed Piping
 - .1 Malleable iron, ground joint, bronze or brass to iron or bronze to bronze seat screwed unions and union elbows with a minimum pressure rating of 1725 kPa (250 psi) steam at 260°C (500°F).
- .2 Flanged Piping
 - .1 Forged carbon steel slip-on type raised faced welding flange unions to ASTM A105, 150 lb. Class for steel pipe, and slip-on type 150 lb. Class bronze flanges for copper pipe.

2.03 Shut-Off Valves

- .1 Ball Type

- .1 Class 600, 4140 kPa (600 psi) WOG rated full port ball valves, each complete with a forged brass or bronze body and cap, blowout-proof stem, solid forged brass chrome plated ball, "Teflon" or "PTFE" seat, threaded ends, and removable lever handle.
- .2 Manufacturers:
 - .1 Toyo Valve Co. Fig. 5044A;
 - .2 Watts Industries (Canada) Inc. #FBV-3;
 - .3 Kitz Corp. Code 58;
 - .4 Victaulic Co. of Canada Ltd. Series 722;
 - .5 Apollo Valve #77-100.
- .2 Butterfly Type
 - .1 Cast ductile iron, lug body style, 1200 kPa (175 psi) rated butterfly valve, each complete with a neck to permit 50 mm (2") of insulation above the flange, a field replaceable EPDM seat, ductile iron disc, stainless steel shaft with EPDM seal, a lever handle for valves to and including 150 mm (6") diameter, a handwheel and gear type operator for valves larger than 150 mm (6") diameter, and each suitable for bubble-tight dead end service with valve closed and either side of connecting piping removed.
 - .2 Manufacturers:
 - .1 DeZurik of Canada Ltd., Figure No. 632;
 - .2 Victaulic Co. of Canada Ltd. Vic-300 MasterSeal or AGS Vic-300;
 - .3 Apollo Valve 143 Series;
 - .4 Watts Industries (Canada) Inc. #BF-03;
 - .5 Kitz Corp. 6112 Series;
 - .6 Toyo Valve Co. 918DESL/G2.

2.04 Drain Valves

- .1 Minimum 2070 kPa (300 psi) WOG rated, 20 mm ($\frac{3}{4}$ ") diameter straight pattern bronze ball valves, each complete with a threaded outlet suitable for coupling connection of 20 mm ($\frac{3}{4}$ ") diameter hose, and a cap and chain.
- .2 Manufacturers:
 - .1 Toyo Valve Co. Ltd. Fig. 5046;
 - .2 Watts Industries (Canada) Inc. #B-6000-CC;
 - .3 Kitz Corp. Code No. 68AC;
 - .4 Apollo Valves #78-104-01.

2.05 Circuit Balancing Valves

- .1 Screwed or flanged as required, globe style, non-ferrous circuit balancing valves designed to facilitate precise flow measurement, precision flow balancing, and positive shut-off, complete with capped and valved drain connection, and valved ports for connection to a differential pressure meter.

- .2 Manufacturers:
 - .1 Equal to Victaulic Co. of Canada Ltd. (Tour & Anderson) Series 787 screwed, Series 788 flanged, and 789 grooved end, and Series 78K "Koil Kit" valves.

2.06 Pressure Relief Valves

- .1 ASME tested, rated, and certified, bronze or cast iron bronze fitted, 1725 kPa (250 psi) rated pressure relief valves, each capable of relieving full output of equipment it is associated with, and each factory set at 415 kPa (60 psi) unless otherwise specified.
- .2 Manufacturers:
 - .1 ITT Bell & Gossett 3301/4100, or 790/1170;
 - .2 Dresser Industries "CONSOLIDATED";
 - .3 Spirax Sarco Ltd. SVI Series;
 - .4 McDonnell & Miller Models 250 and 260;
 - .5 Conbraco 10-600 Series;
 - .6 Watts Industries (Canada) Inc. 174A or 740.

2.07 Air Vents

- .1 Manual Air Vents
 - .1 Equal to Conbraco 27 Series, 3.2 mm (1/8") diameter with a key handle.
- .2 Automatic Air Vents
 - .1 Float actuated air vents, each complete with a semi-steel body and cap, a stainless steel float assembly and seat, and a neoprene head.
 - .2 Manufacturers:
 - .1 Spirax Sarco Ltd., Type 13 W for system working pressures to 1035 kPa (150 psi), 13 WH for system working pressures greater than 1035 kPa (150 psi);
 - .2 Armstrong International Inc. No. 1-AV.

2.08 Strainers

- .1 Cast iron wye shaped strainers, minimum 890 kPa (125 psi) rated and complete with a removable type 304 stainless steel screen with perforations sized to suit the application, and, for strainers 50 mm (2") diameter and larger, a blowdown pipe connection tapping.
- .2 Manufacturers:
 - .1 Spirax Sarco Ltd. Type IF-125 screwed or Type AF-250 flanged;
 - .2 Toyo Valve Co. Ltd. Fig. 380A screwed or Fig. 381 flanged;
 - .3 Victaulic Co. of Canada Style 732 or W732 "Vic-Strainer";
 - .4 Armstrong International Inc. A1 Series;
 - .5 Watts Industries (Canada) Inc. #77SCI;

- .6 Mueller Steam Specialty Products Model 11M screwed or Model 758 flanged.

3 Execution

3.01 Demolition

- .1 Perform required hydronic piping system demolition/revision work. Refer to demolition requirements specified in Section 20 05 05 – Selective Demolition for Mechanical.

3.02 Piping Installation Requirements

- .1 Provide required hydronic piping. Pipe, unless otherwise specified, is to be:
 - .1 For pipe sizes up to and including 50 mm (2") diameter, Schedule 40 black steel, screwed, or type "L" hard copper with solder joints or pressure coupled joints;
 - .2 For pipe 65 mm (2-½") to 300 mm (12") dia. and larger, Standard weight grooved end black steel pipe, 10 mm (0.375") thickness, with grooved end fittings and couplings, or, Standard weight black steel pipe, 10 mm (0.375") thickness, with welding fittings and welded joints;
 - .3 For short branch connections, 25 mm (1") pipe diameter size and less, to heating equipment where structural obstructions occur and site bending of pipe is advantageous, a single length of type "L" soft copper.
- .2 Slope horizontal piping mains to provide a minimum continuous up-grade of 25 mm (1") in 6 m (20') to high points. Slope branch supply and return piping connections to equipment a minimum of 25 mm (1") in 1.2 m (4'). Leave sufficient room at high points for installation and maintenance of air vents.
- .3 Install automatic control valves, piping wells and similar piping and/or equipment mounted control components required for automatic temperature control systems supplied as part of the control work. Refer to drawing control diagrams and details.
- .4 Connect equipment provided as part of the work of other sections with piping as indicated and/or required. Refer to pipe connection details on drawings.
- .5 Provide screwed unions, removable mechanical joint couplings, or weld-on or solder-on flanges in piping at all connections to valves, strainers and similar piping system components which may need maintenance or repair, at equipment connections, in runs of piping exceeding 9 m (30') at 4.5 m (15') regular intervals to permit removal of sections of piping, and wherever else indicated on drawings.
- .6 Provide shut-off valves in piping connections to equipment, to isolate piping risers, to isolate other sections of systems as shown, and wherever else indicated on drawings. Valves in piping to and including 50 mm (2") dia. are to be ball type. All other shut-off valves are to be ball or butterfly type unless otherwise specified. Locate valves so they are easily accessible. Wherever possible, install valves at uniform height. Provide chain operators for valves which are inaccessible for operation from floor level.
- .7 Provide a check valve in discharge piping of every pump, and elsewhere in piping where shown on drawings. Where check valves are required in vertical piping, ensure they are suitable in all respects for the application. Check valves for vertical in-line and/or base mounted circulating pumps are integral with the discharge accessory.
- .8 Provide a drain valve at base of each piping riser, in drain connections to equipment, in low points of horizontal piping, and wherever else shown and/or specified.
- .9 Provide circuit balancing valves in piping generally where shown on drawings but with exact locations in accordance with instructions of personnel doing system flow balancing work. Confirm locations prior to installation.

- .10 Grooved pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to groove for proper gasket sealing. All couplings will meet Victaulic standards for visual inspection sizes 2" to 12". The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Install in accordance with manufacturer's latest recommendations. A Victaulic factory trained representative shall periodically visit the job site and review the installation for best practices. The installing Contractor shall correct any identified deficiencies. Victaulic product that has been examined and has not met the visual inspection criteria for proper installation must be corrected and re-examined by Victaulic prior to the completion of the project.

3.03 Installation of Pressure Relief Valves

- .1 Provide factory set pressure relief valves. Pipe discharge of each water piping relief valve to drain unless otherwise shown or specified.
- .2 Pipe discharge of each glycol solution piping relief valve back to system expansion tank or return piping.
- .3 Confirm relief valve settings.

3.04 Installation of Air Vents

- .1 Provide an air vent in piping mains at all high points, at equipment connections, and wherever else shown and/or specified. Equip each air vent with a ball type shut-off valve. Install vents in 100 mm (4") dia. and larger piping and all vents in mechanical rooms in accordance with drawing detail.
- .2 Provide 9 mm (3/8") dia. copper drain piping from each automatic air vent to nearest suitable drain and terminate so discharge is visible. Identify drain piping.

3.05 Installation of Strainers

- .1 Provide strainers in piping. Locate strainers so baskets are easily accessible and removable. Clean strainer baskets during and after piping system flushing and cleaning is complete, and before water quantity balancing commences.

3.06 Installation of Flexible Piping Connections

- .1 Provide flexible connections in piping connections to equipment.
- .2 Install in accordance with manufacturer's instructions.

3.07 Flushing and Cleaning Piping

- .1 Flush and clean new piping in accordance with requirements specified in Section 23 25 00 – HVAC Water Treatment.

3.08 Testing, Adjusting and Balancing

- .1 When work is complete and equipment is operating as intended, test, adjust and balance water flows in accordance with requirements specified in Section 20 05 93 – Testing, Adjusting, and Balancing for Mechanical Systems, and Section 20 08 00 – Commissioning of Mechanical Systems.

End of Section

1 General

1.01 Section Includes

- .1 HVAC ducts and casings.
- .2 Acoustic duct lining material.
- .3 Special systems ductwork.
- .4 Dampers.
- .5 Louvres.
- .6 Other duct work accessories.

1.02 Submittals

- .1 Submit shop drawings/product data sheets for all products specified in this section except shop fabricated ductwork and fittings.
- .2 Include capacity, throw and terminal velocity, noise criteria, and pressure drops with grille and diffuser shop drawing/product data sheet submission.
- .3 With shop drawing/product data sheet submission, supply evidence that fire rated duct manufacturer is ULC listed to size requirements shows on drawings.
- .4 Submit duct leakage test data prior to ductwork being covered from view.
- .5 Submit manufacturer's colour chart(s) for all items for which a finish colour is to be selected.

1.03 Closeout Submittals

- .1 Submit proper installation certification from fire rated duct manufacturer as specified in Part 3 of this section.

1.04 Maintenance Material Submittals

- .1 Supply and hand to Owner at Substantial Performance of the Work, a minimum of 10 identified (with tags) grille/diffuser volume control damper adjustment keys.

1.05 Coordination

- .1 Supply reviewed copies of ventilator/curb assembly shop drawings or product data sheets to trade who will cut roof openings for ventilators, and ensure openings are properly sized and located.

1.06 Quality Assurance

- .1 Grilles and diffusers are to be tested and performance certified to ANSI/ASHRAE 70, Method of Testing the Performance of Air Outlets and Air Inlets.

2 Products

2.01 Galvanized Steel Ductwork

- .1 Galvanized steel sheet is to be hot dipped in accordance with requirements of ASTM A653. G60 galvanizing for bare uncovered duct to be finish painted. G90 for all other galvanizing.
- .2 Rectangular

- .1 Lock forming grade hot dip galvanized steel, ASTM A653, shop fabricated, minimum #26 gauge.
- .3 Round
 - .1 Factory machine fabricated, spiral, mechanically locked flat seam, single wall duct, fittings and couplings.
- .4 Flat Oval
 - .1 Factory machine fabricated, single wall, 4-ply spiral lock seam duct, fittings and couplings.

2.02 Galvanized Steel Round PVC Coated Ductwork

- .1 Factory made G90 galvanized steel, ASTM A653, spiral seam smooth wall round duct and fittings with metal gauges in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible for a 2.5 kPa (0.36 psi) pressure, with a 4 mm thick PVC coating permanently fused to both sides of the duct, fittings and sleeve joint pieces, and type 316 stainless steel sheet metal screws and support hardware.

2.03 Rectangular Aluminum Ductwork

- .1 Alloy 3003 Temper H14 aluminum, ASTM B209, shop or factory fabricated, water-tight, with metal gauges and fabrication in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit the duct working pressure classification, and type 316 stainless steel support hardware.

2.04 Round Aluminum Ductwork

- .1 Alloy 3003 Temper H14 aluminum, ASTM B209, factory fabricated, water-tight, smooth interior, single wall duct, and fittings of spiral lockseam construction with site sealed beaded sleeve (slip type) joints, all in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit duct working pressure classification, and type 316 stainless steel sheet metal screws and support hardware.

2.05 Flexible Metallic Ductwork

- .1 Bare
 - .1 Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, SMACNA Form "M-UN", CAN/ULC-S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, and supplied in 3 m (10') lengths.
- .2 Insulated
 - .1 Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, SMACNA Form "M-I", CAN/ULC-S110 listed and labelled as a Class 1 Air Duct, constructed of dead soft aluminum strip, supplied in 3 m (10') lengths and factory covered with 40 mm (1-1/2") thick, 12 kg/m³ (0.75 lb/ft³) density fibreglass insulation with a vinyl jacket meeting 25/50 flame spread and smoke developed requirements tested in accordance with CAN/ULC-S102.

2.06 Flexible Connection Material

- .1 Waterproof, indoor-outdoor type flexible connection material meeting requirements of NFPA 90A, consisting of woven glass fibre fabric coated on both sides with synthetic rubber.
- .2 Manufacturers:
 - .1 Duro Dyne Canada Inc. "DUROLON";
 - .2 Dyn Air Inc. "HYPALON".

- .3 Waterproof, flameproof, high temperature flexible connection material meeting requirements of NFPA 90A, consisting of a woven glass fibre fabric coated on both sides with silicone rubber.
- .4 Manufacturers:
 - .1 Duro-Dyne Canada Inc. "THERMAFAB";
 - .2 Dyn Air Inc. "SILICON HI-T".

2.07 Metal Duct System Joint Sealant

- .1 ULC listed and labelled, premium grade, grey colour, water base, non-flammable duct sealer, brush, or gun applied, with a CAN/ULC S102 tested maximum flame spread rating of 5 and smoke developed rating of 0.
- .2 Manufacturers:
 - .1 Johns Manville;
 - .2 Manson Insulation;
 - .3 Knauf Insulation.

2.08 Acoustic Lining

- .1 Minimum 25 mm (1") thick acoustic lining material meeting 25/50 flame spread and smoke developed ratings tested in accordance with CAN/ULC S102, meeting NFPA 90A, ASTM C1071, and ASTM G21 requirements, not supporting microbial growth, flexible for round ducts, board type for rectangular ducts, consisting of a bonded fiberglass mat coated on inside (airside) face with a black fire-resistant coating.
- .2 Manufacturers:
 - .1 Johns Manville;
 - .2 Manson Insulation;
 - .3 Knauf Insulation.

2.09 Factory Insulated Fire Rated Ductwork

- .1 Equal to DuraSystems Barriers Inc. "DuraDuct HP" or "DuraDuct GNX" duct, 2 hour fire rated, constructed, ULC listed and labelled for fire rated ventilation applications. Duct is constructed of a galvanized steel inner liner, a galvanized steel outer jacket, and all required fittings and accessories, including support hardware.

2.10 Casing and Plenum Material and Accessories

- .1 Unless otherwise specified, casing and plenum material is to be same as connecting duct material.
- .2 Accessories such as access doors and drain pans are to be constructed of same material as casing and plenum and are to be in accordance with Chapter 6 of SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.11 Acoustic Plenum Panels

- .1 Vibro-Acoustics Ltd. type "AP", 100 mm (4") thick panels with acoustic media meeting NFPA 90A requirements sandwiched between minimum #24 gauge galvanized sheet steel, with airside face perforated, access doors where shown, and with acoustic performance as follows:

Octave Bands, (Hz)	125	250	500	1000	2000	4000
Transmission Loss	21	28	39	50	53	56
Absorption Coefficient	0.7	0.9	0.99	0.99	0.9	0.9

- .2 Acoustic plenum media factory encapsulated in sealed DuPont "Tedlar" polyvinyl fluoride film to ensure no media enters the airstream.
- .3 Manufacturers:
 - .1 Vibro-Acoustics Ltd.;
 - .2 Kinetics Noise Control Inc.;
 - .3 Carrier Corp. – Racan;
 - .4 Haakon Industries;
 - .5 Price Industries Inc;
 - .6 Alumavent.

2.12 Plenum Access Doors

- .1 Factory fabricated, double wall insulated access doors, sized as indicated on drawings, and constructed of same material as connecting ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit operating pressure of the system.

2.13 Round to Rectangular Duct Connections

- .1 Equal to Flexmaster Canada Ltd. galvanized steel, flared, flanged or notched "Spin-On" round duct take-off collars with locking dampers in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.14 Splitter Dampers

- .1 Minimum #20 gauge damper blade constructed of same material as duct, reinforced as required to suit blade size, system velocity, and to prevent "chatter", and complete with operating hardware equal to DynAir Inc. #Q-50 "DYN-A-QUAD S-S" quadrant regulator with RW-50 backup washers to prevent leakage, long square bearing pin, and slide pin.

2.15 Air Turning Vanes

- .1 For square elbows, multiple-radius turning vanes interconnected with bars, adequately reinforced to suit pressure and velocity of system, constructed of same material as duct they are associated with, and in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .2 For short branch ducts at grille and diffuser connections, air extractor type each equipped with a matching bottom operated 90° opposed blade volume control damper, constructed of same material as duct it is associated with and in accordance with requirements and details in ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.16 Manual Balancing (Volume) Dampers

- .1 Flanged and drilled, single or parallel blade (depending on damper size) manual balancing dampers, each constructed of same material as connecting ductwork unless otherwise specified, each designed to maintain internal free area of connecting duct, and each complete with:
 - .1 hexagonal or square shaft extension through frame;

- .2 non-stick, non-corrosive synthetic bearings for rectangular dampers, flange stainless steel bearings for round dampers;
- .3 blade stops for single blade dampers, designed to prevent blade from moving more than 90°;
- .4 linkage for multiple blade dampers;
- .5 locking hand quadrant damper operator with, for insulated ducts 50 mm (2") standoff mounting.
- .2 Rectangular Dampers: Nailor Industries Inc. 1800 Series, maximum size 1.2 m x 1.2 m (4' x 4') for a single damper.
- .3 Round Dampers: Nailor Industries Inc. model 1890, maximum 600 mm (24") diameter, equipped with a minimum 200 mm (8") deep frame, and blade stiffeners where required.
- .4 Multiple Rectangular Damper Section Assembly: Rectangular assembly supplied with the dampers or site constructed, of same material as damper and designed for tight and secure mounting of individual dampers.
- .5 Manufacturers:
 - .1 Nailor Industries Inc.;
 - .2 T.A. Morrison & Co. Inc. "TAMCO";
 - .3 Greenheck Fan Corp.;
 - .4 Ruskin Co.

2.17 Backdraft Dampers

- .1 Nailor Industries Model 1370CB counterbalanced backdraft dampers, vertical or horizontal mounting, 50 mm (2") wide, sized as shown and complete with:
 - .1 extruded 6063-T5 aluminum frame, 2.3 mm (0.090") nominal wall thickness, with mitred corners;
 - .2 extruded 6063-T5 aluminum blades, 1.3 mm (0.050") nominal wall thickness on 92 mm (3-5/8") centres, and with extruded PVC blade seals;
 - .3 corrosion-resistant synthetic bearings;
 - .4 adjustable plated steel counterweights mounted internally in the airstream;
 - .5 concealed blade linkage located out of the airstream.
- .2 Manufacturers:
 - .1 Nailor Industries Inc.;
 - .2 T.A. Morrison & Co. Inc. "TAMCO";
 - .3 Greenheck Fan Corp.;
 - .4 Ruskin Co.

2.18 Fusible Link Dampers

- .1 Curtain blade type, dynamic, galvanized steel (unless otherwise specified) fusible link dampers, ULC classified to CAN/ULC S112 and in accordance with NFPA 90A requirements, factory tested for closure under airflow, 1-1/2 hour or 3 hour rated as required, and complete with a constant force type 301

stainless steel closure spring, a blade lock assembly, a steel sleeve, retaining angles, and, unless otherwise specified, a 74°C (165°F) rated standard fusible link.

- .2 Fusible link dampers are to be Type "B" or Type "C" (as required) with folded curtain blade out of air stream except where damper size or location requires use of type "A" dampers with curtain blade in air stream.
- .3 Dampers in ductwork other than galvanized steel are to be as specified above but constructed of type 316 stainless steel.
- .4 Manufacturers:
 - .1 Nailor Industries Inc.;
 - .2 Greenheck Fan Corp.;
 - .3 Ruskin Co.;
 - .4 Price Industries (E.H. Price).

2.19 Combination Fire/Smoke Dampers

- .1 Nailor Industries Series 1221, ULC listed to CAN/ULC S112 and CAN/ULC S112.1, meeting requirements of NFPA 80, 90A, 92, 101 and 105, consisting of type A, B, or C fusible link fire dampers as required and a fail-safe, opposed blade, normally closed, motor operated smoke damper complete with factory installed and tested 120 V electric actuator.
- .2 ULC 1-1/2 hour fire rated and ULC Class I leakage rated for smoke, and equipped with a 74°C (165°F) ULC classified fusible link that will cause damper to close and lock independent of actuator when duct temperature reaches maximum temperature of damper assembly.
- .3 Supply damper with factory installed sleeves of minimum 400 mm (16") length, field verified by contractor dependent on wall thickness. Caulk sleeves to ULC requirements and constructed of 20 gauge for sizes up to 2.1 m (84") wide and 18 gauge for sizes greater than 2.1 m (84") wide.
- .4 Dampers in ductwork other than galvanized steel are to be as specified above but constructed of type 316 stainless steel.
- .5 Manufacturers:
 - .1 Nailor Industries Inc.;
 - .2 Greenheck Fan Corp.;
 - .3 Ruskin Co.;
 - .4 Price Industries (E.H. Price).

2.20 Smoke Dampers

- .1 Multi-blade type, fail-safe, dynamic, galvanized steel (unless otherwise specified) smoke dampers, ULC classified to CAN/ULC S112.1, ULC Class I leakage rated for smoke, meeting requirements of NFPA 90A, 92, 101 and 105, normally closed, low pressure drop design, dynamically tested, each complete with jamb and blade seals, linkage concealed in the frame, a steel sleeve to suit the opening, and an electric actuator to automatically close damper upon receiving an external signal, and to automatically open damper when system is reset.
- .2 Dampers in ductwork other than galvanized steel are to be as specified above but constructed of type 316 stainless steel.

- .3 Manufacturers:
 - .1 Nailor Industries Inc.;
 - .2 Greenheck Fan Corp.;
 - .3 Ruskin Co.;
 - .4 Price Industries (E.H Price).

2.21 Duct Access Doors

- .1 In accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, with sizes suitable in all respects for purpose for which they are provided, and, unless otherwise specified, constructed of same material as duct they are associated with.

2.22 Instrument Test Ports

- .1 Equal to Duro-Dyne of Canada Ltd. #IP1 or #IP2 (to suit insulation thickness where applicable) gasketed, leakproof instrument test ports for round or rectangular ducts as required, each complete with a neoprene expansion plug and a plug securing chain.

2.23 Wire Mesh (Birdscreen)

- .1 Heavy-gauge galvanized steel or aluminum mesh, 12 mm x 12 mm (½" x ½") secured in a rigid galvanized steel or aluminum framework, sized as indicated on drawings, and constructed so as to be removable.

2.24 Fire Stop Flaps and Thermal Blanket Material

- .1 Rectangular or round, ULC listed and labelled, blade type galvanized steel fire stop flaps in accordance with CAN/ULC S112, Standard Methods of Fire Test of Fire-Damper Assemblies and CAN/ULC S112.2, Standard Method of Fire Test of Ceiling Firestop Flap Assemblies, each complete with #22 gauge G60 galvanized steel blade(s) and frame, a 74°C (165°F) fusible link, and, for dampers 300 mm (12") and larger, ceramic fibre insulation on both sides of the blades.
- .2 Ceramic fibre material in accordance with 25/50 flame spread/smoke developed ratings when tested to CAN/ULC S102 and of a thickness to suit required fire rating.

2.25 Grilles and Diffusers

- .1 Grilles and diffusers of type, size, capacity, finish, and arrangement as shown on drawings and in accordance with drawing schedule, each equipped with all required mounting and connection accessories to suit mounting location and application.
- .2 Manufacturers:
 - .1 Price Industries Inc.;
 - .2 Anemostat;
 - .3 Krueger Division of Air System Components Inc.;
 - .4 Titus;
 - .5 Nailor Industries Inc.;
 - .6 Tuttle & Bailey.

3 Execution

3.01 Cleanliness Requirements for Handling and Installation of Ductwork

- .1 Handle and install ductwork in accordance with CSA Z317.2, Special Requirements for Heating, Ventilation, and Air-Conditioning (HVAC) Systems in Healthcare Facilities and SMACNA's Duct Cleanliness for New Construction Guidelines at the Advanced Level.
- .2 Handle and install ductwork in accordance with SMACNA's Duct Cleanliness for New Construction Guidelines at the Advanced Level.

3.02 Fabrication and Installation of Galvanized Steel Ductwork

- .1 Provide required ductwork, rectangular, round and/or flat oval. Where rectangular ductwork is shown, round or flat oval ductwork of equivalent cross-sectional area is acceptable.
- .2 It is to be understood that all duct dimensions shown on drawings are clear internal dimensions.
- .3 Unless otherwise specified, construct and install ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit duct pressure class designation of minimum 500 Pa (2" w.c.) positive or negative as applicable, a minimum velocity of 10 m/s (2000 fpm), and so ductwork does not "drum". Flat surfaces of rectangular ductwork are to be cross-broken or beaded per SMACNA standards. Duct system sealing is to meet ANSI/SMACNA Seal Class A requirements.
- .4 Variable air volume ductwork from supply fans to boxes is as above but rectangular duct take-offs are double side straight taper type with a take-off length equal to 0.5 times the branch duct width but minimum 150 mm (6") length, and double taper side is to have an included angle of minimum 60°.
- .5 Confirm routing of all ductwork at site and site measure ductwork prior to fabrication. Duct dimensions may be revised to suit site routing and building element requirements, if dimension revisions are reviewed with and approved by the Consultant. Duct routing and/or dimension revisions to suit conditions at site are not grounds for a claim for an extra cost.
- .6 Refer to structural drawings. Where ductwork is to be run within or through open web steel joists, ductwork shown on mechanical drawings is schematic only and is to be altered as required to suit steel joist configuration, spacing, panel points, and cross-bridging at no additional cost.
- .7 Wherever ductwork is required at locations where sprayed fireproofing is applied to building construction, install ductwork only after fireproofing work is complete and do not compromise fire rating of sprayed fireproofing.
- .8 Install (but do not connect) duct system mounted automatic control components supplied as part of the automatic control work.
- .9 Where indicated, provide duct connections to fan powered heat transfer equipment with integral coils.
- .10 Flange connect ductwork to hot water reheat coils in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Coils will be suspended independent of connecting ductwork as part of the heat transfer work.
- .11 Support horizontal rectangular ducts inside building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but use trapeze hangers with, unless otherwise specified, galvanized steel channels, and galvanized steel hanger rods for exposed ducts and concealed ducts wider than 500 mm (20"). Support hardware constructed of same material as duct for metal duct, and, unless otherwise specified, type 316 stainless steel for non-metal duct. Supports for "heavy" duct such as cementitious core duct is to be suitable in all respects for the application and approved by the Consultant.

- .12 Support round and flat oval ducts inside building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, but, unless otherwise specified, for both uninsulated and insulated ducts exposed in finished areas, use bands and secure at top of duct to a hanger rod, all similar to Ductmate Canada Ltd. type "BA". If duct is insulated, size strap to suit diameter of insulated duct. Unless otherwise specified, duct support hardware for metal duct is constructed of same material as duct, and for non-metal duct, type 316 stainless steel.
- .13 Where flanged duct joints are used, do not locate joints in wall or slab openings, or immediately at wall or slab openings. Do not use flanged joints for exposed uninsulated ducts in finished areas.
- .14 Where watertight horizontal ductwork is required, construct ducts without bottom longitudinal seams. Solder or weld joints of bottom and side sheets. Seal all other joints with duct sealer. Slope horizontal duct to hoods, risers, or drain points. Provide watertight ductwork for:
 - .1 ductwork outside building or otherwise exposed to the elements;
 - .2 dishwasher exhaust;
 - .3 shower exhaust ducts from grilles to duct main or riser;
 - .4 minimum of 3 m (10') upstream and downstream of duct mounted humidifiers or humidifier manifolds;
 - .5 fresh air intakes;
 - .6 wherever else shown.
- .15 Leakage Testing:
 - .1 Ductwork leakage is not to exceed following:
 - .1 ductwork to 2" W.C. Class, 1% of total air quantity handled by respective fans;
 - .2 ductwork exceeding 2" W.C. Class, 2% of total air quantity handled by respective fans.
 - .2 Leakage testing is to be performed by the Testing, Adjusting and Balancing (TAB) agency in accordance with SMACNA HVAC Air Duct Leakage Test Manual and is to be witnessed by the Consultant.
 - .3 Be responsible for following:
 - .1 preparing duct systems for leakage testing prior to installation of external insulation including capping duct runouts and provision of final tap-in for test equipment;
 - .2 schedule testing with TAB agency in advance, be present for all testing and ensure notice is given to the Consultant so they may witness testing;
 - .3 resealing and/or replacement of defective ductwork;
 - .4 bearing all costs associated with retesting ductwork which has failed to pass leakage testing.
- .16 Seal all ductwork in accordance with SMACNA Seal Class "A", except for round duct with self-sealing gasketed fittings and couplings which does not require site applied sealant. Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of sealant.

- .17 Apply sealants by brush or gun to cleaned metal surfaces. Where bare ductwork is exposed apply neat uniform lines of sealant. Randomly brushed, sloppy looking sealant applications will be rejected and must be repaired or replaced with a neat application of sealant.
- .18 Clean exterior exposed (uninsulated) ducts and coat with a heavy full coverage of Bakor #410-02 black metal paint.
- .19 Where dissimilar metal ducts are to be connected, isolate ducts by means of flexible duct connection material.
- .20 Round exposed ductwork in Gymnasium is to be 2 metal gauges heavier than standard metal gauge for same size duct, and duct hangers are to be pairs of 9.5 mm ($\frac{3}{8}$ ") diameter hanger rods secured to 40 mm (1- $\frac{1}{2}$ ") wide #12 gauge galvanized steel split clamps around full circumference of duct at maximum 1.8 m (72") centres. Provide double nuts and lock washers on each hanger rod above and below each clamp.
- .21 Equip ducts with a dimension of 600 mm (24") and larger and located in mechanical equipment rooms of any kind with hanger rods equipped with double deflection neoprene rod isolation hangers properly sized for associated load. Also refer to Section 20 05 48.16 – Seismic Controls for Mechanical Systems.
- .22 In addition to SMACNA duct construction standards specified above, ductwork is to be constructed and installed to meet seismic requirements of British Columbia Building Code and ANSI/SMACNA The Seismic Restraint Manual: Guidelines for Mechanical Systems.

3.03 Installation of Aluminum Ductwork

- .1 Provide aluminum ductwork, rectangular or round.
- .2 Wherever bare aluminum ductwork comes in contact with ferrous metal or copper, paint ferrous metal or copper surface with a heavy, 100% covering coat of zinc chromate paint, asphalt paint or otherwise isolate direct contact with the bare aluminum.
- .3 Refer to "Commentary on Aluminum Ducts" in ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, however, do not use drive and S cleats for joining waterproof aluminum ductwork. Use following SMACNA joining methods:
 - .1 T-21 - welded flange;
 - .2 T-22 - companion angle and gasket;
 - .3 T-24A - flanged.
- .4 Keep longitudinal joints at top surface of horizontal runs. Provide proper transverse supports to prevent deflection. Ensure duct is rigid.
- .5 When mastic is used for sealing such as sealing longitudinal joints, apply mastic to both surfaces before they are mated. When dry, apply mastic again for a water-tight seal.

3.04 Installation of Flexible Ductwork

- .1 For supply air ductwork, provide maximum 1.8 m fully stretched, long lengths of flexible ductwork for connections between galvanized steel duct mains and branches, and necks of ceiling grilles and diffusers. Do not install flexible ductwork through walls, even if shown on drawings.
- .2 For return air ductwork, provide maximum 1.0 m fully stretched, long lengths of flexible ductwork for connections between galvanized steel duct mains and branches, and necks of ceiling grilles. Do not install flexible ductwork through walls, even if shown on drawings.
- .3 At rectangular galvanized steel duct, accurately cut holes and provide flanged or "Spin-in" round flexible duct connection collars. Seal joints with duct sealer.

- .4 Install flexible ducts as straight as possible and support in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, and secure at each end with nylon or stainless steel gear type clamps, and seal joints. Provide long radius duct bends where they are required.
- .5 Do not penetrate fire barriers with flexible duct.

3.05 Installation of Acoustic Lining

- .1 Provide acoustic lining in ductwork in locations as follows:
 - .1 wherever shown and/or specified on drawings;
 - .2 supply ductwork downstream of air terminal boxes for a distance of 2.4 m (8') measured along duct and outward from box in all directions;
 - .3 all transfer air ducts.
- .2 Install lining in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible, however, for all installations regardless of velocity, at leading and trailing edges of duct liner sections, provide galvanized steel nosing channel in accordance with detail entitled Flexible Duct Liner Installation found in the ANSI/SMACNA manual referred to above.

3.06 Installation of Fire Rated Ductwork

- .1 Provide 2 hour fire rated ductwork.
- .2 Install ductwork in strict accordance with duct manufacturer's instructions using support hardware supplied with duct.
- .3 When installation is complete, arrange, and pay for duct manufacturer to visit site and examine duct installation. Make any revisions requested by manufacturer, and when manufacturer is satisfied with installation, obtain and submit a letter certifying proper installation in accordance with ULC requirements.

3.07 Installation of Casings and Plenums

- .1 Provide required shop or site fabricated casings and plenums. Unless otherwise specified or shown, construct casings and plenums of same material as connecting duct system.
- .2 Construct and install casings and plenums in accordance with Chapter 6 of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit systems' pressure classification. Ensure plenums and casings secured to building structure are gasketed air-tight and equipped with angle reinforcing.
- .3 Provide drain pans with accessible trapped drains for fresh air intake plenums, and wherever else shown.
- .4 In addition to SMACNA duct construction standards specified above, casings and plenums are to be constructed and installed to meet seismic requirements of British Columbia Building Code and ANSI/SMACNA - The Seismic Restraint Manual: Guidelines for Mechanical Systems.

3.08 Installation of Acoustic Panels

- .1 Provide acoustic panels for plenums. Integrate acoustic plenums with standard casings and plenums. Install acoustic panels in strict accordance with manufacturer's instructions. Seal panels with acoustic caulking where pipes, ducts or conduit penetrate and make air and watertight.
- .2 Provide floor to ceiling high acoustic plenums where shown, each complete with required framing, including framing for access doors and other openings, each structurally designed to resist excessive deflection or bowing, constructed to be air-tight when subjected to a pressure differential of 2.48 kPa (0.36 psi), and designed so any one panel can be removed without dismantling entire plenum.

- .3 Provide acoustic type access doors where shown, and provide acoustic caulking at all locations where acoustic plenums abut building walls or slabs, and at all points where pipe, ducts or conduit penetrate acoustic panels.
- .4 In addition to SMACNA duct construction standards specified above, acoustic plenums are to be constructed and installed to meet seismic requirements of [British Columbia Building Code] and ANSI/SMACNA, The Seismic Restraint Manual: Guidelines for Mechanical Systems.

3.09 Installation of Casing and Plenum Access Doors

- .1 Provide access doors into all site or shop fabricated casings and plenums requiring access, and wherever shown.
- .2 Construct access doors to open in or out to suit positive and negative pressures of system.
- .3 Provide pitot tube openings in access doors where required for system air quantity balancing purposes.
- .4 Provide suitably sized, engraved, red-white laminated Lamacoid warning nameplates on access doors into casings and plenums where equipment is located, i.e. fans.

3.10 Installation of Round to Rectangular Duct Connections

- .1 Cut round holes in rectangular ducts and provide round to rectangular lock-in fittings with dampers for connection of flexible round ductwork.

3.11 Installation of Splitter Dampers

- .1 Provide splitter dampers in supply ductwork at branch duct connections off supply air mains, and wherever else shown and/or specified on drawings. Install splitter dampers so they cannot vibrate and rattle and so damper operation mechanisms are in an easily accessible and operable location. Ensure operators for dampers in insulated ducts are equipped with stand-off mounting brackets.

3.12 Installation of Turning Vanes

- .1 Provide turning vanes in ductwork elbows where shown on drawings and wherever else required where, due to site installation routing and duct elbow radius, turning vanes are recommended in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .2 Provide volume extractor type turning vanes in short branch supply duct connections off mains to grilles and diffusers where shown and/or specified.

3.13 Installation of Manual Balancing (Volume) Dampers

- .1 Provide manual balancing dampers as required to provide a fully balanced system, including but not limited to in all open end ductwork, in all duct mains, and wherever else shown and/or specified.
- .2 Install dampers so operating mechanism is accessible and positioned for easy operation, and so dampers cannot move or rattle. Ensure operating mechanisms for dampers in insulated ducts are complete with stand-off mounting brackets.
- .3 Where a duct for which a balancing damper is required has dimensions larger than dimensions of maximum size volume damper available, provide multiple dampers bolted together in a properly sized assembly, or bolted to a heavy-gauge black structural steel angle or channel framework which is properly sized. Seal to prevent air by-pass, and provide connecting linkage.
- .4 Confirm exact damper locations with personnel doing air quantity balancing testing work and install dampers to suit. Include for providing 5 additional dampers at no additional cost.

3.14 Installation of Fusible Link Dampers

- .1 Provide fusible link dampers. Ensure damper rating (1-½ or 3 hr) is suitable for fire barrier it is associated with.
- .2 Install dampers with retaining angles on all 4 sides of sleeve on both sides of damper and connect with ductwork in accordance with damper manufacturer's instructions and details, and Code requirements.
- .3 Provide expansion clearance between damper or damper sleeve and opening in which damper is required. Ensure openings are properly sized and located, and all voids between damper sleeve and opening are properly sealed to maintain rating of fire barrier.
- .4 Where size of fire barrier opening requires use of a sectionalized fire damper assembly, provide multiple fusible link dampers (sized to CAN/ULC S112) bolted together in a properly sized assembly or bolted to a heavy-gauge black structural steel angle or channel framework.

3.15 Installation of Combination Fire/Smoke Dampers

- .1 Provide combination fire/smoke dampers. Install dampers with retaining angles on all 4 sides of each side of damper, and, where required, connect with ductwork, all in accordance with damper manufacturer's instructions and details, and Code requirements.
- .2 Coordinate damper installation with electrical work where electrical connections to damper actuators are specified.

3.16 Installation of Smoke Dampers

- .1 Provide smoke dampers. Install dampers with retaining angles on all 4 sides of sleeve on both sides of damper and connect with ductwork in accordance with damper manufacturer's instructions and details, and Code requirements.
- .2 Coordinate damper installation with electrical work where electrical connections to damper actuators are specified.
- .3 Where size of fire barrier opening requires use of a sectionalized fire damper assembly, provide multiple smoke dampers (sized to CAN/ULC S112) bolted together in a properly sized assembly or bolted to a heavy-gauge black structural steel angle or channel framework.

3.17 Installation of Flexible Connection Material

- .1 Provide a minimum of 100 mm (4") of flexible connection material where ducts, plenums, and/or easings connect to fans, and wherever else shown or specified.
- .2 Rigidly secure a minimum of 75 mm (3") of duct material (minimum #24 gauge) to each edge of flexible fabric and to fan, duct, plenum, etc., in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Ensure connections to flexible fabric material are arranged and supported so as to not impose any external forces on the fabric.
- .3 For system use high temperature flameproof flexible connection material.

3.18 Installation of Duct Access Doors

- .1 Provide access doors in ductwork for access to all components which will or may need maintenance and/or repair, including reheat coils. Install in accordance with requirements of ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .2 Identify access doors provided for fusible link damper maintenance with "FLD" stencil painted or marker type red lettering and ensure doors are properly located for damper maintenance.

- .3 When requested, submit a sample of proposed duct access doors for review.
- .4 Where sectionalized fusible link dampers and/or balancing dampers are provided in large ducts, provide a plenum type access door to suit, and adequately reinforce ductwork to suit access door installed.

3.19 Installation of Instruments Test Ports

- .1 Provide instrument test ports in all main ducts at connections to fans, plenums, or casings, in all larger branch duct connections to mains, and wherever else required for proper air quantity balancing and testing.
- .2 Locate test ports where recommended by personnel performing air quantity testing and balancing work.

3.20 Installation of Wire Mesh (Birdscreen)

- .1 Provide framed, removable wire mesh panels over openings in ducts and/or walls where shown and/or specified on drawings. Rigidly secure in place but ensure panels are removable.
- .2 Provide wire mesh panels for open-end return air ducts in ceiling spaces whether shown on drawings or not.

3.21 Installation of Fire Stop Flaps and Thermal Blankets

- .1 Provide fire stop flaps in duct connection necks of grilles and diffusers installed in ULC fire rated suspended ceiling systems where shown on drawings.
- .2 Provide thermal blanket material to completely cover grille and/or diffuser pans above suspended ULC fire rated ceilings. Cut, install, and secure in place in accordance with manufacturer's instructions and ULC requirements.

3.22 Installation of Grilles and Diffusers

- .1 Provide grilles and diffusers. Wherever possible, grilles and diffusers are to be product of same manufacturer.
- .2 Unless otherwise specified connect grilles and diffusers in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible.
- .3 Exactly locate grilles and diffusers to conform to final architectural reflected ceiling plans and detailed wall elevations, and to conform to final lighting arrangement, ceiling layout, ornamental and other wall treatment.
- .4 Equip supply diffusers having a basic 4-way or all round air pattern for operation in 1-, 2-, or 3-way pattern where indicated on drawings.
- .5 Attach troffer type diffusers associated with typical ceiling mounted fluorescent lighting fixtures to the fixtures on floor prior to fixture installation in ceiling. When fixtures are installed, connect diffuser boots with flexible ductwork.
- .6 Provide sheet metal plenums, constructed of same material as connecting duct, for linear grilles and/or diffusers where shown. Construct and install plenums in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible. Where individual sections of linear grilles or diffusers are not equipped with a volume control device, equip duct connection collar(s) with volume control device(s).
- .7 Where linear type diffusers/grilles are installed in suspended T-bar ceilings, clip diffusers/grilles in place using clip supplied by diffuser/grille manufacturer.
- .8 Confirm grille and diffuser finishes prior to ordering.

3.23 Supply of Door Grilles

- .1 Supply door grilles as shown and scheduled.
- .2 Hand grilles to appropriate trade at site for installation.

3.24 Duct System Protection, Cleaning and Start-Up

- .1 Temporarily cover all open ends of ducts during construction.
- .2 Remove all dirt and foreign matter from entire duct systems and clean duct system terminals and interior of air handling units prior to operating fans.
- .3 Prior to starting any supply air handling system provide 50 mm (2") thick glass fibre construction filters at fan equipment in place of permanent filters.
- .4 Provide cheesecloth over duct system inlets and outlets and run system for 24 hours, after which remove cheesecloth and construction filters, and install new permanent filters.
- .5 Include all labour for a complete site walk-through with testing and balancing personnel following route of all duct systems to be tested, adjusted, and balanced for the purpose of confirming proper position and attitude of dampers, location of pitot tube openings, and any other work affecting testing and balancing procedures. Perform corrective work required as a result of this walk-through.

End of Section

1 General

1.01 References

- .1 AHRI Standard 410-2023, Performance Rating of Forced-circulation Air-cooling and Air-heating Coils.
- .2 CSA C22.2 No. 155-M86 (R2022), Electric duct heaters.
- .3 CSA C22.2 No. 236-15, Heating and cooling equipment.

1.02 Submittals

- .1 Submit shop drawings/product data sheets for heating coils, including accessories.

2 Products

2.01 Duct Mounted Hydronic Heating Coils

- .1 Hydronic coils in accordance with drawing schedule, 1 or 2 row as indicated, each certified to AHRI Standard 410, Forced-Circulation Air-Cooling and Air-Heating Coils, each factory leakage tested at 2070 kPa (300 psi) under water, drainable, self-venting, and complete with:
 - .1 horizontal, continuous, 15.9 mm (5/8") diameter, 0.050 mm (0.020") wall thickness seamless copper tubes permanently bonded to plate or spirally wound aluminium fins and equipped with threaded female same end connections;
 - .2 flanged galvanized steel casing arranged to prevent air bypass around coil and factory punched for duct connections.
- .2 Where required, coils are to be manufactured as "Registered Fittings" with a Canadian Registration Number (CRN).
- .3 Manufacturers:
 - .1 Aerofin Canada Services Inc.;
 - .2 Carrier Corp.;
 - .3 McQuay International.

2.02 Duct Mounted Electric Reheat Coils

- .1 Electric reheat coils in accordance with drawing schedule, each certified in accordance with CSA C22.2 No. 155, Electric Duct Heaters and CSA C22.2 No. 236, and each complete with frame members, terminal boxes and covers and associated sheet metal work constructed of heavy-gauge die-formed steel with an integral corrosion-resistant coating and fabricated into coil shape by spot welding, a corrosion protected sheathed heating element, an automatic reset and an auxiliary manual reset snap-action high temperature limit control to protect coils from overheating from any cause, and a pre-wired control panel for electrical power and control connections.
- .2 Each control panel is to be complete with:
 - .1 disconnect switch;
 - .2 magnetic contactor(s);
 - .3 terminal blocks for power and control wiring connections;
 - .4 pre-wired differential pressure switch to shut-down coil upon sensing a "no-airflow" condition;

- .5 fused control transformer;
 - .6 electronic step controller to suit the number of heating stages;
 - .7 fused SCR (silicon control rectifier).
- .3 Manufacturers:
- .1 INDEECO;
 - .2 Thermolec Manufacturing Ltd.;
 - .3 Chromalox Inc.;
 - .4 Condex Wattco Inc.

2.03 Explosion-Proof Duct Mounted Electric Reheat Coils

- .1 Equal to INDEECO "ULTRA-SAFE" FM approved explosion-proof electrical duct heaters in accordance with drawing schedule, each certified in accordance with CSA C22.2 No. 155, CSA C22.2 No. 236, each suitable for Class 1, Division 1 and 2, Group D locations and complete with:
- .1 corrosion-resistant irridite coated liquid-to-air heat exchanger with copper tube, aluminum fins, non-toxic and inhibited propylene glycol heat transfer liquid, pressure reducing valve set at 1170 kPa (175 psi), and industrial grade electric heating elements;
 - .2 flanged stainless steel frame;
 - .3 epoxy coated, cast aluminum, explosion-proof, factory pre-wired terminal box containing electrical power and control components including automatic reset and manual reset high temperature cut-outs, magnetic contacts, 24 volt control transformer, built-in airflow proving switch, disconnect switch, terminal blocks for power and control wiring connections, and solid state control with SCR;
 - .4 explosion-proof 24 volt wall mounting thermostat supplied loose for field installation.

3 Execution

3.01 Installation of Duct Mounted Hydronic Heating Coils

- .1 Provide duct mounting heating coils in supply ductwork.
- .2 Secure each coil in place from structure by means of hanger rods, independent of connecting ductwork but ready for duct connection and located for easy removal and access to power and control panel.
- .3 Connect with piping in accordance with drawing detail.

3.02 Installation of Duct Mounted Electric Reheat Coils

- .1 Provide electric reheat coils in supply ductwork.
- .2 Secure each coil in place from structure by means of hanger rods, independent of connecting ductwork and located for easy removal and access to power and control panel.
- .3 Coordinate installation with electrical trade who will connect coil with power wiring.

End of Section

1 General

1.01 Submittals

- .1 Submit shop drawings/product data sheets for all products specified in this Section. Include motor data sheets and all required information.

1.02 Closeout Submittals

- .1 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this Section.
- .2 Training attendance records.

1.03 Quality Assurance

- .1 Fan coil units are to be CSA or cETL listed and labelled, factory assembled and tested, shipped to site in one-piece, and are to be in accordance with requirements of following codes and regulations:
 - .1 CAN/CSA-C22.2 No. 236, Heating and Cooling Equipment;
 - .2 UL/ANSI 1995, Heating and Cooling Equipment;
 - .3 ANSI/AHRI Standard 350, Sound Performance Rating of Non-Ducted Indoor Air-Conditioning Equipment;
 - .4 ANSI/AHRI Standard 440, Performance Rating of Room Fan-Coils;
 - .5 Applicable Provincial Codes and Regulations.

2 Products

2.01 Horizontal Fan Coil Units

- .1 AHRI rated and certified capacity fan coil units in accordance with drawing schedule and complete with components specified below.
- .2 Cabinet constructed of heavy-gauge galvanized steel with all exterior panels insulated with minimum 15 mm (½") thick neoprene spray coated glass fibre lining material secured in place with adhesive and with all exposed edges treated and sealed to prevent any fibres from entering airstream, all meeting NFPA 90A requirements and 25/50 flame spread/smoke developed fire hazard ratings when tested to CAN/ULC-S102. Each cabinet is to be complete with:
 - .1 accessible galvanized steel filter holding frame and glass fibre, 25 mm (1") thick, disposable, UL Class 1, 25-30% efficient MERV 7 filters in accordance with requirements of UL 900, Air Filter Units, and complete with a cardboard frame;
 - .2 factory tested coils consisting of 12 mm (½") O.D. seamless copper tubes mechanically expanded into plate type aluminium fins and equipped with copper pipe headers, a manual air vent, and a drain plug;
 - .3 full width, watertight stainless steel primary drain pans sloped for positive drainage and equipped with 2, 20 mm (¾") O.D. drain connections, and factory insulated with 25/50 flame spread/smoke developed rated closed cell insulation when tested to CAN/ULC-S102 and NFPA 90A requirements, with secondary drain pans, constructed and insulated as for primary drain pans, to be provided where required to collect condensate from pipe headers and field supplied valves.
- .3 Centrifugal, forward curved, double width and inlet galvanized steel fan wheel, each dynamically balanced, complete with a 3-speed, resiliently mounted, thermal overload protected, permanent split

capacitor motor conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical, and complete with a 3-speed plus "off" motor control switch with faceplate factory mounted in an electrical box secured to unit in an accessible location and factory connected to motor. Fan assemblies are to be accessible and easily removable.

- .4 Horizontal units are to be suspended, equipped with 4 top casing holes for hanger rod connections, and following:
 - .1 rubber-in-shear vibration isolation elements factory supplied with each unit for each suspension point;
 - .2 double deflection discharge grille or flanged discharge duct connection collar as indicated, and either a bottom or rear single deflection return air grille as shown;
 - .3 removable bottom and side panels, and bottom access to filter holding frame;
 - .4 for exposed units, a fused powder epoxy finish on casing and grilles.
- .5 Vertical units are to be, unless otherwise shown or specified, floor mounted on neoprene-steel-neoprene vibration isolation pads and complete with following:
 - .1 condensate drain pan "P" trap factory piped to condensate drain riser;
 - .2 shield to cover entire fan assembly to prevent air by-pass and accidental contact with fan;
 - .3 for exposed front units, a removable decorator front panel with architectural grade aluminium double deflection discharge grille and return air grille, all factory finished with heat cured acrylic powder epoxy enamel;
 - .4 for concealed units, a duct connection collar on the discharge.
- .6 Seismic restraint connection hardware factory secured to each unit.
- .7 Manufacturers:
 - .1 Johnson Controls Co. ENVIRO-TECH;
 - .2 Daiken Industries Inc.;
 - .3 Trane Canada;
 - .4 Carrier Corp.;
 - .5 Greenheck Fan Corp.;
 - .6 Engineered Air.

3 Execution

3.01 Installation

- .1 Provide fan coil units.
- .2 Secure each horizontal fan coil unit in place from structure by means of galvanized steel hanger rods, and vibration isolation elements supplied with fan coil units. Provide additional structural steel for fan coil unit support installation as required.
- .3 Unless otherwise shown or specified, secure each vertical fan coil unit in place on floor, complete with vibration isolation pads supplied with fan coil units.

- .4 Brace and secure each unit in accordance with requirements specified in Section 20 05 48.16 – Seismic Controls for Mechanical Systems.
- .5 Provide shut-off valves and install a control valve in piping for each coil. Refer to drawing detail and piping schematic.

3.02 System Startup

- .1 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.
- .2 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.

3.03 Training

- .1 Include for a 1/2 day on-site operation demonstration and training session. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

End of Section

1 General

1.01 Submittals

- .1 Submit shop drawings/product data sheets for following:
 - .1 all control system components;
 - .2 identified schematic control diagrams with component identification, catalogue numbers, and sequence of operation for all systems;
 - .3 certified wiring diagrams for all systems.

1.02 Closeout Submittals

- .1 Submit a site inspection and start-up report from manufacturer's representative as specified in Part 3 of this Section.
- .2 Submit written confirmation from control component manufacturer that site installation personnel are qualified and experienced in installation of components, and have parts and service availability on a 24/7 basis.

1.03 Quality Assurance

- .1 Control systems are to be installed by control component manufacturer or by licensed personnel authorized by control component manufacturer. Submit written confirmation from control component manufacturer.
- .2 Control wiring work is to be performed by licensed journeyman electricians, or under direct daily supervision of journeyman electricians.

2 Products

2.01 Automatic Control Valves and Operators

- .1 Each control valve must be suitable in all respects for the application, including system pressure, and must be suitable to the existing building automation system protocol.
- .2 Body and trim materials selected in accordance with specification for globe valves, ball valves, or high performance butterfly valves, and in accordance with manufacturer's recommendations for design conditions and service.
- .3 Size control valves for pressure drops and heating and cooling loads as scheduled with same pressure rating as globe valves under same service and pressure conditions.
- .4 Size valves for two port and three port, two position service;
 - .1 line size,
 - .2 ball valves, sizes NPS 1-1/2 and smaller,
 - .3 butterfly valves, sizes NPS 2 and larger.
- .5 For two port and three port modulating service;
 - .1 use globe valves for CV rating 160 and smaller,
 - .2 use butterfly valves for CV rating above 160.

- .6 Select butterfly valves based on CV rating at 70° rotation
- .7 Hydronic system valves;
 - .1 two position service;
 - .1 straight through two port type, single seated, with replaceable disc or ball,
 - .2 quick opening linear or equal percentage flow characteristics.
 - .2 modulating service;
 - .1 straight through two port type, single seated,
 - .2 equal percentage flow characteristics.
 - .3 modulating diverting service; three port mixing valves,
 - .1 linear for each port to give constant total flow or,
 - .2 equal percentage flow characteristics with 25% valve authority (valve pressure drop equal to 33% pressure drop through load at full flow).
 - .4 actuator and trim selected for close-off pressure ratings as follows;
 - .1 two-way modulating or two position service; 150% of pump shut off head.
 - .2 three-way modulating service; 300% of pressure differential between ports A and B at design flow or 100% of pump shut off head.
 - .3 shut off head to be based on maximum rpm when pump is fitted with VFD.
 - .5 sized as follows;
 - .1 for two-position service; line size.
 - .2 for two-way modulating service unless otherwise shown; pressure drop at design flow equal to greatest of;
 - .1 200% of pressure drop through heat exchanger,
 - .2 100% of pressure drop through coil,
 - .3 50% of pressure difference between supply and return mains, or
 - .4 35 kPa (5 psi).
 - .3 for three-way modulating service; pressure drop equal to smaller of;
 - .1 twice pressure drop through coil or heat exchanger, or
 - .2 35 kPa (5 psi).
 - .4 for valves for radiation, terminal units and reheat coils;
 - .1 pressure drop of 7 kPa (1 psig)
 - .6 failed position on isolation from control signal as follows;
 - .1 Heating water and glycol zone valves; fail open.

- .2 Heating coil valves in AHU; fail open.
- .3 Chilled water control valves; fail closed.
- .4 Chilled water differential pressure by-pass control valves; fail open.
- .5 Hot water and glycol differential pressure by-pass control valves; fail closed.
- .8 Valve actuators for service on radiation, radiant panel, and reheat coil valve applications;
 - .1 output shaft driven by gear train mechanism.
 - .2 reversible motor with automatic load limit,
 - .3 input type and range as suitable for interfacing to output of BAS controllers,
 - .4 adjustable span and offset travel,
 - .5 position feedback signal on actuators used for proportional control,
 - .6 general purpose, dustproof, die-cast aluminum housing,
 - .7 actuator rotation limit.
- .9 Chilled water "energy valves":
 - .1 Belimo Energy Valve, pressure independent complete with Power Control and Belimo Delta T Manage logic built in to monitor coil performance and optimize the available energy of the coil by maintaining Delta T, standard analog signal and feedback wiring and connection to the BAS via BACnet MS/TP and built-in web server for visualization of the valves' operation in real time.
- .10 Unless otherwise specified, pneumatic valve operators are to be renewable neoprene diaphragm piston type. Pneumatic operators used to sequence multiple valves must be equipped with a pilot positioner to ensure proper sequence of each valve and allow for an adjustable "dead band" between heating and cooling valves.

2.02 Control Dampers and Operators

- .1 T. A. Morrison & Co. Inc. "TAMCO" 100 mm (4 in) deep, flanged, AMCA low leakage certified aluminium dampers. Dampers for modulating and mixing applications are to be parallel blade type. Dampers for open-shut service are to be opposed blade type. Maximum blade length is to be 1 m (4 ft). Dampers greater than 2 sections wide are to be complete with a jackshaft. Each damper is to be complete with:
 - .1 extruded 6063T5 aluminum frame and airfoil blades, each with an integral slot to receive a gasket;
 - .2 extruded TPE frame gaskets and extruded EPDM blade gaskets;
 - .3 slip-proof aluminium and corrosion resistant plated steel linkage of a metal thickness to prevent warping or bending during damper operation, concealed in frame, equipped with seal-sealing and self-lubricating bearings consisting of a Celcon inner bearing fixed on hexagonal blade pin and rotating in a polycarbonate outer bearing inserted in frame.
- .2 For standard damper(s), Series 1000 as above.
- .3 For insulated damper(s), Series 9000 as above but with all 4 sides of frame insulated with polystyrene, and blades thermally broken and insulated with expanded polyurethane foam.
- .4 For stainless steel dampers, as above but constructed of type 316 stainless steel and equipped with Teflon blade bearings.

- .5 Each damper motor is to be shaft mounted, spring return, fail safe in the normally open or normally closed position, sized to control damper against maximum pressure or dynamic closing pressure, whichever is greater, to suit sizes of dampers involved, and to provide sufficient force to maintain damper rated leakage characteristics. Each operator is to be complete with a damper position indicator, and external adjustable stops to limit length of stroke in either direction, and is to be mounted on a corrosion resistant adjustable bracket. Operating arms are to have double yoke linkages and double set screws for fastening to damper shaft. Operators for dampers to be connected to building fire alarm system or to freeze protection devices are to be equipped with additional relays to permit dampers to respond and go to required position in less than 15 s upon receipt of a signal. Operator enclosures are to be suitable in all respects for environment in which they are located.
- .6 Electric damper operators are to be equal to Belimo EF Series 24 V or 120 VAC spring return, direct coupled electric motor operators for either modulating or 2-position control as required. Each operator is to be overload protected and complete with an enclosure to suit the mounting location.
- .7 Pneumatic damper operators are to be replaceable elastomer diaphragm piston type, suitable in all respects for damper sequence.

2.03 Local Control Panels

- .1 NEMA 1 (NEMA 2 in sprinklered areas) wall mounting, enamelled steel barriered enclosures sized to suit the application with 20% spare capacity, a perforated sub-panel, numbered terminal strips for all low and line voltage wiring, hinged door, and slotted flush latch.

2.04 Control System Components

- .1 Components specified below are required for control of equipment and systems in accordance with drawing control diagrams and sequences of operation. Not all required components may be specified.
- .2 Sensor/transmitter input devices must be suitable in all respects for the application and mounting location. Devices are as follows:
 - .1 unless otherwise specified, temperature sensors are to be resistance type, either 2-wire 1000 ohm nickel RTD or 2-wire 1000 ohm platinum RTD with accuracy (includes errors associated with sensor, lead wire, and A to D conversion), equipped with type 316 stainless steel thermowells for pipe mounting applications, as follows:
 - .1 chilled water, room temperature, and duct temperature points, $\pm 1^{\circ}\text{C}$ ($\pm 0.5^{\circ}\text{F}$);
 - .2 all other points, $\pm 0.75^{\circ}\text{C}$ ($\pm 1.3^{\circ}\text{F}$).
 - .2 room temperature sensors constructed to be selected in accordance with the following classifications:
 - .1 Type 1: Space temperature sensor (private/non-public areas);
 - .1 for measurement of space temperature only as shown on the floor plans and/or as described in the Sequence of Operation;
 - .2 set-point adjustment shall be accessible through the cover;
 - .3 sensor operating temperature range from 4°C to 60°C (40°F to 140°F);
 - .4 surface mounted plastic mono-chromatic guard with surface mounting plate and wall anchors;
 - .5 mono-chromatic guard secured to mounting plate by screws;
 - .2 Type 2: Space temperature sensor (public areas or secure areas);

- .1 for measurement of space temperature of space temperature only in areas subject to vandalism as shown on the floor plans and/or as described in the Sequence of Operation;
- .2 sensor operating temperature range from 4°C to 60°C (40°F to 140°F);
- .3 stainless steel flat plate surface type with sensor epoxy-bonded to back of cover plate;
- .4 tamperproof/secure concealed fasteners;
- .5 set-point adjustment is to be concealed behind the cover.
- .3 Type 3: Adjustable space temperature sensor with display (Private Areas, Office areas);
 - .1 for measurement and adjustment of space temperature as shown on the floor plans and/or as described in the Sequence of Operation;
 - .2 digital set point operating temperature adjustment range from 4°C to 60°C (40°F to 140°F);
 - .3 surface mounted plastic mono-chromatic guard with surface mounting plate and wall anchors;
 - .4 mono-chromatic guard secured to mounting plate by screws;
 - .5 on/off button to allow occupant override feature;
 - .6 three-digit LED digital temperature display with 0.2° display resolution;
 - .7 5% to 95% relative humidity, non-condensing;
 - .8 minimum/maximum limit set point values adjustable from the BAS operator interface and controller.
 - .9 set-point adjustment is to be accessible through the cover.
- .3 outside air sensors designed and constructed for an ambient temperature of -25°C to 60°C (-13°F to 140°F) and 5% to 95% relative humidity, non-condensing, complete with a NEMA 3R enclosure, solar shield, a weatherproof seal at all wall penetrations, and a perforated plate surrounding sensor element where exposed to wind velocity pressure;
- .4 insertion duct mounting sensors type with lock nut and mounting plate, designed to mount in an electrical box (weatherproof with gasket and cover where outside) through a hole in duct;
- .5 for ducts greater than 1.2 m (4 ft) or for ducts where air temperature stratification occurs, averaging type sensors with multiple sensing points, and for plenums for applications such as mixed air temperature measurement to account for air turbulence and/or stratification, an averaging string of sensors with capillary supports on the sides of duct/plenum;
- .6 Where both temperature and humidity are shown to be measured at same location or in same airstream, use of single measuring unit is permitted provided that features and performance of both temperature sensor and humidity sensor are in accordance with requirements of this specification.
- .3 factory solid-state relative humidity sensors with an element that resists contamination, weather-proof with a NEMA 3R enclosure for outside air applications, supplied with a type 304 stainless steel probe with mounting bracket and hardware for duct mounting, each complete with a factory calibrated humidity transmitter which is accurate (including lead loss and analog to digital conversion) to 3% between 25°C to

60°C (-13°F to 140°F) and 5% to 95% relative humidity, non-condensing and complete with non-interactive span and zero adjustments, and a 2-wire isolated loop powered, 4-20 mA, 0 to 100% linear proportional output;

- .4 carbon dioxide sensors for air quality control purposes having a maximum 20 s response time, suitable for operating conditions from 0°C to 50°C (32°F to 122°F) and 0 to 100% RH non-condensing, complete with a calibration kit (to be handed to Owner) and characteristics as follows:
 - .1 measurement range: 0 to 2000 ppm;
 - .2 accuracy: ± 100 ppm;
 - .3 repeatability: ± 20 ppm;
 - .4 drift: ± 100 ppm per year;
 - .5 output signal: 0-10 VDC proportional over the 0 to 2000 ppm range.
- .5 Pressure transmitters are to be constructed to withstand 100% pressure over-range without damage and to hold calibrated accuracy when subject to a momentary 40% over-range input. Pressure transmitters are to transmit a 0 to 5 VDC, 0-10 VDC, or 4-20 mA output signal. Differential pressure transmitters used for flow measurement are to be sized to the flow sensing device and supplied with a tee fitting and shut-off valves in the high and low sensing pick-up lines to allow permanent ease of use connection for balancing, etc. Transmitter housing is to suit mounting location. Standalone pressure transmitters are to be mounted in a minimum NEMA 1 (NEMA 2 in sprinklered area) by-pass valve assembly panel with high and low connections piped and valved, air bleed units, by-pass valves, and compression fittings. Transmitters are to be as follows:
 - .1 low differential water pressure, 0 to 5 kPa (0 to 20" wc): equal to Setra or Mamac industrial quality transmitter capable of transmitting a linear 4-20 mA output signal in response to variation of flow meter differential pressure or water pressure sensing points, each complete with non-interactive zero and span adjustments adjustable from outside the cover, and performance as follows:
 - .1 maintain accuracy up to 20 to 1 ratio turndown;
 - .2 reference accuracy: $\pm 0.2\%$ of full scale.
 - .2 medium to high differential water pressure, over 5 kPa (20" wc): equal to Setra or Mamac transmitters as specified above for low pressure transmitters but with a pressure range of from 2.5 kPa (10" wc) to 2070 kPa (300 psi), a reference accuracy of $\pm 1\%$ of full span (includes non-linearity, hysteresis, and repeatability);
 - .3 building differential air pressure: equal to Setra or Johnson Controls Inc. industrial quality transmitter with a range suitable for the application, capable of transmitting a linear 4-20 mA output in response to variation of differential pressure or air pressure sensing points, each complete with non-interactive zero and span adjustments adjustable from outside the cover, and performance as follows:
 - .1 maintain accuracy up to 20 to 1 ratio turndown;
 - .2 reference accuracy: $\pm 0.2\%$ of full span.
 - .4 low differential air pressure, 0 to 1.25 kPa (0" to 5" wc): equal to Setra or Johnson Controls Inc. industrial quality transmitter with a range suitable for the application, capable of transmitting a linear 4-20 mA output signal in response to variation of differential pressure or air pressure sensing points, each complete with non-interactive zero and span adjustments adjustable from outside the cover, and performance as follows:
 - .1 maintain accuracy up to 20 to 1 ratio turndown;

- .2 reference accuracy: +0.2% of full span.
- .5 medium differential air pressure, over 1.5 kPa (5" wc): equal to Setra or Johnson Controls Inc. transmitters as specified above for low pressure air transmitters but performance requirements as follows:
 - .1 zero and span: (c/o F.S./°F); 0.04% including linearity, hysteresis, and repeatability;
 - .2 accuracy: 1% F.S. (best straight line); static pressure effect: 0.5% F.S.;
 - .3 thermal effects: less than +0.33 F.S./°F over 40°F to 100°F (calibrated at 70°F).
- .6 Air and water flow monitoring stations and probes are to be Air Monitor Corp., Tek-Air Systems Inc., Ebtron, or Dietrich Standard products as follows:
 - .1 Fan Inlet Air Flow Measuring Station: At fan inlet and near exit of inlet sound trap, air flow traverse probes are to continuously monitor fan air volume and system velocity pressure, and traverse probes are to be as follows:
 - .1 each probe is to be of a dual manifold, cylindrical, anodized type 3003 extruded aluminium construction probe with sensors located along the stagnation plane of approaching air flow, and the static pressure manifold is to incorporate dual offset static tops on opposing sides of averaging manifold so as to be insensitive to flow angle variations for as much as $\pm 20^\circ$ in approaching air stream;
 - .2 each probe is not to introduce a measurable pressure drop, nor is sound level within duct to be amplified by its singular or multiple presence in air stream, and each probe is to contain multiple static and total pressure sensors places at equal distances along its length in accordance with ASHRAE Standards for duct traversing.
 - .2 Single Probe Air Flow Measuring Sensor: Duct mounting hot wire anemometer type which utilizes 2 temperature sensors, one is a heater element temperature sensor and the other is to measure downstream temperature, with temperature differential related directly to air flow velocity. Sensor insertion length is to be adjustable up to 200 mm (8 in), and transmitter is to produce a 4-20 mA or 0-10 VDC signal linear to air velocity.
 - .3 Duct Flow Measuring Stations: 14 gauge galvanized steel casing with duct connection flanges of a size to mate with connecting ductwork, and complete with an air directionalizer and a 98% free area parallel cell 20 mm (3/4") honeycomb profile suppressor across entering air stream to equalize velocity profile and eliminate turbulent and rotational flow from the air stream prior to measuring point, mechanically fastened to casing so as to withstand velocities of up to 1828 m (6000 ft) per minute. Additional requirements as follows:
 - .1 total pressure measurement side (high side) is to be designed and spaced to requirements of Industrial Ventilation Manual, 16th Edition, page 9-5, and self-averaging manifolding is to be constructed of brass and copper components;
 - .2 static pressure sensing probes (low side) is to be bullet-nose shaped, per detailed radius, as illustrated in Industrial Ventilation Manual referred to above, page 9-5;
 - .3 main take-off point from both total pressure and static pressure manifolds is to be symmetrical, and manifolds are to terminate with external ports for connection to control tubing;
 - .4 each station is to be equipped with a label on casing indicating unit model number, size, area, and specified air flow capacity;
 - .5 each station is to have a self-generated sound rating of less than NC 40, and sound level within duct is not to be amplified nor is additional sound to be generated.

- .4 Static Pressure Traverse Probe: Duct mounting, complete with multiple static pressure sensors located along exterior surface of cylindrical probe.
- .5 Shielded Static Air Probe: Indoor type or outdoor type as required, each with multiple sensing ports, an impulse suppression chamber, and air flow shielding.
- .6 Water Flow Monitoring: Equal to Onicon microprocessor-based electromagnetic water flow meters with an accuracy of 0.25%.
- .7 Power (amps) monitoring is to be performed by a combination of a current transformer and a current transducer with transformer sized to reduce full amperage of monitored circuit to a maximum 5 A signal which will be converted to a 4-20 mA DDC compatible circuit for use by building automation system. Current transformer and current transducer are as follows:
 - .1 equal to Veris Industries split core current transformer with an operating frequency of from 50 Hz to 400 Hz, 0.6 kV class, 10 kV BIL insulation, and 5 A secondary;
 - .2 equal to Veris Industries current to voltage or current to mA transducer with an accuracy of $\pm 5\%$, a minimum load resistance of 30 kOhm, an input of 0 to 20 A and an output of 4-20 mA, and a 24 VDC regulated power supply.
- .8 Duct mounting smoke detectors supplied as part of electrical work for mounting as part of control system work.
- .9 Double contact switches to monitor equipment status and safety conditions, and generate alarms when a failure or abnormal condition occurs. Status and safety switches are to be as follows:
 - .1 current sensing switches: equal to Veris Industries self-powered dry contact output switches for sensing run status of motor loads, each calibrated to indicate a positive run status only when motor is operating under load, and each consisting of a current transformer, a solid-state current sensing circuit, adjustable trip point, solid-state switch, SPDT relay, and a LED to indicate on or off status;
 - .2 air filter status switches: equal to Johnson Controls Inc. or Cleveland Controls automatic reset type differential pressure switches, each complete with SPDT contacts rated for 2 A at 120 VAC, a scale range and differential pressure adjustment appropriate for the service, and an installation kit which includes static pressure taps, tubing, fittings, and air filters;
 - .3 air flow switches: equal to Johnson Controls Inc. or Cleveland Controls pressure flow switches, bellows actuated mercury switch or snap-acting micro-switch type with an appropriate scale range and pressure adjustment;
 - .4 air pressure safety switches: equal to Johnson Controls Inc. or Cleveland Controls manual reset switches, each complete with SPDT contacts rated for 2 A at 120 VAC and an appropriate scale range and pressure adjustment;
 - .5 water flow switches: equal to Johnson Controls Inc. Model P74;
 - .6 low temperature limit switches: manual reset type equal to Johnson Controls Inc. Model A70, each complete with DPST snap acting contacts rated for 16 A at 120 VAC, a minimum 4.5 m (15 ft) sensing element for mounting horizontally across duct/plenum with sensing reaction from coldest 450 mm (18 in) section of element, and where sensing element does not provide full coverage of air stream, additional switches are to be supplied as required.
- .10 Control relays as follows:
 - .1 control pilot relays: equal to Johnson Controls Inc. or Lectro modular plug-in design with snap-mount mounting bases, retaining springs or clips, DPDT, 3 PDT or 4 PDT as required for the application, with contacts rated for 10 A at 120 VAC;

- .2 lighting control relays: latching type with integral status contacts rated for 20 A at 120 VAC, each complete with a split low voltage coil that moves the voltage contact armature to On or Off latched position, each controlled by a pulsed tri-state output (preferred) or pulsed paired binary outputs, and each designed so power outages will not result in a change-of-state and so multiple same state commands will simply maintain commanded state.
- .11 Electronic signal isolation transducers equal to Advanced Control Technologies for installation whenever an analog output signal from building automation system is to be connected to an external control system as an input (i.e. equipment control panel), or is to receive as an input signal from a remote system, and to provide ground plane isolation between systems.
- .12 Each manual override station is to be complete with contacts rated minimum 1 A at 24 VAC and is to provide following:
 - .1 integral H-O-A switch to override controlled device pilot relay;
 - .2 status input to building automation system to indicate whenever switch is not in the Auto position;
 - .3 status LED to illuminate whenever output is On;
 - .4 override LED to illuminate whenever H-O-A switch is in either the Hand or Off position.
- .13 Electronic/pneumatic transducers equal to Johnson Controls Inc. transducers with an output of from 3 psig to 15 psig, an input of from 4-20 mA or 0-10 VDC, manual output adjustment, a pressure gauge, and an external replaceable supply air filter.
- .14 Thermostats:
 - .1 Wall mounting adjustable set-point thermostats, each suitable in all respects for equipment (and operating sequence) they are provided for, equipped with a thermometer, a cover and any required mounting and connection accessories. Type to match existing building system.
 - .2 Pneumatic thermostats are to be of bimetal element construction, double valve type, operating without constant waste of air.
 - .3 Line voltage thermostats are to be 115 V.
 - .4 Low voltage thermostats are to be 24 V electronic type.
 - .5 Set-point adjustment for thermostats in public spaces is to be concealed behind cover. Set-point adjustment for other thermostats is to be accessible through cover.
 - .6 Covers are to be removable, tamper-proof covers with temperature set-point and thermometer displays.
 - .7 Guards for thermostats are to be clear, ventilated acrylic covers with Allen key locking hardware.
- .15 Hardware to permit building automation system control and monitoring of input/output points in accordance with the existing Building Automation System, points schedule, and drawing control diagrams and operation sequences. All such hardware is to be suitable in all respects for interface with the building automation system.

2.05 System Wiring Materials

- .1 System wiring, conduit, boxes, and similar materials are to be in accordance with requirements specified in appropriate Section(s) of Electrical Work specification.

3 Execution

3.01 General Re: Installation of Controls

- .1 Provide complete systems of control and instrumentation to control and supervise building equipment and systems in accordance with this Section and drawings.
- .2 Control systems are to generally be as indicated on drawing control diagrams and are to have all the elements therein indicated or implied.
- .3 Control diagrams show only the principal components controlling the equipment and systems. Supplement each control system with all relays, transformers, sensors, etc., required to enable each system to perform as specified and to permit proper operation and supervision.
- .4 Brace and secure control system equipment in accordance with requirements specified in Section 20 05 48.16 – Seismic Controls for Mechanical Systems.

3.02 Installation of Control Air Piping and Tubing

- .1 Provide required control air piping and tubing.
- .2 Connect new control air piping/tubing to existing pneumatic control air supply.
- .3 Piping/tubing is to be as follows:
 - .1 for piping mains and branches, type "M" seamless copper;
 - .2 for exposed connections to control components, hard or soft copper tubing;
 - .3 for tubing in accessible ceiling spaces, plenum rated polyethylene, neatly bundled with plastic ties and properly supported;
 - .4 for connections to control components within control cabinets, soft copper or plenum rated polyethylene tubing.
- .4 Properly install and support piping and tubing. Provide suitably sized trap legs with drain valves at all low points to prevent condensation pockets.
- .5 Solder all copper joints except at instruments or panels where compression fittings are to be used.

3.03 Installation of Thermostats

- .1 Unless otherwise noted, provide required thermostats.
- .2 Provide a ventilated clear acrylic cover for each thermostat located in finished areas, and a wire type guard for each thermostat located in unfinished areas and in areas such as mechanical rooms where thermostat is subject to damage.
- .3 Unless otherwise indicated, mount room thermostats 1.5 m (5 ft) above finished floor level. Thermostats intended to be used by building occupants in a barrier-free path of travel to be mounted at 1.2 m (4 ft). Confirm exact location of all thermostats prior to roughing-in.
- .4 Provide stand-off mounting and an insulated sub-base for thermostats on outside walls.
- .5 Perform control wiring associated with installation of electric or electric-electronic thermostats.

3.04 Installation of Control System Components

- .1 Provide required control system components and related hardware. Refer to drawing control diagrams and sequences.
- .2 Where components are pipe, duct, or equipment mounted supply components at proper time, coordinate installation with appropriate trade, and ensure components are properly located and mounted.

3.05 Control Wiring

- .1 Perform required control wiring work for control systems except:
 - .1 power wiring connections to equipment and panels, except as noted below;
 - .2 control wiring associated with mechanical plant equipment and systems whose control is not part of work specified in this Section;
 - .3 starter interlock wiring.
- .2 Except as specified below, install wiring in conduit. Unless otherwise specified, final 600 mm (2 ft) connections to sensors and transmitters, and wherever conduit extends across flexible duct connections is to be liquid-tight flexible conduit.
- .3 Control wiring in ceiling spaces and wall cavities may be plenum rated cable installed without conduit but neatly harnessed, secured, and identified.
- .4 Wiring work is to be in accordance with certified wiring schematics and instructions, and wiring standards specified in appropriate Sections of Electrical Work Specification.

3.06 Identification and Labelling of Equipment and Circuits

- .1 Refer to identification requirements specified in Section 20 05 00 – Common Work Results for Mechanical.
- .2 Identify equipment as follows:
 - .1 enclosures and components: engraved laminated nameplates with wording listed and approved prior to manufacture of nameplates;
 - .2 wiring: numbered sleeves or plastic rings at both ends of conductor, with numbering corresponding to conductor identification on shop drawings and "as-built" record drawings.

3.07 Testing, Adjusting, Certification, Start-Up, and Training

- .1 When control work is complete, check installation of components and wiring connections, make any required adjustments, and coordinate adjustments with personnel doing HVAC testing, adjusting, and balancing work.
- .2 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.
- .3 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.
- .4 Include for 2 full, 8 hour days on-site operation demonstration and training sessions. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

- .5 Include for 2 follow-up site training and troubleshooting visits, one 6 months after Substantial Completion and other at end of warranty period, both when arranged by Owner and for a full, 8 hour day to provide additional system training as required, and to demonstrate troubleshooting procedures.

End OF Section

1 General

1.01 Summary

- .1 Section Includes
 - .1 Staging and coordination requirements for the replacement of main electrical distribution equipment, while eliminating, or minimizing the impact to the Owner's ongoing use of the facility during the changeover. This includes, but is not limited to:
 - .1 Replacement of obsolete main switchboard and utility service.
 - .2 Temporary power provisions, and temporary wiring.
 - .3 Re-connection of existing branch feeders.
 - .2 Related Requirements
 - .1 Section 26 21 16 – Low-Voltage Underground Electrical Service Entrance.
 - .2 Section 26 24 13 – Switchboards.
 - .3 Single Line Diagram.

1.02 References

- .1 Ontario Electrical Safety Code: Section 76 – Temporary Wiring.

1.03 Submittals

- .1 Refer to Section 01 33 00.
- .2 Submit staging plan to the Consultant for scheduling replacement of switchboard to maintain operation of existing facility. Include proposed routing of all temporary feeders.
- .3 Submit a detailed Method of Procedures (MOP) document that provides detailed step-by-step instructions for how the work is to be executed.

2 Products

- .1 Temporary Electrical Distribution
 - .1 Weatherproof distribution centres capable of being mounted outdoors to suit space constraints indoors in area of work, installed in a temporary trailer, or included as part of the temporary generator.
 - .2 120/208 volt, 3-phase, 4-wire distribution, match size of existing branch circuit devices.

2.02 Temporary Cables, Connectors, and Supports

- .1 Cables to OESC Section 75 requirements, lengths to suit generator location.
 - .1 SJO cables unless noted otherwise.
 - .2 Non-metallic (NM) building wire with sheathed plastic coating is permitted for feeds up to 100 A.
- .2 Connectors.
- .3 Cable covers: yellow and black, rigid plastic, installed in all pedestrian paths.

- .4 Cable tray: aluminum cable tray sized to support conductors.

3 Execution

3.01 Examination

- .1 Verification of Conditions
 - .1 Refer to single line diagram and existing panelboard schedules for a summary of existing branch circuits.
 - .2 During the bidding period, the Contractor is to conduct a survey of all loads fed from the existing main switchboard, and determine locations, and pathways for all temporary feeders.
 - .3 During the bidding period, Owner to submit existing peak demand load over the past 12 months for sizing of temporary power and location for temporary power source. Temporary power source up to 200 m from main electrical room.
 - .4 Meter each branch circuit during peak periods to determine maximum draw. Review readings with the Consultant to determine whether feeder and fusing reductions will be permitted.

3.02 Preparation

- .1 Submit detailed staging plan to the Consultant, and provide a Method of Procedures (MOP) document detailing timeline for each step in the changeover process. Staging plan to be submitted a minimum of 60 days before changeover work begins.
- .2 Include delivery date of the new electrical distribution, and applicable work on new utility feeder.

3.03 Installation

- .1 Install all temporary wiring and temporary distribution prior to start of replacement of distribution equipment.
 - .1 Locate temporary wiring so as to minimize interference with equipment replacement operations. This work may occur during normal working hours.
 - .2 Megger test existing feeders, and allow for upsizing temporary cables to maintain 2% voltage drop on distribution feeders.
- .2 Transfer loads to temporary power. Allow for this work to be conducted during premium hours.
 - .1 Maximum 4 hour duration for any power outage during a switchover.
 - .2 Bring new diesel generator online.
 - .3 One by one, remove feeder from existing equipment, and connect equipment to temporary distribution. Cap off and make safe existing feeder to ensure no power at the point of normal supply.
- .3 Once all loads are on temporary power, perform work including removal of existing electrical equipment, and installation of new. Arrange for prompt inspection by Authorities Having Jurisdiction, including Electrical Utility, and Electrical Safety Authority.
- .4 Once new distribution is in place, perform above sequence in reverse to suit operation.

End of Section

1 General

1.01 Section Includes

- .1 Procedures for luminaire replacement.
- .2 Procedures for in-situ luminaire upgrades.
- .3 Disposal of existing fixtures.

1.02 Related Requirements

- .1 Section 26 05 05 – Selective Demolition for Electrical.
- .2 Section 26 51 19 – LED Interior Lighting.
- .3 Section 26 52 13.13 – Emergency Lighting.
- .4 Section 26 52 13.16 – Exit Signs.
- .5 Section 26 56 19 – LED Exterior Lighting.

1.03 References

- .1 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
 - .3 CSA C22.2 No. 9.0-96 (R2016) – General Requirements for Luminaires.
 - .4 CSA C22.2 No. 250.0:21 – Luminaires (Trinational standard, with UL 1598 and MNX-J307/1-ANCE).
 - .5 CAN/CSA E920-98 (R2017) - Ballasts for Tubular Fluorescent Lamps - General and Safety Requirements (Adopted IEC 920:1990, first edition, including Amendment 1:1993 and Amendment 2:1995, with Canadian deviations).
 - .6 CAN/CSA-E61347-1:03 (R2013) – Lamp controlgear – Part 1: General and safety requirements.
 - .7 CAN/CSA-E61347-2-3:03 (R2013) - Lamp controlgear - Part 2-3: Particular Requirements for A.C. supplied electronic ballasts for fluorescent lamps (Adopted CEI/IEC 61347-2-3:2000, first edition, 2000-10, with Canadian deviations).

1.04 Action Submittals

- .1 Submit a table of all luminaire types indicating the total energy consumption of the existing and the proposed luminaires, indicating the nominal energy consumption is equal to or less than the existing luminaire.
- .2 Provide field measurements of three samples of each type and wattage of existing fixtures prior to exchanging for new luminaires. After normal fixture burn-in time, measure the new fixtures to demonstrate actual energy savings.
- .3 Clearly indicate ballast and/or driver losses.

- .2 Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes and the following:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Provide complete photometric data prepared by independent testing laboratory for each luminaire, for approval by Engineer.
 - .3 Physical description of lighting fixtures including dimensions.
 - .4 Ballast, including BF.
 - .5 Energy-efficiency data, including ballast input wattage.
 - .6 Life, output (lumens, CCT and CRI), and energy efficiency data for lamps.
- .3 Photometric Data and Calculations
 - .1 Provide Luminaire Data Photometric Testing performed by an independent agency complying with IESNA Lighting Measurement Testing and Calculation Guides.
 - .2 Submit photometric calculations for typical areas based on layouts as indicated on the drawings.
 - .1 Submit a photometric calculation for the typical areas based on the existing conditions.
 - .2 Submit a photometric calculation for the same typical areas based on the proposed new fixtures.
 - .3 Clearly indicate mounting heights, heights of calculation zones, light loss factors and surface reflectance values.
 - .4 Use the follow photometric parameters:
 - .1 Recoverable Light Loss Factors: 0.8
 - .2 Ceiling reflectance values of 80%
 - .3 Wall reflectance value of 50%
 - .4 Floor reflectance value of 20%.
 - .3 Submittals in PDF format, and the native file of the software used to make the photometric analysis.
 - .4 Submit IES photometric data files for the existing and proposed luminaires.
- .4 Mock-Ups:
 - .1 Provide mock-ups of luminaires to demonstrate compatibility with existing HVAC air handling boots for applicable luminaire types.

1.05 Closeout Submittals

- .1 Luminaire disposal data.

1.06 Delivery, Storage, and Handling

- .1 Disposal and recycling of fluorescent lamps as per local regulations.

2 Products

2.01 Luminaires

- .1 In accordance with Related Requirements.

2.02 Luminaire Retrofit Kits

- .1 The contractor is permitted the use of manufacturer's standard retrofit kits to allow the reuse of existing [parabolic] luminaire housings.

3 Execution

3.01 Examination

- .1 Measure samples of each existing luminaire type to be replaced as described in PART 1 of this section for demonstration of energy savings.

3.02 Demolition

- .1 Remove lamps from existing luminaires for disposal in accordance with AHJ requirements.
- .2 Dispose of PCB ballasts as described in Section 02 84 00.

3.03 Installation

- .1 Install all new luminaire work in accordance with Related Requirements.
- .2 Luminaire Supports
 - .1 Support luminaires larger than 600 mm by 1200 mm (2 ft x 4 ft) size independent of ceiling framing. Confirm if T-bar ceilings are metric or imperial and provide luminaires to suit ceiling dimensions.
 - .2 Provide adequate support (new chain hangers) for new and existing luminaires to suit code requirements where removed luminaires do not have independent support.
- .3 Wiring
 - .1 Install luminaire disconnect plugs on all new luminaires not provided as such from the manufacturer.
 - .2 Connect luminaires to branch circuit outlets provided under Section 26 05 33.16 using flexible conduit.
 - .3 Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
 - .4 Bond products and metal accessories to branch circuit equipment grounding conductor.
- .4 Install specified lamps in luminaire.
- .5 Season all lamps for a minimum of 12 hours and a maximum of 100 hours in full-on mode without dimming. All lamps used for convenience lighting during construction shall be replaced with identical new lamps, which shall then be seasoned as described above, immediately prior to the date of substantial completion as determined by the Consultant.

3.04 Cleaning

- .1 Clean all luminaires and accessories thoroughly after installation. All fingerprints, dirt, tar, smudges, drywall mud and dust, etc. shall be removed by the Contractor from the luminaire bodies, reflectors, trims, and lens or louvers prior to final acceptance. All reflectors shall be free of paint other than factory-applied, if any. All reflectors, cones and lenses shall be cleaned only according to manufacturers' instructions.
- .2 Clean electrical parts to remove conductive and deleterious materials.
- .3 Remove dirt and debris from enclosures.
- .4 Clean photometric control surfaces as recommended by manufacturer.
- .5 Clean finishes and touch up damage.
- .6 Clean and re-lamp existing luminaires to be reused.
- .7 Clean new luminaires.

3.05 Site Tests and Inspections

- .1 Measure samples of each new luminaire type to be replaced as described in PART 1 of this section for demonstration of energy savings.

3.06 Protection

- .1 Re-lamp luminaires that have failed lamps.
- .2 Re-lamp luminaires used for temporary lighting at Substantial Completion.

End of Section

1 General

1.01 Section Includes

- .1 Common requirements for electrical work.
- .2 Mounting heights for electrical equipment and devices.

1.02 Related Requirements

- .1 Provisions of this section apply to all sections of Division 26, Division 27, Division 28, and sections related to electrical utilities in Division 33.
- .2 Document 00 64 01 – Request for Electronic Files Form.
- .3 Section 07 60 00 – Flashing and Sheet Metal.
- .4 Section 07 84 00 – Firestopping.
- .5 Section 08 31 00 – Access Doors and Panels.
- .6 Section 09 91 00 – Painting.
- .7 This section is to be read in conjunction with Division 00 documents, and Division 01 specification sections, which take precedence as described in CCDC 2-2020.
 - .1 General Conditions.
 - .2 Supplementary General Conditions.
 - .3 General Requirements.

1.03 Intent

- .1 Include all material, labour, equipment, and plant construction as necessary to make a complete installation as shown and specified hereinafter.
- .2 Leave complete systems ready for continuous and efficient satisfactory operation.
- .3 Discipline and Trade Jurisdiction:
 - .1 In accordance with CCDC 2-2020 GC 1.1.9: Neither the organization of the Specifications nor the arrangement of Drawings shall control the Contractor in dividing the work among Subcontractors and Suppliers.
 - .2 MasterFormat's organizational structure used in a project manual does not imply how the work is assigned to various design disciplines, trades, or subcontractors. MasterFormat is not intended to determine which particular elements of the project manual are prepared by a particular discipline. Similarly, it is not intended to determine what particular work required by the project manual is the responsibility of a particular trade. A particular discipline or trade is likely to be responsible for subjects from multiple Divisions, as well as from multiple Subgroups.

1.04 Specifications Language and Style

- .1 These specifications are written in the imperative mood and in streamlined form. The imperative language is directed to Contractor, unless stated otherwise.
- .2 Complete sentences by reading "shall", "Contractor shall", "shall be", and similar phrases by inference. Where a colon (:) is used within sentences and phrases, read the words "shall be" by inference.

- .3 Fulfill and perform all indicated requirements whether stated imperatively or otherwise.
- .4 When used in the context of a Product, read the word “provide” to mean “supply and install to result in a complete installation ready for its intended use.”

1.05 Drawings and Specifications

- .1 The drawings and specifications are complementary each to the other and what is called for by one to be binding as if called for by both. Should any discrepancy appear between the drawings and specifications, which leaves the Contractor in doubt as to the true intent and meaning of plans and specifications, a ruling is to be obtained from the Consultant in writing before submitting Bid. If this is not done, the maximum, the most expensive alternate or option will be provided in base tender bid.
- .2 All drawings and all Divisions of these specifications shall be considered as a whole, and work of this Division shown anywhere therein shall be furnished under this Division.
- .3 Drawings are diagrammatic and indicate the general arrangement of equipment and pathways. Most direct routing of conductors and wiring is not assured. Exact requirements are governed by architectural, structural, and mechanical conditions of the job. Consult all other drawings in preparation of the bid. Extra lengths of wiring or addition of pull and junction boxes, etc. necessitated by such conditions are to be included in the bid. Check all information and report and apparent discrepancies before submitting the bid.
- .4 Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pathways so as to best fit the layout of the job. Plan, coordinate, and establish exact locations and routing of services with affected trades prior to installation such that services clear each other, as well as other obstructions.
- .5 Determine final locations of major work within ceiling spaces based on the largest equipment first.
- .6 Unless otherwise shown or specified, conceal work in finished areas, and conceal work in partially finished and/or unfinished areas to extent made possible by the area construction. Install services as high as possible to conserve headroom and/or ceiling space. Notify the Consultant where headroom or ceiling space appears to be inadequate prior to installation of the work.
- .7 Scaling off the drawings will not be sufficient or accurate for determining these locations. Where job conditions require reasonable changes in indicated arrangement and locations, such changes shall be made at no additional cost to the Owner.
- .8 Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit fittings, etc. may not be shown, but where such items are required by other sections of the specifications of where there are required for proper installation of the work, such items are to be furnished and installed.
- .9 Before ordering any conduit, cable tray, conductors, wireways, raceway bus duct, fittings, etc., verify all pertinent dimensions at the job site and be responsible for their accuracy.
- .10 If obvious ambiguities or omissions are noticed when tendering refer same to the Consultant for a ruling and obtain the ruling in writing in the form of an Addendum. Claims for extras for ambiguities or omission of items brought to the attention of the Consultant after the award of a contract which, due to the nature of the ambiguity or omission, should have been brought to the attention of the Consultant during the tendering period, will not be allowed.
- .11 The drawings are performance drawings, diagrammatic, and show locations for apparatus and materials. The drawings are intended to convey the scope of work and do not intend to show Architectural and Structural details. The locations shown are approximate, and may be altered, when approved by the Consultant, to meet requirements of the material and/or apparatus, other equipment and systems being installed, and of the building. Do not scale drawings.

- .12 Control devices, equipment requiring maintenance, junction boxes, and similar products, particularly such products located above suspended ceilings must be located for easy access for servicing and/or removal. Products which do not meet this location requirement are to be relocated to an accessible location at no additional cost.
- .13 Be responsible for making necessary changes, at no additional cost, to accommodate structural and building conditions that were foreseeable by a review of existing conditions or a review of drawings prepared by other disciplines.
- .14 Where drawings indicate that acoustic tile ceiling is being suspended below existing plaster ceilings, coordinate the design of framework used to support this suspended ceiling, lighting, diffusers, and other components that are mounted within or through ceiling. Do not mount devices to suspended ceilings. Secure and mount to ceiling slab above. Seal ceiling openings to maintain required fire rating.
- .15 Provide any fitting, offset, transformation, etc., required to suit architectural and structural details but not shown.

1.06 Work Restrictions

- .1 Refer to Section 01 14 00.
- .2 Existing buildings:
 - .1 Examine the existing building, the site and surrounding areas and be fully informed as to the conditions and limitations under which the work has to be executed. Claims for additional costs will not be entertained with respect to conditions which could reasonably be ascertained by an inspection prior to Tender closing.
 - .2 All work in the existing building, other than minor works required to permit construction of the new addition, is to be performed in such a manner as to not disrupt the building operations.
 - .3 All systems are to be kept in full operation during normal building hours.
 - .4 Note that any noise generating works that disrupt the building operation shall be coordinated accordingly and carried out after/before normal operating hours.
 - .5 Cut, modify, or extend as necessary or as directed by the Consultant, the existing material or equipment to be reused or relocated to suit work under this contract.
 - .6 Existing materials and equipment which are to be used in new work shall be repaired and refinished as necessary. Provide additional new materials and components as required to facilitate reinstallation of such existing materials and equipment.
 - .7 Co-ordinate with the Owner, and refer to General Conditions.
 - .8 Do work in existing areas to best suit available space and not interfere with or obstruct use of existing facilities.
 - .9 Where disruptions of existing services are required, coordinate shut down with the Owner's operating staff and do the work at a time and in a manner mutually acceptable. Carefully schedule disruptions to keep "down time" to a minimum.
- .3 Do all cutting, patching, and making good to leave in a finished condition and to make the several parts of the Work come together properly. Co-ordinate work to keep cutting and patching to a minimum.
- .4 Quality of workmanship and materials used in patching, making good and refinishing of existing construction and/or compartments shall be of a standard equal to that specified for new construction and if not specified, equal to or exceeding that of original existing work.

- .5 Prior to cutting openings, examine wall, floor, and ceiling construction for buried electrical cables and pipes; and take adequate protection. Conduct cable locating tests to locate buried cables in existing work.

1.07 Substitution Procedures

- .1 Refer to Section 01 25 00 and General Provisions of the Contract.
- .2 Additionally, "Approved equal" shall be defined as a substitution approved by the Consultant.
- .3 If during the tender bid process, the bidding contractor wishes to substitute the specified equipment for an "Approved equal", the bidding contractor must submit shop drawings to the Consultant before the tender close for approval. If no substitution request is made, the as-specified equipment is that to be provided.
- .4 Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required to be used in this contract.
- .5 This contractor, at his option, may use equipment as manufactured by any of the listed manufacturers. This Contractor is responsible to ensure that all items submitted by these other manufacturers meets are requirements of the drawings and specification and fits in the allocated space. The final determination of a product being equivalent is to be determined by the Consultant when a catalog number is not listed, or listed in part.
- .6 Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Consultant as described in the General Provisions of the Contract for Submittals. The Contractor bears full responsibility for the unnamed manufacturers' equipment adequately meeting the intent of the design. The Owner or the Consultant may reject manufacturer at time of shop drawing submittal.
- .7 In addition to manufacturer's products base specified or named as acceptable, other manufacturers of products may be proposed as substitutions to the Consultant for review and consideration for acceptance, listing in each case a corresponding credit for each substitution proposed. However, base Bid Price on products base specified or named as acceptable. Certify in writing to the Consultant that proposed substitution meets space, power, design, energy consumption, and other requirements of base specified or acceptable product. It is understood that there will be no increase in Contract Price by reason of any changes to associated equipment, mechanically, electrically, structurally, or architecturally, required by acceptance of proposed substitution. The Consultant has sole discretion in accepting any such proposed substitution of product. Indicate any proposed substitutions in areas provided on Bid Form. Do not order such products until they are accepted in writing by the Consultant.

1.08 Contract Modification Procedures

- .1 Refer to Section 01 26 00.
- .2 Whenever the Consultant proposes in writing to make a change or revision to design, arrangement, quantity, or type of work from that required by Contract Documents, prepare, and submit to the Consultant for review, a quotation being proposed cost for executing change or revision.
- .3 Quotation is to be a detailed and itemized estimate of product, labour, and equipment costs associated with change or revision, plus overhead and profit percentages and applicable taxes and duties.
- .4 Unless otherwise specified in Division 00, Division 01, or as identified in the Owner/Contractor agreement, allowable maximum percentages for overhead and profit are to be 7% and 5% respectively.
- .5 Unless otherwise specified in Division 00, or Division 01, following additional requirements apply to all quotations submitted:

- .1 When change or revision involves deleted work as well as additional work, cost of deleted work (less overhead and profit percentages but including taxes and duties) is to be subtracted from cost of additional work before overhead and profit percentages are applied to additional work.
- .2 Electrical material labour unit costs are to be in accordance with National Electrical Contractors Association (NECA) Manual of Labor Units (MLU), less 25%.
- .3 Costs for journeyman and apprentice labour must not exceed prevailing rates at time of execution of Contract and must reflect actual personnel performing work.
- .4 Cost for site superintendent must not exceed 10% of total hours of labour estimated for change or revision, and change or revision must be such that site superintendent's involvement is necessary.
- .5 Overhead percentage will be deemed to cover quotation costs other than actual site labour and materials, and rentals.
- .6 Quotations, including those for deleted work, to include a figure for any required change to Contract time.
- .6 The Consultant reserves the right to request backup quotations for any materials and/or rentals included within the quotation.
- .7 Quotations submitted that are not in accordance with requirements specified above will be rejected and returned for re-submittal. Failure to submit a proper quotation to enable Consultant to expeditiously process quotation and issue a Change Order will not be grounds for any additional change to Contract time.
- .8 Make requests for changes or revisions to work to Consultant in writing and, if Consultant agrees, will issue Notice of Change.
- .9 Do not execute any change or revision until written authorization for the change or revision has been obtained from the Consultant.

1.09 Coordination

- .1 Coordinate work with other trades to avoid conflict and to provide correct rough-in and connection for equipment furnished under other trades that require electrical connection. Inform Contractors of other trades of the required access to and clearances around electrical equipment to maintain serviceability and code compliance.
- .2 Verify equipment dimensions and requirements with provision specified under this Section. Check actual job conditions before fabricating work. Report necessary changes in time to prevent needless work. Changes or additions subject to additional compensation, which are made without written authorization and an agreed price, shall be at Contractor's risk and expense.
- .3 Read specifications and drawings of other trades and conform with their requirements before proceeding with any work specified in this Division related to other trades. Co-operate with all other trades on the job, so that all equipment can be satisfactorily installed, and so that no delay is caused to any other trades.
- .4 Coordinate utility service outages with the Owner. Obtain permission from Owner at least 24 hours before partially or completely disabling system. Minimize outage duration.
- .5 Existing Fire Alarm System: Maintain existing system in service. Disable system only to make switch overs and connections. Notify Owner at least 72 hours before partially or completely disabling system. Minimize outage duration.

- .6 Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- .7 Co-ordinate work with all trades to ensure a proper and complete installation. Notify all trades concerned of the requirement for openings, sleeves, inserts, and other hardware necessary for the installation and, where work is to be integrated with the work of other trades or is to be installed in close proximity with the work of other trades, carefully co-ordinate the work prior to installation.
- .8 Working Detail Drawings
 - .1 The contractor is to prepare working detail drawings supplementary to the contract drawings, when deemed necessary by the Consultant, for all areas where a multiplicity of materials and or apparatus occur, or where the work due to architectural and structural considerations involves special study and treatment. Such drawings may be prepared jointly by all trades affected, or by the one trade most affected with due regard for and approval of the other trades, all as the Consultant will direct in each instance. Such drawings must be reviewed by the Consultant before the affected work is installed.
 - .2 Carry out all alterations in the arrangement of work which has been installed without proper study and approval, even if in accordance with the contract documents, in order to make such work come within the finished lines of walls, floors and ceilings, or to allow the installation of other work, without additional cost. In addition, make any alterations necessary in other work required by such alterations, without additional cost.

1.10 Submittal Procedures

- .1 Refer to Section 01 33 00.
- .2 Before delivery to site of any item of equipment, submit shop drawings complete with all data, pre-checked and stamped accordingly, for review by the Consultant. Indicate project name on each brochure or sheet, make reference to the number and title of the appropriate specification section, type identifier such panelboard ID or luminaire type as indicated on appropriate schedule, and provide adequate space to accommodate the Consultant's review stamp(s).
- .3 Verify field measurements and affected adjacent Work are coordinated, including passageway clearances for movement of equipment into location.
- .4 Submit shop drawings to the Consultant in electronic (PDF) format, as coordinated after award of contract. Where submittals are derived from digital originals, do not print and rescan documents; submittals made as such will be immediately rejected.
- .5 Submit a schedule of shop drawings within one week after award of contract. Group submittals by specification division as appropriate.
- .6 Shop Drawings
 - .1 Submit for review, properly identified shop drawings showing in detail the design and construction of all equipment and materials as requested in sections of the specification governed by this Section.
 - .2 Obtain and comply with the manufacturer's installation instructions.
 - .3 Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS", stamp each copy with your company name, date each copy with the submittal date, and sign each copy. Shop drawings which are received and are not endorsed, dated, and signed will be returned for re-submittal.
 - .4 The Consultant will stamp shop drawings as follows:

- .1 Reviewed ()
- .2 Reviewed as Modified ()
- .3 Revise and Re-Submit ()
- .4 Not Reviewed ()
- .5 If "REVIEWED" is checked-off, the shop drawing is satisfactory. If "REVIEWED AS MODIFIED" is checked-off, the shop drawing is satisfactory subject to requirements of remarks put on shop drawing copies. If "REVISE AND RE-SUBMIT" is checked-off, the shop drawing is entirely unsatisfactory and must be revised in accordance with comments written on shop drawing copies and resubmitted. If "NOT REVIEWED" is checked-off, the shop drawing is in error of submission, not applicable for this project.
- .6 This review by the Consultant is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the Consultant approved the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor, and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the contract documents. Be responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for co-ordination of the work as well as compliance with codes and inspection authorities such as CSA, etc.
- .7 Confirm layouts of major electrical equipment rooms with the dimensions of as-procured equipment, and submit a layout sketch to the Consultant showing the major equipment and required clear spaces. The contractor may, at their option, revise the layout of the major electrical equipment rooms, but take responsibility for these new layouts and meeting the requirements of the local electrical utilities. Capture final room layouts on as-built drawings.

1.11 Submittals

- .1 The Contractor is to submit dimensioned drawings or sketches that indicates the dimensions of the procured equipment, demonstrates that the equipment will fit in the allocated spaces, and demonstrates that manufacturer and code required clear spaces are provided.
- .2 Include sketches for the following locations that includes at minimum, major equipment such as switchboards, panelboards, splitters, transformers, generators, transfer switches, major wall mounted or floor mounted telecommunications equipment, and fire alarm panels, passive graphics, and annunciator panels.
 - .1 Electrical closets
 - .2 Telecommunications rooms

1.12 Safety Requirements

- .1 Be responsible for the safety of workers and the equipment on the project in accordance with all applicable safety legislation passed by Federal, Provincial, and local authorities governing construction safety. The more stringent regulations prevail.

1.13 Infection Control Procedures

- .1 Comply with the following standards:
 - .1 CAN/CSA-Z317.13, Infection Control During Construction, Renovation, and Maintenance of Health Care Facilities.

- .2 CAN/CSA-Z317.10, Handling of Waste Materials in Healthcare Facilities.
- .3 CAN/CSA-Z318.0, Commissioning of Healthcare Facilities.
- .2 Prepare a list of all areas of the work where the infection control procedures are to be in force and review the list and procedures with the healthcare facility's infection control officer or a designated healthcare facility representative prior to any work in the areas commencing, and as work proceeds ensure that all infection control procedures are being maintained.
- .3 Healthcare facility has policies and procedures that are to be reviewed and followed when working within areas of healthcare facility. Include for requirements specified in Division 01 and in this article.
- .4 Comply with healthcare facility's latest policies and procedures regarding infection prevention measures during work of construction/renovation/installation/maintenance.
- .5 Comply with healthcare facility's latest requirements regarding decontamination. Exact requirements and scope of this work are to be defined on drawings or in specifications where applicable and also may be defined in Division 01.
- .6 Patient Care Areas
 - .1 Comply with requirements for patient care areas (PCA) included in Work as required by Section 24 of OESC. Patient care areas are identified on drawings or in schedule appended to end of this Section. Review final PCA nomenclature with the Consultant prior to start of Work.
 - .2 Note that room and area names/numbers are based on information available at time of preparation of documents and such names/numbers may be revised in later documents or during construction of Work. In no way are patient care area classifications to be reduced due to name/number revisions. Confirm exact classifications as per local governing electrical code requirements to suit final construction and any design changes made by the Consultant.
 - .3 Provide testing and verification of circuits and devices to confirm compliance with OESC.]
- .7 **Mental Health Areas:**
 - .1 Products accessible to patients in mental health area and any other areas subject to abuse shall include the following features:
 - .1 Anti-ligature;
 - .2 Tamper-resistant exposed mounting hardware;
 - .3 Impact resistant.
 - .2 Provide anti-pick sealant around each device, confirm colour prior to installation.

1.14 Regulatory Requirements

- .1 Codes and Standards
 - .1 Ontario Electrical Safety Code including all bulletins and amendments.
 - .2 Ontario Building Code and its referenced standards.
 - .3 Applicable CSA and ULC standards.
 - .4 All work shall be in accordance with Owner's Design Guidelines.
- .2 Permits and Fees

- .1 Obtain and pay for all permits and fees required for the execution and inspection of the electrical work and pay all charges incidental to such permits. Submit to Electrical Inspection Department and Supply authority necessary number of drawings and specifications for examination and approval prior to commencement of work. Arrange and pay for any special inspection of equipment specified if and when required.
- .2 Apply, pay and obtain all permits as required for the electrical work.
- .3 Upon substantial completion of your work, supply and turn over to the Consultant all required inspection certificates from governing authorities to certify that the work as installed conforms to the rules and regulations of the governing authorities.
- .3 Patents
 - .1 Pay all royalties and licence fees, and defend all suits or claims for infringement of any patent rights, and save the Owner, Architect, Project Manager and Consultants harmless of loss or annoyance on account of suit, or claims of any kind for violation or infringement of any letters patent or patent rights, by this Subcontractor or anyone directly or indirectly employed by him or by reason of the use by him or them of any part, machine, manufacture or composition of matter on the work, in violation or infringement or such letters patent or rights.

1.15 References

- .1 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 CSA C235:19, Preferred voltage levels for AC Systems up to 50 000 V.
 - .3 Do underground systems in accordance with CSA C22.3 No. 7-15, Underground systems, except where specified otherwise.
 - .4 Ontario Electrical Safety Code (29th edition/2024), and all bulletins.
 - .5 CSA Z317.5:17 (R2022), Illumination Systems in Health Care Facilities.
 - .6 CSA Z32:21, Electrical Safety and Essential Systems in Health Care Facilities.
 - .7 CSA Z8000:24, Canadian Health Care Facilities.
 - .8 CSA Z8001-13 (R2023), Commissioning of Health Care Facilities.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 Electrical utility requirements and local applicable codes and regulations.
- .5 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE 100-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.
- .6 2024 Ontario Building Code.
- .7 CAN/ULC-S1001-11, Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.16 Definitions

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE 100.

1.17 Quality Assurance

- .1 The specifications contained herein are set forth as the minimum acceptable requirements. This does not relieve the Contractor from executing other quality assurance measures to obtain a complete operating system within the scope of this project.
- .2 Ensure that all workmanship, all materials employed, all required equipment, and the manner and method of installation conforms to accepted construction and engineering practices, and that each piece of equipment is in satisfactory working condition to satisfactorily perform its functional operation.
- .3 Provide quality assurance tests and operational check on all components of the electrical distribution system, all lighting fixtures, and communication systems.
- .4 Only first class workmanship will be accepted, not only in regards to durability, efficiency and safety, but also in regards to neatness of detail. Present a neat and clean appearance on completion to the satisfaction of the Consultant. Any unsatisfactory workmanship will be replaced at no extra cost.
- .5 Conform to the best practices applicable to this type of work. Install all equipment and systems in accordance with the manufacturer's recommendations, but consistent with the General Requirements of this specification. Electrical Contractor will be held responsible for all damage to the work of his own or any other trade, resulting from the execution of his work. Store all electrical equipment and materials in dry locations.
- .6 Provide foreman in charge of this work at all times.
- .7 The contractor shall be fully liable to provide and maintain in force during the life of this Contract, such insurance, including Public Liability Insurance, Product Liability Insurance, Auto Liability Insurance, Worker's Compensation, and Employer's Liability Insurance.
- .8 Governing Federal, Provincial and Municipal codes and regulations will be considered minimum standards for the work and where these are at variance with the drawings and specification, the more stringent ruling will apply.
- .9 Where any code, regulation, bylaw, or standard is quoted it shall mean the current edition including all revisions or amendments at the time of the tender.
- .10 In case of conflict, the codes and regulations take precedence over the Contract Documents. In no instance reduce the standard or scope of work or intent established by the drawings and specifications by applying any of the codes referred to herein.

1.18 Quality Control

- .1 Provide a full time Superintendent to oversee and coordinate all sub-trades in these divisions.

1.19 Temporary Utilities

- .1 Refer to Section 01 51 00.
- .2 Do not use any of the permanent facility systems during construction except as may be specified, or unless written approval is obtained from the Consultant.
- .3 The use of permanent facilities for temporary construction service will not affect in any way the commencement day of the warranty period.

- .4 Temporary heating during the construction period will be provided as described in Division 01.

1.20 Temporary Facilities and Controls

- .1 Refer to Section 01 56 00.
- .2 Prior to start of each work period in occupied area, install temporary protection to prevent damage to any personal property or furnishing. Coordinate with Owner's representative if any furniture must be relocated to facilitate work.
- .3 Submit temporary protection plan to Owner's Representative for approval prior to use.
- .4 Take necessary steps to ensure that required firefighting apparatus is accessible at all times. Flammable materials shall be kept in suitable places outside the building.

1.21 Product Requirements

- .1 Refer to Section 01 61 00.
- .2 The design, manufacture and testing of electrical equipment and materials shall conform to or exceed the latest applicable CSA, IEEE, and ANSI standards.
- .3 All materials must be new and be ULC or CSA listed. Any materials not covered by the aforementioned listing standards shall be tested and approved by an independent testing laboratory, Technical inspection Services, or other government agency.
- .4 Materials and equipment are specifically described and named in this Specification in order to establish a standard of material and workmanship.
- .5 Materials required for performance of work shall be new and the best of their respective kinds and of uniform pattern throughout work.
- .6 Materials shall be of Canadian manufacture where obtainable. Materials of foreign manufacture, unless specified, shall be approved before being used.
- .7 Equipment items shall be standard products of approved manufacturers. Identical units of equipment shall be of same manufacturer. In any unit of equipment, identical component parts shall be of same manufacturer, but the various component parts comprising the unit need not be of one manufacturer.
- .8 Chemical and physical properties of materials and design performance characteristics and methods of construction and installation of items of equipment, specified herein, shall be in accordance with latest issue of applicable Standards or Authorities when such are either mentioned herein, or have jurisdiction over such materials or items of equipment.
- .9 Materials shall bear approval labels as required by Code and/or Inspection Authorities.
- .10 Install materials in strict accordance with manufacturer's recommendations.
- .11 Include items of material and equipment not specifically noted on Drawings or mentioned in Specification but which are necessary to make a complete and operating installation.
- .12 Remove materials, condemned as not approved for use, from job site and deliver and install suitable approved materials in their place.
- .13 Unless otherwise noted, equipment and material specifications in Sections of the Specification governed by this Section are based on products of a manufacturer selected by the Consultant for the purpose of setting a standard of quality, size, performance, capacity, appearance, and serviceability.

- .14 In most instances the names of acceptable manufacturers are also stated for materials and equipment, and you may base your tender price on equipment and materials produced by either the specified manufacturer or a manufacturer listed as acceptable.
- .15 For any items of equipment, material, or for any system where acceptable manufacturers are not stated, you must provide only the equipment, material or system specified.
- .16 If materials or equipment manufactured and/or supplied by a manufacturer named in the specifications are used in lieu of products of the manufacturer noted as "basis of design", be responsible for ensuring that the substituted material or equipment is equivalent in size, performance and operating characteristics to the specified materials or equipment, and it shall be understood that all costs for larger starters, additional space, larger power feeders, and changes to associated or adjacent work required as a result of providing materials and equipment named as acceptable in lieu of the specified product will be borne by the Contractor.
- .17 In addition to the manufacturers specified or named as acceptable, the Contractor may propose substitute manufacturers of equipment and/or apparatus to the Consultant for acceptance, listing in each case a corresponding credit for each substitute proposed, however, the tender price must be based on apparatus or materials specified or named as acceptable. Certify in writing to the Consultant that the substitute meets all space, power, design, and all other required of the specified or equivalent material or apparatus. In addition, it shall be understood that all costs for larger starters, space, power feeders, and changes to associated equipment, mechanical and/or electrical, required by acceptance of proposed substitutions, will be borne by the party making the proposal. Substitute equipment requiring greater than specified energy requirements or unduly limiting service space requirements will not be accepted.
- .18 Where a manufacturer is not listed for a particular product, it will be deemed to mean that the Contractor will provide the specified manufacturer's product.

1.22 Examination and Preparation

- .1 Refer to Section 01 71 00.
- .2 Examine the existing equipment, the site and surrounding areas and be fully informed as to the conditions and limitations under which the work has to be executed. Claims for additional costs will not be entertained with respect to conditions which could reasonably have been ascertained by an inspection prior to Tender closing.
- .3 Examine work upon which your work depends. Report in writing defects in such work. Application of your work shall be deemed acceptance of work upon which your work depends.
- .4 Drawings are, in part, diagrammatic and are intended to convey scope of work and indicate general and approximate location, arrangement and sizes of equipment, piping, and similar items. Obtain more accurate information about locations, arrangement and sizes from study and coordination of drawings, including shop drawings and manufacturers' literature and become familiar with conditions and spaces affecting these matters before proceeding with work.
- .5 Where job conditions require reasonable changes in indicated locations and arrangements, make such changes with approval of the Consultant at no additional cost to the Owner. Similarly, where existing conditions interfere with new installation and require relocation, such relocation is included in work.

1.23 Cutting and Patching

- .1 Refer to Section 01 73 29.
- .2 The Electrical Contractor will be responsible for all cutting and patching required for the electrical installation. Structural members are not to be cut without the consent of the Consultant.
- .3 All cutting and patching required under Division 26, Division 27, and Division 28 shall be in accordance with Division 01. Layout such work for approval before undertaking same.

- .4 Cutting shall be kept to an absolute minimum and performed in a neat and workmanlike manner using the proper tools and equipment. Caution shall be exercised in all cutting and procedures to ensure that concealed services are not affected. Do not cut if in doubt. Request the Consultant's presence to determine if concealed services exist.
- .5 Assume responsibility for prompt installation of Work in advance of concrete pouring or similar Work. Should any cutting or repairing of finished/unfinished Work be required because such installation was not done, employ the particular trade, whose Work is involved, to do such cutting and patching. Pay for any resulting costs. Layout such Work for approval before undertaking same.

1.24 Cleaning and Waste Management

- .1 Refer to Section 01 74 00.
- .2 The Contractor and associated sub trades, at all times during construction, to keep the site free of all debris, boxes, packing, etc., resulting from work of this trade. At the completion of this work, the electrical installation is to be left in a clean and finished condition to the satisfaction of the Consultant.
- .3 Clean and repair existing materials and equipment which remain or are to be reused.
- .4 Luminaires to be reinstalled: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.
- .5 Assume responsibility for removing tools and waste materials on completion of Work, and leave Work in clean and perfect condition.

1.25 Starting and Adjusting

- .1 Conduct acceptance tests to demonstrate that the equipment and systems actually meet the specified requirements. Tests may be conducted as soon as conditions permit, and consequently make all changes, adjustments, or replacements required as the preliminary tests may indicate prior to the final tests. Tests shall be as specified in various sections of this Division. Carry out tests in the presence of the Consultant. Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project. The Electrical Contractor shall be in charge of the plant during tests. He shall assume responsibility for damages in the event of injury to the personnel, building, equipment, and shall bear all costs for liability, repairs, and restoration in this connection. Submit test results.
- .2 Make tests of equipment and wiring at times requested.
- .3 Tests shall include meggered insulation values, voltage and current readings to determine balance of panels and feeders under full load, and operation of each piece of equipment for correct operation.
- .4 Supply meters, materials and personnel as required to carry out these tests.
- .5 Test electrical work to standards and function of Specification and applicable codes in an approved manner. Replace defective equipment and wiring with new material and leave entire system in complete first class operating condition.
- .6 Connect single phase loads so that there is the least possible unbalance of the supply phases.
- .7 Submit all test results in report format.
- .8 Trial Usage
 - .1 The Consultant reserves the right to use any system, 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, or for the purpose of learning operational procedures, before the final completion and acceptance of the work. Such tests shall not 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 above due to the aforementioned tests, where such injuries or breakage are caused by a weakness or inaccuracy of parts, or by defective materials or workmanship of any kind. Supply all labour and equipment required for such tests.

- .2 Perform and pay for all costs associated with any testing required on the system components where, in the opinion of the Consultant the equipment manufacturer's ratings or specified performance is not being achieved.

1.26 Closeout Procedures

- .1 Refer to Section 01 77 00.
- .2 The Consultant will carry out inspections and prepare deficiency list for action by the Contractor, during and on completion of project.
- .3 Building Permit Compliance
 - .1 Provide a minimum of 10 business days notice to the Consultant for scheduling of Consultant's occupancy inspection.
 - .2 Prior to requesting the Consultant's letter "Review of General Conformance" for submission to the municipal building department to allow occupancy, the following items must be complete and submitted to the Consultant, as applicable:
 - .1 General
 - .1 Submit all applicable inspection reports from Authorities Having Jurisdiction.
 - .2 Continuity of fire separations at service penetrations must be complete.
 - .2 Electrical
 - .1 Provide Certificate of Acceptance from Electrical Inspection Department.
 - .2 Any devices not installed must have the wiring made safe and terminated in an outlet box complete with cover.
 - .3 All outlets must have cover plates installed. All electrical equipment not located in service rooms must have covers and/or doors installed complete.
 - .4 Emergency lighting system must be operational and tested by the Contractor. Where battery units and remote heads are indicated on the drawing, provide certification letter from equipment manufacturer indicating the system meets code requirements.
 - .5 If the building is provided with emergency power with CSA C282 equipment (emergency generator or similar), or emergency lighting inverter, the contractor is to perform light meter measurements and submit a letter indicating the system meets code requirements.
 - .6 Simulate normal power failure within the premises in the presence of the consultant and the Owner's representative. Test and verify exit lights and emergency lighting operations under emergency conditions. Submit letter of certification copy to the Consultant stating that the systems have been tested, witnessed by the Consultant or the Owner's representative, etc., and the methods of installation and performance are satisfactory to all parties.
 - .7 All exit lights must be installed and operational.

- .3 Electronic Safety and Security
 - .1 Fire alarm system and devices must be operational. Submit fire alarm verification report per CAN/ULC-S537, and submit audibility test. Indicate tap settings of all signalling devices.
 - .2 CAN/ULC-S561 Fire Protective Signaling Certificate.
 - .3 Functional testing of the fire alarm system and interconnected systems per CAN/ULC-S1001 must be completed.
- .3 If any of the above items have not been completed at the time of Consultant's Inspection, and the letter of "assurance of professional field review and compliance" cannot be issued, any costs for subsequent Inspections will be charged to the Contractor.

1.27 Closeout Submittals

- .1 Refer to Section 01 78 00.
- .2 Project Record Documents
 - .1 Provide extra sets of white prints on which to make, as the job progresses, all approved changes and deviations from the original drawings. Complete as-built drawings accurately marked up in red ink must be submitted for review by the Consultant before the contract is considered to be completed.
 - .2 Changes and deviations include those made by addenda, change orders, and supplemental instructions, and changes and deviations to be marked on the white print record drawings indicated on supplemental drawings issued with addenda, change orders, and supplemental instructions. Maintain the "as-built" white prints at the site for periodic inspection by the Consultant throughout the duration of the work.
 - .3 Upon substantial completion of the work, obtain a set of reproducible white prints of the drawings and neatly amend the print in accordance with the marked-up white prints to produce a true "as-built" set of drawings.
 - .4 As-built drawings are to indicate all circuiting as installed and all distribution junction box locations as well as conduit routes.
 - .5 Trace routing of existing panelboard feeders for all panelboards and indicate on as-built drawings.
 - .6 As-Built AutoCAD drawings
 - .1 Submit completed Document 00 64 01 to the Consultant, and remit payment as indicated for release of the Consultant's AutoCAD files.
 - .7 As-built Single Line Diagram
 - .1 Provide in Main Electrical Room one wall mounted copy of as-built Single Line Diagram on 6 mm (1/4 in) foam board.
 - .2 As-built Single Line Diagram to indicate manufacturer name and catalogue numbers of as-installed products.
- .3 Operations and Maintenance (O&M) Data
 - .1 Submit two complete sets of Operation and Maintenance instruction manuals in hard copy, and one in electronic format. Include in each copy of the manual:

- .1 Verification certificates for installation of life safety systems by the manufacturer's representative.
- .2 A copy of "reviewed" shop drawings.
- .3 Complete explanation of operating principles and sequences.
- .4 Recommended maintenance practices and precautions.
- .5 Complete wiring and connection diagrams.
- .6 Certificates of guarantees.
- .2 Ensure that operating and maintenance instructions are specific and apply to the model and types of equipment provided.
- .3 Include attendance records for each training session in the O&M manual.
- .4 Warranty documentation.

1.28 Warranty

- .1 Submit a written guarantee to the Owner for one year from the date of acceptance. This guarantee shall bind the contractor to correct, replace or repair promptly any defective equipment workmanship without cost to the Owner.
- .2 All equipment, materials and workmanship shall be unconditionally guaranteed for a minimum period of one year from the date of acceptance.
- .3 Provide warranty certificates, wherever given or required, in excess of the normal warranty period showing the name of the firm giving the warranty, dated and acknowledged, on specific equipment and systems.
- .4 Warranties for temperature controls and building automation systems will start on the date of verification of acceptance by the Consultant.
- .5 Include these certificates with the maintenance and operating manuals in the appropriate sections.

2 Products – Not Used

3 Execution

3.01 Demolition

- .1 Refer to Division 02 and Section 26 05 05.
- .2 Remove all electrical equipment and devices on redundant structures. Make safe all circuits, and provide continuity of remaining circuits.
- .3 To make safe: Withdraw redundant wiring and remove unwanted conduit/wiring and accessories. Position breakers to OFF position and update panel schedules.
- .4 Make safe any redundant mechanical devices as shown on mechanical drawings.
- .5 Maintain continuity of existing services for other circuits/devices serving areas outside the Work area. Provide additional wiring/conduits/boxes etc. to suit existing services to be maintained and also implement new Work as detailed.

- .6 Allow for this work in Tender Price.
- .7 Turn over designated equipment to the Owner. Dispose of unwanted materials and equipment.

3.02 Concrete Work

- .1 Refer to Division 03 – Concrete, and Section 26 05 29.
- .2 Provide all concrete work required for the electrical work. Reinstall surfacing as per architectural requirements.
- .3 Provide a 100 mm (4 in) high concrete housekeeping pad for floor mounted electrical distribution equipment, such as the following:
 - .1 Transformers.
 - .2 Switchgear and switchboards.
 - .3 Distribution panelboards.
 - .4 Engine Generators.
 - .5 Uninterruptible Power Supplies and batteries.
 - .6 Transfer Switches.

3.03 Lintels

- .1 Refer to Division 04 – Masonry.
- .2 Lintels for openings in masonry shall conform with requirements of by-laws, and as approved by the Structural Engineer.
- .3 Pay all costs for lintels over openings, required solely by the electrical trades, not shown on architectural or structural drawings.

3.04 Metals

- .1 Refer to Division 05 – Metals.
- .2 Steel construction required solely for the work of this trade, and not shown on architectural or structural drawings shall be provided by this Division to the requirements of Division 05.

3.05 Flashing and Sheet Metal

- .1 Refer to Section 07 60 00.
- .2 Flash all conduits and systems passing through roof or built into an outside wall, or a waterproof floor.
- .3 Provide copper flashing for sleeves passing through exterior walls or waterproof floors.

3.06 Firestopping

- .1 Provide firestopping in accordance with Section 07 84 00 and Section 26 05 44.13.
- .2 Ensure that fire ratings of floors and walls are maintained.
- .3 Provide ULC classified firestopping products by 3M, Hilti, STI, or approved equal which have been tested in accordance with CAN/ULC-S115.

- .4 Pack clearance spaces, fill all spaces between openings, pipes and ducts passing through fire separations and install firestopping systems in accordance with the appropriate ULC system number for the products and type of penetration.
- .5 Install firestopping systems using personnel trained or instructed by the product manufacturer.

3.07 Access Doors

- .1 Provide access doors in accordance with Section 08 31 00.
- .2 Before commencing installation of work, coordinate with other trades and prepare on a set of reflected ceiling plans and wall elevations, complete layouts of access doors. Submit these layouts for Consultant's review and show exact sizes and locations of such access doors. Locate and arrange the work to suit.
- .3 Group conduit work to ensure the minimum number of access doors is required.
- .4 Access doors are to be installed by the trade responsible for the particular type of construction in which the doors are required.

3.08 Painting and Finishes

- .1 Refer to Section 09 91 00.
- .2 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
- .3 Repair and finish factory finished equipment, damaged, or scratched during installation, in an approved manner.
- .4 All structural steel including hangers, brackets, supports and other ferrous metals shall be shop or factory prime painted wherever practicable. Wherever structural steel including hangers, brackets, supports, and other ferrous metals cannot be shop or factory prime painted, wire brush to remove all traces of rust, clean of all traces of dirt, oil, and grease, and apply one coat of an approved rust inhibiting primer in accordance with CGSB-GB-40d, and leave ready to receive finish paint.
- .5 Primary and final painting for Work, other than items specified as factory primed or finished, will be performed as described in Division 09 – Finishes.
- .6 All electrical fittings, supports, hanger rods, pull boxes, channel frames, conduit racks, outlet boxes, brackets, clamps etc., to have galvanized finish or paint finish over corrosion-resistant primer.
- .7 All panelboards, motor starters etc., to be factory finished with baked on enamel. All enamel to be baked on gloss over corrosion resistant primer.
- .8 Touch up minor damage to finish on factory finished equipment. Items suffering major damage to finish shall be replaced at the direction of the Consultant.
- .9 Protect work so that finishes will not be damaged or marred during construction. Maintain the necessary protection until completion of the work.
- .10 Provide all exposed ferrous metal work on equipment with at least one factory prime coat, or paint one prime coat on job. Clean up or wire brush all equipment, etc., before painting.
- .11 For factory applied finishes, repaint or refinish surfaces damaged during shipment, erection or construction work.

3.09 Location of Outlets

- .1 Refer to Architectural drawings for dimensions denoting exact locations.

- .2 The Consultant reserves the right to change the location of outlets to within 3 m from the point indicated on the plans without extra charge providing the Contractor is advised before installation is made.
- .3 Location of lighting, convenience, telephone, power, and communication outlets shall be subject to change, without extra cost to Owners, provided information is given prior to installation. No extra amount will be paid for extra labour and materials for relocating outlets up to 3000 mm from their original location nor will credits be anticipated where relocation up to 3000 mm reduces materials and labour. Other cases will be considered on their individual merits.
- .4 Coordinate location of boxes with latest architectural drawings and instructions to suit door swings, millwork etc. prior to rough-in.

3.10 Mounting Heights and Device Locations

- .1 Refer to architectural drawings for exact location of electrical equipment and devices.
- .2 Architectural elevations take precedence over electrical elevations. If there are conflicts between architectural and electrical, adjust locations of electrical equipment at no additional cost to the Owner.
- .3 Prior to roughing-in, the contractor is to mark locations of electrical equipment and devices for conflicts with architectural, studs, etc. If conflicts are noted, inform the Consultant for a decision prior to commencing the rough-in.
- .4 Mounting heights of equipment and devices listed below is from finished floor to centreline of equipment, unless specified or indicated otherwise.
- .5 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .6 Install electrical equipment at following heights above finished floor (AFF). Dimensions are to centre of device unless indicated otherwise.
 - .1 Power door operator push buttons: 1000 mm.
 - .2 HVAC thermostats and manual HVAC controls: 1200 mm.
 - .3 Local switches, and manual lighting control devices:
 - .1 1100 mm.
 - .2 Locate on lock side of door.
 - .4 System furniture service fittings: to suit furniture layout.
 - .5 Wall receptacles:
 - .1 General: min. 400 mm AFF.
 - .2 Above top of counters: 175 mm.
 - .3 Above top of continuous baseboard heater, or mechanical heating/radiation units: 75 mm to bottom of device.
 - .4 In fan rooms, mechanical rooms, and electrical rooms: 1100 mm.
 - .5 For electric ranges: 130 mm.
 - .6 Outlets in raceways or millwork to be located as per Architectural details.
 - .7 Door bell pushbuttons: 1100 mm.

- .8 Panelboards: as indicated in Section 26 24 16.
- .9 Emergency lighting remote heads: 300 mm below finished ceiling, or 2400 mm AFF for exposed areas or areas with ceiling height above 2750 mm (9 ft).
- .10 Communications:
 - .1 Typical communication outlets (voice and data): 400 mm.
 - .2 Communications outlets for wall mounted telephones, intercom, or similar: 1100 mm.
 - .3 Television outlets: 200 mm below finished ceiling.
 - .4 Wall mounted public address speakers: 2100 mm.
 - .5 Clocks: 2100 mm.
- .11 Access control card readers and keypads: 900 mm.

"Manual stations shall be installed 1050 mm to 1150 mm above the finished floor level measured from the centre of the manual station. Fire alarm manual stations: 1200 mm.

- .13 Wall mounted fire alarm audible devices, including bells or horns:
 - .1 2300 mm to the top of the device in areas of ceiling height 2450 mm or greater.
 - .2 150 mm below the finished ceiling for ceiling heights less than 2450 mm, measured to the top of the device.
- .14 Wall mounted fire alarm visible signal devices, including strobes: 2300 mm.
- .15 Fire Alarm emergency telephones: 1400 mm.

3.11 Manufacturer's Instructions

- .1 Where the specifications call for an installation to be made in accordance with Manufacturer's recommendations, a copy of such recommendations shall be at all times be kept on the job site and be available to the Owner's Representative.
- .2 Follow manufacturer's instructions where they cover points not specifically indicated on the drawings and specifications. If they are in conflict with the drawings and specifications obtain clarification from the Consultant before starting work.

3.12 Tests and Acceptance

- .1 The operation of the equipment and electrical system does not constitute an acceptance of the work by the Owner. The final acceptance is to be made after the Contractor has adjusted his equipment and demonstrated that it fulfills the requirements of the drawings and the specifications.
- .2 Testing of all systems shall be performed in the presence of the Owner's designated representative. The contractor shall give 72 hours advance notice to the Owner before beginning the tests.
- .3 Upon completion of the installation, the Contractor shall furnish certificates of approval from all authorities having jurisdiction, as applicable. Contractor shall demonstrate that work is complete and in perfect operating condition, with raceway and conduit systems properly grounded, wiring free from grounds, shorts, and that the entire installation is free from any physical defects.
- .4 Provide labour and material to conduct the integrated systems testing of interconnected life safety systems in accordance with CAN/ULC-S1001-11, and provide written report for Consultant's review.

Ensure all required trade contractors are present on site as directed by the Integrated Testing Coordinator during the CAN/ULC-S1001 functional testing. Refer to Section 01°91°26.13.

3.13 Closeout Activities

- .1 Refer to Section 01 79 00.
- .2 In the presence of the Owner, demonstrate the proper operation of all systems.
- .3 Instruct the Owner's designated representatives in all aspects of the operation and maintenance of systems and equipment listed in the trade sections governed by this Section. Obtain in writing from the Consultant a list of the Owner's representatives qualified to receive instructions.
- .4 Arrange for and pay for the services of qualified service technicians and other manufacturer's representatives required for instruction of specialized portions of the installation.

End of Section

1 General

1.01 Section Includes

- .1 Work in existing facilities.
- .2 Electrical demolition.

1.02 Related Requirements

- .1 Section 02 41 19 – Selective Demolition.

1.03 Scheduling

- .1 Refer to Section 01 14 00, and Section 01 73 00.
- .2 All work in the existing building, other than minor works required to permit construction of the new Work, is to be performed in such a manner as to not disrupt the building operations.
- .3 All systems are to be kept in full operation during normal building hours.
- .4 Coordinate any noise generating works that disrupt the building operation to be carried out after/before normal operating hours.

2 Products

2.01 Materials

- .1 Materials and equipment for patching and extending work: As specified in individual sections.

3 Execution

3.01 Examination

- .1 Verification of Conditions
 - .1 Verify field measurements and circuiting arrangements are as shown on Drawings.
 - .2 Verify that abandoned wiring and equipment serve only abandoned facilities.
 - .3 Demolition drawings are based on visual field observations and conditions derived from existing drawings, and do not assess the interiors of electrical equipment. Report discrepancies to the Consultant before disturbing existing installation.
 - .4 Beginning of demolition means installer accepts existing conditions.
- .2 Tracing Existing Electrical Circuits
 - .1 Trace all circuits in the area of work listed as existing, and verify existing conditions prior to any modifications as indicated.
 - .2 Where drawings indicate "connect to existing circuit", use a spare breaker, where available. Otherwise, verify existing load with a meter and advise the Consultant if the additional load will cause a circuit to trip.
 - .3 Where provided panelboard schedules indicate "Existing Circuit" or similar, provide the correct description for the circuit. Existing Circuit will not be acceptable in the final panelboard schedules submitted as part of closeout submittals.

- .3 Existing Cabling in Return Air Plenums
 - .1 In ceilings being used as a return air-plenum, Contractor to review existing low-voltage cabling uncovered as part of the work.
 - .2 Immediately notify the Consultant if any cables identified are not plenum rated (i.e. CMP, or FT6 rated).
- .4 Existing feeders to remain.
 - .1 Where the drawings call for the re-use of existing feeders and re-connection to new equipment, (such as when equipment is replaced like-for-like), confirm the size and quantity of conductors of the existing feeder, and provide lug kits on new equipment suitable for the existing feeder.

3.02 Preparation

- .1 Coordinate utility service outages with utility company.
- .2 Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- .3 Existing electrical service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switch overs and connections. Obtain permission from Owner at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
- .4 Existing Telephone System: Maintain existing system in service. Notify Owner at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.
- .5 Existing Fire Alarm System: Maintain existing system in service. Minimize outage duration. Provide fire watch as required. Make temporary connections to maintain service in areas adjacent to work area.

3.03 Demolition

- .1 Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.
- .2 Demolish and extend existing electrical work to Section 02 41 19, and this Section.
- .3 Remove, relocate, and extend existing installations to accommodate new construction.
- .4 Remove abandoned wiring to source of supply.
- .5 When relocating or removing equipment, should any circuits be abandoned, the conductors to these circuits must be removed or properly terminated as detailed in Ontario Electrical Safety Code (OESC) bulletin 12-25-6, or latest revision.
- .6 Provide knockout fillers when removing circuits from any panelboard or splitter.
- .7 Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- .8 Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.
- .9 Disconnect and remove abandoned panelboards and distribution equipment.
- .10 Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

- .11 Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- .12 Repair adjacent construction and finishes damaged during demolition and extension work.
- .13 Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.
- .14 Maintain continuity of existing services for other circuits/devices serving areas outside the Work area. Provide additional wiring/conduits/boxes etc. to suit existing services to be maintained, and also implement new Work as detailed.

3.04 Restoration

- .1 Install relocated materials and equipment under the provisions of Division 01.

3.05 Cleaning

- .1 Clean and repair existing materials and equipment which remain or are to be reused.
- .2 Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts.
- .3 Waste Management
 - .1 Turn over designated equipment to the Owner.
 - .2 Dispose of unwanted materials and equipment.

3.06 Protection

- .1 Maintain access to existing electrical installations which remain active. Modify installation or provide access panels as appropriate.

End of Section

1 General

1.01 Section Includes

- .1 Building wire and cable.
 - .1 Armoured cable.
 - .2 Metal clad cable.
 - .3 Fire resistive cables.
 - .4 Wiring connectors and connections.
- .2 Permitted voltage drop for feeder and branch circuits.
- .3 Conductor sizes are based on copper

1.02 References

- .1 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
 - .3 CSA C22.2 No. 0.3:09 (R2023), Test methods for electrical wires and cables.
 - .4 CSA C22.2 No. 48:15 (R2020), Nonmetallic sheathed cable.
 - .5 CSA C22.2 No. 51:20, Armoured cables.
 - .6 CSA C22.2 No. 52:17 (R2022), Underground secondary and service-entrance cables.
 - .7 CSA C22.2 No. 65-18 (R2022), Wire connectors.
 - .8 CSA C22.2 No. 75:17 (R2022), Thermoplastic insulated wires and cables.
 - .9 CSA C22.2 No. 123:16 (R2021), Aluminum sheathed cables.
 - .10 CSA C22.2 No. 131:17 (R2022)14, Type TECK 90 cable.
 - .11 CSA Z32:21 - Electrical safety and essential electrical systems in health care facilities.
- .2 NECA (National Electrical Contractors Association) - Standard of Installation.
- .3 NETA (International Electrical Testing Association) - ATS-2021 - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- .4 CAN/ULC-S139:2017 – Standard Method of Fire Test for Evaluation of Integrity of Electrical Power, Data and Optical Fibre Cables.

1.03 Coordination

- .1 Where wire and cable destination is indicated, and routing is not shown, determine exact routing and lengths required.

1.04 Patient Care Areas

- .1 Comply with requirements for patient care areas (PCA) included in Work as required by Section 24 of OESC. Patient care areas are identified on drawings. Review final PCA nomenclature with the Consultant prior to start of Work.
- .2 Note that room and area names/numbers are based on information available at time of preparation of documents and such names/numbers may be revised in later documents or during construction of Work. In no way are patient care area classifications to be reduced due to name/number revisions. Be responsible for confirming exact classifications as per local governing electrical code requirements to suit final construction and any design changes made by the Consultant.

1.05 Closeout Submittals

- .1 Record Documents: Indicate as-constructed feeder sizes on single line diagram.
- .2 Megger test results.
- .3 Testing and verification of circuits per CSA Z32.
- .4 Thermographic survey report.
- .5 Fire resistive cables: manufacturer's certification that the cables have been installed in accordance with the manufacturer's instructions.

1.06 Qualifications

- .1 Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

2 Products

2.01 Manufacturers

- .1 American Wire Group.
- .2 BICC Phillips.
- .3 General Cable.
- .4 Nexans.
- .5 Prysmian.
- .6 Southwire.

2.02 Regulatory Requirements

- .1 Provide products listed and classified by CSA Group as suitable for the purpose specified and indicated.

2.03 Conductor Material

- .1 Submit bid based on copper conductors only,
- .2 Aluminum: Not permitted.

2.04 Building Wire

- .1 RW90:
 - .1 Single copper conductor.
 - .2 Minimum 12 AWG for branch circuit wiring.
 - .3 Minimum 14 AWG for 120 V control wiring.
 - .4 Chemically cross-linked polyethylene insulation.
 - .5 Rated for 90°C, 600 V.
 - .6 Suitable for handling to -40°C.
 - .7 For interior installations in conduit.
- .2 RWU90:
 - .1 Single copper conductor.
 - .2 Minimum 12 AWG for branch circuit wiring.
 - .3 Minimum 14 AWG for 120 V control wiring.
 - .4 Chemically cross-linked polyethylene insulation.
 - .5 Rated for 90°C, 1000 V.
 - .6 Suitable for handling to -40°C.
 - .7 For exterior installations, direct buried, or in conduit.
- .3 T90 Nylon:
 - .1 Single copper conductor.
 - .2 Thin wall PVC insulation with nylon covering.
 - .3 Rated for 90°C, 600 V.
 - .4 May be used up to size 10 AWG for interior installations.
 - .5 Base conduit fill on RW90 cable diameters.
 - .6 Minimum 12 AWG for 15 A circuits in suites of residential occupancy.

2.05 Armoured Cable

- .1 General
 - .1 Connectors: standard as required, complete with anti-short rings.
 - .2 Runs to be limited to fixture drops, and runs to devices in walls and partitions, maximum horizontal runs in exposed areas and ceiling spaces to be 1.8 m (6 ft).
 - .3 Do not daisy chain (leap frog) luminaires with armoured cable. Do not daisy chain (leap frog) luminaires with armoured cable except where installed in inaccessible ceilings.
- .2 Type AC:

- .1 Two, three or four copper conductors rated RW90, 1000 V.
- .2 Bare copper ground wire.
- .3 Insulation Voltage Rating: 600 V.
- .4 Insulation Temperature Rating: 90°C (194°F).
- .5 Insulation Material: Thermoplastic.
- .6 Overall interlocked aluminum tape armour.
- .3 Type SPC90:
 - .1 Use for LED lighting, fluorescent dimming controls, and other SMART building applications.
 - .2 Colour coded cable with power, control, and signal under one cable.
 - .3 12-2C Power with a 16-2C Control.
 - .4 Bare copper ground wire.
 - .5 Insulation Voltage Rating: 600 V.
 - .6 Insulation Temperature Rating: 90°C (194°F).
 - .7 Insulation Material: Thermoplastic.

2.06 Fire Resistive Cables

- .1 General:
 - .1 2 hour fire rating to CAN/ULC-S139 and to meet 2024 Ontario Building Code rule 3.2.7.10.
 - .2 Alternative means of compliance:
 - .1 Conduits encased in a minimum of 50 mm (2 in) of concrete.
 - .2 Be protected by a fire rated assembly listed to achieve the minimum fire rating as indicated.
- .2 Manufacturers:
 - .1 nVent Pyrotenax 1850 series Mineral Insulated (MI) cable.
 - .2 VITALink MC Brand Type MC-RC90, manufactured by Marmon Wire & Cable Inc. (listed by ULC under ULC category code 'FHIT7' or 'FHJR7', dated 19 May 2015). This cable is not to be installed in conduit.
 - .1 Request quotation from manufacturer or manufacturer's representative for field certification of installed Vitalink cables prior to requesting Consultant's construction field review.
 - .2 Power cable must be installed according to UL protocol FHIT7.120 – Electrical circuit integrity systems certified in Canada.
 - .3 Prysmian Lifeline RC90 cable.
 - .1 Installation in accordance with UL protocol FHIT7-51, and FHIT7-51A.

- .2 System makes use of Remke connectors and Resolve boxes, with no substitutions.
- .3 Substitution Limitations:
 - .1 Substitutions may only be considered by the Consultant if the product is listed by ULC under ULC Category Codes 'FHIT7' or 'FHJR7'.

2.07 TECK90 Cable

- .1 Single, three, or four conductors as indicated on drawings.
- .2 Cable to CSA C22.2 No. 131.
- .3 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .4 Insulation: Cross-linked polyethylene (XLPE), type RW90, rating: 600 V.
- .5 Inner jacket: polyvinyl chloride.
- .6 Armour: interlocking aluminum.
- .7 Overall covering: thermoplastic.
- .8 Fastenings:
 - .1 One-hole steel straps to secure surface cables 50 mm diameter and smaller. Two-hole steel straps for cables larger than 50 mm diameter.
 - .2 Channel type supports for two or more cables at 1500 mm centres.
 - .3 Threaded rods: 6 mm diameter to support suspended channels.
- .9 Connectors: Watertight, approved for TECK cable.

2.08 Conductor Pulling Lubricant

- .1 Where pulling lubricant is required, use non-wax based cable lubricants compatible with cable manufacturer recommendations, such as American Polywater.

2.09 Connectors

- .1 Armoured cable connectors must be proper squeeze type connectors and plastic anti-short bushings at terminations.
- .2 Connectors for conductors connecting to devices as per local governing electrical requirements to be equal to IDI Electric (Canada) Ltd., "Ideal" No. 451, No. 452, and No. 453, "Wing-Nut", CSA certified, 600 V, rated pressure type connectors.
- .3 For conductors sized 3/0 AWG and greater, provide long barrel double crimp, two (2) hole compression type lug connectors, unless otherwise noted.

2.10 Wiring Termination

- .1 Lugs, terminals, or screws used for termination of wiring to be suitable for copper conductors. Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both

ends of phase conductors of feeders and branch circuit wiring. Maintain phase sequence and colour coding throughout.

- .2 Splice wire, up to and including 6 AWG, with nylon insulated expandable spring type connectors.

- .1 Thomas & Betts – Marr Max series.

- .3 Splice large conductors using compression type connections insulated with heat shrink sleeves.

- .1 Thomas & Betts – 5400 Series lugs & heat shrink type #s series.

3 Execution

3.01 Examination

- .1 Verify that field measurements are as indicated.
- .2 Wire and cable routing indicated is approximate unless dimensioned.
- .3 Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
- .4 Voltage Drop
 - .1 Ensure voltage drop in power and control conductors is in accordance with the requirements of the OESC.
 - .2 Size conductors accordingly when sizes are not identified.
 - .1 Feeder conductors: maximum voltage drop of 2%.
 - .2 Branch circuit conductors: maximum voltage drop of 3%.
- .5 Verify that mechanical work likely to damage wire and cable has been completed.
- .6 Verify that raceway installation is complete and supported.

3.02 Preparation

- .1 Completely and thoroughly swab raceway before installing wire.

3.03 Installation

- .1 Route wire and cable as required to meet project conditions.
- .2 Install cable to CSA C22.1 and per manufacturer's installation guidelines.
- .3 Conduit and cable supports:
 - .1 All wiring to be installed in EMT at all exposed areas unless otherwise specified.
 - .2 All mechanical equipment to be connected with liquid tight flexible conduit.
 - .3 Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
- .4 Conductors
 - .1 Provide separate neutral for each circuit. Common neutrals not permitted.

- .2 Use solid conductor for feeders and branch circuits 10 AWG and smaller.
- .3 Use stranded conductors for control circuits.
- .4 Use conductor not smaller than 12 AWG for power and lighting circuits.
- .5 Use conductor not smaller than 16 AWG for control circuits.
- .6 Use 10 AWG conductors for 20 A, 120 V branch circuits longer than 25 m.
- .5 Pulling conductors
 - .1 Pull all conductors into raceway at same time.
 - .2 Use suitable wire pulling lubricant for building wire 4 AWG and larger.
 - .3 Neatly train and lace wiring inside boxes, equipment, and panelboards.
 - .4 Protect exposed cable from damage.
- .6 Connectors
 - .1 Use suitable cable fittings and connectors.
 - .2 Clean conductor surfaces before installing lugs and connectors.
 - .3 Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
 - .4 Use split bolt connectors for copper conductor splices and taps 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 per cent of insulation rating of conductor.
 - .5 Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 - .6 Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- .7 Identification
 - .1 Identify and colour code wire and cable to Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
 - .2 Where colour-coded tape is utilized, apply a minimum of 50 mm (2 in) at terminations, junction and pull boxes and conduit fittings. Do not paint conductors under any condition.
 - .3 Utilize colour coding on bussing in panels and, switchgear, disconnects, and metering cabinets to match conductor colour coding.

3.04 Conductors, Wires, and Cables

- .1 Provide fire rated conductors or provide a fire rated assembly around conductors used for life safety applications as described in 2012 OBC 3.2.7.10.
- .2 Indoor wiring installed in conduit, unless otherwise noted: 600 V "RW90 XLPE".
- .3 Wiring in channel back of fluorescent and LED lighting fixtures: 600 V type GTF or TEW.
- .4 Lighting and power branch circuit wiring:

- .1 Copper, minimum 12 AWG.
- .2 Home runs to lighting and receptacle panels, which exceed 22 m (75 ft) in length: minimum 10 AWG.
- .5 Size wires for 2 per cent maximum voltage drop to farthest outlet on a maximum 80% loaded circuit.
- .6 Outdoor wiring: "RWU90 XLPE".
- .7 Conductors shall be colour coded. Conductors 10 AWG and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size 8 AWG and larger may be colour coded with adhesive colour coding tape, but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible.
- .8 Colour coding as follows:
 - .1 Phase "A" – Red.
 - .2 Phase "B" – Black.
 - .3 Phase "C" – Blue.
 - .4 Control – Orange.
 - .5 Ground – Green.
 - .6 Neutral – White.
- .9 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.

3.05 Site Tests and Inspections

- .1 Perform continuity tests of all feeders, motor circuits, and branch circuits.
- .2 Perform all tests of branch circuits as described in CSA Z32.
- .3 Perform infrared thermographic survey in accordance with NETA ATS, Section 9 "Thermographic Survey". Submit report to the Consultant.
- .4 Perform insulation-resistance test (megger test) on each feeder. Submit report to the Consultant.

End of Section

1 General

1.01 Section Includes

- .1 Low-voltage control cabling.
- .2 Control-circuit conductors.

1.02 References

- .1 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
 - .3 CSA C22.2 No. 0.3:09 (R2023), Test methods for electrical wires and cables.
 - .4 CSA C22.2 No. 48:15 (R2020), Nonmetallic sheathed cable.
 - .5 CSA C22.2 No. 51:2014, Armoured cables.
 - .6 CAN/CSA C22.2 No. 65-18 (R2022), Wire connectors (Trinational standard with NMX-J-543-ANCE and UL 486A-486B).
 - .7 CSA C22.2 No. 75:17 (R2022), Thermoplastic insulated wires and cables.
 - .8 CSA C22.2 No. 208:18 (R2023), Fire alarm and signal cable.
- .2 NECA (National Electrical Contractors Association) – Standard of Installation.

1.03 Qualifications

- .1 Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

1.04 Coordination

- .1 Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

2 Products

2.01 Regulatory Requirements

- .1 Conform to CSA C22.1.
- .2 Provide products listed and classified by CSA Group as suitable for the purpose specified and indicated.

2.02 Low Voltage Wiring

- .1 LVT:
 - .1 Multi conductor PVC insulated.
 - .2 Bare copper ground conductor.
 - .3 Overall PVC jacket.

- .4 Rated 30 V.
- .5 CMP (FT6) rated if cable is exposed.
- .6 CMR (FT4) rated if cable is installed in conduit.
- .2 Category 5e Network Cabling.
 - .1 CMP (FT6) rated if cable is exposed.
 - .2 CMR (FT4) rated if cable is installed in conduit.

2.03 Terminations and Splices

- .1 All terminations and splices shall be of an approved type for the conductors being used.
- .2 Where conductors are terminated or spliced, it shall be done in the following manner:
 - .1 Where a single solid conductor is terminated in a device under one screw or clamping mechanism, no additional terminating hardware is required.
 - .2 Where multiple or stranded conductors are terminated in a device under one screw or clamping mechanism, self insulated crimp-on cable ends or approved equal shall be used up to and including 10 AWG sized conductors. Approved compression lugs shall be used for larger conductor sizes.
 - .3 Where multiple conductors are spliced, properly sized Wing Nut connectors, or approved equal, shall be used for up to two 8 AWG or three 10 AWG conductors. Pressure type sleeve cable connectors, splices, tee's, etc., shall be used for all larger size connections and terminations.
 - .4 Insulate all bare surfaces of splices with heat shrink sleeving or equivalent.
 - .5 Conductors connected to ground rods for service or equipment grounding or to building structural or architectural elements shall be terminated, connected, and spliced using a thermoweld process or approved non-mechanical compression type connectors.
- .3 Install all service and feeder conductors as continuous lengths without breaks, measured and cut based on site dimensions.

3 Execution

3.01 Examination

- .1 Verify that mechanical work likely to damage wire and cable has been completed.
- .2 Verify that raceway installation is complete and supported.
- .3 Verify that field measurements are as indicated.
- .4 Wire and cable routing indicated is approximate unless dimensioned.

3.02 Preparation

- .1 Completely and thoroughly swab raceway before installing wire.

3.03 Installation

- .1 Route control cabling as required to meet project conditions.

- .2 Install cable to the CSA C22.1.
- .3 Conduit and supports
 - .1 All wiring to be installed in EMT at all exposed areas and in partitions unless otherwise specified.
 - .2 All mechanical equipment to be connected with liquid tight flexible conduit.
 - .3 Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.
- .4 Conductors
 - .1 Use stranded conductors for control circuits.
 - .2 Use conductor not smaller than 16 AWG for control circuits.
- .5 Pulling conductors
 - .1 Pull all conductors into raceway at same time.
 - .2 Neatly train and lace wiring inside boxes, equipment, and panelboards.
 - .3 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.
 - .4 Protect exposed cable from damage.
- .6 Connectors
 - .1 Use suitable cable fittings and connectors.
 - .2 Clean conductor surfaces before installing lugs and connectors.
 - .3 Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
 - .4 Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- .7 Identification
 - .1 Identify and colour code wire and cable to Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.
 - .2 Where colour coded tape is utilized, apply a minimum of 50 mm (2 in) at terminations, junction and pull boxes and conduit fittings. Do not paint conductors under any condition.

End of Section

1 General

1.01 Section Includes

- .1 Grounding electrodes and conductors.
- .2 Equipment grounding conductors.
- .3 Bonding.
- .4 The terms "connect" and "bond" are used interchangeably in this Specification and have the same meaning.

1.02 Related Requirements

- .1 Section 27 05 26 – Grounding and Bonding for Communications Systems.

1.03 References

- .1 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
 - .3 CSA C22.2 No. 0.4:17 (R2022), Bonding of electrical equipment.
 - .4 CSA C22.2 No. 41:22, Grounding and bonding equipment (Trinational standard with NMJ-J-590-ANCE and UL 467).
 - .5 CSA C22.2 No. 75:17 (R2022), Thermoplastic insulated wires and cables.
- .2 ANSI/TIA/EIA J-STD-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
- .3 Institute of Electrical and Electronics Engineers, Inc.
 - .1 IEEE 81-2012 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.
- .4 InterNational Electrical Testing Association (NETA):
 - .1 NETA ATS, Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.04 Action Submittals

- .1 Product Data: Provide for grounding electrodes and connections.

1.05 Informational Submittals

- .1 Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- .2 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 Closeout Submittals

- .1 Project Record Documents: Record actual locations of components and grounding electrodes.
- .2 Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.07 Qualifications

- .1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years' experience.

1.08 Regulatory Requirements

- .1 Products: Listed and classified testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

2 Products

2.01 Manufacturers

- .1 B-Line by Eaton.
- .2 Hubbell (Burdny).
- .3 Panduit.
- .4 Thomas & Betts.

2.02 Performance Criteria

- .1 Grounding System Resistance: 5 ohms.
- .2 Provide all equipment grounding as required regardless of whether it has been shown on drawings or called for in this specification. Arrange grounds so that under normal operating conditions no injurious amount of current will flow in any grounding conductor.

2.03 Grounding and Bonding Conductors

- .1 Electrical grounding conductors shall be CSA C22.2 No. 75 insulated stranded copper, except that sizes 10 AWG and smaller shall be solid copper. Insulation colour shall be continuous green for all equipment grounding conductors.
- .2 Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes 10 AWG and smaller shall be ASTM B1 solid bare copper wire.

2.04 Rod Electrodes

- .1 Material: Copper-clad steel.
- .2 Diameter: 19 mm.
- .3 Length: 3000 mm.

2.05 Ground Rods

- .1 Copper clad steel, 19 mm (3/4 in) diameter by 3000 mm (10 ft) long, conforming to CSA C22.2 No. 41.
- .2 Quantity of rods shall be as required to obtain the specified ground resistance.

2.06 Splices and Termination Components

- .1 Components shall meet or exceed CSA C22.2 No. 41, and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.07 Ground Connections

- .1 Below Grade: Exothermic-welded type connectors.
- .2 Above Grade:
 - .1 Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.
 - .2 Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.

2.08 Ground Terminal Blocks

- .1 At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.09 Splice Case Ground Accessories

- .1 Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 6 AWG insulated ground wire with shield bonding connectors.

2.10 Mechanical Connectors

- .1 Material: Bronze.

2.11 Wire

- .1 Material: Stranded copper.
- .2 Foundation Electrodes: 2/0 AWG.
- .3 Grounding Electrode Conductor: Size to meet Ontario Electrical Safety Code requirements.

2.12 Grounding Well Components

- .1 Well Pipe: 200 mm by 600 mm long concrete pipe with belled end.
- .2 Well Cover: Cast iron with legend "GROUND" embossed on cover.

3 Execution

3.01 Examination

- .1 Verify that final backfill and compaction has been completed before driving rod electrodes.

3.02 Installation

- .1 General
 - .1 Ground in accordance with the Ontario Electrical Safety Code, as shown on drawings, and as hereinafter specified.
 - .2 System Grounding:

- .1 Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.
- .2 Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.
- .3 Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.
- .4 Ground electrical equipment and wiring in accordance with Ontario Electrical Safety Code and Local Inspection Authority's Rules and Regulations.
- .5 Install grounding conductors, outside Electric Rooms and Electrical Closets in conduit and conceal where possible. Make connections to water mains, all metallic piping systems, neutral and equipment with brass, copper or bronze bolts and connectors or weld using Cadweld or Thermoweld processes.
- .6 Provide grounding conductors, sized as per Code, and connect to grounding bus or water main wherever non-raceways are installed.
- .2 Provide grounding electrode conductor and connect to reinforcing steel in foundation footing. Bond steel together.
- .3 Provide bonding to meet Regulatory Requirements.
- .4 Bond together metal siding not attached to grounded structure; bond to ground.
- .5 Install ground grid under access floors indicated.
- .6 Bond together each metallic raceway, pipe, duct, and other metal object entering space under access floors. Bond to underfloor ground grid. Use 6 AWG bare copper conductor.
- .7 Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- .8 Ground Resistance
 - .1 Grounding system resistance to ground not to exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the Owner. Final tests shall assure that this requirement is met.
 - .2 Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.
 - .3 Services at power company interface points shall comply with the power company ground resistance requirements.
- .9 Ground Rod Installation
 - .1 Drive each rod vertically in the earth, not less than 3000 mm (10 ft) in depth.

- .2 Where permanently concealed ground connections are required, make the connections by the exothermic process to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.
- .3 Where rock prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified resistance.
- .10 Inaccessible Grounding Connections
 - .1 Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.
- .11 Secondary Equipment and Circuits
 - .1 Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.
 - .2 Metallic Piping, Building Steel, and Supplemental Electrode(s):
 - .1 Provide a grounding electrode conductor sized per code between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to CSA C22.2 No. 41.
 - .2 Provide a supplemental ground electrode and bond to the grounding electrode system.
 - .3 Conduit Systems:
 - .1 Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.
 - .2 Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.
 - .3 Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.
 - .4 Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.
 - .5 Boxes, Cabinets, Enclosures, and Panelboards:
 - .1 Bond the equipment grounding conductor to each pull box, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).
 - .2 Provide lugs in each box and enclosure for equipment grounding conductor termination.
 - .3 Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.
 - .6 Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.
 - .7 Raised Floors: Provide bonding of all raised floor components.

- .12 Corrosion Inhibitors
 - .1 When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.
- .13 Conductive Piping
 - .1 Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.03 Grounding and Bonding in Healthcare Facilities

- .1 Provide required grounding and bonding work in accordance with the drawings and in accordance with requirements of governing authorities, including the OESC. Review grounding requirements of project areas with specific requirements of use of areas as outlined in Contract Documents. Review exact requirements with the Consultant prior to start of work.
- .2 Review medical equipment grounding with equipment vendor and provide requirements to suit.
- .3 Throughout the renovated areas, solidly ground and bond the system equipment and make all required grounding connections to all new electrical devices and apparatus. Ground conductors shall be insulated copper wire connected with approved fittings in accordance with the OESC.
- .4 All ground connections in slab shall be made using OESC approved welded copper connections - Cadweld as supplied by Erico Products.
- .5 Service conductors exceeding 400 A shall be provided with minimum No. 3/0 AWG grounding conductors, unless otherwise noted.
- .6 Do not use conduit systems as ground conductors in patient care areas or in areas as per local governing electrical code requirements.
- .7 Ground and bond telecommunication components as required.
- .8 Provide conductors as sized on drawings and in accordance with OESC requirements, but which shall be of size no smaller than the requirements specified herein this article or on drawings.

3.04 Field Quality Control

- .1 Perform inspections and tests listed in NETA ATS, Section 7.13.

End of Section

1 General

1.01 Section Includes

- .1 Conduit and equipment supports.
- .2 Anchors and fasteners.

1.02 References

- .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (29th edition/2024).
- .3 CECA – Canadian Electrical Contractors Association.

1.03 Action Submittals

- .1 Submit detail, sealed by Contractor retained structural engineer for struct channel support for stacked transformers.

1.04 Closeout Submittals

- .1 Submit the following in the Operation and Maintenance Manual for products used over the course of the project:
 - .1 Product Data: Provide manufacturer's catalogue data for fastening systems.
 - .2 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.05 Regulatory Requirements

- .1 Provide products listed and classified by Canadian Standards as suitable for purpose specified and shown.

2 Products

2.01 Manufacturers

- .1 B-line by Eaton.
- .2 Burndy Canada Ltd. (Hubbell).
- .3 Erico Caddy.
- .4 E. Myatt & Co. Inc.
- .5 Hilti Canada.
- .6 Thomas & Betts.
- .7 Unistrut.

2.02 General

- .1 All supporting devices, strut channel, threaded rod, anchors, etc. to be used shall be of the "hot dipped" galvanized type. Electrogalvanized components will not be accepted.
- .2 Materials and Finishes: Provide adequate corrosion resistance.
- .3 Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
- .4 Anchors and Fasteners:
 - .1 Concrete Structural Elements: Use expansion anchor and preset inserts.
 - .2 Steel Structural Elements: Use beam clamps and welded fasteners.
 - .3 Concrete Surfaces: Use self-drilling anchors and expansion anchors.
 - .4 Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.
 - .5 Solid Masonry Walls: Use expansion anchors and preset inserts.
 - .6 Sheet Metal: Use sheet metal screws.
 - .7 Wood Elements: Use wood screws.

2.03 Anchors and Hangers

- .1 Hangers for electrical conduit shall be galvanized after fabrication.
- .2 Perforated strapping: not permitted.

2.04 Inserts

- .1 Use only factory-made threaded or toggle type.
- .2 Where inserts cannot be placed, use factory-made expansion shields for light weights, where approved by the Consultant.
- .3 Do not use powder-activated tools except with the written permission of the Consultant.

2.05 Sleeves

- .1 Through interior walls, use standard weight steel pipes, conduit, or 18 gauge galvanized steel. Cut flush with finished surfaces. Check room finish schedules.
- .2 Through exterior walls above grade, floors, and roof use standard weight steel pipes, machine cut, flush with finished surface inside and to suit flashing outside.
- .3 Through exterior walls below grade, water-proofed floors, and other water-proof walls, use heavy weight cast iron pipes, machine cut. Extend sleeves 100 mm (4 in) above finished floors, and cut flush with underside of floor.

2.06 Steel Channel

- .1 Description: Painted steel.

2.07 Supports

- .1 Steel supports in wet or dry locations to be galvanized after fabrication.
- .2 Where galvanized members are bolted together use cadmium plated bolts.
- .3 For hanger rods use minimum 10 mm (3/8 in) diameter steel threaded rod. Use clevis type attachment.
- .4 Provide minimum 100 mm (4 in) high concrete bases for all floor mounted equipment.

2.08 Supports and Bases

- .1 Submit proposed method of attachment of hangers and beam clamps, to cellular steel deck for approval before proceeding with Work.
- .2 Supply and erect special structural Work required for the installation of electrical equipment. Provide anchor bolts and other fastenings unless noted otherwise. Mount equipment required to be suspended above floor level, where details are not shown, on a frame or platform bracketed from the wall or suspended from the ceiling. Carry supports to either the ceiling or the floor, or both as required, at locations where, because wall thickness is inadequate, it is not permitted to use such brackets.
- .3 Electrical panels, switches or other electrical equipment shall be complete with suitable bases or mounting brackets.
- .4 Provide channel or other metal supports where necessary, to adequately support lighting fixtures. Do not use wood unless wood forms part of the building structure.
- .5 Support hangers, in general, from inserts in concrete construction or from building structural steel beams, using beam clamps. Provide additional angle or channel steel members, required between beams for supporting conduits and cables.
- .6 Provide any additional supports required from existing concrete construction for any piping or equipment, by drilling same and installing expansion bolt cinch anchors.
- .7 Do not use explosive drive pins in any section of Work without obtaining prior approval.

2.09 Threaded Rod Covers

- .1 Protect cable from abrasion caused by contact with threaded rod.
- .2 To meet UL 94V-0 specifications.
- .3 Colour: Black.
- .4 Manufacturers:
 - .1 Panduit TRC18FR-X20Y.
 - .2 Approved equal.

2.10 Stacked Transformer Supports

- .1 Stacking of transformers is only allowed if all other options have been exhausted due to lack of space. Stacking is only applicable to floor mount applications and is not allowed for ceiling or wall mount configurations. Stacking shall comply with the following requirements:
 - .1 The transformer stacked on top is the same size or smaller than the transformer below.
 - .2 The OESC clearance requirements for each individual transformer is satisfied.

- .3 The ambient temperature must not exceed 30°C.
- .2 Strut channel structure to support transformers shown on Drawings to be stacked above another transformer.
- .3 Provide sheet metal heat diversion shield between stacked transformers. Install shield at an angle as not to trap heat.

2.11 Concrete Bases and Housekeeping Pads

- .1 Provide concrete bases of dimensions where indicated, but not less than 100 mm (4 in) larger in both directions than supported unit, and 100 mm (4 in) high, and so anchors will be a minimum of 10 bolt diameters from edge of the base. Chamfer edges.
- .2 Use 20 MPa (3000 psi) 28 day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Division 03 – Concrete.
- .3 Install dowel rods to connect concrete bases to concrete floor. Unless otherwise indicated, install dowel rods on 450 mm (18 in) centres around full perimeter of base.
- .4 Anchor equipment to concrete base.
- .5 Provide a housekeeping pad for floor mounted equipment, including but not limited to the following:
 - .1 Transformers.
 - .2 Switchgear and switchboards.
 - .3 Distribution panelboards.
 - .4 Engine Generators.
 - .5 Uninterruptible Power Supplies and batteries.
 - .6 Transfer Switches.

2.12 Concrete Anchors

- .1 Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
- .2 Drilled expansion anchors for anchors set in concrete block or poured concrete after the concrete has set. Size the insert and number of anchors so that the maximum load per anchor does not exceed the manufacturer's recommendation.
- .3 U-channel concrete inserts shall be 12 gauge steel 1-5/8 in square with insert anchors 1 3/8 in long and 100 mm (4 in) on centre.
- .4 Install anchor bolts to elevations required for proper attachment to supported equipment.

2.13 Plywood Equipment Boards

- .1 Plywood Equipment Boards: preservative treated, and kiln dried; thickness as indicated, or if not indicated, not less than 19 mm (3/4 in) deep. Provide marine grade plywood where subject to moisture conditions.
- .2 Paint plywood board white, or to match adjacent finishes. Leave the fire-retardant label unpainted for verification by the Consultant and by Authority Having Jurisdiction (AHJ).

- .3 Unless otherwise noted, boards shall be painted with two coats of good grade weatherproof flat gray non-conductive fire-retardant paint on all sides and edges (prior to mounting) and plumbed in a true vertical position. Provide nominal 13 mm (1/2 in) rustproof spacers between back of plywood and wall. Cut, fit, and place plywood equipment boards accurately in location, alignment, and elevation to support and anchor electrical materials and equipment. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members. Attach to substrates as required to support applied loads. Maintain at least 100 mm (4 in) from bottom of plywood equipment boards and the finished floor surface.
- .4 Unless directed otherwise in field, plywood equipment boards shall be 2440 mm (8 ft) high by 19 mm (3/4 in) deep by length shown on drawings (as dimensioned or as scaled) or length as required to accommodate equipment if not indicated on drawings. Unless directed otherwise in field, provide plywood equipment boards for all indoor surface mounted panelboards and systems "head-end" equipment for all applications where located in mechanical or electrical rooms/areas and only where specifically shown on drawings for all other applications.

2.14 Roof Supports

- .1 High-density polyethylene platform and base, height adjustable with rounded corners and edges to reduce likelihood of roof penetration.
- .2 Large surface area to spread the weight of supported objects including conduits, and cable trays over a large surface footprint.
- .3 No penetration of the waterproof membrane.
- .4 Self drains water, rot proof, and sunlight resistant.
- .5 Manufacturers:
 - .1 Thomas & Betts Superstrut Adjustable Universal Support.
 - .2 Eaton Dura-Blok series.

3 Execution

3.01 Installation

- .1 Obtain permission from the Consultant before drilling or cutting structural members.
- .2 Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- .3 Install surface-mounted cabinets and panelboards with minimum of four anchors.
- .4 In wet and damp locations use steel channel supports to stand cabinets and panelboards 25 mm (1 in) off wall.
- .5 Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.
- .6 Provide inserts, sleeves, equipment supports and hangers, sealing of sleeves and openings, as required for all electrical work. Ensure that the load onto structures does not exceed the maximum loading per square metre as shown on Structural Drawings or as directed by the Consultant.
- .7 Provide insets, holes, anchor bolts and sleeves in time when walls, floors, and roof are erected.

- .8 Place insets only in structural members and not in the finishing material.
- .9 Secure all supports and hangers to the structure unless noted otherwise.
- .10 Suspend hanger rods from approved concrete inserts and from beam clamps. Obtain Consultant's approval before welding to steel structural members.
- .11 Secure supports to precast concrete members to inserts originally cast into the members or by rods passing between the members and connected to a steel plate bearing.
- .12 Sealing of Sleeves and Openings to Maintain Fire Rating
 - .1 Use Dow-Corning #3-6548 'Silicone RTV' foam, Thomas & Betts 'Flamesafe' firestop system, Electrovert 'Flameseal' firestop putty, or approved equal materials installed in accordance with the manufacturer's specifications and recommendations.
 - .2 Submit data sheets for review prior to installation.
- .13 Supports
 - .1 All conduits, panels, etc. to be securely and adequately supported.
 - .2 Where more than three conduits run together, conduit racks to be used.
 - .3 Single runs of conduit to be supported by galvanized conduit straps or ring bolt type hangers. Tie wire or perforated metal strap hangers will NOT be accepted.

End of Section

1 General

1.01 Section Includes

- .1 Rigid metal conduit.
- .2 Flexible metal conduit.
- .3 Liquid tight flexible metal conduit.
- .4 Electrical metallic tubing (EMT).

- .5 Rigid PVC conduit.
- .6 Fittings and conduit bodies.

1.02 References

- .1 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
 - .3 CSA C22.2 No. 45.1:22 – Electrical rigid metal conduit – steel.
 - .4 CSA C22.2 No. 56-17 (R2022), Flexible metal conduit and liquid-tight flexible metal conduit.
 - .5 CSA C22.2 No. 83.1:07 (R2022), Electrical Metallic Tubing – Steel.
 - .6 CSA C22.2 No. 211.1-06 (R2021), Rigid types EB1 and DB2/ES2 PVC conduit.
 - .7 CSA C22.2 No. 211.2-06 (R2021), Rigid PVC (unplasticized) conduit.
 - .8 CSA C22.2 No. 227.1:19 (R2023), Electrical nonmetallic tubing.
 - .9 CSA C22.2 No. 227.2.1:19 (R2023), Liquid-tight flexible nonmetallic conduit.
 - .10 CSA C22.2 No. 2420-09 (R2019), Belowground reinforced thermosetting resin conduit (RTRC) and fittings.

1.03 Record Documentation

- .1 Accurately record actual routing of conduits larger than 51 mm (2 in).
- .2 Accurately record actual routing of all conduits installed below grade, regardless of size, including whether direct buried or installed in concrete duct bank.

1.04 Regulatory Requirements

- .1 Provide products listed and classified by CSA (Canadian Standards Association) as suitable for purpose specified and shown.

1.05 Delivery, Storage, and Handling

- .1 Accept conduit on site. Inspect for damage.

- .2 Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.06 Project Conditions

- .1 Verify that field measurements are as shown on drawings.
- .2 Verify routing and termination locations of conduit prior to rough-in.
- .3 Conduit routing, if shown on drawings, is approximate unless dimensioned. Route as required to provide a complete wiring system.

2 Products

2.01 Manufacturers

- .1 Where products are listed in this section based on a single manufacturer, the equivalent product from the following manufacturers is acceptable:
 - .1 Appleton.
 - .2 Columbia-MBF.
 - .3 Crouse-Hinds by Eaton.
 - .4 Hubbell.
 - .5 Thomas & Betts Ltd.

2.02 Rigid Metal Conduit

- .1 Rigid metal conduit: to CSA C22.2 No. 45, hot dipped galvanized steel, threaded.
- .2 Epoxy coated conduit: to CSA C22.2 No. 45, with zinc coating and corrosion resistant epoxy finish inside and outside.
- .3 Fittings and conduit bodies: Material to match conduit.

2.03 Flexible Metal Conduit

- .1 Flexible metal conduit: to CSA C22.2 No. 56, interlocked steel construction.
- .2 Fittings: CSA C22.2 No. 56.

2.04 Liquid Tight Flexible Metal Conduit

- .1 Description: Interlocked steel construction with PVC jacket.
- .2 Fittings: CSA C22.2 No. 56.

2.05 Electrical Metallic Tubing (EMT)

- .1 Description: CSA C22.2 No. 83.1; galvanized tubing.
- .2 Fittings and Conduit Bodies: CSA C22.2 No. 83.1; steel type.

2.06 Electrical Non-metallic Tubing (ENT)

- .1 To CSA C22.2 No. 227.1.

2.07 Non-Metallic Conduit

- .1 Rigid Type EB1 PVC Conduit: to CSA C22.2 No. 211.1.
- .2 Rigid Type DB2/ES2 PVC Conduit: to CSA C22.2 No. 211.1.

2.08 Conduit, Fittings, and Accessories

- .1 Conduit accessories, conduits and fittings conforming to CSA Standard C22.2 No. 18-1972.
- .2 Provide rain tight connectors, couplings, fittings, junction boxes, pull boxes and surface outlet boxes shall be used for surface conduit installations exposed to moisture or in sprinklered buildings.
- .3 Rigid conduit bushings:
 - .1 Thomas & Betts Ltd. - Series 5031.
- .4 EMT Connectors:
 - .1 Thomas & Betts Ltd. - Steel City TC121A series.
- .5 Ground Bushings:
 - .1 Thomas & Betts – Blackjack or 1220 series.
- .6 Flexible conduit connectors:
 - .1 Thomas & Betts Ltd. - Series 3110.
 - .2 EMT couplings: steel concrete tight to match connectors.
- .7 Terminate rigid conduit entering boxes or enclosures with nylon insulated steel threaded bushings.
 - .1 Thomas & Betts – 8125 series.
- .8 Terminate EMT entering boxes or enclosures with nylon insulated steel concrete tight connectors.
- .9 Terminate flexible conduit entering boxes or enclosures with nylon insulated steel connectors.
 - .1 Thomas & Betts – 5332 series.

3 Execution

3.01 Preparation

- .1 Produce layout sketches of conduit runs through mechanical and electrical service areas, through corridors, and other congested areas in order to resolve any interferences with other work, and to determine the most efficient route to run the conduit.

3.02 Installation

- .1 Minimum size: 21 mm (3/4 in) unless otherwise specified.
- .2 Conceal all conduit except in mechanical rooms and electrical rooms, or unless otherwise indicated in this specification, or noted on the drawings. Surface conduit work is not permitted unless specifically noted.
- .3 Install wiring in conduit unless otherwise specified. Where conduit sizes are not shown on drawings, provide conduits sized in accordance with Ontario Electrical Safety Code, CSA C22.1. When conduits are

indicated, they are the minimum size required, and must be increased to suit the length of run or voltage drop requirements.

- .4 Conduit use:
 - .1 Unless otherwise specified below or shown on the drawings, all systems shall be installed in electrical metallic tubing (EMT).
 - .2 Equipment subject to vibration:
 - .1 Use liquid tight flexible metal conduit for connections to transformers, motors, and equipment, subject to vibration and movement.
 - .3 Outdoor locations, above grade: use rigid steel.
 - .4 Underground: Use rigid PVC conduit for wiring in slabs on grade, and wiring below grade.
 - .5 Wet and damp locations:
 - .1 Use rigid steel.
 - .2 Use liquid tight flexible metal conduit for connections to transformers, motors, and equipment, subject to vibration and movement.
 - .6 Dry locations:
 - .1 Concealed in metal stud partitions:
 - .1 Use electrical metallic tubing.
 - .2 Use of AC90 (Bx) as described in Section 26 05 19.
 - .2 Concealed in concrete: Use electrical non-metallic tubing or rigid PVC.
 - .3 Exposed areas: Use electrical metallic tubing.
 - .4 Use flexible metal conduit for connections to transformers, motors, and equipment, subject to vibration and movement.
 - .5 Use liquid tight flexible metal conduit below raised floors for connections to all devices.
 - .6 Aluminium conduit may be used, in lieu of steel conduit, in clean and dry locations, but shall not be used in poured concrete, or for signal and intercommunication systems wiring.
 - .7 Raceways installed less than 2 m above grade in an area where they are subject to mechanical damage, shall be of the rigid steel type or protected by a steel guard of not less than no. 10 MSG, adequately secured in place.
 - .8 Use epoxy coated conduit in corrosive areas.
 - .7 Equipment in sprinklered spaces:
 - .1 Provide CSA certified sealing rings for rigid steel galvanized conduit and CSA certified raintight connectors for steel galvanized electrical metallic tubing (EMT) where conduits enter the top or the sides of enclosures.
 - .8 Telecommunications conduits: in accordance with Section 27 05 28.
- .5 Arrangement and supports:

- .1 Arrange supports to prevent misalignment during wiring installation.
- .2 Arrange conduit to maintain headroom and present neat appearance.
- .3 Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- .4 Group related conduits; support using conduit rack.
- .5 Construct rack using steel channel; provide space on each for 25 per cent additional conduits.
- .6 Fasten conduit supports to building structure and surfaces to Section 26 05 29.
- .7 Do not support conduit with wire or perforated pipe straps.
- .8 Remove wire used for temporary supports.
- .9 Do not attach conduit to ceiling support wires.
- .10 Route exposed conduit parallel and perpendicular to walls.
- .11 Route conduit installed above accessible ceilings parallel and perpendicular to walls.
- .12 Route conduit in and under slab from point-to-point.
- .13 In damp and unheated areas, avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- .14 Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.
- .6 Clearances:
 - .1 Maintain adequate clearance between conduit and piping.
 - .2 Maintain 300 mm (12 in) clearance between conduit and surfaces with temperatures exceeding 40°C.
- .7 Conduit bends:
 - .1 Install no more than equivalent of three 90 degree bends between boxes.
 - .1 Use conduit bodies to make sharp changes in direction, as around beams.
 - .2 Use hydraulic one-shot bender to fabricate bends in metal conduit larger than 50 mm size or provide prefabricated conduit bends.
- .8 Install wall entrance seals where conduits pass through exterior walls below grade.
- .9 Provide expansion coupling in conduit runs at building expansion joints and in long runs subject to thermal expansion, all in accordance with manufacturer recommendations.
- .10 Cut conduit square using saw or pipe cutter; de-burr cut ends.
- .11 Bring conduit to shoulder of fittings; fasten securely.
- .12 Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- .13 Use conduit hubs or sealing locknuts to fasten conduit and to cast boxes.

- .14 Provide suitable pull string in each empty conduit except sleeves and nipples.
- .15 Ground and bond conduit to Section 26 05 26.
- .16 Identify conduit to Section 26 05 53.
- .17 Flexible conduit and armoured cable will be accepted for a maximum length of 1500 mm for final connection to lighting fixtures. Do not connect from fixture to fixture.

3.03 Cleaning

- .1 Conduit manufacturer's touch-up enamel shall be used to repair all scratches and gouges on epoxy-coated conduit.

End of Section

1 General

1.01 Section Includes

- .1 Wall and ceiling outlet boxes.
- .2 Pull and junction boxes.

1.02 Related Requirements

- .1 Section 26 09 23 – Lighting Control Devices.
- .2 Section 26 27 16 – Electrical Cabinets and Enclosures.
- .3 Section 26 27 26 – Wiring Devices: Wall plates in finished areas, floor box service fittings, fire-rated poke-through fittings, and access floor boxes.
- .4 Section 26 27 26.13 – Floor Box Assemblies.

1.03 References

- .1 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
 - .3 CSA C22.2 No. 18.1:13 (R2022), Metallic Outlet Boxes (Tri-national standard, with UL 514A and ANCE NMJ-J-023/1).
 - .4 CSA C22.2 No. 40:17 (R2022), Junction and Pull Boxes.
 - .5 CSA C22.2 No. 85:14 (R2023) – Rigid PVC Boxes and Fittings.

1.04 Closeout Submittals

- .1 Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.05 Regulatory Requirements

- .1 Provide products listed and classified by CSA (Canadian Standards Association) as suitable for the purpose specified and indicated.

2 Products

2.01 Outlet Boxes

- .1 Sheet Metal Outlet Boxes: CSA C22.2 No. 18.1, galvanized steel.
 - .1 Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 13 mm male fixture studs where required.
 - .2 Concrete Ceiling Boxes: Concrete type.
- .2 Non-metallic Outlet Boxes: CSA C22.2 No. 18.1.

- .3 Cast Boxes: CSA C22.2 No. 18.1, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.
- .4 Wall Plates for Finished Areas: As specified in Section 26 27 26.

2.02 Pull Boxes and Junction Boxes

- .1 Sheet Metal Boxes: CSA C22.2 No. 18.1, galvanized steel.
- .2 Hinged Enclosures: As specified in Section 26 27 16.
- .3 Surface Mounted Cast Metal Box: CSA C22.2 No. 18.1, Type 4; flat-flanged, surface mounted junction box:
 - .1 Material: Cast aluminum.
 - .2 Cover: Provide with ground flange, neoprene gasket, and stainless steel cover screws.

2.03 Outlet Boxes

- .1 Conform to CSA C22.2 No. 18.1.
- .2 Where 103 mm (4 in) square outlet boxes are installed in exposed concrete or cinder block finished areas, blocks will be cut as described in Division 04 as instructed under this Section. Cut openings to provide a close fit to boxes and covers so that edges of openings are not visible after installation of plates. Use of mortar to patch up openings that are cut too large or to patch ragged edges is not permitted.
- .3 Ceiling boxes: 103 mm (4 in) octagon or square, complete with fittings, where required to support fixtures.
- .4 Switch, receptacle, and telecommunication outlet boxes:
 - .1 103 mm (4 in) square with plaster ring, where flush mounted in walls and partitions, as required.
 - .2 Iberville 1104 series box, or equal, where flush mounted in wood or drywall, with stud fasteners as required.
 - .3 Masonry boxes in masonry walls.
- .5 Where boxes are surface mounted in unfinished areas they shall be FS conduits.
- .6 Standard outlet boxes manufactured from code gauge galvanized steel.
- .7 Provide a suitable outlet box for each light, switch, receptacle, or other outlet, approved for the area it is to be installed.
- .8 Support outlet boxes independently of conduit and cable.
- .9 Locate outlet boxes, mounted in hung ceiling space, so they do not obstruct or interfere with the removal of lay-in ceiling tiles.
- .10 Offset outlet boxes, shown back to back in partitions, horizontally a minimum 150 mm (6 in) to minimize noise transmission between adjacent rooms.
- .11 Use gang boxes at locations where more than one device, of the same system only, is to be mounted. Utilize separate boxes for each system.
- .12 Use tile wall covers where 103 mm (4 in) square outlet boxes are installed in exposed concrete or cinder block in finished areas.

- .13 Provide flush mount boxes, panels, cabinets, and electrical devices, which are installed in finished areas, with suitable flush trims and doors or covers, unless specifically noted otherwise.
- .14 Provide pre-formed polyethylene vapour barriers for all boxes located in walls with internal vapour barriers.

3 Execution

3.01 Examination

- .1 Verify locations of floor boxes prior to rough-in.

3.02 Installation

- .1 Install boxes to CSA C22.1.
- .2 Install in locations as shown on drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
- .3 Set wall mounted boxes at elevations to accommodate mounting heights indicated.
- .4 Electrical boxes are shown on drawings in approximate locations unless dimensioned. Adjust box location up to 3 m (10 ft) if required to accommodate intended purpose.
- .5 Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
- .6 Maintain headroom and present neat mechanical appearance.
- .7 Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
- .8 Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 150 mm (6 in) from ceiling access panel or from removable recessed luminaire.
- .9 Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods.
- .10 Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- .11 Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
- .12 Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
- .13 Use flush mounting outlet box in finished areas.
- .14 Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
- .15 Do not install flush mounting box back-to-back in walls; provide minimum 150 mm (6 in) separation. Provide minimum 600 mm (24 in) separation in acoustic rated walls.
- .16 Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
- .17 Use stamped steel bridges to fasten flush mounting outlet box between studs.
- .18 Install flush mounting box without damaging wall insulation or reducing its effectiveness.
- .19 Use adjustable steel channel fasteners for hung ceiling outlet box.

- .20 Do not fasten boxes to ceiling support wires.
- .21 Support boxes independently of conduit.
- .22 Use gang box where more than one device is mounted together. Do not use sectional box.
- .23 Use gang box with plaster ring for single device outlets.
- .24 Use cast outlet box in exterior locations exposed to the weather.
- .25 Use cast outlet box in wet locations.
- .26 Set floor boxes level.
- .27 Large pull boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.
- .28 Provide painted cover plate screwed onto junction box to match adjacent material colour finish for all junction and outlet boxes. Where empty boxes or boxes allocated for future services are installed with conduit, provide cover plate. If the box is provided a circuit, provide circuit label in accordance with Section 26 05 53.

3.03 Adjusting

- .1 Adjust floor box flush with finish flooring material.
- .2 Adjust flush-mounting outlets to make front flush with finished wall material.
- .3 Install knockout closures in unused box openings.

3.04 Cleaning

- .1 Clean interior of boxes to remove dust, debris, and other material.
- .2 Clean exposed surfaces and restore finish.

End of Section

1 General

1.01 Section Includes

- .1 Metal Raceway is an enclosed pathway used for surface distribution of branch circuit electrical wiring, and cabling for voice, data, multi-media, low voltage, and optical fiber. Raceway is typically installed in existing building structures, or after construction is complete. A complete raceway system includes raceway, covers, mounting hardware, various fittings, and outlet boxes installed at specific locations. Specific codes and standards apply to electrical wires and telecommunications cables that are deployed within metal raceway. Compliance to codes and standards is required for installation, grounding and bonding, and cable deployment.

1.02 Related Requirements

- .1 Section 26 05 33.13 – Conduit for Electrical Systems.
- .2 Section 26 05 33.16 – Boxes for Electrical Systems.

1.03 Quality Assurance

- .1 Product free from defects in material or workmanship.
- .2 Materials and work specified in this document shall comply with, and are not limited to the codes, standards, and regulations listed below.
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
 - .3 National Electrical Manufacturer's Association (NEMA)
 - .1 ANSI/NEMA WD 6-2021: Wiring Devices – Dimensional Specifications.
 - .2 ANSI/NEMA 250-2020: Enclosures for Electrical Equipment.
 - .4 UL 94, Standard for Safety of Flammability of Plastic Materials for Parts in Devices and Appliances testing.
- .3 Performance Requirements:
 - .1 Metal raceway and fittings UL Listed and CSA certified.

1.04 Submittals

- .1 Product Data Sheet.
- .2 Manufacturer's Instructions.
- .3 Product Catalog Literature.
- .4 Product Drawings.

1.05 Warranty

- .1 Product is warranted free of defects in material or workmanship.
- .2 Product is warranted to perform the intended function within design limits.

2 Products

2.01 Manufacturers

- .1 Wiremold Legrand.
- .2 Hubbell.
- .3 Thomas & Betts Canada.

2.02 Surface Mounted Raceway, General

- .1 The raceway and all system components must be UL Listed and exhibit non-flammable self-extinguishing characteristics tested to comparable specifications of UL 94V-0. The raceway base and cover shall be manufactured by rigid compound, available in ivory or white colours, and allow for field painting.

2.03 Single Channel Metal Raceway

- .1 Raceway:
 - .1 Metal raceway shall be a one-piece design with base and cover, factory assembled, with mounting hardware and instructions included.
 - .2 Metal raceway, cover, surface boxes, shall be a formed steel construction with a thickness of 0.040", and zinc plated. Related fittings shall be galvanized on all surfaces.
 - .3 Metal raceway, cover, and related fittings shall have an ivory colour powder coat paint finish on all external surfaces.
 - .4 Have tools available for field cutting and bending.
 - .5 Assembly and disassembly of raceway base, cover, and fittings requiring no special tools.
 - .6 Available fittings including couplings, internal and external elbows, tees, entrance fittings, conduit adapters and bushings.
 - .7 Available fittings including internal, external and flat elbows, and tee fitting, with a 1-½" radius to accommodate communications UTP and fiber cabling minimum bend radius requirements.
 - .8 Installed fittings designed to overlap the raceway to cover exposed or uneven edges from field cutting.
- .2 Device Boxes
 - .1 Compatible device boxes shall have a removable knockout portion to permit metal raceway entry and exit.
 - .2 Device boxes available in standard NEMA single- and double-gang, and multiple gang up to six-gang. Device box depth shall range from 1.125" to 2.75".
 - .3 Device boxes shall have a single seam construction with rounded corners to eliminate sharp edges.
 - .4 Assembled device box front face design to permit flush mounting of standard wall plates to minimize perimeter profile exposure.
 - .5 Device boxes shall have threaded standoff posts attached to the base, to facilitate mounting of covers with short screws for ease of alignment during installation.
- .3 Basis of Design: Wiremold 500 and 700 series.

2.04 Two-Channel Metal Raceway

- .1 Surface metal raceway, single or complete with snap-in divider to form 2 compartments for power and data, with removable cover. Width to suit application while keeping code and telecommunication standard filling ratios.
- .2 Elbows, couplings, end caps, device brackets and faceplates for power, data and voice, and fittings manufactured as accessories for wireway supplied. 120 V power receptacles and mounting for voice/data.
- .3 Finish: Designer Grey.
- .4 Basis of Design: Wiremold DS4000 series.

3 Execution

3.01 Preparation

- .1 Submit layout drawings of the raceway system for reviewed prior to installation.
- .2 Installation of metal raceway in wet areas is not permitted.
- .3 Manufacturer's instructions for installing raceway and fittings shall be followed by the installer.
- .4 All wall surfaces, or other permanent structures to which raceway is mounted shall be finished complete.

3.02 Installation

- .1 Mount base and cover together to wall or structure using the appropriate fasteners and clips, per manufacturer's instructions.
- .2 Securely support raceway in intervals not exceeding 3 m (10 ft) or per manufacturer's instructions.
- .3 Install fittings and device boxes in the specified locations, per manufacturer's instructions and per contract drawing specifications.
- .4 Completed raceway installation shall be mechanically continuous and connected to all electrical outlets, device boxes, and enclosures with no gaps or exposed cuts.
- .5 Provide insulated ground wire for power raceways per OESC requirements. Raceway shall not be used as the primary ground path.
- .6 Prior to wire and cable installation, the raceway system shall be installed complete, including insulating bushings, adapters, fittings, outlets, boxes, and enclosures. Unused raceway openings shall be closed.
- .7 Make wiring connections with the proper approved insulated wire connectors or lugs. Exposed conductors at harness wiring junctions are not permitted regardless of connection method.
- .8 Provide a physical barrier in raceway and boxes to separate power and communication wiring.
- .9 Install covers on raceway, boxes and fittings after wiring is complete, or if wire and cable installation is to be done at a later date.

3.03 Field Quality Control

- .1 Verify layout of system to contract drawings.
- .2 Raceway system shall be free of dents, scratches, bare metal edges, and exposed uneven cuts.

- .3 Securely fasten all outlets, boxes, and enclosures walls or permanent structures.
- .4 Verify that all wiring junctions or connections have no exposed conductors prior to energizing the circuits.
- .5 Verify that all bonding locations are code and standards compliant.
- .6 Verify that power and communications wiring are separated by a physical barrier in raceway and boxes.

End of Section

1 General

1.01 Section Includes

- .1 Sleeves, sealing of sleeves and openings, as required for all electrical work.

1.02 References

- .1 CAN/ULC-S101-14, Standard methods of fire endurance tests of building construction and materials.
- .2 CAN/ULC-S115:2013, Standard method of fire tests of firestop systems.

1.03 Submittals

- .1 Submit data sheets for firestopping in accordance with Section 01 33 00.
- .2 Submit copies of firestopping drawings with ULC certificate and system number for each specific installation.
- .3 Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.
- .4 Submit dimensioned location drawings indicating required sleeves and formed openings in structural poured concrete or precast concrete construction or in roofing, and locations of cutting or drilling required for Electrical work.

2 Products

2.01 Sleeves

- .1 Galvanized steel sleeves:
 - .1 24 gauge with an integral flange at one (1) end to secure sleeve to formwork construction.
 - .2 Schedule 40 pipe.
- .2 Schedule 40 PVC sleeves.

2.02 Sleeve Seals

- .1 Manufacturers
 - .1 Hilti Canada.
 - .2 Specified Technologies Inc.
 - .3 3M Canada Inc.
 - .4 Tremco.
 - .5 A/D Fire Protection Systems.
 - .6 Nelson.
- .2 Asbestos-free, elastomeric materials and intumescent materials, tested, listed, and labelled by ULC in accordance with CAN/ULC-S101, and CAN/ULC-S115 for installation in ULC designated firestopping, and smoke seal systems to provide a positive fire, water and smoke seal and a fire resistance rating (flame, hose stream and temperature) no less than fire rating for surrounding construction.

- .3 Materials are to be compatible with abutting dissimilar materials and finishes and complete with primers, damming and back-up materials, supports, and anchoring devices in accordance with firestopping manufacturer's recommendations and ULC tested assembly. Coordinate material requirements with trades supplying abutting areas of materials.
- .4 Maintain fire rating of separation in accordance with architectural drawings.

3 Execution

3.01 Installation

- .1 Where conduits and conductors pass through structural poured concrete, provide sleeves of type suitable for application, and approved by local governing codes.
- .2 Sleeves in concrete slabs, except as noted below, are to be 24 gauge or equivalent, with an integral flange to secure sleeves for formwork construction.
- .3 Sleeves in waterproof concrete slabs and in other slabs where waterproof sleeves are required are to be lengths of Schedule 40 pipe sized to extend 100 mm (4 in) above floor.
- .4 Sleeves in poured concrete walls and foundation are to be Schedule 40 pipe.
- .5 Through interior walls, use standard weight steel pipes, conduit, or galvanized steel. Cut flush with finished surfaces. Check room finish schedules.
- .6 Through exterior walls above grade, floors, and roof use standard weight steel pipes, machine cut, flush with finished surface inside and to suit flashing outside.
- .7 Through exterior walls below grade, water-proofed floors, and other water-proof walls, use heavy weight cast iron pipes, machine cut. Extend sleeves 100 mm (4 in) above finished floors, and cut flush with underside of floor.
- .8 Size sleeves, unless otherwise noted, to leave 13 mm (1/2 in) clearance around conduit, duct, conductor, etc. Void between sleeves and conduit, duct, conductors, etc., to be packed and sealed for length of sleeves as in accordance with article entitled "Sleeve Seals" specified in this Section. Pack and seal sleeves set in exterior walls with governing authority approved materials suitable for application and pack both ends of sleeves watertight with approved permanently flexible and water tight materials. Coordinate exact responsibility of work with General Trades Contractor.
- .9 Submit to concrete reinforcement detailer at proper time, drawings indicating required sleeves, recesses and formed openings in poured concrete work. Completely and accurately dimension such drawings and relate sleeves, recesses and formed openings to suitable grid lines and elevation datum.
- .10 Supply sleeves of a water protecting type in accordance with detail found on drawings for installation in following locations:
 - .1 in Mechanical and Fan Room floor slabs, except where on grade.
 - .2 in slabs over Mechanical, Fan, Electrical and Telephone Equipment Rooms or closets.
 - .3 in floors equipped with waterproof membranes.
- .11 "Gang" type sleeving to be permitted only with approval of Owner and reviewed with the Consultant.
- .12 Terminate sleeves for work which is exposed, so that sleeve is flush at both ends with wall, partition, or slab surface such that sleeve may be covered completely by escutcheon plates.
- .13 Sleeves are not required in interior walls and dry area floors where conduit is installed ahead of floor construction.

- .14 Seal all openings and sleeves after installation of equipment:
 - .1 With an approved material to maintain fire rating where sleeves and openings pass through fire separations and floors.
 - .2 With an approved material to maintain fire rating for sleeves and openings provided for future equipment.
 - .3 Flash all conduits and systems passing through roof or built into an outside wall, or a waterproof floor.
 - .4 Provide copper flashing for sleeves passing through exterior walls or waterproof floors.
- .15 Provide all flashing and waterproofing for sleeves through roof and exterior walls to the requirements of Division 07.
- .16 Firestop sleeves in accordance with the manufacturer's specifications and recommendations.

End of Section

1 General

1.01 Section Includes

- .1 Tested firestop systems used in penetrations for the passage of cables, conduit, and other electrical equipment through fire-rated vertical barriers (walls and partitions), horizontal barriers (floor/ceiling assemblies), and vertical service shaft walls and partitions.

1.02 Related Requirements

- .1 Coordinate work of this section with work of other sections as required to properly execute the work and as necessary to maintain satisfactory progress of the work of other sections, including:
 - .1 Section 07 84 00 – Firestopping.
 - .2 Section 27 05 44 – Sleeves and Sleeve Seals for Communications Pathways and Cabling.

1.03 References

- .1 Underwriter's Laboratories (UL) and Underwriters Laboratories of Canada (ULC):
 - .1 Test Requirements: CAN/ULC-S115:2023, Standard Method of Fire Tests of Firestop Systems.
 - .2 Underwriters Laboratories of Canada (ULC) runs CAN/ULC-S115:2023 under their designation of ULC-S115:2023 and publishes the results in their "FIRE RESISTANCE RATINGS DIRECTORY" that is updated annually.
 - .3 Underwriters Laboratories (UL) of Northbrook, IL runs ASTM E814 under their designation of UL 1479 and publishes the results in their "FIRE RESISTANCE DIRECTORY" that is updated annually. UL tests that meet the requirements of ULC-S115 are given a cUL listing and are published by UL in their "Products Certified for Canada (cUL) Directory."
 - .4 CAN/ULC-S101-14, Fire Endurance Tests of Building Construction and Materials.
 - .5 CAN/ULC 102:2019 (R2024), Standard Test Method for Surface Burning Characteristics of Building Materials.
- .2 ASTM:
 - .1 Omega Point Laboratories runs ASTM E814 and publishes the results annually in their "Omega Point Laboratories Directory".
 - .2 Inspection Requirements: ASTM E2174, "Standard Practice for On-site Inspection of Installed Fire Stops.", and ASTM E2393 Standard Practice for On-Site Inspection of Installed Fire Resistive Joint Systems and Perimeter Fire Barriers.
 - .3 Test Requirements: ASTM E2307, "Standard Test Method for Determining Fire Resistance of Perimeter Fire Barrier Systems Using Intermediate-Scale, Multi-story Test Apparatus".
 - .4 ASTM D6904, "Standard Practice for Resistance to Wind Driven Rain for Exterior Coatings Applied on Masonry".
 - .5 ASTM C679, "Standard Test Method for Tack-Free Time of Elastomeric Sealants".
- .3 International Firestop Council Guidelines for Evaluating Firestop Systems Engineering Judgments.
- .4 Ontario Building Code.
- .5 Ontario Electrical Safety Code.

1.04 Definitions

- .1 Firestopping: Material or combination of materials used to retain integrity of fire-rated construction by maintaining an effective barrier against the spread of flame, smoke, and hot gases through penetrations in fire rated wall and floor assemblies.

1.05 Submittals

- .1 Submit Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of ULC or cUL firestop systems to be used and manufacturer's installation instructions to comply with Section 01 33 00.
- .2 Manufacturer's engineering judgment identification number and drawing details when no ULC or cUL system is available for an application. Engineered judgment must include both project name and contractor's name who will install firestop system as described in drawing.
- .3 Submit material safety data sheets provided with product delivered to project site.
- .4 Submit shop drawings in accordance with Section 01 33 00:
 - .1 Submit complete cUL, ULC, or equivalent approved systems for all applications. Ensure the listing is clearly noted on the submittal.

1.06 Closeout Submittals

- .1 On completion of firestopping and smoke sealing installation, submit a Letter of Assurance to the Consultant certifying the firestopping and smoke sealing installation has been carried out throughout the building to electrical service penetrations and that installation has been done in strict accordance with requirements of the Ontario Building Code, any applicable municipal bylaws, ULC requirements, and manufacturer's instructions.

1.07 Quality Assurance

- .1 Fire-Test-Response Characteristics: Provide through-penetration fire stop systems and fire-resistive joint systems that comply with specified requirements of tested systems.
- .2 Firestop System installation must meet requirements of CAN/ULC-S115 tested assemblies that provide a fire rating as shown in Section 2.1 Clauses 4, 5, 6, and 7 below.
- .3 Proposed firestop materials and methods shall conform to applicable governing codes having local jurisdiction.
- .4 Firestop Systems do not re-establish the structural integrity of load bearing partitions/assemblies, or support live loads and traffic. Installer shall consult the structural engineer prior to penetrating any load bearing assembly.
- .5 For those firestop applications that exist for which no ULC or cUL tested system is available through a manufacturer, a manufacturer's engineering judgment derived from similar ULC or cUL system designs or other tests will be submitted to local authorities having jurisdiction for their review and approval prior to installation. Engineering judgment drawings must follow requirements set forth by the International Firestop Council.

1.08 Installer Qualifications

- .1 Engage an experienced Installer who is certified, licensed, or otherwise qualified by the firestopping manufacturer as having the necessary training to install manufacture's products per specified requirements. A supplier's willingness to sell its firestopping products to the Contractor or to an Installer engaged by the Contractor does not in itself confer qualification on the buyer.

- .2 Installation Responsibility: assign installation of through-penetration fire stop systems and fire-resistive joint systems in Project to a single sole source firestop specialty contractor.
- .3 The work is to be installed by a contractor with at least one of the following qualifications:
 - .1 FM 4991 approved contractor.
 - .2 ULC approved contractor.
 - .3 Manufacturer's accredited fire stop specialty contractor.
- .4 Installer: Minimum 3 years experience with fire stop installation.

1.09 Delivery, Storage, and Handling

- .1 Deliver materials undamaged in manufacturer's clearly labeled, unopened containers, identified with brand, type, and ULC or cUL label where applicable.
- .2 Coordinate delivery of materials with scheduled installation date to allow minimum storage time at project site.
- .3 Store materials under cover and protect from weather and damage in compliance with manufacturer's requirements.
- .4 Comply with recommended procedures, precautions or remedies described in material safety data sheets as applicable.
- .5 Do not use damaged or expired materials.

1.10 Project Conditions

- .1 Do not use materials that contain flammable solvents.
- .2 Scheduling
 - .1 Schedule installation of CAST IN PLACE firestop devices after completion of floor formwork, metal form deck, or composite deck but before placement of concrete.
 - .2 Schedule installation of Drop-In firestop devices after placement of concrete but before installation of the pipe penetration. Diameter of sleeved or cored hole to match the listed system for the device.
 - .3 Schedule installation of other firestopping materials after completion of penetrating item installation but prior to covering or concealing of openings.
- .3 Verify existing conditions and substrates before starting work. Correct unsatisfactory conditions before proceeding.
- .4 Weather conditions: Do not proceed with installation of firestop materials when temperatures exceed the manufacturer's recommended limitations for installation printed on product label and product data sheet.
- .5 During installation, provide masking and drop cloths to prevent firestopping materials from contaminating any adjacent surfaces.

2 Products

2.01 Performance Requirements

- .1 Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by the firestopping manufacturer based on testing and field experience.
- .2 Provide components for each firestopping system that are needed to install fill material. Use only components specified by the firestopping manufacturer and approved by the qualified testing agency for the designated fire-resistance-rated systems.
- .3 Provide a round fire-rated cable management device whenever cables penetrate fire rated walls, where frequent cable changes and additions may occur. The fire-rated cable management device shall consist of a corrugated steel tube with zinc coating, contain an inner plastic housing, intumescent material rings, and inner fabric smoke seal membrane. The length of the sleeve shall be 315 mm (12.4 inches). The fire-rated cable management device shall contain integrated intumescent firestop wrap strip materials sufficient to maintain the hourly rating of the barrier being penetrated. The fire-rated cable management device shall contain a smoke seal fabric membrane or intumescent firestop plugs sufficient to achieve the L-Rating requirements of the barrier type. Install device per the manufacturer's published installation instructions.
- .4 Penetrations in Horizontal Assemblies: Provide firestopping with ratings determined in accordance with CAN/ULC-S115. For penetrations through a Fire Wall or horizontal Fire Separation provide a firestop system with a "FT" Rating as determined by ULC or cUL which is equal to the fire resistance rating of the construction being penetrated.
- .5 W-ratings: in accordance with Section 07 84 00.
- .6 Provide a firestop system with an Assembly Rating as determined by CAN/ULC-S115 which is equal to the time rating of construction joint assembly.
- .7 Penetrations in Smoke Barriers: Provide firestopping with ratings determined in accordance with CAN/ULC-S115.
 - .1 L-Rating: Not exceeding 5.0 CFM/sqft of penetration opening at both ambient and elevated temperatures.
- .8 Mold Resistance: Provide penetration firestopping with mold and mildew resistance rating of 0 as determined by ASTM G21.
- .9 Rain and water resistance: provide perimeter joint sealant tested in accordance with ASTM D 6904 with less than 1 hour tack free time as tested in accordance with ASTM C 679.

2.02 Manufacturers

- .1 Manufacturer List:
 - .1 AD Fire Protection Systems.
 - .2 Hilti (Canada) Corporation
 - .3 3M.
 - .4 Specified Technologies, Inc. (STI).
 - .5 Tremco, Inc.

- .2 Substitutions: Where a specific manufacturer is noted in this Section, equivalent products from the manufacturers listed above may be used, subject to compliance with through penetration firestop systems and joint systems listed in the ULC Fire Resistance Directory – Volume III, or UL Products Certified for Canada (cUL) Directory.

2.03 Materials

- .1 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire-rating involved for each separate instance.
- .2 Accessories: provide components for each firestopping and smoke seal systems that are needed to install fill materials. Use only components specified by firestopping material manufacturer, and approved by the qualified testing agency. Accessories include, but are not limited to, the following items:
 - .1 Permanent forming, damming, and backing material.
 - .2 Temporary forming material.
- .3 Pre-formed firestop devices for use with non-combustible and combustible pipes (closed and open systems), conduit and/or cable bundles penetrating concrete floors and/or gypsum walls:
 - .1 Hilti Tub Box Kit (CP 681) for use with tub installations.
 - .2 Hilti Cast-In Place Firestop Device (CP 680-PX) for use with XFR pipe.
 - .3 Hilti Cast-In Place Firestop Device (CP 680-M) for use with non-combustible penetrants.
 - .4 Hilti Speed Sleeve (CP 653) for use with cable penetrations.
 - .5 Hilti Firestop Drop-In Device (CFS-DID) for use with non-combustible and combustible penetrants.
 - .6 Hilti Cast-in Firestop sleeve (CFS-CID MD P) and (CFS-CID MD M) for use with combustible and non-combustible pipes through metal deck.
 - .7 Hilti Firestop Block (CFS-BL).
 - .8 STI SpecSeal series SSC Firestop Collars.
 - .9 STI SpecSeal series LCC Firestop Collars.
- .4 Sealants or caulking materials for use with non-combustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT).
 - .1 Hilti Intumescent Firestop Sealant (FS-ONE MAX).
 - .2 Hilti Fire Foam (CP 620)/CP 660.
 - .3 Hilti Flexible Firestop Sealant (CP 606).
 - .4 Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).
 - .5 Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).
- .5 Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe.
 - .1 Hilti Intumescent Firestop Sealant (FS-ONE MAX).

- .6 Foams, intumescent sealants, or caulking materials for use with flexible cable or cable bundles.
 - .1 Hilti Intumescent Firestop Sealant (FS-ONE MAX).
 - .2 Hilti Fire Foam (CP 620)/660.
 - .3 Hilti Flexible Firestop Sealant (CP 606).
 - .4 Hilti Firestop Silicone Sealant Gun Grade (CFS-S SIL GG).
 - .5 Hilti Firestop Silicone Sealant Self Leveling (CFS-S SIL SL).
- .7 Firestop Putty Pads: Intumescent, non-hardening putty pads to be installed on metallic and non-metallic electrical switch and receptacle boxes to reduce horizontal separation between boxes to less than 610 mm (24 in):
 - .1 STI SpecSeal Series SSP Firestop Putty Pads.
 - .2 Hilti Firestop Putty Pad (CP 617).
- .8 Materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways.
 - .1 Hilti Firestop Block (CFS-BL).
 - .2 Hilti Composite Sheet (CFS-COS).
 - .3 Hilti Firestop Mortar (CP 637).
 - .4 Hilti Fire Foam (CP 620)/660.
 - .5 Hilti Firestop Board (CP 675T).
- .9 Non-curing, re-penetrable materials used for large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways.
 - .1 Hilti Firestop Block (CFS-BL).
 - .2 Hilti Firestop Board (CP 675T).
- .10 Re-penetrable, round cable management devices for use with new or existing cable bundles penetrating gypsum or masonry walls.
 - .1 Hilti Speed Sleeve (CP 653) with integrated smoke seal fabric membrane.
 - .2 Hilti Firestop Cable Collar (CFS-CC).
 - .3 Hilti Firestop Sleeve (CFS-SL SK).
 - .4 Hilti Retrofit Sleeve (CFS-SL RK) for use with existing cable bundles.
 - .5 Hilti Gangplate (CFS-SL GP) for use with multiple cable management devices.
 - .6 Hilti Gangplate Cap (CFS-SL GP CAP) for use at blank openings in gangplate for future penetrations.
- .11 For blank openings made in fire-rated wall or floor assemblies, where future penetration of pipes, conduits, or cables is expected.
 - .1 Hilti CFS-BL Firestop Block (for walls and floors).

- .2 Hilti CFS-PL Firestop Plug (for walls and floors).
- .12 Cast-In-Place Firestop Device: Single component molded firestop device installed on forms prior to concrete placement with totally encapsulated, tamper-proof integral firestop system and smoke sealing gasket. Device shall allow for a concrete floor thickness of minimum 63 mm (2-1/2 in) up to 914 mm (36 in) without the use of field applied extension tubing:
 - .1 STI SpecSeal CID Cast-In Firestop Device.
 - .2 Hilti CP 680 Cast-In Place Firestop Device (for floors only).
- .13 For single or cable bundles up to 25 mm (1 in) diameter penetrating gypsum, masonry, concrete walls or wood floor assemblies.
 - .1 Hilti CFS-D Firestop Cable Disc.

3 Execution

3.01 Installers

- .1 Labour Use to Install Firestop Systems
 - .1 To ensure complete harmony on the project site, the installation of each scope of work is to be performed jurisdictionally correct per existing trade agreements.

3.02 Preparation

- .1 Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper or timely completion.
 - .1 Verify penetrations are properly sized and in suitable condition for application of materials.
 - .2 Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, laitance, release agents, water repellents, and any other substances that may affect proper adhesion.
 - .3 Provide masking and temporary covering to prevent soiling of adjacent surfaces by firestopping materials.
 - .4 Comply with manufacturer's recommendations for temperature and humidity conditions before, during and after installation of firestopping.
 - .5 Do not proceed until unsatisfactory conditions have been corrected.

3.03 Coordination

- .1 Coordinate construction of openings, penetrations to ensure that the fire stop systems are installed according to specified requirements.
- .2 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration fire stop systems.
- .3 Coordinate fire stopping with other trades so that obstructions are not placed in the way prior to the installation of the fire stop systems.
- .4 Do not cover up through-penetration fire stop and joint system installations that will become concealed behind other construction until each installation has been examined by the building inspector.

3.04 Installation

- .1 Regulatory Requirements: Install firestop materials in accordance with ULC Fire Resistance Directory or UL Products Certified for Canada (cUL) Directory or Omega Point Laboratories Directory.
- .2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of through-penetration and construction joint materials.
 - .1 Seal all holes or voids made by penetrations to ensure an air and water-resistant seal.
 - .2 Consult with mechanical engineer, project manager, and damper manufacturer prior to installation of ULC or cUL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
 - .3 Protect materials from damage on surfaces subjected to traffic.

3.05 Field Quality Control

- .1 Examine sealed penetration areas to ensure proper installation before concealing or enclosing areas.
- .2 Keep areas of work accessible until inspection by applicable code authorities.
- .3 Inspection of through-penetration firestopping shall be performed in accordance with ASTM E 2174, "Standard Practice for On-Site Inspection of Installed Fire Stops", or other recognized standard.
- .4 Perform under this section patching and repairing of firestopping caused by cutting or penetrating of existing firestop systems already installed by other trades.
- .5 Manufacturer's Field Services: During Installation, provide periodic destructive testing inspections to assure proper installation/application. After installation is complete, submit findings in writing indicating whether or not the installation of the tested system identified was installed correctly.

3.06 Identification and Documentation

- .1 The firestop contractor is to supply documentation for each single application addressed. This documentation is to identify each penetration location on the entire project.
- .2 The Documentation Form for through penetrations is to include:
 - .1 A Sequential Location Number.
 - .2 The Project Name.
 - .3 Date of Installation.
 - .4 Detailed description of the penetration location.
 - .5 Tested System or Engineered Judgment Number.
 - .6 Type of assembly penetrated.
 - .7 A detailed description of the size and type of penetrating item.
 - .8 Size of opening.
 - .9 Number of sides of assemblies addressed.
 - .10 Hourly rating to be achieved.
 - .11 Installer's Name.

- .3 Copies of these documents are to be provided to the general contractor at the completion of the project.
- .4 Identify through-penetration firestop systems with pressure-sensitive, self-adhesive, preprinted vinyl labels. Attach labels permanently to surfaces of penetrated construction on both sides of each firestop system installation where labels will be visible to anyone seeking to remove penetrating items or firestop systems. Include the following information on labels:
 - .1 The words: "Warning-Through Penetration Firestop System-Do Not Disturb. Notify Building Management of Any Damage."
 - .2 Contractor's Name, address, and phone number.
 - .3 Through-Penetration firestop system designation of applicable testing and inspecting agency.
 - .4 Date of Installation.
 - .5 Through-Penetration firestop system manufacturer's name.
 - .6 Installer's Name.

3.07 Adjusting and Cleaning

- .1 Remove equipment, materials, and debris, leaving area in undamaged, clean condition.
- .2 Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

End of Section

1 General

1.01 Section Includes

- .1 Provide positive seismic restraints on electrical systems and components required by the building code and by the local authority having jurisdiction.
- .2 This section covers design, supply, installation, and inspection of complete SFRS (Seismic Force Resisting System) for electrical systems.

1.02 References

- .1 Seismic restraints are to be provided for all electrical and non-structural components of building services in accordance with the current: NBCC; OBC, and good engineering practice (references listed below):
 - .1 CSA S832-14 (R2019), Seismic risk reduction of operation and functional components (OFCs) of buildings.
 - .2 CAN/CSA-S6-88, Design of Highway Bridges (withdrawn).
 - .3 SMACNA (Sheet Metal and Air-conditioning Contractors' National Association's) Seismic Restraint Manual Guidelines for Mechanical Systems (3rd ed.).
 - .4 ASHRAE (American Society for Heating, Refrigerating and Air-conditioning Engineers) A Practical Guide to Seismic Restraint; ASHRAE Applications Handbook, Seismic and Wind Restraint Design Chapter; ASHRAE Standard 171-2017: Methods of Test for Seismic restraints.
 - .5 VISCMA (The Vibration Isolation and Seismic Control Manufacturers Association) has developed Testing and Rating Standards for Seismic Restraint Components that comply with Code and ASHRAE based requirements.
- .2 The following guides may be used for supplemental information on typical seismic installation practices. Where a conflict exists between the guides and these construction documents, the construction documents will preside.
 - .1 Federal Emergency Management Agency (FEMA) manual 413, Installing Seismic Restraints for Electrical Equipment, January 2014.

1.03 Coordination

- .1 Trades shall supply necessary information to the Vibration Isolation Manufacturer regarding equipment to be isolated.
- .2 Provide shop drawings to other trades for setting anchor bolts and other appurtenances necessary for the proper installation of this equipment.

1.04 Submittals

- .1 Shop Drawings:
 - .1 Include placement drawings for electrical equipment and equipment assemblies including runs of cable trays and conduit/cable racks showing methods of attachment to particular structure for each piece of equipment and assembly and provide anchorage/attachment details. Submit samples of materials required to complete seismic restraint work for review if and when required.
- .2 Product Data:
 - .1 Include Seismic Rating Data for each seismically rated isolator or restraint component.

- .2 Submit copies of documents requested herein, testing reports, certificate of approvals, and commissioning sheets.
- .3 Delegated Design Submittals:
 - .1 Submit for Consultant's review, seismic design drawings and product shop drawings with calculations approved and sealed by a Professional Engineer licensed and registered in Place of Work and experienced in such Work. Be responsible for costs for services of this Professional Engineer. Shop drawings to identify equipment type, manufacturer's name, model number and weight of equipment to be restrained.
 - .2 Include for manufacturer of vibration control products, to develop/design a seismic restraint system and perform seismic calculations in accordance with latest requirements of local governing building code, requirements of local governing authority having jurisdiction, and additional requirements specified in this article. Design of seismic restraints to include requirements to withstand forces of area rating as per local governing building code requirements.
 - .3 Provide calculations to determine restraint loadings for all restrained systems and equipment resulting from seismic forces.

1.05 Closeout Submittals

- .1 Include for Professional Engineer to inspect same on site (note that multiple inspections to be required as work progresses) and to provide typewritten Inspection Reports to the Consultant throughout construction and to provide "Letters of Assurance and Conformance" with specified Codes, Standards and Bylaws. Additionally, include copies of documents in Operating and Maintenance Manuals.
- .2 At the completion of the project, upon request by the Consultant, attend a review of the installation on site.
- .3 Provide a sealed written report, certifying that the installations have been completed in accordance with the specified design(s) and shop drawing(s) can be furnished, by others, upon this request.
- .4 The installing contractor shall submit a report to the Consultant, including the manufacturer's representative's final report, indicating that all seismic restraint material has been properly installed, or steps that are to be taken by the Contractor to properly complete the seismic restraint work as per the specifications.
- .5 Record documents: documented torques.

1.06 Quality Assurance

- .1 The contractor shall utilize a supplier familiar/experienced with the design of seismic systems to provide a comprehensive package of isolation and seismic restraint for the project. Provide detailed shop drawings showing the proposed restraint system for all required equipment, piping, and ductwork on the project. The shop drawings shall include calculations certified by a Profession Engineer (Structural), licensed in the jurisdiction where the project occurs.
- .2 Certification documents to be signed and sealed by a Professional Engineer (Structural) with at least 5 years experience in the design of seismic restraints.

2 Products

2.01 Manufacturers

- .1 Manufacturer List:

- .1 Eaton TOLCO.
- .2 Mason Industries.
- .3 Kinetics Noise Control.
- .4 nVent (Caddy).
- .5 Vibro-Acoustics.

- .2 Substitutions: Other manufacturers acceptable to the Authority Having Jurisdiction.

2.02 Design Criteria

- .1 Review architectural and structural drawings to confirm the seismic criteria for the project.

2.03 General

- .1 Electrical equipment installation is to meet local governing authority having jurisdiction and code seismic requirements and additional requirements for vibration isolation.
- .2 Provide labour, materials, and equipment required and necessary to seismically restrain electrical equipment and equipment bases including concrete pads, and guarantee function of materials and equipment supplied.
- .3 Provide additional seismic requirements for suspended electrical raceways, luminaires, and other equipment as per governing local authority requirements and requirements of current codes and by-laws.
- .4 Provide seismic restraining devices to restrain mechanical, electrical, and related equipment, and equipment bases including concrete pads, as per governing local authority requirements and requirements of current codes and by-laws.
- .5 In event that inadequate isolation is provided by isolation product manufacturer's isolation package, be responsible for improving isolation to an acceptable standard at no additional cost to contract. Isolation product manufacturer's seismic restraint engineer to verify that seismic restraints and combination isolator/restraints intended for use on project are fit for intended purpose. Be responsible for ensuring that manufacturer's seismic restraints are in compliance with applicable local building code requirements for Place of Work.

2.04 Vibration Controls and Seismic Restraints

- .1 Electrical equipment installation is to meet local governing authority having jurisdiction and code seismic requirements and additional requirements outlined herein.
- .2 Provide labour, materials, and equipment required and necessary to seismically restrain electrical equipment and equipment bases including concrete pads, and guarantee function of materials and equipment supplied.
- .3 Make electrical connections to vibration-isolated equipment with flexible conduit or other flexible means acceptable to the Consultant and local governing authority having jurisdiction so as not to restrict maximum anticipated movement of equipment under seismic excitation movement.
- .4 In event that inadequate isolation is provided by isolation product manufacturer's isolation package, be responsible for improving isolation to an acceptable standard at no additional cost to contract. Isolation product manufacturer's seismic restraint engineer to verify that seismic restraints and combination isolator/restraints intended for use on project are fit for intended purpose. Be responsible for ensuring that manufacturer's seismic restraints are in compliance with applicable local building code requirements for Place of Work.

- .5 Provide additional seismic requirements for suspended electrical raceways, luminaires, and other equipment as per governing local authority requirements and requirements of current codes and by-laws.
- .6 Include for manufacturer of vibration control products to develop/design a seismic restraint system and perform seismic calculations in accordance with latest requirements of local governing building code, requirements of local governing authority having jurisdiction, and additional requirements specified in this article. Design of seismic restraints to include provisions to withstand forces of area rating as per governing building code requirements.
- .7 Provide vibration isolation for equipment or parts connected rigidly to isolated equipment.
- .8 Provide vibration isolation for transformers by means of bridge bearing neoprene isolators or open steel spring isolators. Static deflection of vibration isolators for electrical transformers is indicated below. Isolators requiring a static deflection greater than 13 mm (1/2") to be open spring isolators unless otherwise specified.

Transformer Rating	On Grade (Isolated Slab)	Location on Grade (Continuous Slab)	Upper Floor (Suspended Slab)
Less than 10 kVA	6 mm	6 mm	18 mm
10 – 100 kVA	6 mm	12 mm	25 mm
Greater than 100 kVA	6 mm	25 mm	38 mm

- .9 Standard vibration isolation requirements of equipment such as gensets, power transformers and distribution equipment, to comply with following:
 - .1 Choose equipment isolation mounts on basis of achieving 98% vibration isolation efficiency at lowest operating speed. Natural frequency of each vibration isolation system to be at least 1/10 of lowest excitation frequency of rotating machinery, whenever practicable, but in no case less than 1/7. Where structural floor deflection exceeds 1/10 of determined static deflection of isolator, increase isolator static deflection to maintain this minimum ratio of floor to isolator deflection. Where static deflections are shown on drawings, Specifications, or schedules, they are to be used as a guide only. Actual isolators are to achieve required static deflection under load, with at least 50% reserve deflection;
 - .2 Submit shop drawings identifying equipment, lowest operating speed, weight, brand, type and location of isolators prior to ordering or fabrication.
- .10 Neoprene Isolators:
 - .1 Neoprene isolators to be bridge bearing rated type manufactured from bridge bearing quality neoprene, CAN/CSA-S6-88 Section 11.5.8.
 - .2 Where a ribbed pad is used, height of ribs is not to exceed 0.7 times width of rib. A steel layer to be used to distribute load in a multi-layered unit.
 - .3 Select neoprene pads or elements at supplier's optimum recommended loading and do not load beyond limit specified in neoprene manufacturer's literature.
 - .4 Test neoprene isolators to ASTM specifications. Submit to Consultant, following test data to verify performance of neoprene isolators:
 - .1 A data sheet listing all of ASTM test results.
 - .2 Load deflection curves for isolator indicating deflection to full compression for both laterally restrained and unrestrained isolators.

- .11 Open Steel Spring Isolators:
 - .1 Springs to be "Iso-Stiff" (spring coefficient 1.0 to 1.5) with a working deflection between 0.3 and 0.6 of solid deflection.
 - .2 Spring mounts to be complete with levelling devices, minimum 6 mm (1/4") thick neoprene sound pads, and zinc chromate plated hardware.
 - .3 Sound pads to be sized for a minimum deflection of 1.2 mm (0.0472") and meet requirements for neoprene isolators.
- .12 Seismic restraints to restrain equipment in all directions and to be sized to meet appropriate Sp factor defined in Table 4.1.9.D of current National Building Code and Commentary J of Supplement to current Code. Calculations bearing seal of a qualified Professional Engineer to be submitted with shop drawings to justify stated seismic restraint requirements.
- .13 Attachment points and fasteners to be capable of withstanding a load of 3 times sized capacity of restraint. Equipment suppliers to provide proof of conformance with this clause by means of shop drawings certified by a qualified Professional Engineer.
- .14 Submit test data to the Consultant, showing load deflection curves up to 1.5 times rated capacity of restraint, and certifying that neither neoprene elements nor restraint body sustained any deformation after release of load.
- .15 Adjust restraints to have clearances between 3 mm (1/8") and 6 mm (1/4") under normal operating conditions of equipment.

3 Execution

3.01 General

- .1 The following typical electrical equipment requires seismic protection (as applicable to Project):
 - .1 Transformers;
 - .2 Switchboards/switchgear;
 - .3 Panelboards;
 - .4 Engine/generator and generator control panel;
 - .5 Automatic transfer switches;
 - .6 Fire alarm system, cabinets and devices;
 - .7 Luminaires;
 - .8 Mobile generator connection box;
 - .9 Conduit and duct banks;
 - .10 Genset PLC system and cabinet;
 - .11 Other electrical equipment, as required.

3.02 Preparation

- .1 The Contractor shall notify the local representative of the seismic restraint materials manufacturer prior to installing any seismic restraint devices. The Contractor shall seek the representative's guidance in any installation procedures with which he/she is unfamiliar.
- .2 Obtain required training from manufacturer's representative on any special installation procedures. Install components in accordance with manufacturer's instructions to suit specific installation requirements.
- .3 Coordinate size, shape, reinforcement, and attachment of all housekeeping pads supporting vibration/seismically rated equipment. Concrete shall have a minimum compressive strength of 20 kPa (3,000 psi) or as specified by the Consultant. Coordinate size, thickness, doweling, and reinforcing of concrete equipment housekeeping pads and piers with vibration isolation and seismic restraint device manufacturer to ensure adequate space, embedment and prevent edge breakout failures. Pads and piers must be adequately doweled into structural slab.
- .4 Housekeeping Pads must be adequately reinforced and adequately sized for proper installation of equipment anchors. Refer seismic restraint manufacturer's written instructions.
- .5 Coordinate with vibration/seismic restraint manufacturer and the structural engineer of record to locate and size structural supports underneath vibration/seismically restrained equipment (e.g., roof curbs, cooling towers and other similar equipment). Installation of all seismic restraint materials specified in this section shall be accomplished as per the manufacturer's written instructions. Adjust isolators and restraints after piping systems have been filled and equipment is at its operating weight, following the manufacturer's written instructions.

3.03 Installation

- .1 Isolated and restrained equipment, conduit located on roofs must be attached to the structure. Supports (e.g., sleepers) that are not attached to the structure are not acceptable.
- .2 Attach conduit to the trapeze per seismic restraint manufacturer's design. Install cables so they do not bend across sharp edges of adjacent equipment or building structures.
- .3 Do not brace or support equipment to separate portions of the structure that may act differently in response to an earthquake. For example, do not connect a transverse restraint to a wall, and then a longitudinal restraint to either a floor/ceiling/roof at the same braced location.
- .4 Install vertical braces to stiffen hanger rods and prevent buckling per seismic restraint manufacturer's design. Clamp vertical brace to hanger rods. Requirements apply equally to hanging equipment. Do not weld vertical braces to hanger rods.
- .5 General Seismic Controls for Electrical Systems:
 - .1 Seismically restrain per specific code requirements all Electrical components listed below (unless otherwise indicated on the drawings), using seismic cable restraints:
 - .1 Seismically restrain all conduit 78 mm (3") in nominal diameter and larger. Single supported conduit is restrained in the same fashion as single clevis supported pipe.
 - .2 Seismically restrain all conduit, bus ducts, or cable trays that are supported on trapeze bars, that have been assigned a Component Importance Factor equal to 1.5, and that have a total weight greater than 146 N/m (10 lb/ft). This total weight includes not only the conduit, bus duct, or cable trays, but also includes the trapeze bars as well.
 - .2 The Contractor is to provide the weight per unit length for cable trays and bus duct.
 - .3 Single supported conduit and trapeze supported conduit, bus duct, and cable trays to be seismically restrained in a manner similar to mechanical pipes and HVAC ducts.

- .4 Provide seismic restraint components intended to be used with suspended single supported conduit and trapeze supported conduit, cable trays, and bus ducts. Components intended to both support and restrain distribution systems such as wall mounted conduit, cable trays, and bus ducts will need to be designed and evaluated for both the dead weight load and the design horizontal seismic load.
- .5 To ensure that the seismic forces are transferred properly to the restraint points, cables should be strapped either individually or in bundles to the cable tray at regular intervals. It is necessary for the conduit, bus ducts, and cable trays to be attached to the trapeze bars sufficiently to resist the design horizontal seismic forces, both transverse (T) and longitudinal (L).
- .6 Brace a change of direction longer than 3.7 m (12 ft).
- .7 This specification does not allow the use of the "12 inch rule" where the piping and electrical may be exempted from seismic restraint based on the length of the support rods provided that the rods are not subjected to bending moments.
- .8 Install restraint cables so they do not bend across edges of adjacent equipment or building structure. Tie back to structure at 45 degrees to the structure.
- .9 Longitudinal restraints for single pipe supports shall be attached rigidly to the pipe, not to the pipe hanger.
- .10 For supports with multiple pipes (trapezes), secure pipes to trapeze member with clamps approved for application.
- .11 Install flexible metal hose loops in piping which crosses building seismic joints, sized for the anticipated amount of movement.
- .12 Install flexible piping connectors where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.
- .13 Roof mounted duct is to be installed on sleepers or frames mechanically connected to the building structure. Roof anchors and seismic cables or frames shall be used to resist seismic and wind loading. Wind loading factors shall be determined by the registered design professional.
- .14 Longitudinal restraints for single conduit supports shall be attached rigidly to the pipe, not to the pipe/conduit hanger.
- .15 For supports with multiple conduits (trapezes), secure conduit to trapeze member with clamps approved for application.
- .16 Rod Stiffener Clamps are required where the hanger rod exceeds the maximum length shown in the seismic calculation sheets. They are only required at restraint locations.
- .17 Seismically Rated Beam Clamps are required where welding to or penetrations to steel beams are not approved.
- .18 Adjust restraint cables so that they are not visibly slack. Cable not to support weight during normal operation.
- .19 Seismic systems are to be compatible with requirements for anchoring and guiding of systems.
- .20 Drilled or power-driven anchors or fasteners shall not be permitted for use with seismic control measures.
- .21 Friction due to gravity does not constitute a seismic attachment.

- .22 Seismic restraint connections are not to be connected to the bottom chord of steel joists or the bottom flange of steel beams.
- .23 Standard beam clamps can be used to support restrained components; they cannot be used to connect the seismic restraint to the structure – only for the hanger rods.
- .24 Make electrical connections to vibration-isolated equipment with flexible conduit or other flexible means acceptable to the Consultant and local governing authority having jurisdiction so as not to restrict maximum anticipated movement of equipment under seismic excitation movement.
- .6 Panelboards, Lighting, Emergency Lighting Battery Units, and Emergency Remote Heads
 - .1 Wall mounted panelboards, lighting, emergency lighting battery units, and emergency remote heads can be directly mounted to the building structure with approved fasteners to suit. Minimum two or more anchors shall be provided on each side of all wall mounted equipment.
 - .2 For emergency battery units, pre-installed brackets must be used.

3.04 Field Tests and Inspections

- .1 Test, adjust, and certify installation. Submit copies of test report to the Consultant.
- .2 Inspect for removal of break away hardware to ensure proper torques of installed systems.
- .3 For non-visually verifiable product, manufacturers to verify proper torque for a minimum 10% of application. Document torques for applications per manufacturer's instructions.
- .4 The contractor shall notify the local representative of the seismic restraint materials manufacturer mid-way through the listed project if they require an inspection of any and all vibration and seismic restraint devices already installed. A typewritten report of any installation errors, improperly selected devices, or other fault in the system which could affect the performance of the system shall be documented and the contractor shall perform all steps that are required from this written report to properly complete the vibration and seismic restraint work as per the specifications. Report to include clear sketches as required.
- .5 The installing contractor shall submit a report to the Consultant, including the manufacturer's representative's final report, indicating that all seismic restraint material has been properly installed, or steps that are to be taken by the contractor to properly complete the seismic restraint work as per the specifications.

End of Section

1 General

1.01 Section Includes

- .1 Nameplates and labels.
- .2 Wire and cable markers.
- .3 Conduit markers.
- .4 Receptacle labels.
- .5 Signage.

1.02 Related Requirements

- .1 Section 09 91 00 – Painting.
- .2 Section 27 05 53 – Identification for Communications Systems.

1.03 Submittals

- .1 Product Data: Provide catalogue data for nameplates, labels, and markers.
- .2 Provide shop drawings of nameplates for Consultant's review prior to fabrication (scale 1:1).
- .3 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.04 Regulatory Requirements

- .1 Provide products listed and classified by CSA Group as suitable for the purpose specified and indicated.

2 Products

2.01 Nameplates and Labels

- .1 Nameplates:
 - .1 Engraved three-layer laminated plastic, letters on contrasting background.
 - .2 Colours to match existing building system, where applicable. If no building system exists, use the following:
 - .1 347/600 volt system: White text on Blue background.
 - .2 120/208 volt system: Black text on White background.
 - .3 Fire Detection system: White text on Red background.
 - .4 Emergency Lighting system: Red text on White background.
 - .5 LV systems: White text on Green background.
 - .6 120/208 volt Uninterruptable Power Supply (UPS): White text on Orange background.
 - .3 Confirm colours with the Consultant prior to ordering nameplates.
- .2 Equipment Nameplates to indicate:

- .1 Equipment/Panelboard ID.
- .2 Ampacity.
- .3 Voltage.
- .4 Number of Phases.
- .5 Number of wires in system.
- .6 Interrupting Capacity.
- .7 Size, number of poles, Panelboard ID, and circuit number of upstream overcurrent protection device.
 - .1 Location of upstream device if not in the same room.
- .3 Coordination Study Labels to Section 26 05 73.16.
- .4 Arc Flash Study Labels to Section 26 05 73.19.
- .5 Locations:
 - .1 Distribution panelboards, and individual distribution panelboard branch breakers.
 - .2 Receptacle panelboards.
 - .3 Each electrical distribution and control equipment enclosure.
 - .4 Uninterruptible Power Supply.
 - .5 Mechanical Equipment.
 - .6 UPS receptacles.
 - .7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
 - .8 Terminal cabinets, junction boxes, and pull boxes: indicate system and voltage.
 - .9 Transformers: indicate capacity, primary and secondary voltages.
- .6 Letter Size:
 - .1 Use 3 mm letters for identifying individual equipment and loads.
 - .2 Use 6 mm letters for identifying grouped equipment and loads.
- .7 Labels:
 - .1 Mechanically fastened with sheet metal screws, with 5 mm white letters on black background.
 - .2 White letters on red background for UPS and equipment, and devices downstream of UPS.
 - .3 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
 - .4 Wording on nameplates and labels to be reviewed by the Consultant prior to manufacturing.
 - .5 Allow for minimum of twenty-five (25) letters per nameplate and label.
 - .6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

- .7 Terminal cabinets and pull boxes: indicate system and voltage.

2.02 Wiring Identification

- .1 Identify wiring with permanent indelible identifying markings, numbered, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour coding: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

2.03 Wire Markers

- .1 Description: tape, split sleeve, or tubing type wire markers.
- .2 Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes and each load connection.
- .3 Legend:
 - .1 Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
 - .2 Control Circuits: Control wire number indicated on shop drawings.

2.04 Conduit and Box Markers

- .1 Colour code conduits, boxes, and metallic sheathed cables.
- .2 Location: Provide markers for each conduit longer than 2 m.
- .3 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .4 Colours to match equipment nameplate background colour:
 - .1 347/600 volt system: Blue.
 - .2 120/208 volt system: Black.
 - .3 Fire Alarm system: Red.
 - .4 Emergency Lighting system: Red/White.
 - .5 LV Systems (EPO, Remote Monitoring, Generator Control, Communications): Green.
 - .6 120/208 volt Uninterruptable Power Supply (UPS): Orange.
- .5 Confirm colours with the Consultant prior to commencing rough-in.

2.05 Junction and Pull Boxes

- .1 Clearly identify main pull or junction boxes (excluding obvious outlet boxes) by painting outside of covers.
- .2 Spray painting: not permitted.
- .3 Paint colours to be in accordance with following schedule:
 - .1 Lighting: yellow.

- .2 Normal power: blue.
- .3 Emergency power: orange.
- .4 Fire alarm: red.
- .5 Communications systems including telephone and data: green.
- .6 Miscellaneous signals: brown.
- .4 In addition to painting miscellaneous signal boxes, clearly identify specific system in which box is installed. Identify source panelboard for power circuits.

2.06 Branch Breaker Labels

- .1 General:
 - .1 Legibly identify every circuit and circuit modification as to its clear, evident, and specific purpose or use. Include sufficient detail to allow each circuit to be distinguished from all others.
 - .2 Label spare positions that contain unused overcurrent devices or switches.
 - .3 Do not describe any circuit in a manner that depends on transient conditions of occupancy.
- .2 Switchboards, distribution panelboards, enclosed breakers, and disconnect switches:
 - .1 Locate identification at each switch.
 - .2 Branch breaker nameplates on switchboards, distribution panelboards and switchboards, and generator load breakers to indicate:
 - .1 Locate identification at each switch on a switchboard.
 - .2 Identification of downstream equipment fed from the breaker.
 - .1 Location of downstream device if not in the same room.
 - .3 Breaker size and number of poles.
 - .4 Interrupting Capacity.
 - .5 Circuit number (where applicable).
 - .6 Do not describe any circuit in a manner that depends on transient conditions of occupancy.
- .3 Lighting and Receptacle Panelboards:
 - .1 Provide a circuit directory that is located on the face or inside of the panel door.
 - .2 Do not describe any circuit in a manner that depends on transient conditions of occupancy.

2.07 Receptacle Labels

- .1 Label all receptacles with the panelboard ID and circuit number.
- .2 Use receptacle labels by electronic labeller Brother P-Touch, model PT-20/25, Dymo-Tape or approved equal.
- .3 Location: On receptacle wall plate.

3 Execution

3.01 Equipment Nameplates from Manufacturers

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.
- .2 Manufacturers' nameplates and CSA labels are to be visible and legible after equipment is installed. Provide warning signs, as specified, or to meet requirements of Inspection Department, Health and Safety, and the Consultant.
- .3 Label power outlets with circuit identification on visible portion of faceplate or surface mounted outlet box.

3.02 Conduit and Box Identification

- .1 Locate labels as follows:
 - .1 At every end of every conduit, duct, or cable run, adjacent to item of equipment serviced.
 - .2 On each exposed conduit, duct or cable passing through a wall, partition, or floor (one on each side of such wall partition or floor).
 - .3 At intervals of 15 m (50 ft) along every exposed conduit, duct or cable run exceeding 15 m (50 ft) in length.
 - .4 At every access point on concealed conduit duct or cable.
 - .5 At each junction box.
- .2 Place labels so as to be visible from 1500 mm (5 ft) above adjacent floor platform.

3.03 Preparation

- .1 Degrease and clean surfaces to receive nameplates and labels.

3.04 Application

- .1 Confirm colours prior to start of work.
- .2 Install nameplate and label parallel to equipment lines.
- .3 Secure nameplate to equipment front using adhesive.
- .4 Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
- .5 Identify conduit using field painting.
- .6 Paint coloured band on each conduit longer than 2 m.
- .7 Paint bands 6 m on centre.

3.05 Labelling

- .1 Colour code wiring consistently throughout the installation and generally match colour coding of internal wiring of pre-wired components.
- .2 Label wiring with point name using Thomas & Betts 12 character polestar metalized labels with 3 rows of characters per label, or equal by Brady. Label to occur as a minimum at both ends and at pull boxes of the wiring run.

- .3 Identify all pull boxes, junction boxes, etc. (installed as part of this project or used by this project) with the exact use of the box. Indelible felt pen marker is acceptable.
- .4 Label light control items with point name using Thomas & Betts 12 character label, or equal by Brady. Label to be black lettering on clear backing.
- .5 Label relays and controllers inside panels using Thomas & Betts 12 character label, or equal by Brady.
- .6 Provide red, 13 mm (1/2 in) diameter, sticker on emergency light fixture frame. Include circuit number on sticker with thin permanent black mark pen.

3.06 Labels and Signs

- .1 Manufacturers' nameplates and CSA labels are to be visible and legible after equipment is installed. Provide warning signs, as specified, or to meet requirements of Inspection Department, Health and Safety, and the Consultant.
- .2 Label power outlets with circuit identification on visible portion of faceplate or surface mounted outlet box.

End of Section

1 General

1.01 Section Includes

- .1 Provide a short circuit and coordination study for the [existing and] new portions of electrical distribution system. The basic analysis shall include a protective device evaluation, and a protective device coordination study.
- .2 The project shall begin at the point of utility service for the facility and continue down through the system to all downstream distribution and branch panelboards, motor control centres and significant motor locations.
- .3 The project shall include any new generators and any associated emergency power distribution equipment, including automatic transfer switches and generator ground fault protection.

1.02 Related Requirements

- .1 Section 26 05 73.19 – Arc-Flash Hazard Analysis.
- .2 Single Line Diagram.

1.03 Reference Standards

- .1 American National Standards Institute (ANSI):
 - .1 ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
 - .2 ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
 - .3 ANSI C 37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
 - .4 ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
- .2 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - .1 IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
 - .2 IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
 - .3 IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - .4 IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
 - .5 IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.

1.04 Submittals

- .1 In accordance with Section 01 33 00:
- .2 Submit the following:
 - .1 Submit electronic copy of the protection coordination study for Consultant's review.

- .2 Shop drawings for equipment affected by the coordination study will not be reviewed until the coordination study has been submitted and reviewed.
- .3 Include a one-line diagram of the system.
- .3 Projection System Coordination:
 - .1 Prepare a graph or coordination curves, prior to manufacture of service entrance and distribution equipment on K & E No. 336E Time-Current characteristic graph paper. Time-current characteristics shall be plotted of the following:
 - .1 Supply Authorities relays or fuses protecting incoming service (Contractor under this section shall obtain this information).
 - .2 Main and feeder protective devices at every voltage level used in distribution system.
 - .3 Protective devices associated with largest motor and/or refrigeration compressor.
 - .2 Preliminary submission of graph for comment will be accepted. Submit graph to Supply Authority for approval by them as providing satisfactory co-ordination. When curves have been approved by Supply Authority, they shall be submitted for approval. After approval has been obtained, order protective devices, and calibrate to conform with these curves.
 - .3 Each time-current characteristic curve sheet shall include:
 - .1 A single line diagram for the portion of the system involved.
 - .2 Transformer damage curves (where applicable).
 - .3 Cable damage curves (where applicable).
 - .4 Available fault levels for the portion of the system involved.
 - .4 Consult manufacturer of the refrigeration compressors and obtain recommendations for settings on starters. Incorporate information in co-ordination curves and submit the associated curves to Compressor Manufacturer and obtain approval from the manufacturer.
 - .5 Compressor manufacturer and mechanical trade contractor will determine and calibrate proper protection on motor starters and will ensure that it coordinates with protective devices on switchboard.
 - .6 Co-ordination curves, mentioned above, shall be prepared by distribution equipment manufacturers as soon as possible after award of contract.
 - .7 At the option of this contractor under this section, these co-ordination curves may also be prepared by an independent testing organization. In this case, the independent testing organization shall determine the proper settings of all protective relays and devices and pass them on to the switchboard manufacturer for incorporation into the switchboards. Include all associated costs in the tender.
 - .8 Distribution Equipment manufacturers shall examine drawings and specifications prior to award of contract to ensure that relays and devices being supplied by them will co-ordinate satisfactorily to Supply Authority requirements. Payment will not be allowed, after award of contract, for extra charges due to device changes to comply with recommended practices, due to oversight or negligence by distribution equipment manufacturers.
- .4 [Upon review by the Consultant, submit the coordination study to the local electrical utility for their review and approval.]

1.05 Closeout Submittals

- .1 The Engineer who prepared the report shall visit the site and confirm that the feeder sizes as installed are consistent with the report as submitted.
- .2 Submit final version of the report with as-constructed feeder lengths and feeder sizes.
- .3 Provide one electronic copy of the coordination study. Provide one hardcopy of the final report in the O&M manual, and provide one electronic copy of the final report.

1.06 Quality Assurance

- .1 Preparer Qualifications: Firm experienced in the analysis, evaluation, and coordination of electrical distribution systems and similar to the system for this project.
- .2 The study shall be prepared in accordance with the latest edition of NETA ATS, the Canadian Electrical Code, as well as manufacturer's recommendations.
- .3 Short-Circuit Analysis and Coordination Study shall be performed by a registered Professional Engineer. Study shall be signed and sealed by the Engineer. The Engineer shall have a minimum of eight years experience in the analysis, evaluation, and coordination of electrical distribution systems.
- .4 The firm conducting the study shall have one million worth of Professional Liability Insurance in addition to standard general insurance.

2 Products

2.01 Manufacturers

- .1 Independent Testing Organizations
 - .1 AC Tesla.
 - .2 Brosz and Associates.
 - .3 C-INTECH.
 - .4 Eastenghouse.
 - .5 G.T. Wood.
 - .6 Haronitis and Associates Ltd.
 - .7 Qualus (formerly Enkompass).
- .2 [Electrical distribution manufacturers:]
 - .1 Eaton.
 - .2 Schneider Electric.

2.02 Protective Device Coordination Study

- .1 Prepare coordination time-current characteristic curves to determine the required settings/sizes of the protective devices to maximize selectivity. The utility upstream protective device feeding the facility shall be maintained as the upper limit for coordination. These settings shall be obtained by the preparer, along with any other protective device setting requirements. The coordination curves shall be prepared on log-log paper and illustrate adequate clearing times between series devices. The curves shall be created through the use of the study software package, but must reflect actual protective devices to be installed.

Adequate time-current curves shall be generated to depict coordination. In addition, protective device characteristics shall be suitably determined to reflect calculated short-circuit levels at the location.

- .2 A narrative analysis shall accompany each coordination curve sheet and describe the coordination and protection in explicit detail. All curve sheets shall be multi-colour for improved clarity. Areas lacking complete coordination shall be highlighted and reasons provided for allowing condition to remain or provide solution to resolve situation. System coordination, recommended ratings, and setting of protective devices shall be accomplished by a registered professional electrical engineer with a minimum of eight years of current experience in the coordination of electrical power systems.
- .3 The following information shall be provided on all curve sheets:
 - .1 Device identification and associated settings/size.
 - .2 Voltage at which curves are plotted.
 - .3 Current multiplier.
 - .4 ANSI frequent fault damage curve.
 - .5 Cable insulation damage curves.
 - .6 Transformer inrush point.
 - .7 Single-line for the portion of the system.
 - .8 Motor starting profiles (where applicable).

2.03 Single Line Diagram

- .1 The final report shall include a multi-colour single line diagram of the electrical distribution system within the scope of the project. The single line diagram shall include:
 - .1 Transformer rating, voltage ratio, impedance, and winding connection.
 - .2 Feeder cable phase, neutral and ground sizes, length of cable, conductor material, and conduit size and type.
 - .3 Switchgear, switchboards, panelboards, MCC's, fuses, circuit breakers, ATS's and switches continuous current ratings.
 - .4 Protective relays with appropriate device numbers and CT's and PT's with associated ratios.
 - .5 Detailed legend indicating device type identification and other significant details.

3 Execution

3.01 Examination

- .1 Obtain fault level and X/R ratio information from the utility.

3.02 Summary

- .1 The results of the system studies shall be summarized in a final report.
- .2 Where required, copies of the final report shall be submitted to the Supply Authority for their review and approval. Submit approved copies of the report to the Consultant.

3.03 Adjusting

- .1 The contractor shall engage the manufacturer's service group or alternately a qualified independent testing firm to perform field adjustments of the protective devices as required for placing the equipment in final operating condition. The settings shall be in accordance with the approved short circuit study and protective device evaluation / coordination study.
- .2 Necessary field settings of devices and adjustments and minor modifications to equipment to accomplish conformance with the approved protective device coordination study, shall be carried out by manufacturer's service group.
- .3 Submit a final service report confirming that settings have been completed.

End of Section

1 General

1.01 Section Includes

- .1 Provide an Arc Flash Hazard Analysis Study per the requirements described in CSA Z462 Standard for Electrical Safety in the Workplace.
- .2 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are obtained in CSA Z462-08, Annex D, or more recent version of the standard as cited by this Section.
- .3 The scope of the studies shall include all existing distribution equipment and all new distribution equipment supplied by the equipment manufacturer under this contract.

1.02 Related Requirements

- .1 Section 26 05 73.16 – Coordination Studies.
- .2 Single Line Diagram.

1.03 References

- .1 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - .1 IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems.
 - .2 IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems.
 - .3 IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis.
 - .4 IEEE 241 – Recommended Practice for Electric Power Systems in Commercial Buildings.
 - .5 IEEE 1015 – Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
 - .6 IEEE 1584-2018 - Guide for Performing Arc-Flash Hazard Calculations.
- .2 American National Standards Institute (ANSI):
 - .1 ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers.
 - .2 ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures.
 - .3 ANSI C37.010-2016 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis.
 - .4 ANSI C37.41 – Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories.
- .3 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
 - .3 CSA Z462:24, Workplace electrical safety.

1.04 Submittals

- .1 Submit the arc flash study to the Consultant prior to receiving final review of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.
- .2 [Upon review by the Consultant, submit the arc-flash study to the local electrical utility for their review and approval.]

1.05 Closeout Submittals

- .1 The results of the protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. Three (3) bound copies of the complete final report shall be submitted. Additional copies of the complete report with input and output data shall be provided on CD in PDF format.
- .2 The report shall include the following sections:
 - .1 Executive Summary.
 - .2 Descriptions, purpose, basis, and scope of the study.
 - .3 Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short circuit duties.
 - .4 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.
 - .5 Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
 - .6 Details of the incident energy and flash protection boundary calculations.
 - .7 Recommendations for system improvements, where needed.
 - .8 Single Line Diagram.
- .3 Arc flash labels (refer to CSA Z462 Annex Q) shall be provided in hard copy only.

1.06 Qualifications

- .1 Arc flash hazard analysis studies shall be conducted under the supervision and approval of a licensed Professional Electrical Engineer skilled in performing and interpreting the power system studies.
- .2 The licensed Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer or an approved engineering firm.
- .3 The licensed Professional Electrical Engineer shall have a minimum of eight (8) years of experience in performing power system studies.
- .4 The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

1.07 Computer Analysis Software

- .1 The studies shall be performed using the latest revision of the SKM or equivalent.

2 Products

2.01 Manufacturers

- .1 Independent Testing Organizations:
 - .1 AC Tesla.
 - .2 Brosz and Associates.
 - .3 C-INTECH.
 - .4 Eastenghouse.
 - .5 G.T. Wood.
 - .6 Haronitis and Associates Ltd.
 - .7 Qualus (formerly Enkompass).
- .2 [Electrical distribution manufacturers:]
 - .1 Eaton.
 - .2 Schneider Electric.

2.02 Studies

- .1 The contractor shall furnish an Arc Flash Hazard Analysis Study per CSA Z462, reference Section 4.1.8.2.2, 4.3.3.

2.03 Data Collection

- .1 Contractor shall furnish all data as required by the power system studies. The Engineer performing arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- .2 Source combination may include present and future motors and generators.
- .3 If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.04 Arc Flash Hazard Analysis

- .1 The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in CSA Z462 Annex D.
- .2 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, panelboards, and splitters) where work could be performed on energized parts.
- .3 The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 112.5 kVA where work could be performed on energized parts.
- .4 Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 calories per square centimetre.

- .5 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
- .6 The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.
- .7 The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
 - .1 Fault contribution from induction motors should not be considered beyond 3-5 cycles.
- .8 Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- .9 For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- .10 When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- .11 Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- .12 Arc Flash calculations shall be based on actual overcurrent protective device clearing time.
- .13 Maximum clearing time will be capped at 2 seconds based on IEEE 1584.
- .14 Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.05 Report Sections

- .1 Incident energy and flash protection boundary calculations:
 - .1 Arcing fault magnitude.
 - .2 Protective device clearing time.
 - .3 Duration of arc.
 - .4 Arc flash boundary.
 - .5 Working distance.

- .6 Incident energy.
- .7 Hazard Risk Category.
- .8 Recommendations for arc flash energy reduction.

3 Execution

3.01 Field Adjustment

- .1 Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.
- .2 Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- .3 Notify Owner in writing of any required major equipment modifications.

3.02 Arc Flash Warning Labels

- .1 The contractor of the Arc Flash Hazard Analysis shall provide a 90 mm (3.5 in) by 125 mm (5 in) thermal transfer type label of high adhesion polyester for each work location analyzed.
- .2 All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.
- .3 The label shall include the following information, at a minimum:
 - .1 Location designation.
 - .2 Nominal voltage.
 - .3 Flash protection boundary.
 - .4 Hazard risk category.
 - .5 Incident energy.
 - .6 Working distance.
 - .7 Engineering firm and issue date.
 - .8 Labels shall be machine printed, with no field markings.
- .4 Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
 - .1 For each 600 volt, and applicable 208 volt panelboard, one arc flash label shall be provided.
 - .2 For each motor control centre, one arc flash label shall be provided.
 - .3 For each low voltage switchboard, one arc flash label shall be provided.
 - .4 For each switchgear, one flash label shall be provided.
 - .5 For medium voltage switches one arc flash label shall be provided.

- .5 Arc Flash Warning Label General Instructions:
 - .1 Only qualified electricians who recognize and avoid the electrical and Arc Flash hazards are allowed to place the arc flash warning labels.
 - .2 Electricians should wear suitable PPE, such as electrical safety boots, Safety Glasses, etc. while performing labeling.
 - .3 Generally, arc flash label shall be put on a prominent pre-cleaned place on the front of the electrical equipment (such as switchgear, panel, disconnect switch, generator output breaker). Label should be visible and readable, displayed horizontally, attached flatly and securely, and not allowed to cover other signs or labels on the equipment.
 - .4 Under the special request of the client, labels could be put on the back of the panel door when the panel is located in clean and finished spaces such as an office area.
 - .5 When putting a label on small equipment with no space labeling on the wall just beside the equipment is allowed.
 - .6 Special request may be attached to this General Instruction. For examples, more than one identical label is applied for large equipment; different labels could be applied for different sections of one equipment; for a splitter with several disconnect switches only one label is placed on the splitter for this group.
 - .7 Take the pictures for each label to indicate both names of the label and equipment and labeling area of the equipment. Email these pictures to the Consultant for quality control and record.

End of Section

1 General

1.01 Section Includes

- .1 Electrical connections to equipment specified in other sections.
- .2 [Conduit rough-ins for future equipment.]

1.02 Related Requirements

- .1 Division 08 – Openings.
- .2 Division 11 – Equipment.
- .3 Division 14 – Conveying Equipment.
- .4 Division 20 – Common Mechanical Requirements.
- .5 Section 20 05 13 – Common Motor Requirements for Mechanical Equipment.
- .6 Division 21 – Fire Suppression.
- .7 Division 22 – Plumbing.
- .8 Division 23 – Heating, Ventilating, and Air Conditioning.
- .9 Division 25 – Integrated Automation.

1.03 References

- .1 NEMA WD 1 - General Color Requirements for Wiring Devices.
- .2 NEMA WD 6 - Wiring Devices - Dimensional Specifications.

1.04 Coordination

- .1 Coordinate work to Section 01 31 00.
- .2 Obtain and review shop drawings, product data, and manufacturer's instructions for equipment provided under other sections.
- .3 Determine connection locations and requirements.
- .4 Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
- .5 Sequence electrical connections to coordinate with start-up schedule for equipment.

1.05 Submittals

- .1 Submit to Section 01 33 00.
- .2 Product Data: Provide wiring device manufacturer's catalogue information showing dimensions, configurations, and construction.
- .3 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.06 Regulatory Requirements

- .1 Provide products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

2 Products

2.01 Common Motor Requirements

- .1 Motors up to and including 1/3 hp, shall be 1 phase, 60 Hz, 120 V.
- .2 Motors 1/2 hp and above shall be 3 phase, 60 Hz, [575 V or] 208 V.

2.02 Cords and Caps

- .1 Attachment Plug Construction: Conform to NEMA WD 1.
- .2 Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
- .3 Cord Construction: NFPA 70, Type SJO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
- .4 Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

3 Execution

3.01 Conduit Pathways and Rough-Ins

- .1 Where drawings indicate to rough-in conduits for future equipment, or equipment to be provided by the Owner, or other systems as noted on the plans, provide pull string in the conduit, and tag the conduit for the reserved future use/purpose.
- .2 Where circuits breakers, disconnect switches, or other electrical distribution is provided for future equipment, tag the devices with the reserved future use/purpose.

3.02 Wiring of Equipment Provided Under Other Divisions

- .1 Use the following procedures for wiring of motors and equipment provided under other Divisions.
- .2 The following equipment shall be responsibility of the trade supplying the equipment unless otherwise noted, in accordance with the requirements laid out in the individual section, or this division:
 - .1 Motors.
 - .2 Starters.
 - .3 Variable Frequency Drives.
 - .4 Motor Control Centres.
 - .5 Control wiring.
- .3 In every instance, install starter, motor control centre, variable frequency drivers (VFD), etc. and wire to line side of the starter, the Motor Control Centre (MCC), or VFD. Extend wiring from starter, MCC, or VFD to motor as indicated.

- .4 Provide all wiring for starters and VFD's from supply to starter to VFD and to motor. Coordinate requirements with the appropriate trade.
- .5 Provide 500 mm of liquid tight flexible metal conduit for final connection to motor. Provide disconnect switches where required by code, and as indicated on the drawings.
- .6 Where individual starters and controls are grouped together provide a panel for mounting this equipment. Provide a feeder, main fused disconnect and a splitter of adequate size and capacity and wire to line side of the starters on this panel and from starters to motors.
- .7 Equipment, General
 - .1 Ascertain exact locations of starters, motor control centres, motors, etc. from drawings and coordinate exact locations with the supplying trade.
 - .2 Control wiring shall be the responsibility of the supplying trade.
 - .1 Control wiring shall be in accordance with Section 26 05 19, and Section 26 05 23.
 - .2 Control wiring shall be installed in conduit in accordance with Section 26 05 33.13.
- .8 Doors
 - .1 Ascertain exact locations of door operators, actuator push buttons, automatic sensors, and other door hardware.
 - .2 Locate power door operator actuators not less than 600 mm and not more than 1500 mm beyond the door swing where the door opens towards the control.
 - .3 Provide branch circuit wiring for door operators.
 - .4 Provide control and control wiring for all low voltage door interconnections.
- .9 Barrier Free Washrooms
 - .1 Ascertain exact locations of door operator, actuator push buttons, automatic sensors, electronic locking actuator, door lock indicators, and other door hardware.
 - .2 Locate power door operator actuators not less than 600 mm and not more than 1500 mm beyond the door swing where the door opens towards the control.
 - .3 Provide branch circuit wiring for door operators.
 - .4 Provide control and control wiring for all low voltage door interconnections.
- .10 Universal Washrooms
 - .1 Ascertain exact locations of door operator, actuator push buttons, automatic sensors, electronic locking actuator, door lock indicators, and other door hardware.
 - .2 Locate power door operator actuators not less than 600 mm and not more than 1500 mm beyond the door swing where the door opens towards the control.
 - .3 Provide branch circuit wiring for door operator and emergency call system.
 - .4 Provide control and control wiring for all low voltage door interconnections.
 - .5 Provide rough-in, boxes, conduit and control wiring for emergency call system, including integration with power door operator, and indicators located inside and outside the universal washroom, and actuator push button.

- .6 Provide one 5-15R duplex receptacle to accommodate the adult-size change table.
- .11 [Overhead Doors and Folding Vehicle Doors]
 - .1 Ascertain exact locations of control panels, remote controls, safety equipment such as safety eyes, overhead door contacts, etc. from shop drawings and architectural drawings, and coordinate exact locations with overhead door trade.
 - .2 Provide branch circuit wiring for door controls.
 - .3 Provide control and control wiring for all low voltage door interconnections.
 - .4 [Provide vehicle detection loops where indicated.]
- .12 [Healthcare Equipment]
 - .1 [CT Simulator and associated equipment to be provided and/or relocated into areas of Work. Refer to issued equipment vendor drawings including Philips and Varian Medical Systems documents, and review requirements necessary for their equipment installation. Where applicable, comply with equipment vendor limitations to material composition of devices being installed in vicinity of equipment.
 - .2 Provide required wiring devices fully wired in operation, power feeders, raceways, conduits, feeders, boxes, and wiring. Refer to electrical drawings and medical equipment vendor drawing notes and schedules.
 - .3 CT Simulator includes associated equipment such as CCTV camera viewing equipment, specialty luminaires and door interlock system. Review exact requirements onsite, on drawings and with equipment vendor and provide required installations, connections, testing and verification of work.
 - .4 Note any special power requirements such as transformer impedances and power/voltage regulation, from medical equipment vendor documents.
 - .5 Note any special instructions on installed surfaces on ceiling/walls/floors that cannot be cut or penetrated by Work.
 - .6 Provide required grounding and bonding of equipment.
 - .7 Coordinate with respective medical equipment vendor, communications system vendors, security system vendors and telecommunication system vendors to ensure compliance with medical equipment vendor requirements.
 - .8 Obtain equipment vendor contact information from the Consultant and the Owner.]
- .13 Conveying Equipment (e.g. Elevators): in accordance with Section 26 05 83.14.
- .14 Fire-Suppression
 - .1 Ascertain exact locations of starters, motors, compressors, and pumps from fire suppression drawings and coordinate exact locations with the fire protection trade.
 - .2 Provide branch circuit wiring to pumps, compressors, etc.
 - .3 [Provide control wiring (including start/stop signals) from fire pump controllers to generator.]
- .15 Plumbing Equipment
 - .1 Ascertain exact locations of starters, motor control centres, motors, infra-red plumbing fixture controls from Mechanical Drawings and coordinate exact locations with plumbing trade.

- .2 Provide branch circuit wiring and an outlet for each infra-red plumbing fixture control.
- .3 Control wiring shall be the responsibility of the plumbing trade, as described above.
- .16 HVAC Equipment
 - .1 Ascertain exact locations of starters, motor control centres, motors, motorized dampers, VAV boxes, and heating control valves from HVAC drawings and coordinate exact locations with HVAC Division.
 - .2 In the case of unit heaters, reheat coils and cabinet unit heaters, terminate wiring on terminals provided. Control wiring, thermostats, or other control devices shall be the responsibility of the HVAC trade, as described above.
 - .3 Provide branch circuit wiring and an outlet for each motorized damper, variable air volume (VAV) box, or heating control valve. Control wiring shall be the responsibility of the HVAC trade, as described above.
 - .4 [Provide 120 V power connections to small exhaust fans, and ceiling fans for all line voltage control devices, including but not limited to wiring through toggle switches, line voltage thermostats, countdown timer switches, or line voltage speed controllers. Refer to mechanical drawings and schedules for control devices and coordinate requirements with HVAC Division.]
 - .5 Provide 120 V wiring connections to duplex receptacles integral with air handling unit control panels.
 - .6 Provide 120 V wiring connections to HVAC maintenance receptacles integral with roof mounted HVAC equipment.
 - .7 Provide 120 V wiring connections to lighting fixture/switch combinations integral with air handling units.
- .17 Integrated Automation (Building Automation System)
 - .1 [Refer to drawing notes for requirements.]
 - .2 Provide 120 V wiring connections to BAS system controllers/panels and other control system or component requiring 120 V power including, but not limited to, VAV boxes, dampers, low voltage transformers, etc.
 - .3 From equipment as noted on drawings, extend suitable wiring in conduit from equipment contacts to designated BMS panel serving area, terminating wiring and conduit in a junction box. Leave wiring un-terminated with slack coiled length of minimum 2 m (6 ft) long. Clearly label junction box and wiring end for termination onto BMS panel by respective Mechanical Trade.

3.03 Examination

- .1 Verify that equipment is ready for electrical connection, wiring, and energization.

3.04 Electrical Connections

- .1 Provide a local disconnect switch for all equipment, regardless of if a disconnect switch is shown or not shown on the plans.
- .2 Make electrical connections to equipment manufacturer's instructions.
- .3 Make conduit connections to equipment using flexible conduit. Use liquid-tight flexible conduit with watertight connectors in damp or wet locations.

- .4 Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.
- .5 Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.
- .6 Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- .7 [Coolers and Freezers: Cut and seal conduit openings in freezer and cooler walls, floor, and ceilings.]
- .8 Install disconnect switches, controllers, control stations, and control devices as indicated.
- .9 Modify equipment control wiring with terminal block jumpers as indicated.
- .10 Provide interconnecting conduit and wiring between devices and equipment where indicated.

End of Section

1 General

1.01 Section Includes

- .1 Commissioning of all building electrical systems and component including:
 - .1 Testing and adjustment.
 - .2 Demonstration and training.
 - .3 Instructions of all procedures for Owner's personnel.
 - .4 Updating as-built data.
 - .5 Co-ordination of Operation and Maintenance material.
- .2 Provide labour and material to conduct the commissioning process as outlined in this specification section, including the hiring of an Independent Testing Contractor (ITC) as detailed below.
- .3 Provisions of this section shall apply to all sections of Division 26, Division 27, Division 28, and sections related to electrical utilities in Division 33.

1.02 Related Requirements

- .1 Testing and commissioning are called for throughout the individual specifications. This does not relieve this trade from providing all testing and commissioning necessary to ensure that systems and equipment operate as required and that they interface with other systems and equipment as required.
- .2 Section 26 08 50 – Commissioning of Lighting: additional commissioning requirements for commissioning of lighting and lighting controls.

1.03 Commissioning Process Allocation

- .1 The commissioning process shall be allocated a value equal to 5 per cent of the contract. The Electrical Contractor may draw from this allocation as the commissioning process is completed.
- .2 The Electrical Contractor shall submit all test and verification forms. The Consultant will use these forms to calculate percentage complete.
- .3 The Electrical Contractor may claim up to 3 per cent of the contract from this allocation leading up to performance testing. The remaining 2 per cent shall not be paid out until the performance testing, O&M manuals, and training have been completed satisfactorily.

1.04 Definitions

- .1 Cx – Commissioning.
- .2 Commissioning Authority
 - .1 The Commissioning Authority (CxA), also referred to as the Commissioning Consultant, shall be hired by The Owner.
 - .2 The CxA responsibilities shall include:
 - .1 preparing the commissioning plan.
 - .2 co-ordinating with the contractor to schedule tests.
 - .3 preparing a test form manual.

- .4 witnessing selected tests.
- .5 receiving all test forms.
- .6 co-ordinating the contractors training.
- .7 chair the commissioning meetings.
- .3 The Electrical Contractor shall co-operate with the CxA.
- .4 The Electrical Contractor shall provide assistance to the CxA and have personnel available during the performance testing procedure. Each electrical system shall be tested in the operational mode.

1.05 Submittals

- .1 Conform to Section 01 33 00 for requirements for shop drawings and record drawings.
- .2 A commissioning document shall be prepared by the CxA prior to conducting these activities for use by the Commissioning Team.
- .3 The electrical sub-contractor shall be responsible for ensuring all activities are properly documented in this manual and co-ordinated through the General Contractor.
- .4 As-built drawings and data books must be available two weeks prior to commissioning for review and use by the consultant and Commissioning Team prior to the start of the commissioning activities.

1.06 Closeout Submittals

- .1 Attendance records for all training sessions.
- .2 Testing reports for system load balance measurements, infra-red test and harmonics tests.

1.07 Quality Assurance

- .1 Provide qualified trades persons, certified testing agencies, factory trained and approved by the Commissioning Team Leader.
- .2 Submit the names of all personnel to be used during the Commissioning activities.

1.08 Warranty

- .1 Equipment and system warranties shall not begin until the system demonstration and turnover has been conducted successfully and accepted by the Owner.
- .2 The Electrical Contractor shall fill out the warranty form listing the equipment and systems and the start and finishing dates for warranty.
- .3 Refer to Division 01 and Section 26 05 00 for the requirements during the warranty period.

2 Products

2.01 Equipment

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

3 Execution

3.01 The Commissioning Process

- .1 The purpose of the commissioning process is to fully test all building systems including architectural, mechanical, and electrical components and operating procedures by challenging these systems to realistic operation conditions.
- .2 The commissioning process consists of:
 - .1 Shop Drawings and Record Drawings.
 - .2 Installation inspection and equipment verification.
 - .3 Independent testing contractor.
 - .4 Testing of equipment and systems.
 - .5 Commissioning meetings.
 - .6 Operating and maintenance manuals.
 - .7 Operating training.
 - .8 Commissioning Agent testing.
 - .9 Systems Demonstration and turnover.
 - .10 Testing forms.
 - .11 Warranties.

3.02 Preparation

- .1 Provide test instruments required for all activities as defined in the commissioning documents.
- .2 Verify all systems are in compliance with the requirements of the commissioning documents prior to the pre-commissioning check out operation.
- .3 Confirm all scheduled activities have identified personnel available.
- .4 Where systems or equipment do not operate as required, make the necessary corrections or modifications, re-test and re-commission.

3.03 System Description

- .1 Perform all start-up operations, control adjustment, trouble shooting, servicing and maintenance of each item of equipment as defined in the commissioning documentation.
- .2 Owner will provide list of personnel to receive instructions and will co-ordinate their attendance at agreed upon times.
- .3 Prepare and insert additional data in the operations and maintenance manuals and update as-built drawings when need for additional data becomes apparent during the commissioning exercise.
- .4 Where instruction is specified in the commissioning manual, instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.
- .5 Conduct presentation on Owner's premises. Owner will provide space.

3.04 Commissioning

- .1 Commission the components of the electrical system using the NETA Acceptance Testing Specifications.
- .2 Refer to the project commissioning plan prepared by the CxA.
- .3 Commissioning activities for the electrical systems must have available up to date as-built drawing information and accurate Operations and Maintenance Manuals. These documents shall be a major part of this activity.
- .4 Contractor shall be responsible to update all documentation with information and any changes duly noted during the Commissioning exercise.
- .5 Contractor shall arrange for all outside suppliers, equipment manufacturers, test agencies and others as identified in the commissioning sections of this specification. The cost associated with this requirement shall be included as part of the tender price.

3.05 Final Report

- .1 This trade shall assemble all testing data and commissioning reports and submit them to the General Contractor for submission to the Owner.
- .2 Each form shall bear signature of recorder, and that of supervisor of reporting organizer.

3.06 Schedule of Activities

- .1 Commissioning activities shall be conducted based on pre-established schedule with all members of the commissioning team.
- .2 In addition, there will be two meetings held through the contract duration to introduce the parties of the commissioning team, establish the schedules and deadlines for the various activities and review the Commissioning Manual.
- .3 Adhering to the established schedule is very important as the co-ordination and scheduling of the participants will be difficult to alter once this is established. Close co-ordination of this schedule is important.
- .4 In the event project cannot be commissioned in the allotted time slot, the contractor shall pay for all costs associated with assembling the Commissioning Team at a later date. If the contractor has not performed his duties to reach commissioning stage as outlined earlier, he will incur all expenses of other trades and the Commissioning Team due to his non-compliance.

3.07 Installation Inspection and Equipment Verification

- .1 The Electrical Contractor shall co-ordinate with the Electrical Consultant who will inspect the electrical installation.
- .2 The Electrical Contractor shall complete the equipment verification forms for each piece of equipment. The forms shall be included in the operating and maintenance manual. The equipment data shall include:
 - .1 Manufacturers name, address, and telephone number.
 - .2 Distributors name, address, and telephone number.
 - .3 Make, model number and serial number.
 - .4 Voltage and current ratings.

3.08 Independent Testing Contractor

- .1 The Independent Testing Contractor (ITC) shall be hired by the contractor and shall issue reports to the Electrical Consultant.
- .2 The ITC shall conduct load balancing measurements to verify load balancing performed in accordance with Section 26 05 00.

3.09 Testing of Equipment and Systems

- .1 The Electrical Contractor shall be responsible for all tests detailed in this Section, and those tests required by a manufacturer as part of their installation requirements.
- .2 The Electrical Contractor shall schedule all tests which shall be witnessed by the Electrical Consultant or the Commissioning Consultant. The contractor shall complete and sign the testing forms.
- .3 The Electrical Contractor shall conduct tests on the following equipment as a minimum. Refer to the individual specification sections for test procedures.
 - .1 Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.
 - .2 Section 26 05 73.16 – Coordination Studies.
 - .3 Section 26 24 13 – Switchboards.
 - .4 Section 26 24 16 – Panelboards.
 - .5 Section 26 24 19 – Motor Control Centres.
 - .6 Section 27 51 16 – Public Address Systems.
 - .7 Section 28 10 00 – Access Control.
 - .8 Section 28 46 13 – Fire-Alarm Systems.
- .4 When all testing has been completed and all mechanical and electrical systems are operational the contractor shall conduct system load balance measurements, infra-red test and harmonics tests.

3.10 Commissioning Meetings and Reporting

- .1 The Electrical Contractor shall include the schedule for all tests in the construction schedule.
- .2 The Commissioning meetings shall occur during the regular construction meetings. The testing schedules and the results of all tests shall be reviewed.
- .3 All testing forms and reports associated with the electrical systems shall be directed to the Electrical Consultant, with copies to the Consultant, Commissioning Consultant, and the Owner.
- .4 The forms and reports to be issued shall include:
 - .1 Shop drawings, issued and accepted.
 - .2 Equipment verification forms.
 - .3 Testing forms.
 - .4 Reports resulting from tests.
 - .5 Testing schedule.

- .6 Minutes of commissioning meetings.
- .7 Manufacturers' Certificates.

3.11 Operating and Maintenance Manual

- .1 Conform to the specification section for the requirements of the O&M manuals.

3.12 Closeout Activities

- .1 Conform to section for requirements for instructions to the Building Owner for each system and equipment.
- .2 The training shall be provided by qualified technicians or electricians and shall be conducted in a classroom and at the equipment or system.
- .3 The training sessions shall be scheduled, co-ordinated and video recorded by the Contractor.
- .4 Each training session shall be structured to cover:
 - .1 The operating and maintenance manual.
 - .2 Operating procedures.
 - .3 Maintenance procedures.
 - .4 Troubleshooting procedures.
 - .5 Spare parts.
- .5 Submit a course outline to the Electrical Consultant before training commences. Provide course documentation for up to eight people.
- .6 The training session shall be scheduled and co-ordinated by the Commissioning Consultant. The Contractor shall video tape the sessions.
- .7 Training shall be provided for the following systems:
 - .1 Electrical Systems including distribution and lighting: 8 hour minimum
 - .2 Section 27 51 16 – Public Address Systems: 1 hour minimum
 - .3 Section 28 10 00 – Access Control: 1 hour minimum
 - .4 Section 28 46 13 – Fire-Alarm Systems: 2 hours minimum
- .8 The Electrical Contractor shall conduct a walkthrough of the installation. During the walkthrough the Electrical Contractor shall:
 - .1 Identify equipment.
 - .2 Identify electrical panels.
 - .3 Identify starters and disconnects.
 - .4 Review the electrical power distribution.
 - .5 Review the light power distribution.
 - .6 Review the switchgear.

- .7 Review the general maintenance procedures.

3.13 The Electrical System Demonstration and Turnover

- .1 The system demonstration and turnover to The Owner shall occur when:
 - .1 The installation is complete.
 - .2 The acceptance test conducted by the Electrical Consultant has been completed successfully.
 - .3 Training has been completed.
 - .4 Equipment Operating and Maintenance Manuals have been accepted.
 - .5 System operating manuals have been accepted.
 - .6 Shop-drawings have been updated.
 - .7 As-built drawings have been completed.
 - .8 The commissioning process has been completed successfully and system operation accepted by the Electrical Consultant and Commissioning Consultant.
- .2 The systems demonstration shall be conducted by the Electrical Contractor and manufacturers. The demonstration shall cover a physical demonstration of equipment installation and operation.

3.14 Testing Forms

- .1 The Electrical Contractor and manufacturers shall fill out the forms listed in this section or provide other forms. The forms must be approved by the Electrical Consultant and the Owner before they are used.

End of Section

1 General

1.01 Section Includes

- .1 Common requirements for commissioning of all electric lighting, including interior, exterior, and emergency lighting.
- .2 The party responsible for the functional testing shall not be directly involved in either the design or construction of the project.

1.02 Related Requirements

- .1 Section 26 09 23 – Lighting Control Devices.
- .2 Section 26 09 43 – Network Lighting Controls.
- .3 Section 26 51 19 – LED Interior Lighting.
- .4 Section 26 52 13.13 – Emergency Lighting.
- .5 Section 26 56 19 – LED Exterior Lighting.

1.03 References

- .1 ASHRAE
 - .1 ASHRAE Guideline 0-2005 – The Commissioning Process.
 - .2 ANSI/ASHRAE/IES 90.1-2013 – Energy Standard for Building Except Low-Rise Residential Buildings.
- .2 Illumination Engineering Society (IES)
 - .1 IES DG-29-11 – Design Guide for the Commissioning Process Applied to Lighting and Control Systems.
- .3 Ontario Building Code
 - .1 Supplementary Standard SB-10: Energy Efficiency Requirements, December 22, 2016 update.

1.04 Action Submittals

- .1 Refer to Section 01 33 00.
- .2 Submit sample commissioning forms.

1.05 Closeout Submittals

- .1 Section 01 78 00: Submittals for project closeout.
- .2 Submit commissioning reports.
 - .1 Submit a floor plan or spreadsheet table checklist that indicates each local lighting control device, occupancy sensors, daylighting controls, system component.
 - .2 Submit the system sequence of operation fully describing the equipment components and functionality, including set points and alarm functions.
 - .3 The detailed sequence of operation shall be provided regardless of the completeness and clarity of the sequences in the controls specification and/or drawings.

- .3 The functional testing party shall provide documentation certifying that the installed lighting controls meet or exceed all documented performance criteria.

2 Products – Not Used

3 Execution

3.01 Site Tests and Inspections

- .1 [Measure samples of each new luminaire type to be replaced as described in PART 1 of this section for demonstration of energy savings.]
- .2 Sensor placement and orientation for all sensor types.
- .3 Occupancy sensor function, sensitivity, and time delays.
- .4 Daylight harvesting sensor calibration.
- .5 Automated shade operation.
- .6 Manual control placement and operation.
- .7 Automated control operation, including scheduled on/off functions and dimming trims and presets.
- .8 Override operation, access, and functionality.
- .9 Centralized control interfaces and operation.
- .10 Client education of operations.
- .11 Documentation archived to client.

3.02 Functional Testing

- .1 Lighting control devices and control systems shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the construction documents and manufacturer's installation instructions.
- .2 When occupant sensors, time switches, programmable schedule controls, or photosensors are installed, at a minimum, the following procedures shall be performed:
 - .1 Confirm that the placement, sensitivity, and time-out adjustments for occupant sensors yield acceptable performance, lights turn off only after space is vacated and do not turn on unless space is occupied.
 - .2 Confirm that time switches and programmable schedule controls are programmed to turn the lights off.
 - .3 Confirm that photosensor controls reduce electric lights levels based on the amount of usable daylight in the space as specified.

End of Section

1 General

1.01 Section Includes

- .1 Materials and installation for contactors for system voltages up to 600 V.

1.02 References

- .1 CSA Group:
 - .1 CSA C22.2 No. 14-18, Industrial Control Equipment.

2 Products

2.01 Manufacturers

- .1 Allen Bradley "500L" series
- .2 Eaton.
- .3 Schneider Electric.
- .4 Siemens.

2.02 Contactors

- .1 Contactors: to CSA C22.2 No. 14.
- .2 Electrically held controlled by pilot devices as indicated and rated for type of load controlled. Half size contactors not accepted.
- .3 Contactors shall be electrically held 60 Hz, 120 V coil; NEMA Type 1 general purpose enclosure.
- .4 Fused switch combination contactor as indicated.
- .5 Complete with 2 normally open and 2 normally closed auxiliary contacts unless indicated otherwise.
- .6 Mount in a minimum CSA type 2 enclosure suitable for sprinklered areas unless otherwise indicated.
- .7 Include following options in cover:
 - .1 Red indicating lamp.
 - .2 Hand-Off-Auto selector switch.
- .8 Provided complete with control transformer, in contactor enclosure.

3 Execution

3.01 Installation

- .1 Install contactors and connect auxiliary control devices.

3.02 Equipment Identification

- .1 Provide equipment identification in accordance with Section 26 05 53.

- .2 Size 4 nameplate indicating name of load controlled as indicated.

End of Section

1 General

1.01 Section Includes

- .1 Occupancy and Vacancy sensors.
- .2 Power packs, and auxiliary relays, momentary switches.
- .3 Manual controls devices, including dimming switches and low voltage momentary switches.
- .4 Timer switches.
- .5 Daylight harvesting photo sensors.
- .6 Emergency lighting control units.

1.02 Products Installed But Not Supplied Under This Section

- .1 Line voltage manual control devices, as described in Section 26 27 26 – Wiring Devices.

1.03 Related Requirements

- .1 Section 26 08 50 – Commissioning of Lighting.
- .2 Section 26 27 26 – Wiring Devices.
- .3 Section 26 51 19 – LED Interior Lighting.
- .4 Section 26 56 19 – LED Exterior Lighting.

1.04 References

- .1 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
 - .3 CSA C22.2 No. 14-13 – Industrial Control Equipment.
 - .4 CSA C22.2 No. 42 - General Use Receptacles.
 - .5 CSA C22.2 No. 42.1 - Cover Plates for Flush Mounted Wiring Devices.
 - .6 CSA C22.2 No. 184 - Solid-State Lighting Controls.
 - .7 CSA C22.2 No. 184.1 - Solid State Dimming Controls.
 - .8 CSA C22.2 No. 156 - Solid-State Speed Controls.
- .2 National Electrical Manufacturers Association (NEMA):
 - .1 WD1 (R2005) — General Color Requirements for Wiring Devices.
 - .2 WD6 – Dimensional Specifications.
- .3 Ontario Building Code.
- .4 UL 924 - Standard for Safety of Emergency Lighting and Power Equipment.

1.05 Submittals

- .1 In accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's descriptive literature and product specifications for each product.
 - .2 Manufacturer's product drawings.
 - .3 Manufacturer's installation instructions.
- .3 Where the lighting controls include the option for custom engraving, or custom touchscreen user interfaces on control devices, switches, or scene controllers, the Contractor is to submit proposed engraving/labelling/graphics as part of the shop drawing submittal, for review by the Owner.

1.06 Closeout Submittals

- .1 Documentation of all lighting control system setpoints, sensor sensitivities, occupancy sensor timeouts, and as-programmed sequences of operation to aid in future troubleshooting.
- .2 Lighting controls functional test report.

1.07 Quality Assurance

- .1 Manufacturer Qualifications: Products free of defects in material and workmanship.

1.08 Warranty

- .1 Product is warranted free of defects in material and workmanship.
- .2 Product is warranted to perform the intended function within design limits.

2 Products

2.01 Manufacturers

- .1 Wattstopper DLM [(Basis of Design)].
- .2 Acuity Brands Lighting (nLight, Sensorswitch).
- .3 Cooper Lighting Solutions.
- .4 Crestron
- .5 Current Lighting (formerly Hubbell/GE).
- .6 Leviton.
- .7 Lutron Vive.

2.02 General Requirements of all Sensors and Power Packs

- .1 Manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1 per cent.
- .2 Five year warranty and CUL listed.
- .3 In the event of failure, provide a bypass manual "override on" feature on each sensor.

- .4 When bypass utilized, lighting to remain on constantly, or control is to be diverted to a wall switch until sensor is replaced. The override feature is to be designed for use by building maintenance personnel and not be readily achieved by building occupants.

2.03 Occupancy and Vacancy Sensors

- .1 General:
 - .1 Sensors using passive infrared, ultrasonic, microphonic, and multi-technology adaptive technology.
 - .2 Sensor timeouts configurable by system software.
 - .3 Electrical: Rating: 24 VDC input voltage, up to 40 mA current draw.
 - .4 Mechanical: Mounting: Sensors for mounting on ceilings and walls, including corners, must be available.
 - .5 Environmental:
 - .1 Operating Temperature Range: 0 degrees C to 40 degrees C
 - .2 Relative Humidity: 0 per cent to 95 per cent non-condensing.
- .2 Dual Technology Wall Switch Sensor, 24V
 - .1 Wattstopper DW-100-24-W series (Basis of Design).
 - .2 Sensor capable of detecting presence in the control area by detecting Doppler shifts in transmitted ultrasound and passive infrared heat changes.
 - .3 Utilize a dual sensing verification principle for coordination between ultrasonic and Passive Infrared (PIR) Technologies to reduce likelihood of false triggering.
 - .4 For best results, sensor shall feature a trigger mode where the end-user can choose which technology will activate the sensor from Off mode (initial), the type of detection that will reset the time delay (maintain), and the type of detection that will cause the sensor to be turned back on immediately after the lights are turned off due to lack of motion (re-trigger). Selection of technologies for initial, maintain, and re-trigger shall be done with DIP switches.
 - .5 Sensor shall have its trigger mode factory preset to allow for quick installation in most applications. In this default setting, both technologies must occur in order to initially activate lighting systems. Detection by either technology shall maintain the lighting on, and detection by either technology shall turn lights back on after lights were turned off for 5 seconds or less in automatic mode, and 30 seconds or less in manual mode.
 - .6 Robotic test method, as referred in the NEMA WD 7 Guide, shall be utilized for minor motion coverage verification.
 - .7 Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 kHz. It shall utilize Advanced Signal Processing which automatically adjusts the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
 - .8 The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall filter short wavelength IR, such as those emitted by the sun and other visible light sources. Face lens grooves in to avoid dust and residue build up which affects IR reception.
 - .9 Utilize zero crossing circuitry to reduce stress on relay, and therefore increase sensor life.

- .10 Operate at 24 VDC and halfwave rectified and utilize a power pack or lighting control system input module to supply power.
 - .11 To blend in aesthetically, sensor protrusion not more than 3/8" from the wall and utilize colour-matched lens.
 - .12 To assure detection at desktop level uniformly across the space, sensor shall have a 28 segment, 2 level, Fresnel injection molded lens.
 - .13 Sensor shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds, set by DIP switch.
 - .14 To avoid false ON activations and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, to respond only to those signals caused by human motion.
 - .15 Coverage up to 1,000 sq. ft. for walking motion, with a field view of 180 degrees.
 - .16 Automatic-ON or manual-ON operation, adjustable with a DIP switch.
 - .17 Sensor shall have an adjustable time delay.
 - .18 Each sensing technology shall have an LED indicator that remains active at all times, in order to verify detection within the area to be controlled.
 - .19 Sensor shall have a service switch to allow end-users to operate the sensor in the unlikely event of a failure; set by a trim pot.
 - .20 Sensor shall have a built-in light level that features simple, one-step daylighting setup that works from 8 fc to 180 fc.
 - .21 The Dual Technology wall switch sensor shall be a completely self-contained control system that replaces a standard toggle switch
- .3 Dual Technology Ceiling Mounted Sensor, 24V
- .1 Wattstopper DT-300 series (Basis of Design).
 - .2 The Dual Technology sensor shall be capable of detecting presence in the control area by detecting doppler shifts in transmitted ultrasound and passive infrared heat changes.
 - .3 Sensor shall utilize Dual Sensing Verification Principle for coordination between ultrasonic or microphonic and Passive Infrared (PIR) Technologies. Detection verification of both technologies must occur in order to activate lighting systems. Upon verification, detection by either technology shall keep the lighting on.
 - .4 Sensor shall have a retrigger feature in which detection by either technology shall retrigger the lighting system on within 5 seconds of being switched off.
 - .5 Sensors shall be ceiling mounted with a flat, unobtrusive appearance, and provide 360 degree coverage.
 - .6 Ultrasonic sensing shall be volumetric in coverage, with a frequency of 40 kHz. It shall utilize Advanced Signal Processing that automatically adjusts the detection threshold dynamically to compensate for changing levels of activity and airflow throughout a controlled space.
 - .7 To avoid false ON activations, and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, in order to respond only to those signals caused by human motion.

- .8 The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.
- .9 Sensors shall operate at 24 VDC, and halfwave rectified, and utilize a 24 V power pack.
- .10 Sensors shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds.
- .11 The sensor shall have a built-in light level sensor that works from 10 fc to 300 fc.
- .12 The sensors shall feature terminal style wiring.
- .13 Each sensing technology shall have an LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED can be disabled for applications that require less sensor visibility.

2.04 Special Purpose Occupancy Sensors

- .1 Occupancy Sensors for High bay applications:
 - .1 For use in warehouses, distribution centres, and gymnasiums.
 - .2 Maximum 14 m (45 feet) mounting height.
 - .3 Surface-mount or end-mount model to suit application.
 - .4 180 degree and 360 degree coverage lenses available.
 - .5 Low-voltage, passive infrared (PIR) sensor.
 - .6 End-mount model to attach directly to industrial T5HO and T8 fixtures through an extended 13 mm (0.5 inch) chase nipple or junction box.
 - .7 Adjustable timeout for maximum energy savings.
 - .8 Basis of design: Lutron LUT-WSPSM24V-360-CPN6111 and similar.

2.05 Power Packs

- .1 General:
 - .1 Self-contained transformer and relay module.
 - .2 Internal relay controlling up to 20A for 120, 230, 277VAC or 347VAC ballast loads and 120VAC incandescent loads.
 - .3 Provide a 24 VDC, 150 mA output.
 - .4 Capable of parallel wiring without regard to AC phases on primary.
 - .5 Power pack can be used as a standalone, low voltage switch, or can be wired to sensor for auto control.
 - .6 Construction: high impact, UL rated plastic case
 - .7 Power pack shall be UL/CUL Listed, FCC Certified, UL 2043 plenum rated and meets ASHRAE 90.1 requirements

- .8 Shall at minimum meet the following environmental specifications:
 - .1 Operating Temperature Range: 0 degrees C to 40 degrees C
 - .2 Relative Humidity: 0 per cent to 95 per cent non-condensing
- .2 Power Pack and Auxiliary Relay, 347 V
 - .1 Power Pack: Wattstopper B347D-P Series (Basis of Design)
 - .2 Auxiliary Relay: Wattstopper S347-E-P Series (Basis of Design)
 - .3 Power pack shall be a self-contained transformer and relay module measuring 45 mm by 70 mm by 38 mm (1.75 inch by 2.75 inch by 1.5 inch).
 - .4 For ease and speed of installation, power pack shall have 12 mm (1/2") snap-in nipple for 12 mm (1/2") knockouts and mounting on outside of enclosure.
 - .5 Power pack shall have dry contacts capable of switching 15 amp ballast @ 347 VAC, 60Hz.
 - .6 Power pack shall have primary voltage input of 347 VAC.
 - .7 Power pack shall provide a 24 VDC, 114 mA output, with the relay connected.
 - .8 Power pack shall be capable of parallel wiring without regard to AC phases on primary.
 - .9 Power pack can be used as a standalone, low voltage switch, or can be wired to sensor for auto control.
 - .10 Power pack shall have hold-ON and hold-OFF inputs for integration with lighting control panels, BMS and other building systems.
 - .11 Power pack shall have overcurrent protection if the low voltage current drawn exceeds 150 mA. In the event of an overcurrent, the low voltage output current shuts down and the LED will blink to indicate a fault condition.
 - .12 Power pack shall have an LED to indicate status of relay.
 - .13 Power pack shall utilize Zero Crossing Circuitry to protect from the effects of inrush current and increase product longevity.

2.06 Decorator Low Voltage Momentary Switches

- .1 Wattstopper DCC2 series (Basis of Design).
- .2 Switch intended for use with power packs and sensors requiring a momentary contact switch that provides on/off signals.
- .3 12 VAC/VDC, 24 V Rectified, 24 VAC/VDC
- .4 50 mA Max. Internal Contact rating
- .5 500 mΩ resistance when closed
- .6 Single pole, double throw with centre position rest.

2.07 Dimming Switches

- .1 Direct control of dimming luminaires up to the luminaire manufacturer's specified rating.

- .2 Coordinate dimming signal configuration (2-wire phase cut, 3-wire, 4-wire 0-10V, or 4-wire DALI) with the fixture ballast or driver per Section 26 51 19, lighting fixture schedule, and related sections.
- .3 Compatible with related lighting control devices i.e. occupancy sensors.
- .4 Submit luminaire manufacturer's dimmer compatibility documentation to demonstrate compatibility and limits of dimming level.
- .5 Manufacturers:
 - .1 Lutron NovaT* style dimmers.
 - .2 Cooper
 - .3 Leviton.
 - .4 Approved Equal.

2.08 Timer Switches

- .1 Digital time switch programmable to turn loads off after a preset time.
- .2 Capable of operating as an ON/OFF switch.
- .3 Five terminal, completely self-contained control system that replaces a standard toggle switch. Switching mechanism 30 V @ 1 A air gap relay.
- .4 24 VAC when used in conjunction with power packs. For small rooms, or small localized loads, line voltage is permitted.
- .5 No minimum load requirement.
- .6 Time scroll feature permitting manual overriding of the preset time-out period. Selecting time scroll UP shall allow time-out period to scroll up throughout the timer possibilities to the maximum. Time scroll DN (down) shall allow time-out period to scroll down to minimum.
- .7 Options available for user to enable:
 - .1 One second light flash warning at five minutes before the timer runs out and twice when the countdown reaches one minute (when used to control lighting loads).
 - .2 Beep warning sounding every five seconds once the time switch countdown reaches one minute.
- .8 Manual timer reset where pressing the ON/OFF switch for more than 2 seconds resets the timer to the programmed time-out period.
- .9 Liquid crystal display (LCD) that shows the timer's countdown.
- .10 Incorporates two pulsed, open collector NPN transistor outputs for external latching relay coil drives or lighting control panel inputs.
- .11 Fit behind a decorator style faceplate. Concealed calibration switch for setting time-out, time scroll, one second light flash, and beep warning to prevent tampering of adjustments and hardware.
- .12 Time-out period adjustable in increments of 5 minutes from 5 minutes to 1 hour, and in increments of 15 minutes from 1 hour to 12 hours.
- .13 Operate with power packs in order to control additional loads.
- .14 Utilize terminal style wiring.

- .15 For safety, in the event there is an open circuit in the low voltage line, automatically switch to OFF mode.
- .16 Warranty: 5 year warranty.
- .17 CUL listed.
- .18 Wattstopper TS-400 and TS-400-24 series (Basis of Design).

2.09 Emergency Lighting Control Unit for 120 Volt Circuits

- .1 Description:
 - .1 Sequence of Operation: activate emergency lighting in the event of loss of normal utility power, regardless of control status of the luminaire.
 - .2 Provide all required functionality to allow any standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.
- .2 Device shall be listed to UL 924 to meet the intent of Ontario Building Code for “fail-safe operation”, and be approved for use in Canada.
- .3 Example Manufacturers
 - .1 Functional Devices Inc. ESR01P series.
 - .2 Douglas Lighting Controls WR-RIB2401B-EL.
 - .3 Philips Bodine BLCD-20B.
 - .4 Schneider Electric SLSERC1277.
 - .5 Wattstopper ELCU-200 series.
 - .6 Approved Equal.
- .4 Mounting: Able to fit in a standard junction box knockout.
- .5 Features:
 - .1 Senses local single circuit power failure.
 - .2 LED indication for emergency and normal power.
 - .3 Provides absolute fail-to-on emergency lighting.
 - .4 Emergency lights are controlled with normal lighting.
 - .5 Sequence of Operation: automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.
- .6 Specifications:
 - .1 120 VAC; 60 Hz.
 - .2 Maximum Ballast Load: 10A @ 120 VAC.
 - .3 Housing: Fire rated V-0, 80 degrees C.

- .4 Zero crossing circuitry to protect relay contacts from damaging effects of inrush current generated by switching electronic ballast loads.
- .5 UL94 V-O plenum rated with compression wire terminals.
- .6 UL, cUL listed Emergency Lighting and Equipment; five year warranty.

2.10 Daylight Harvesting Photo Sensors

- .1 General:
 - .1 Class 2, low voltage.
 - .2 Ambient light sensor designed to interface directly with the analog input of the Lighting Control System.
 - .3 Supply an analog signal to the Lighting Control System proportional to the light measured.
 - .4 Sensor output shall provide for zero or offset based signal.
 - .5 Capable of a fully adjustable response in the range between 0 and 10,000 foot candles with a +/- 1 per cent accuracy at 21 degrees C.
 - .6 Input: 10 VDC.
 - .7 Output: 0 VDC to 10 VDC.
 - .8 Flame retardant housing and meet UL 94 HB standards.
 - .9 Operating temperature: -10 degrees C to 60 degrees C.
- .2 Interior sensors: Fresnel lens, with a 60 degree cone of response. Range between 0 fc and 750 fc.
- .3 Exterior sensors: Complete with hood over the aperture to shield the sensor from direct sunlight. Outdoor sensor circuitry completely encased in an optically clear epoxy resin. Sensor range between 0 fc and 750 fc.
- .4 Atrium sensors: Translucent dome with a 180 degree field of view. Range from 2 fc to 2,500 fc.
- .5 Skylight sensors: Translucent dome with a 180 degree field of view. Range between 10 fc and 7,500 fc.

2.11 Sequences of Operation

- .1 To Section 26 06 50.19.
- .2 Vacancy Sensor Operation: Manual On, Manual/Auto Off.
- .3 In accordance with ASHRAE 90.1-2013

3 Execution

3.01 Installation

- .1 In accordance with manufacturer's instructions.
- .2 Minimum 14 AWG from the circuit control hardware relays.
- .3 It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the

manufacturer's recommendations. Rooms shall have 90 per cent to 100 per cent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room.

- .4 It is the contractor's responsibility to arrange a pre-installation meeting with manufacturer's factory authorized representative, at Owner's facility, to verify placement of sensors and installation criteria.
- .5 Proper judgement must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.
- .6 Install manual control devices and sensors in accordance with manufacturer's instructions for Vacancy Operation.

3.02 System Startup

- .1 The lighting controls manufacturer's representative shall conduct system startup and submit startup report.

3.03 Site Tests and Inspections

- .1 The lighting controls manufacturer's representative and Contractor shall conduct functional testing and provide report as described in ASHRAE 90.1-2013:
 - .1 Lighting control devices and control systems shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the construction documents and manufacturer's installation instructions.
 - .2 When occupant sensors, time switches, programmable schedule controls, or photosensors are installed, at a minimum, the following procedures shall be performed:
 - .1 Occupant Sensors
 - .1 Certify that the sensor has been located and aimed in accordance with manufacturer recommendations.
 - .2 For projects with up to seven (7) occupancy sensors, all occupancy sensors shall be tested.
 - .3 For projects with more than seven (7) occupancy sensors, testing shall be done for each unique combination of sensor type and space geometry.
 - .4 For each sensor to be tested, verify the following:
 - .1 Status indicator (as applicable) operates correctly.
 - .2 Controlled lights turn off or dim down to the specified level within the required time (20 minutes, or as noted), as applicable to the space type.
 - .3 For auto-on occupant sensors (occupancy mode), the lights turn on to the permitted level when someone enters the space.
 - .4 For manual-on sensors (vacancy mode), the lights turn on only when manually activated.
 - .5 The lights are not incorrectly turned on by movement in nearby areas or by HVAC operation.

- .2 Automatic Time Switches
 - .1 Confirm that the automatic time switch control is programmed with appropriate weekday, weekend, and holiday (as applicable) schedules.
 - .2 Document for the owner automatic time switch programming, including weekday, weekend, and holiday schedules, as well as all setup and preference program settings.
 - .3 Verify that correct time and date are properly set in the time switch.
 - .4 Verify that any battery backup (as applicable) is installed and energized.
 - .5 Verify that the override time limit is set to no more than two (2) hours.
 - .6 Simulate occupied condition. Verify and document the following:
 - .1 All lights can be turned on and off by their respective area control switch.
 - .2 The switch only operates lighting in the enclosed space in which the switch is located.
 - .7 Simulate unoccupied condition. Verify and document the following:
 - .1 All non-exempt lighting turns off.
 - .2 Manual override switch allows only the lights in the enclosed space where the override switch is located to turn on or remain on until the next scheduled shut off occurs.
- .3 Daylight Controls
 - .1 All control devices (photocontrols) have been properly located, field-calibrated, and set for appropriate set points and threshold light levels.
 - .2 Daylight controlled lighting loads adjust to appropriate light levels in response to available daylight.
 - .3 The location where calibration adjustments are made is readily accessible only to authorized personnel.
- .3 The individual(s) responsible for the functional testing shall not be directly involved in either the design or construction of the project and shall provide documentation certifying that the installed lighting controls meet or exceed all documented performance criteria.
- .2 Test lighting controls with fire alarm system in accordance with Section 28 08 46 and Section 28 46 51.
- .3 Commissioning:
 - .1 Upon completion of the installation, the system shall be completely commissioned to verify all adjustments and sensor placement to ensure a trouble-free lighting control system.
 - .2 Submit commissioning report to the Consultant and the commissioning authority for review.
 - .3 Provide the Consultant and Commissioning Authority with ten working days written notice of the scheduled commissioning date.

3.04 Training

- .1 Provide training session of minimum 4 hours duration in accordance with Section 01 79 00.

End of Section

1 General

1.01 Section Includes

- .1 Materials and components for dry type distribution transformers up to 600 V primary, equipment identification, and transformer installation.

1.02 References

- .1 ANSI/ASHRAE/IES Standard 90.1-2019 – Energy Standard for Buildings Except Low-Rise Residential Buildings.
- .2 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
 - .3 CSA C22.2 No. 47-13 (R2023), Air-cooled transformers (dry type).
 - .4 CSA C9:17 (R2022), Dry-type transformers.
 - .5 CSA C802.2-18 (R2023), Minimum Efficiency Values for Dry-Type Transformers.
- .3 IEEE C57.110-2018, IEEE Recommended Practice for Establishing Liquid-Immersed and Dry-Type Power and Distribution Transformer Capability When Supplying Nonsinusoidal Load Currents: this standard defines how K-factor is calculated.
- .4 National Electrical Manufacturers Association (NEMA):
 - .1 NEMA ST 20-2021, Dry-Type Transformers for General Applications: sound levels.
- .5 Natural Resources Canada (NRCan):
 - .1 SOR/2018-201, Regulations Amending the Energy Efficiency Regulations, 2016 (also referred to as NRCan 2019).
- .6 NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).
- .7 Ontario Building Code and its referenced standards.
- .8 UL 1561, Standard for Dry-Type General Purpose and Power Transformers.

1.03 Action Submittals

- .1 Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, power, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

1.04 Informational Submittals

- .1 Test Reports: Indicate loss data, efficiency at 25, 50, 75, and 100 per cent rated load, and sound level.
- .2 Submit manufacturer's installation instructions.
 - .1 Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements.

- .2 Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.05 Closeout Submittals

- .1 Record actual locations of transformers in project record documents.
- .2 Document test results from NETA ATS.
- .3 Copies of completed factory reports and testing reports.

1.06 Delivery, Storage, and Handling

- .1 Store and handle in strict compliance with manufacturer's instructions and recommendations. Protect from potential damage from weather and construction operations.
- .2 Store so condensation will not form on or in the transformer housing and if necessary, apply temporary heat where required to obtain suitable service conditions. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- .3 Handle to manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.
- .4 Handle transformer using proper equipment for lifting and handling, use when necessary lifting eye, and/or brackets provided for that purpose.

1.07 Warranty

- .1 The transformer shall carry a 1 year warranty from the time of substantial performance.

2 Products

2.01 General

- .1 Transformers shall be standard general purpose dry type unless otherwise indicated on drawings as K-Rated or Harmonic Mitigation type.
- .2 Use transformers of one manufacturer throughout project and in accordance with CSA C22.2 No. 47 and CSA C9.

2.02 Manufacturers

- .1 Manufacturer List:
 - .1 Atlas Transformer.
 - .2 Bemag.
 - .3 Delta Transformer.
 - .4 Eaton.
 - .5 Hammond.
 - .6 Powersmiths.
 - .7 Rex Power Magnetics.

- .8 Siemens.
- .9 Schneider Electric.
- .10 STI.

.2 Substitutions: permitted if approved by the Consultant prior to Tender closing date.

2.03 Regulatory Requirements

- .1 Products: Listed and classified by CSA (Canadian Standards Association).
- .2 Efficiency ratings:
 - .1 Meet or exceed the efficiency levels indicated in the following standards:
 - .1 SOR/2018-201 (NRCan 2019).
 - .2 CSA C802.2.
 - .3 ASHRAE 90.1, Table 8.4.4.

2.04 General Purpose Transformers

- .1 NEMA ST-20, factory-assembled, air cooled low-inrush dry type transformer, ratings and voltages as indicated on drawings.
- .2 Single or three phase as indicated on drawings.
- .3 Type: AN/AA ventilated self-cooled.
- .4 Copper windings.
- .5 Finish: Final coating to be ANSI 61 Grey Epoxy Powder.
- .6 T-connected transformers are not acceptable.
- .7 Isolate core and coil from enclosure using vibration-absorbing mounts.
- .8 Impedance: standard (3% to 5% nominal for up to 75 kVA, 4% to 6% for transformers 112.5 kVA and greater).

2.05 K-Factor Rated Transformers

- .1 Provide where indicated on drawings.
- .2 K-Factor Rating: Transformers shall be K-Factor 7, 13, or higher rated and comply with UL 1561 requirements for non-sinusoidal load current-handling capability to the degree defined by designated K-factor.
 - .1 Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
 - .2 Indicate value of K-factor on transformer nameplate.

2.06 Harmonic Mitigating Transformers

- .1 Provide where indicated on drawings.

2.07 Primary Voltage

- .1 415 V delta, 3 phase.
- .2

2.08 Secondary Voltage

- .1
- .2 120/208 V, 3 phase wye.

2.09 Insulation System and Average Winding Temperature Rise

- .1 1 kVA to 15 kVA: Class 185 with 115°C rise.
- .2 16 kVA to 500 kVA: Class 220 with 115°C rise.

2.10 Case Temperature

- .1 Limits in accordance with CSA C22.2 No. 47.

2.11 Winding Taps

- .1 To NEMA ST-20.
- .2 Four full capacity 5 per cent adjustment taps, 2 at 2.5 per cent FCBN (full capacity below nominal) and 2 at 2.5 per cent FCAN (full capacity above nominal).

2.12 Basic Impulse Level

- .1 10 kV BIL.

2.13 Grounding

- .1 Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

2.14 Mounting

- .1 1 kVA to 15 kVA: suitable for wall mounting.
- .2 16 kVA to 75 kVA: suitable for wall, or floor, as shown.
- .3 Larger than 75 kVA: suitable for floor mounting.

2.15 Coil Conductors

- .1 Continuous windings with terminations brazed or welded.

2.16 Enclosure

- .1 NEMA ST 20, CSA type 2 ventilated, sprinkler-proof. Provide lifting eyes or brackets.
- .2 CSA type 3R for outdoor locations.

2.17 Catcher/Drip Base Plate

- .1 Constructed from galvanized steel sheet metal having the minimum thickness as that of the transformer's enclosure.

- .2 Provide for all transformers that are wall mounted, or suspended off the floor.

2.18 Sound Levels

- .1 To NEMA ST-20 for transformers up to 300 kVA:
 - .1 Up to 9 kVA: 40 dB.
 - .2 10 kVA – 50 kVA: 45 dB.
 - .3 51 kVA – 150 kVA: 50 dB.
 - .4 151 kVA – 300 kVA: 55 dB.
- .2 Sound levels 3 dB less than NEMA ST-20 for transformers 301 kVA and greater:
 - .1 301 kVA – 500 kVA: 57 dB.
 - .2 501 kVA – 700 kVA: 59 dB.
 - .3 701 kVA – 1000 kVA: 61 dB.
 - .4 Above 1000 kVA: 3 dB less than NEMA ST-20.

2.19 Nameplate

- .1 Transformer shall have embossed aluminum or stainless steel nameplate indicating, but not restricted to the following:
 - .1 kVA rating.
 - .2 Voltage rating.
 - .3 Impedance.
 - .4 Type.
 - .5 Insulation class.
 - .6 Temperature rise.
 - .7 Connection diagram.
 - .8 Serial number.
- .2 Mark enclosure with kVA value, stencilled in a contrasting colour from enclosure finish, minimum 100 mm character height.

2.20 Equipment Identification

- .1 Provide equipment identification in accordance with Section 26 05 53.

2.21 Source Quality Control

- .1 Production test each unit according to NEMA ST 20.

3 Execution

3.01 Installation

- .1 Mounting:
 - .1 Mount dry type transformers up to 75 kVA, on floor, wall, or suspended from ceiling, as indicated on plans.
 - .2 For transformers rated greater than 50 kVA, ensure a minimum horizontal working space of 1 m is provided and maintained on the sides of the transformer that provide access to conductor connections, in accordance with 2024 OESC Rule 2-312.
 - .3 Mount dry type transformers rated above 75 kVA on floor.
 - .4 For wall mounted transformers, provide rubber-in-shear isolation mounts above bracket-supported rails secured from the wall.
 - .5 For ceiling mounted transformers, provide trapeze hangers and provide rubber-in-shear isolation mounts.
 - .6 Where a transformer is wall mounted or suspended off the floor, provide a metal catcher/drip base plate, and bolt to the bottom of the transformer below the base channel to conform to CSA C22.2 No. 47. Install in accordance with transformer manufacturer's instructions and recommendations.
 - .7 Mount floor mounted transformers on concrete housekeeping pads, minimum 100 mm (4") thick, and extending a minimum of 150 mm (6") beyond the footprint of the transformer.
 - .8 Mount vibration isolating pads suitable for isolating the transformer noise from the building structure in accordance with Section 26 05 48.13.
- .2 Provide seismic restraints in accordance with Section 26 05 48.16.
- .3 Set transformer plumb and level.
- .4 Use flexible conduit, under the provisions of Section 26 05 33.13, 600 mm minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- .5 Provide grounding and bonding to Section 26 05 26.
- .6 Ensure adequate clearance around transformer for ventilation.
- .7 Install transformers in level upright position.
- .8 Remove shipping supports only after transformer is installed and just before putting into service.
- .9 Loosen isolation pad bolts until no compression is visible.
- .10 Make primary and secondary connections in accordance with wiring diagram.
- .11 Energize transformers after installation is complete.

3.02 Field Quality Control

- .1 Section 01 43 00: Field Inspection, Testing, Adjusting.
- .2 Perform inspections and tests listed in NETA ATS, Section 7.2.

3.03 Adjusting

- .1 Measure primary and secondary voltages and make appropriate tap adjustments.

End of Section

1 General

1.01 Section Includes

- .1 Power distribution panelboards – Circuit breaker type.
- .2 Lighting and appliance branch circuit panelboards.
- .3 [Suite panelboards (loadcentres).]

1.02 Related Requirements

- .1 Section 26 28 16.02 – Molded Case Circuit Breakers.
- .2 [Section 26 43 13 – Surge Protective Devices for Low-Voltage Electrical Power Circuits: externally mounted surge protective devices.]

1.03 References

- .1 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
 - .3 CSA C22.2 No. 5:16 (R2021), Molded Case Circuit Breakers, molded-case switches, and circuit-breaker enclosures.
 - .4 CSA C22.2 No. 29-15 (R2024), Panelboards and Enclosed Panelboards.
 - .5 [CSA C22.2 No. 269.2-17 (R2022), Surge Protective Devices - Type 2 - Permanently Connected.]
- .2 NEMA:
 - .1 NEMA ICS 2-2000 (R2020) – Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 volts.
 - .2 NEMA KS 1-2013 – Heavy Duty Enclosed and Dead-Front Switches (600 volts Maximum).
 - .3 NEMA PB 1-2011 – Panelboards.
 - .4 NEMA PB 1.1-2013 – General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 volts or Less.
- .3 NETA ATS – Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).

1.04 Submittals

- .1 Submit in accordance with Section 01 33 00.
- .2 Work of this Section is to be submitted for review after Consultant's review of Coordination Study per Section 26 05 73.16 is completed.
- .3 Shop drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.
- .4 Shop drawings:

- .1 Indicate the following:
 - .1 Outline and support point dimensions.
 - .2 Voltage.
 - .3 Main bus ampacity.
 - .4 Integrated short circuit ampere rating.
 - .5 Circuit breaker arrangement, types, and sizes.
- .2 The following information shall be submitted to the Consultant:
 - .1 Breaker layout drawing with dimensions indicated and nameplate designation.
 - .2 Component list.
 - .3 Conduit entry/exit locations.
 - .4 Assembly ratings including:
 - .1 Short-circuit rating.
 - .2 Voltage.
 - .3 Continuous current.
 - .5 Cable terminal sizes.
 - .6 Product data sheets.
- .3 Where applicable, the following additional information shall be submitted to the Consultant:
 - .1 Key interlock scheme drawing and sequence of operations.
- .5 Submittals for Construction
 - .1 The following information shall be submitted for record purposes:
 - .1 Installation information.

1.05 Closeout Submittals

- .1 Refer to Section 01 78 00.
- .2 Record actual locations of panelboards and record actual circuiting arrangements in project record documents.
- .3 Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.
- .4 Final as-built drawings and information shall incorporate all changes made during the manufacturing and installation process.
- .5 Include a copy of each panelboard schedule in the Operation and Maintenance manual.

1.06 Maintenance Material Submittals

- .1 Manufacturer shall provide installation instructions and NEMA Standards Publication PB 1.1 – Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 volts or Less.

- .2 Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.
- .3 Provide two of each panelboard key.
- .4 Provide final panelboard schedules indicating panelboard data, phasing, breaker sizes, and loads served.

1.07 Quality Assurance

- .1 Regulatory Requirements
 - .1 Products: Listed and classified by CSA (Canadian Standards Association).
- .2 Qualifications
 - .1 Company specializing in manufacturing of panelboard products with a minimum of 20 years' experience.
 - .2 The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
 - .3 For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
 - .4 The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Consultant, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.08 Delivery, Storage, and Handling

- .1 Inspect and report concealed damage to carrier within their required time period.
- .2 Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.
- .3 Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.
- .4 Equipment shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment.

1.09 Warranty

- .1 Warrant specified equipment to be free from defects in materials and workmanship for eighteen (18) months from the date of purchase.

2 Products

2.01 General

- .1 Description: CSA C22.2 No. 29, circuit breaker type.

2.02 Distribution Panelboards – Circuit Breaker Type

- .1 Manufacturers:
 - .1 Square D by Schneider Electric, I-LINE Series.

- .2 Eaton Cutler-Hammer, PRL 3 and PRL4 Series.
- .3 Equal by Siemens.
- .2 The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Consultant ten days prior to bid date.
- .3 Panelboard Bus:
 - .1 Copper, ratings as indicated.
 - .2 Provide copper neutral bus for panelboards indicated for 4-wire systems.
 - .3 Provide copper ground bus in each panelboard.
- .4 Short Circuit Ratings:
 - .1 Panelboards rated 600 V shall have minimum integrated short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 65 000 amperes RMS symmetrical.
 - .2 Distribution panelboards with bolt-on devices contained therein shall have interrupting ratings as specified herein or indicated on the drawings.
 - .3 Panelboards shall be fully rated.
 - .4 Where indicated, provide circuit breakers ULC listed for application at 100 per cent of their continuous ampere rating in their intended enclosure.
- .5 Minimum integrated short circuit rating: Panelboards rated 240 V shall have minimum integrated short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 10 000 amperes RMS symmetrical.
- .6 Molded Case Circuit Breakers: To Section 26 28 16.02.
- .7 Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.
- .8 Cabinet Front: Surface type, fastened hinge and latch, metal directory frame, finished in manufacturer's standard gray enamel.
- .9 Enclosures: CSA type 2 sprinklerproof complete with drip hood, or as noted.
- .10 Trims shall be equipped with a flush lock.
- .11 Breaker positions labeled as "Spare" or "Space" shall constitute no less than 20 per cent of available breaker positions, whether indicated or not in panelboard schedules.
- .12 Each panel shall be complete with a directory which shall be mounted inside door in a metal frame with clear plastic cover and copy in each Data Book. Use final Room Numbers for directories.

2.03 Branch Circuit Panelboards

- .1 Manufacturers:
 - .1 Square D by Schneider Electric, NQ or NQOD Series.
 - .2 Eaton Cutler-Hammer, POW-R-LINE 1, POW-R-LINE 2, POW-R-LINE 3 Series.
 - .3 Equal by Siemens.

- .2 Description: CSA C22.2 No.29, circuit breaker type, lighting and appliance branch circuit panelboard.
- .3 Panelboard Bus:
 - .1 Copper, ratings as indicated.
 - .2 Provide copper neutral bus in each panelboard.
 - .3 Provide copper ground bus in each panelboard.
 - .4 Provide insulated ground bus where scheduled.
- .4 Minimum Integrated Short Circuit Rating: 10 000 amperes RMS symmetrical for 240 V panelboards, or as indicated.
- .5 Molded Case Circuit Breakers: NEMA AB 1, plug-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.
- .6 Current Limiting Molded Case Circuit Breakers where indicated: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.
- .7 Cabinet Front: Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.
- .8 Enclosure shall be CSA type 2 sprinklerproof complete with drip hood, or as noted.
- .9 Trims shall be equipped with a flush lock.
- .10 Breaker positions labeled as "Spare" or "Space" shall constitute no less than 20 per cent of available breaker positions, whether indicated or not in panelboard schedules.
- .11 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
 - .1 Install circuit breakers in panelboards before shipment.
 - .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .12 Panelboards rated 240 VAC or less shall have short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 10,000 amperes RMS symmetrical.
- .13 Bus and breakers rated for symmetrical interrupting capacity, as indicated.
- .14 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.
- .15 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .16 Two keys for each panelboard and key panelboards alike.
- .17 Copper bus with neutral of same ampere rating as mains.
- .18 Mains: suitable for bolt-on breakers.
- .19 Trim with concealed front bolts and hinges.

- .20 Trim and door finish: baked grey enamel.
- .21 The minimum short-circuit rating for branch circuit panelboards shall be as specified herein or as indicated on the drawings. Panelboards shall be fully rated.
- .22 Bolt-on type, heavy-duty, quick-make, quick-break, single- and multi-pole circuit breakers of the types specified herein, shall be provided for each circuit with toggle handles that indicate when unit has tripped.
- .23 Circuit breakers shall be thermal-magnetic type with common type handle for all multiple pole circuit breakers. Circuit breakers shall be minimum 100 A frame and through 100 A trip sizes shall take up the same pole spacing. Circuit breakers shall be ULC listed as type SWD for lighting circuits.
 - .1 Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.
- .24 Circuit breakers shall have a minimum interrupting rating of 10 000 A symmetrical at 240 V, and 14 000 amperes symmetrical at 480 V, unless otherwise noted on the drawings.
- .25 Each panel shall be complete with a directory which shall be mounted inside door in a metal frame with clear plastic cover and copy in each Data Book. Use final Room Numbers for directories.
- .26 Panels shall be dead front type in code gauge steel enclosures. All panels shall be sprinkler proof c/w drip hoods as required.
- .27 Panels shall have mains of voltage and capacity, and main and branch breakers, as shown on the drawings. Spaces shall include necessary bus work such that Owners, at a later date, need buy only the breakers.
- .28 [Where branch circuit metering is used on a [lighting or receptacle or residential suite distribution] panelboard, provide 762 mm (30") tub width to accommodate the metering devices within the panelboard.]
- .29 Where panels exceed [42] circuits, use multi-section panel with main cross-over solid bus bars unless noted otherwise on drawings. Main bus capacity of each section shall be full size to match cross-over bus.
- .30 Breakers shall have bolted type connections. Multi-pole breakers shall be common trip type with a single handle, suitable for voltage applied and of same manufacture as single pole breakers.
- .31 Panels for 120/208 V, 3-phase, 4-wire systems shall be complete with full size breakers.
- .32 Where shown on drawings or required by code, certain breakers shall include ground fault interrupter.
- .33 Provide lighting and receptacle panels suitable for surface, or flush-mounting type, as shown.
- .34 Provide locking bars on non-switched circuits where panels are used for switching lighting circuits.
- .35 Panels for non-linear loads shall be complete with lugs for double neutrals.
- .36 Panels shall be given a rust-resistant treatment to both tub and trim.
- .37 Flush panels shall have concealed hinges and flush type combination lock latch. Locks shall be chrome plated. Doors shall open minimum 135 degrees. Trims shall have fasteners concealed and shall be prime coated to receive room finish paint.
- .38 Surface mounted panels shall have manufacturer's standard surface door trim complete with lock and latch. Finish shall be grey.
- .39 Recessed panels shall have standard flush trims.

- .40 Co-ordinate panel finish with Room Finish Schedule.

2.04 [Residential Suite Panels (Loadcentres)]

- .1 Manufacturers:
 - .1 Schneider Electric Homeline series.
 - .2 Eaton BR series.
 - .3 Siemens EQL series.
- .2 Description:
 - .1 120/240 A, 1-phase 3-wire, 125 A rating.
 - .2 Panelboards suitable for recessed or surface mounted applications.
 - .3 99 mm (3.875 in) nominal depth.
 - .4 Tin-plated aluminum bus.
 - .5 Suitable for plug-on circuit breakers.
 - .6 CSA certified.
 - .7 White cover colour.
 - .8 CSA Type 1 enclosure.
 - .9 Minimum 30 branch circuit positions.
 - .10 Ensure [apartment dwelling unit] panelboards have minimum [two] adjacent spaces in accordance with 2024 OESC 8-108.

2.05 Molded Case Circuit Breakers

- .1 Breakers: to Section 26 28 16.02.
- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.
- .4 Lock-on devices for 10 per cent of 15 A to 30 A breakers installed as indicated. Turn over unused lock-on devices to Owner.
- .5 Lock-on devices for fire alarm, security, and sprinkler circuits.
- .6 Provide shunt trips, bell alarms, and auxiliary switches as shown on the contract drawings.
- .7 [Provide breakers for externally mounted Surge Protective Devices in accordance with Section 26 43 13.]

2.06 Construction

- .1 General:
 - .1 Interiors shall be completely factory assembled. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.

- .2 Surface trims shall be same height and width as box. Flush trims shall overlap the box by 3/4 of an inch on all sides.
- .3 A temporary directory card with a clear plastic cover shall be supplied and mounted on the inside of each door.
- .4 All locks shall be keyed alike. [Key same as existing.]
- .2 Branch Circuit Panelboards:
 - .1 Trims for branch circuit panelboards shall be supplied with a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a semi flush cylinder lock and catch assembly. Door-in-door trim shall be provided. Both hinged trim and trim door shall utilize three point latching. No tools shall be required to install or remove trim. Trim shall be equipped with a door-actuated trim locking tab. Equip locking tab with provision for a screw such that removal of trim requires a tool, at the owner's option. Installation shall be tamper resistant with no exposed hardware on the panelboard trim.
- .3 Distribution Panelboards:
 - .1 Distribution panelboard trims shall cover all live parts. Switching device handles shall be accessible.

2.07 Bus

- .1 Lugs: Copper and listed by CSA, or cUL, for use with copper conductors and sized to accept copper conductors of the ampacity specified.
- .2 Main bus bars shall be copper sized in accordance with CSA standards to limit temperature rise on any current carrying part to a maximum of 65°C above an ambient of 40°C maximum.
- .3 A copper system ground bus shall be included in all panelboards.
- .4 Full-size (100 per cent rated) insulated copper neutral bars shall be included for panelboards shown with neutral. Bus bar taps for panels with single-pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection. 200 per cent rated neutrals shall be supplied for panels designated on drawings with oversized neutral conductors.

2.08 [Integral Mounted Surge Protective Device]

- .1 Where shown on the drawings, furnish panelboards with integral surge protective devices (SPDs), mounted internal to the panelboard.
- .2 Certification:
 - .1 Listed to most recent edition of CSA C22.2 No. 269.2.
 - .2 Products certified by a recognized testing agency accredited by the Standards Council of Canada, and bear a certification mark from that agency indicating acceptance to Canadian standards.
 - .1 Equipment certification by one of the following bodies:
 - .1 Listed by Underwriters Laboratories, Inc. and exhibit the cUL Listing Mark for the category "Surge Protective Devices" or SPD. Provide UL Listing Card under category VZCA7 (SPDs certified for Canada) to confirm compliance to CSA C22.2 No. 269.2, and assigned Voltage Protection Ratings.

- .2 Listed by ETL.
- .3 Certified by CSA Group.
- .2 SPD to be labeled with no less than a 100 kA Short Circuit Current Rating (SCCR).
- .3 SPD shall be factory installed integral to the panelboard by the original equipment manufacturer, and shall be a product of the same manufacturer as the panelboard and breakers.
- .4 The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable single-mode modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
- .5 Electrical Requirements:
 - .1 Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
 - .2 Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.
 - .3 The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards. End of life mode to be open circuit. Unit with end of life short-circuit mode are not acceptable.
 - .4 Unit shall operate without the need for an external overcurrent protection device (OCPD), and be listed by UL as such. Unit must not require external OCPD or replaceable internal OCPD for the UL Listing.
 - .5 Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	X	X	X	X
Delta	N/A	X	X	N/A
Single Split Phase	X	X	X	X
High Leg Delta	X	X	X	X

- .6 Nominal Discharge Current (In) – All SPDs applied to the distribution system shall have a 20 kA In rating regardless of their SPD Type (includes Type 1 and Type 2) or operating voltage. SPDs having an In less than 20 kA shall be rejected.

- .7 ANSI/UL 1449 4th Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 4th Edition VPR for the device shall not exceed the following:

Voltage	L-N	L-G	N-G
208Y/120	800 V	800 V	800 V
480Y/277	1200 V	1200 V	1200 V
600Y/347	1500 V	1500 V	1500 V
Voltage	L-L	L-G	
480 Delta	1800 V	1800 V	
600 Delta	2500 V	2500 V	

2.09 Equipment Identification

- .1 Provide equipment identification in accordance with Section 26 05 53.
- .2 Nameplate for each panelboard size 4 engraved.
- .3 Nameplate for each branch circuit in distribution panelboards size 2 engraved.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.
- .5 Provide an engraved nameplate for each panelboard section.
- .6 Provide copies of all circuit directories in manuals.

2.10 Source Quality Control

- .1 The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of NEMA and CSA standards.

3 Execution

3.01 Installation

- .1 Install panelboards to CSA C22.1.
- .2 Install panelboards plumb.
- .3 Height: 1800 mm to top of panelboard; install panelboards taller than 1800 mm with bottom no more than 100 mm above floor.
- .4 Provide filler plates for unused spaces in panelboards.
- .5 Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- .6 Provide engraved plastic nameplates under the provisions of Section 26 05 53.
- .7 Ground and bond panelboard enclosure according to Section 26 05 26.
- .8 Locate panelboards as indicated and mount securely, plumb, true, and square, to adjoining surfaces.
- .9 Install surface mounted panelboards on fire rated plywood backboards in accordance with Section 26 05 29. Where practical, group panelboards on common backboard.

- .10 Connect loads to circuits.
- .11 Connect neutral conductors to common neutral bus with respective neutral identified.
- .12 Deliver five (5) duplicate keys for each panel lock to the Owner.
- .13 Mount electrical panels, where possible, with top of trim at uniform height of 2000 mm.
- .14 Cap ends of conduits in accessible locations in ceiling spaces above panels, to allow for future wiring.
- .15 The Contractors shall install all equipment per the manufacturer's recommendations and the contract drawings.
- .16 Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and Electrical Code requirements.
- .17 After completion of wiring, type directory showing a clear description of each circuit being controlled from panel and place in metal frame inside door.
- .18 [Provide revised directories for existing panels if revised.]
- .19 Provide circuit breaker handle locks for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.
- .20 [Provide three 27 mm empty conduits from top of lighting, receptacle, telephone, signal and communication panels recessed in walls, to ceiling space.]

3.02 Field Quality Control

- .1 Perform inspections and tests listed in NETA ATS, Section 7.4 for switches, Section 7.5 for circuit breakers.
- .2 Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.
- .3 Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20 per cent of each other. Maintain proper phasing for multi-wire branch circuits.
- .4 Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

3.03 Adjusting

- .1 Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other.
- .2 Maintain proper phasing for multi-wire branch circuits.

End of Section

1 General

1.01 Section Includes

- .1 600 V class low voltage Motor Control Centres (MCCs) for use on alternating current power systems.

1.02 References

- .1 CSA Group
 - .1 CSA C22.2 No. 254:21 - Motor Control Centres (Tri-National standard, with UL 845 and NMX-J-353-ANCE-2021).
 - .2 CAN/CSA-ISO 9000:16 (R2020), Quality Management Systems - Fundamentals and Vocabulary.
 - .3 CAN/CSA-Q9000-92, Quality Management and Quality Assurance Standards - Guidelines for Selection and Use.

1.03 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01 33 00.
- .2 Indicate:
 - .1 Outline dimensions.
 - .2 Configuration of identified compartments.
 - .3 Floor anchoring method and dimensioned foundation template.
 - .4 Cable and Bus duct entry and exit locations to suit entries and exits indicated on the drawings.
 - .5 Dimensioned position and size of busbars and details of provision for future extension.
 - .6 Schematic and wiring diagrams.
- .3 Product Data
 - .1 Submit product data in accordance with Section 01 33 00.
 - .2 Submit product data sheets for sills, busbars, and compartments. Include product characteristics, physical size, and finish.
 - .3 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, and cleaning procedures.

1.04 Closeout Submittals

- .1 Provide operation and maintenance data for motor control centre for incorporation into manual specified in Section 01 78 00.
- .2 Include data for each type and style of starter.

1.05 Extra Stock Materials

- .1 Provide maintenance materials in accordance with Section 01 78 00.

2 Products

2.01 Manufacturers

- .1 Allen-Bradley CenterLine 2100 series.
- .2 Eaton Freedom 2100 series.
- .3 Equal by Siemens.
- .4 Equal by Square D by Schneider Electric.

2.02 Supply Characteristics

- .1 600 V, 60 Hz, delta connected, 3-phase, 3 wire, grounded, or as indicated.

2.03 General Description

- .1 Compartmentalized vertical sections with common power busbars.
- .2 Floor mounting, free standing, enclosed dead front.
- .3 Indoor CSA 2 gasketed enclosure, front mounting.
- .4 Class II Type B.

2.04 Vertical Section Construction

- .1 Independent vertical sections fabricated from rolled flat steel sheets bolted together to form rigid, completely enclosed assembly.
- .2 Each vertical section divided into compartment units, minimum [305 mm] [165 mm] high, as indicated.
- .3 Each unit to have complete top and bottom steel plate for isolation between units.
- .4 Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of motor control centre, isolated from busbars by steel barriers.
- .5 Vertical wireways c/w doors for load and control conductors extending full height of vertical sections, and equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.
- .6 Openings, with removable cover plates, in side of vertical sections for horizontal wiring between sections.
- .7 Incoming cables or bus duct to enter at top, as indicated on the drawings.
- .8 Provision for outgoing cables to exit via top, as indicated.
- .9 Removable lifting means.
- .10 Provision for future extension of both ends of motor control centre including busbars without need for further drilling, cutting or preparation in field.
- .11 Divide assembly for shipment to site, as indicated, complete with hardware and instructions for re-assembly.

2.05 Sills

- .1 Continuous 100 mm channel iron floor sills for mounting bases with 19 mm diameter holes for bolts.

2.06 Bus Bars

- .1 Main horizontal and branch vertical, three phase high conductivity tin plated copper busbars in separate compartment bare self-cooled, extending entire width and height of motor control centre, supported on insulators, and rated:
 - .1 Main horizontal busbars: as indicated.
 - .2 Branch vertical busbars: as indicated.
- .2 Branch vertical busbars for distribution of power to units in vertical sections.
- .3 No other cables, wires, equipment in main and branch busbar compartments.
- .4 Brace bus work to withstand effects of short-circuit current of 42 kA RMS symmetrical, or as indicated.
- .5 Bus supports: with high dielectric strength, low moisture absorption, high impact material and long creepage surface designed to discourage collection of dust.

2.07 Ground Bus

- .1 Copper ground bus extending entire width of motor control centre.

2.08 Motor Starters and Devices

- .1 Refer to Drawings.

2.09 Starter Unit Compartments

- .1 Units NEMA size 5 and smaller, circuit breaker units 225 A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses energized.
- .2 Disconnects for motor control centres shall be heavy-duty, CSA approved, front operated with a handle suitable for padlocking in the "OFF" position and arranged so that the enclosure cover cannot be opened while the handle is in the "ON" position. Fusible units shall be complete with fuse clips for HRC fuses, unless otherwise noted. Enclosures shall be CSA type 1 or CSA type 2 as specified for loose starters above.
- .3 Unit mounting:
 - .1 Engaged position - unit stabbed into vertical bus.
 - .2 Withdrawn position - unit isolated from vertical bus but supported by structure. Terminal block accessible for electrical testing of starter.
 - .3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.
 - .4 Stab-on connectors free floating tin plated clips, self-aligning, backed up with steel springs.
- .4 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for 3 padlocks to lock operating handle in "off" position and lock door closed.
- .5 Hinge unit doors on same side.
- .6 Overload relays manually reset from front with door closed.
- .7 Pushbuttons and indicating lights mounted on door front.

- .8 Devices and components by one manufacturer to facilitate maintenance.
- .9 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

2.10 Wiring Identification

- .1 Provide wiring identification in accordance with Section 26 05 53.

2.11 Equipment Identification

- .1 Provide equipment identification in accordance with Section 26 05 53.
 - .1 Motor control centre main nameplate: size No. 7, engraved.
 - .2 Individual compartment nameplates: size No. 5, engraved as indicated.

2.12 Finishes

- .1 Apply finishes in accordance with Section 26 05 00.
- .2 Paint motor control centre exterior light gray and interiors white.

2.13 Source Quality Control

- .1 Provide manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.
- .2 Consultant and Construction Manager to witness standard factory testing of complete motor control centre including operation of switches, circuit breakers, starters, and controls.
- .3 Manufacturer to provide proof of quality control program in accordance with CAN/CSA-ISO 9000.

3 Execution

3.01 Installation

- .1 Set and secure motor control centre in place on channel bases, rigid, plumb, and square to building floor and wall.
- .2 Make field power and control connections as indicated.
- .3 Ensure correct overload heater elements are installed.

3.02 Field Quality Control

- .1 Perform tests in accordance with Section 26 08 00.
- .2 Ensure moving and working parts are lubricated where required.
- .3 Operate starters in sequence to prove satisfactory performance of motor control centre during 8 hour period.

3.03 System Startup

- .1 Provide the services of a qualified factory-trained manufacturer's representative to assist the Contractor in the installation and start-up of the equipment.

- .2 Follow the manufacturer's instructions and the contract documents concerning any short circuit device settings, heater selection, timing relays, or startup of components.

3.04 Waste Management

- .1 Separate and recycle waste materials in accordance with Section 01 74 00.
- .2 Collect, package and store existing busbars, wireways, sills, copper ground straps and other associated components for recycling and reuse.

3.05 Training

- .1 Provide comprehensive manufacturer's qualified representative training and comply with requirements of Section 26 08 00.

End of Section

1 General

1.01 Section Includes

- .1 Electrical cabinets.
- .2 Electrical enclosures.
- .3 Splitters.

1.02 Related Requirements

- .1 Section 26 27 26 – Wiring Devices.

1.03 References

- .1 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
 - .3 CSA C22.2 No. 94.2:20 – Enclosures for Electrical Equipment, Environmental Considerations.
- .2 Underwriters Laboratories Inc. (UL):
 - .1 UL 50 – Enclosures for Electrical Equipment, Non-Environmental Considerations.
 - .2 UL 50E – Enclosures for Electrical Equipment, Environmental Considerations

1.04 Submittals

- .1 Comply with Section 01 33 00.
- .2 Product Data: Provide manufacturer's catalogue information showing dimensions, colours, and configurations.

1.05 Quality Assurance

- .1 Manufacturer Qualifications: Products shall be free of defects in material and workmanship.
- .2 Furnished products shall be listed or classified by third party agencies as suitable for the intended purpose.

1.06 Warranty

- .1 Product is warranted free of defects in material and workmanship.
- .2 Product is warranted to perform the intended function within design limits.

2 Products

2.01 General

- .1 NEMA 12/4X screw cover enclosures.
- .2 NEMA 12/4X hidden hinge cover enclosures.
- .3 NEMA 12/4X external hinge cover enclosures.

2.02 Manufacturers

- .1 Bel Products.
- .2 EXM Manufacturing.
- .3 Hammond Manufacturing.
- .4 Hoffman.
- .5 Thomas & Betts.
- .6 Ralston Metal.

2.03 Regulatory Requirements

- .1 Provide products listed and classified by CSA (Canadian Standards Association).

2.04 Design and Performance Requirements

- .1 NEMA 12/4X screw cover enclosures:
 - .1 Enclosure shall be UL listed in accordance with UL-50 and CSA or cUL certified to CSA C22.2 No. 94.2.
 - .2 Enclosure shall have CSA enclosure ratings type 1, 2, 3, 3S, 3X, 3SX, 4, 4X and 12.
 - .3 Body shall be manufactured from a high-impact, corrosion resistant solid engineering thermoplastic material; UV stabilized for outdoor use and complies with UL-94 minimum V-2 requirements.
 - .4 Cover shall be manufactured from either a high-impact, corrosion resistant solid engineering material, UV stabilized for outdoor use and comply with UL-94 minimum V-2 requirements, or a clear polycarbonate material, UV stabilized for outdoor use and comply with UL-94 minimum V-2 requirements.
 - .5 Body and cover shall maintain physical properties through overall temperature range of -35°C to 110°C (-31°F to 230°F).
 - .6 Body shall be an industrial grey colour, and lid shall be either industrial grey or clear.
 - .7 Cover and body shall be free of rough corners, sharp edges, or burrs.
 - .8 Cover screws (10-32) shall be captive with a slotted stainless steel (type 304) fillister head.
 - .9 Factory installed brass inserts shall be provided for cover (10-32), mounting flanges (1/4-20), and panel mounting (10-32) screws.
 - .10 Mounting flanges shall be removable and shall permit vertical or horizontal placement on the body.
 - .11 Back panel mounting means shall accept standard size back panels.
 - .12 Interior body corners shall have dovetail to permit panel to be mounted at any depth.
 - .13 Swing out panel mounts shall be utilized when a second panel is desired, or when access to the rear of the primary panel is desired.
 - .14 Hardware kit for adjustable panel mounting shall be available.

- .15 Hardware kit for swing out panel mounting shall be available.
- .16 Enclosure gasket shall be oil resistant continuous closed cell neoprene.
- .17 Enclosure body shall have tapered edges to keep liquids away from cover opening.
- .18 Back panel shall be available in either 14 gauge steel, painted white, or in 7 mm (1/4 in) PVC.
- .19 Enclosure shall be available as factory assembly or as individual components.
- .2 NEMA 12/4X hidden hinge cover enclosures:
 - .1 Enclosure shall be UL listed in accordance with UL-50 and CSA or cUL certified to CSA C22.2 No. 94.2.
 - .2 Enclosure shall have CSA enclosure ratings type 1, 2, 3, 3S, 3X, 3SX, 4, 4X, and 12.
 - .3 Body shall be manufactured from a high-impact, corrosion resistant solid engineering thermoplastic material; UV stabilized for outdoor use and comply with UL-94 minimum V-2 requirements.
 - .4 Cover shall be manufactured from either a high-impact, corrosion resistant solid engineering material, UV stabilized for outdoor use and comply with UL-94 minimum V-2 requirements, or a clear polycarbonate material, UV stabilized for outdoor use and comply with UL-94 minimum V-2 requirements.
 - .5 Body and cover shall maintain physical properties through overall temperature range of -35°C to 110°C (-31°F to 230°F).
 - .6 Body shall be an industrial grey colour, and lid shall be either industrial grey or clear.
 - .7 Cover and body shall be free of rough corners, sharp edges, or burrs.
 - .8 Cover shall be mounted to body with integral hidden non-metallic hinges that shall provide 145° opening.
 - .9 Cover shall be removable and interchangeable.
 - .10 Body shall have integral boss for mounting quick release latches.
 - .11 Quick release (lockable) latches shall be available in either non-metallic, or in type 304 stainless steel.
 - .12 Cover screws (10-32) shall be captive with a slotted stainless steel (type 304) fillister head.
 - .13 Factory installed brass inserts shall be provided for cover (10-32), mounting flanges (1/4-20), and panel mounting (10-32) screws.
 - .14 Mounting flanges shall be removable and shall permit vertical or horizontal placement on the body.
 - .15 Back panel mounting means shall accept standard size back panels.
 - .16 Interior body corners shall have dovetail to permit panel to be mounted at any depth.
 - .17 Swing out panel mounts shall be utilized when a second panel is desired, or when access to the rear of the primary panel is desired.
 - .18 Hardware kit for adjustable panel mounting shall be available.

- .19 Hardware kit for swing out panel mounting shall be available.
- .20 Enclosure gasket shall be oil resistant continuous closed cell neoprene.
- .21 Enclosure body shall have tapered edges to keep liquids away from cover opening.
- .22 Back panel shall be available in either 14 gauge steel, painted white, or in 7 mm (1/4 in) PVC.
- .23 Enclosure shall be available as factory assembly or as individual components.
- .3 NEMA 12/4X external hinge cover enclosures:
 - .1 Enclosure shall be UL listed in accordance with UL 50 and CSA or cUL certified to CSA C22.2 No. 94.2.
 - .2 Enclosure shall have CSA enclosure ratings type 1, 2, 3, 3S, 3X, 3SX, 4, 4X, and 12.
 - .3 Body shall be manufactured from a high-impact, corrosion resistant solid engineering thermoplastic material, UV stabilized for outdoor use and comply with UL-94 minimum V-2 requirements.
 - .4 Cover shall be manufactured from either a high-impact, corrosion resistant solid engineering material, UV stabilized for outdoor use and comply with UL-94 minimum V-2 requirements, or a clear polycarbonate material, UV stabilized for outdoor use and comply with UL-94 minimum V-2 requirements.
 - .5 Body and cover shall maintain physical properties through overall temperature range of -35°C to 110°C (-31°F to 230°F).
 - .6 Body shall be an industrial grey colour, and lid shall be either industrial grey or clear.
 - .7 Cover and body shall be free of rough corners, sharp edges, or burrs.
 - .8 Cover shall be mounted to body with integral external non-metallic hinges that shall provide 240° opening.
 - .9 Cover shall be removable and interchangeable.
 - .10 Body shall have integral boss for mounting quick release latches.
 - .11 Quick release (lockable) latches shall be available in either non-metallic, or in type 304 stainless steel.
 - .12 Cover screws (10-32) shall be captive with a slotted stainless steel (type 304) fillister head.
 - .13 Factory installed brass inserts shall be provided for cover (10-32), mounting flanges (1/4-20), and panel mounting (10-32) screws.
 - .14 Mounting flanges shall be removable and shall permit vertical or horizontal placement on the body.
 - .15 Back panel mounting means shall accept standard size back panels.
 - .16 Interior body corners shall have dovetail to permit panel to be mounted at any depth.
 - .17 Swing out panel mounts shall be utilized when a second panel is desired, or when access to the rear of the primary panel is desired.
 - .18 Hardware kit for adjustable panel mounting shall be available.

- .19 Hardware kit for swing out panel mounting shall be available.
- .20 Enclosure gasket shall be oil resistant continuous closed cell neoprene.
- .21 Enclosure body shall have tapered edges to keep liquids away from cover opening.
- .22 Back panel shall be available in either 14 gauge steel, painted white, or in 7 mm (1/4 in) PVC.
- .23 Enclosure shall be available as factory assembly or as individual components.

2.05 Splitter Troughs

- .1 CSA approved.
- .2 CSA type 2 sprinklerproof, formed, factory primed and painted steel box enclosure with knockouts.
- .3 Hinged front cover plate.
- .4 Suitable mounting provisions.
- .5 Nameplate giving its rating.
- .6 Terminal blocks consist of pressure type main lugs and branch lugs approved for copper wiring and mounted on porcelain bases.
- .7 Splitter trough ratings are scheduled on the drawings.

3 Execution

3.01 Installation

- .1 Install to CSA C22.1.
- .2 Install devices plumb and level.

3.02 Cleaning

- .1 Clean exposed surfaces to remove splatters and restore finish.

End of Section

1 General

1.01 Section Includes

- .1 Switches, receptacles, wiring devices, cover plates, and their installation.

1.02 Related Requirements

- .1 Section 26 09 23 – Lighting Control Devices.
- .2 Section 26 27 26.13 – Floor Box Assemblies.

1.03 Unit Prices

- .1 [Refer to Document 00 43 00.26.]
- .2 Submit with Tender unit prices to provide the following. Include installation in the unit price:
 - .1 5-15R [specification grade] duplex receptacle, complete with wiring and conduit, based on 10 metre distance from the local panelboard.
 - .2 5-20R [specification grade] duplex receptacle, complete with wiring and conduit, based on 10 metre distance from the local panelboard.
- .3 Unit cost of additional conduit and wire for the above items.

1.04 References

- .1 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
 - .3 CSA C22.2 No. 14-18 (R2022), Industrial control equipment.
 - .4 CSA C22.2 No. 42-10 (R2015), General use receptacles, attachment plugs, and similar devices.
 - .5 CSA C22.2 No. 42.1:13 (R2022), Cover plates for flush-mounted wiring devices.
 - .6 CSA C22.2 No. 55:15 (R2020), Special use switches.
 - .7 CSA C22.2 No.111-18 (R2023), General-use snap switches.
 - .8 [CSA C22.2 No. 159-18 (R2022), Plugs, connectors, receptacles, and similar wiring devices for use in hazardous locations.]
 - .9 CSA C22.2 No. 182.1:17 (R2021), Plugs, receptacles, and cable connectors of the pin and sleeve type.
 - .10 [CSA Z32:21, Electrical safety and essential electrical systems in health care facilities.]

1.05 Informational Submittals

- .1 Submit shop drawings and product data in accordance with Section 01 33 00.
- .2 Product Data: Provide manufacturer's catalogue information showing dimensions, colours, and configurations.

- .3 Submit manufacturer's installation instructions.

1.06 [Closeout Submittals]

- .1 [Third party testing reports for receptacles in any spaces where CSA Z32 applies.]

2 Products

2.01 Manufacturers

- .1 Eaton.
- .2 Hubbell Bryant.
- .3 Leviton.
- .4 Molex.
- .5 Pass & Seymour (Legrand).

2.02 [Mental Health Areas]

- .1 [Products accessible to patients in mental health areas and any other areas subject to abuse shall include the following features:
 - .1 Anti-ligature;
 - .2 Tamper-resistant exposed mounting hardware;
 - .3 Impact resistant.]
- .2 Provide anti-pick sealant around each device, confirm colour prior to installation.

2.03 Wall Switches

- .1 Single pole, double pole, three-way, four-way switches to: CSA C22.2 No. 55 and CSA C22.2 No.111.
- .2 Description: CSA C22.2 No. 111, Commercial Spec Grade, AC only general-use snap switch.
- .3 Local switches shall be 20 A, silent, brown coloured, AC type and CSA certified, specification grade. Provide switches rated to suit system voltage 120 V or 347 V.
- .4 Manually-operated general purpose AC switches with following features:
 - .1 Terminal holes approved for 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
- .5 Voltage: 120 V or 347 V, AC as indicated.
- .6 Current: 20 A.
- .7 Body and Handle: white plastic with toggle handle. Confirm finish colour prior to ordering.
- .8 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

- .9 Example Products (Decorator style):
 - .1 120 V:
 - .1 Hubbell HBL2121 series.
 - .2 347 V:
 - .1 Pass & Seymour 2601-347 series.
- .10 Example Products (Toggle style):
 - .1 120 V:
 - .1 Hubbell HBL1221 (single pole).
 - .2 Hubbell HBL1222 (double pole).
 - .3 Hubbell HBL1223 (three-way).
 - .4 Hubbell HBL1224 (four-way).
 - .2 347 V:
 - .1 Hubbell HBL18221 (single pole).
 - .2 Hubbell HBL18223 (three-way).
 - .3 Pass & Seymour PS372030I.
- .11 Local switches and receptacles shall be of the same manufacturer throughout except where a specified item is not made by that manufacturer.

2.04 Receptacles

- .1 General
 - .1 Description: CSA C22.2 No. 42, Commercial Spec Grade general use receptacles.
 - .2 Device Body: white plastic.
 - .3 Configuration: Type as specified and indicated.
 - .4 Convenience Receptacle: Type 5-15, 5-20 where indicated.
 - .5 GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.
 - .6 Data Room Receptacle Types: As indicated on drawings.
 - .7 Receptacles of one manufacturer throughout project.
- .2 Receptacles shall be white coloured, specification grade, unless noted otherwise.
- .3 Receptacles shall be as listed below:
 - .1 15 A, 120 V, single phase grounded duplex receptacle shall be NEMA-U- ground type CSA Configuration 5-15R.

- .2 20 A, 120 V, single phase grounded duplex receptacle shall be NEMA-U-ground type CSA Configuration 5-20RA
- .3 15 A, 120 V, weatherproof receptacles shall be equal to those above but complete with gasketed cast plate and hinged covers.
- .4 Other types of receptacles shall be provided as shown on Drawings.
- .5 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No. 42 with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and riveted grounding contacts.
- .6 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Four back wired entrances, 2 side wiring screws.
- .7 Other receptacles with ampacity and voltage as indicated.
- .8 Example Products
 - .1 Decorator style duplex 5-15R:
 - .1 Pass & Seymour 26252 series.
 - .2 Hubbell HBL2152 series.
 - .2 Decorator style duplex 5-20R:
 - .1 Pass & Seymour 26352 series.
 - .2 Hubbell HBL2162 series.
- .9 Ground Fault Circuit Interrupter (GFCI or GFI) receptacles:
 - .1 Protected by a ground fault circuit interrupter of the Class A type.
 - .2 Any receptacle within 1.5 m (5 ft) of a sink must be GFCI protected.
 - .3 Any receptacle installed outdoors and within 2.5 m of finished grade outdoor must be GFCI protected.
 - .4 Any receptable located on rooftops required for maintenance of HVAC equipment shall be GFCI protected.
- .10 Isolated Ground (IG) Receptacles:
 - .1 Marked as such (green triangle).

- .2 Example Products:
 - .1 Hubbell IG2152 (15 A duplex decorator style, orange faceplate).
 - .2 Hubbell IG2162 (20 A duplex decorator style, orange faceplate).
- .11 Tamper-resistant receptacles.
 - .1 Marked as such (for example "TR").
 - .2 To be used in the following spaces:
 - .1 Child care facilities and kindergarten classrooms.
 - .2 Guest rooms and suites of hotels and motels.
 - .3 Preschools and elementary education facilities, including kindergarten facilities.
 - .4 Dwelling units.
 - .3 Example Products:
 - .1 Hubbell BR15WHITR (15 A duplex decorator style).
 - .2 Hubbell BR20WHITR (20 A duplex decorator style).
- .12 USB Charger receptacles: duplex tamper resistant device.
 - .1 USB ports: one type A and one type C USB charging port, 5 A, 5 V.
 - .2 Example: Hubbell USB15AC5WWR.

2.05 [Hospital Grade Receptacles]

- .1 [General:
 - .1 Description: CSA C22.2 No. 42, Extra heavy duty hospital grade use receptacles with green dot symbol back and side wired, tamper-resistant, flush, thermoplastic polyester face/body construction, duplex U-ground, 15 A, 125 V, 2-pole, 3-wire grounding receptacles complete with one piece nickel-plated brass mounting strip with integral grounding clips, ground retention clips, nickel-plated brass wiring clamps with nickel-plated brass screws, front circuit identification area and reinforced thermoplastic base.
 - .2 Tamper-resistant receptacles shall permit current to flow only while a standard plug is in the proper position in the receptacle. All exposed screws shall be tamper-resistant.
 - .3 Black colour for normal power and red colour for emergency power.
 - .4 Configuration: Type as specified and indicated.
 - .5 GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.
 - .6 Receptacles of one manufacturer throughout project.
- .2 Receptacles shall be extra heavy-duty hospital grade, unless noted otherwise.
- .3 Other types of receptacles shall be provided as shown on Drawings.]

2.06 Cover Plates

- .1 Cover plates for wiring devices to: CSA C22.2 No. 42.1.
- .2 Cover plates from one manufacturer throughout project.
- .3 [Secure cover plates to the device frames with tamper-resistant screws to match the cover plate.]
- .4 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .5 Stainless steel, vertically brushed, cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
- .6 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
- .7 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
- .8 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.
- .9 Decorative Cover Plate: Polycarbonate.
 - .1 Pass & Seymour TP26W series.
- .10 Switch, receptacle, telephone, and other plates shall be stainless steel 18-8 chrome metal alloy, Type 302, non-metallic in finished areas and pressed steel in unfinished areas. Finish brush marks shall be run in a vertical direction.
- .11 Wet Location and weatherproof devices: receptacles and cover plates shall be suitable for wet locations and provide shielding with and without a plug inserted into the receptacle in accordance with 2024 OESC rule 26-708.
 - .1 [Weatherproof Cover Plate: Ultra-rugged polycarbonate and synthetic neoprene rubber:
 - .1 Hubbell ML500GCN series (single-gang):
 - .1 low profile design which expands from 25 mm (1 in) to 75 mm (3 in) for weatherproof protection while an outlet is in use while maintaining the "Extra Duty" ratings.
 - .2 Clear window allows for quick/easy visual inspection.
 - .3 All required gasket and mounting hardware.
 - .4 Pre-configured for GFCI type receptacles.
 - .5 Complete with gaskets to accommodate duplex receptacles or Data outlets.
 - .6 NEMA 3R compliant.
 - .7 Colour: [Gray].
 - .2 Hubbell ML2450GCN series (2-gang):
 - .1 low profile design which expands from 25 mm (1 in) to 75 mm (3 in) for weatherproof protection while an outlet is in use while maintaining the "Extra Duty" ratings.
 - .2 Clear window allows for quick/easy visual inspection.

- .3 All required gasket and mounting hardware.
- .4 Pre-configured for GFCI type receptacles.
- .5 Complete with gaskets to accommodate quadplex receptacles or Data outlets.
- .6 NEMA 3R compliant.
- .7 Colour: [Gray].]

2.07 Pendant Receptacles

- .1 Pendant cord mounted single receptacles complete with strain relief device.
- .2 Strain relief system: Hubbell Kellems Grips, Molex, or equal.

2.08 Receptacle Cord Reels

- .1 Retractable cable reel, mounted to structure above. 125 V, [5-15R] [5-20R] C/W [25] [40] feet of cabtire (or equal).
- .2 Provide framing bracket to support reel at underside of structure above.
- .3 [Connect to GFCI breakers.]
- .4 Manufacturers:
 - .1 Hubbell HBL-C40-123TT.
 - .2 Woodhead (Molex) 997 series.

2.09 Special Wiring Devices

- .1 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic jewel flush type.

2.10 Pin and Sleeve Devices

- .1 Manufacturers:
 - .1 Crouse-Hinds by Eaton.
 - .2 Hubbell.
 - .3 Meltric.
 - .4 Mennekes.
 - .5 Russellstoll (Thomas & Betts).
 - .6 Walther Electric.
- .2 Refer to equipment schedule and plans for locations and specific requirements.

2.11 [Hazardous (Classified) Location Receptacles]

- .1 Devices in accordance with CSA C22.2 No. 159.
- .2 Manufacturers:
 - .1 Crouse-Hinds.

- .2 Appleton Electric.
- .3 Killark; Division of Hubbell Inc.

2.12 Regulatory Requirements

- .1 Provide products listed and classified by CSA (Canadian Standards Association).

3 Execution

3.01 Examination

- .1 Verify that outlet boxes are installed at proper height.
- .2 Verify that wall openings are neatly cut and will be completely covered by wall plates.
- .3 Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.02 Preparation

- .1 Provide extension rings to bring outlet boxes flush with finished surface.
- .2 Clean debris from outlet boxes.

3.03 Installation

- .1 Install to CSA C22.1.
- .2 Mounting heights in accordance with Section 26 05 00.
- .3 Install devices plumb and level.
- .4 Install switches with OFF position down.
- .5 Install wall dimmers to achieve full rating specified and indicated after de-rating for ganging as instructed by manufacturer.
- .6 Do not share neutral conductor on load side of dimmers.
- .7 Install receptacles with grounding pole on bottom.
- .8 Connect wiring device grounding terminal to outlet box with bonding jumper.
- .9 Install decorative plates on switch, receptacle, and blank outlets in finished areas.
- .10 Connect wiring devices by wrapping conductor around screw terminal.
- .11 Use jumbo size plates for outlets installed in masonry walls.
- .12 Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.
- .13 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.

- .3 [In bathrooms and similar spaces with bathtub or shower stalls, locate switches controlling luminaires a minimum of 1 m from the bathtub or shower stall. If this cannot be achieved, locate the switch a minimum of 500 mm from the bathtub or shower stall, and provide a ground fault circuit interrupter of the Class A type.]
- .14 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .3 Connect receptacle grounding terminal to the outlet box with an insulated green ground strap.
 - .4 [Receptacles to be [black] [ivory] for devices connected to normal power circuits, red for devices connected to essential power circuits including isolated power centres. Isolated ground receptacles connected to circuits fed from uninterruptible power supply units to be orange colour. Generally, install receptacles in Patient Care Areas vertically with ground pins up.
 - .5 Safety shutter type receptacles to be located where shown and required by code and CSA Z32.
 - .6 In patient care areas, 15 A/20 A straight blade receptacles to be hospital grade.
 - .7 Comply with requirements of CSA Standard Z32, with regards to identifying circuit number and supplying panelboard, permanently identified at outlets. Identify this information in areas on front of each receptacle. In addition, provide typed label on wall below each device faceplate, identifying circuit number and panelboard from where each device is fed. Confirm nomenclature with the Consultant prior to printing of labels and nameplates. Turn over label maker to Consultant/Owner prior to application for Certificate of Substantial Performance of the Work.
 - .8 Within special imaging/scanning unit type rooms, devices including mounting screws and hardware must be of non-ferrous construction as per unit manufacturer's instructions.]
 - .9 [Provide a combination-type arc-fault circuit interrupter on all dwelling unit branch circuit breakers supplying 125 V receptacles rated 20 A or less except for receptacles serving kitchen counters, refrigerators, bathrooms, or sump pumps in accordance with 2024 OESC rule 26-658.]
 - .10 Receptacles for maintenance of HVAC and similar equipment located on rooftops.
 - .1 Provide weatherproof GFI 5-20R receptacles on roof, installed at 750 mm (30 in) above finished roof level, complete with wet location "while in use" "extra duty" cover plate.
 - .2 Locate within 7500 mm (25 ft) of new HVAC equipment, and at least 2000 mm (6.5 ft) away from roof line.
 - .3 Refer to 2024 OESC rules 2-316, 26-708, and 26-710, and OESC bulletin 26-27-4, or latest edition.
- .15 Cover plates:
 - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
 - .2 Install suitable common cover plates where wiring devices are grouped.
 - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.
 - .4 Do not install plates until final painting of room or area is completed. Remove protective covering.

- .5 [Within special imaging/scanning unit type rooms, devices including mounting screws and hardware to be of non-ferrous construction as per unit manufacturer's instructions.
 - .6 Confirm exact material, finish, and colour of faceplates for devices in any particular area with the Consultant prior to ordering. Submit sample board as per requirements of Part 1.
 - .7 Provide faceplates with printed self-adhesive label on inside face identifying circuit number and panel feeding device. Turn over label maker to the Consultant prior to application for Certificate of Substantial Performance of the Work.]
- .16 Circuit identification: in accordance with Section 26 05 53.

3.04 Field Quality Control

- .1 Inspect each wiring device for defects.
- .2 Operate each wall switch with circuit energized and verify proper operation.
- .3 Verify that each receptacle device is energized.
- .4 Test each receptacle device for proper polarity.
- .5 Test each GFCI receptacle device for proper operation.

3.05 Adjusting

- .1 Adjust devices and wall plates to be flush and level.

3.06 Cleaning

- .1 Clean exposed surfaces to remove splatters and restore finish.

End of Section

1 General

1.01 References

- .1 CSA C22.2 No. 248 series.

1.02 Submittals

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Provide fuse performance data characteristics for each fuse type and size above 200 amps. Performance data to include average melting time-current characteristics.
- .3 Shop Drawings:
 - .1 Provide shop drawings in accordance with Section 01 33 00.

1.03 Closeout Submittals

- .1 Documentation on operating any means to reduce the arcing fault cleaning time for overcurrent devices so equipped (i.e. rated 1200 A or higher).

1.04 Delivery, Storage, and Handling

- .1 Ship fuses in original containers.
- .2 Do not ship fuses installed in switchboard.
- .3 Store fuses in original containers in storage cabinet.
- .4 Waste Management and Disposal:
 - .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00.

1.05 Maintenance Material Submittals

- .1 Provide maintenance materials in accordance with Section 01 78 00.
- .2 3 spare fuses of each type and size installed above 600 A.
- .3 6 spare fuses of each type and size installed up to and including 600 A.

2 Products

2.01 Manufacturers

- .1 Bussman by Eaton.
- .2 GEC.
- .3 Littelfuse.
- .4 Mersen.
- .5 Substitutions: not permitted.

2.02 Fuses – General

- .1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.
- .2 Fuses: product of one manufacturer.
- .3 Fuses shall be sized as shown, time delay type, and of the same type throughout.
- .4 Fuses shall be CSA certified Class-J for 1 A-600 A or Class-L for 650 A and above.
- .5 Provide the following accessories where indicated or where required to complete installation:
 - .1 Fuseholders: Compatible with indicated fuses.
 - .2 [Fuse Reducers: For adapting indicated fuses to permit installation in switch designed for uses with larger ampere ratings.]

2.03 Fuse Types

- .1 Class J fuses.
 - .1 Type J1, time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum.
 - .2 Type J2, fast acting.
- .2 Class L fuses.
 - .1 Type L1, time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum.
 - .2 Type L2, fast acting.
- .3 Class R fuses.
 - .1 Type R1, (UL Class RK1), time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum, to meet UL Class RK1 maximum let-through limits.
 - .2 Type R2, time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum.
 - .3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.

2.04 Fuse Requirements

- .1 Dimensions and Performance: CSA C22.2 No. 248 series, Class as specified or indicated.
- .2 Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.
- .3 Power Load Feeder Switches: HRC-1 Class J time delay type.
- .4 Other Feeder Switches: HRC-1 Class J time delay type.

2.05 Arc Flash Mitigation

- .1 Provide means to reduce the arc fault clearing time for all fusible disconnects rated 1200 A and higher

2.06 Spare Fuse Cabinet

- .1 Description: Wall-mounted sheet metal cabinet, suitably sized to store spare fuses and fuse pullers specified.
- .2 Doors: Hinged, with hasp for Owner's padlock.
- .3 Finish: Prime finish for field painting.
- .4 Dimensions: Minimum 914 mm by 914 mm by 305 mm (3 ft by 3 ft by 1 ft).

3 Execution

3.01 Installation

- .1 Install fuses to manufacturer's instructions.
- .2 Install fuse with label oriented such that manufacturer, type, and size are easily read.
- .3 Install spare fuse cabinet in electrical room.
- .4 Provide a complete set of fuses in each fusible device supplied under this Division and provide 3 spare fuses for each size used in spare fuse cabinet.

End of Section

1 General

1.01 Section Includes

- .1 Molded-case circuit breakers.
- .2 Molded-case switches.
- .3 Accessories.
- .4 [Circuit breakers for existing distribution equipment.]

1.02 Related Requirements

- .1 Section 26 24 13 – Switchboards.
- .2 Section 26 24 16 – Panelboards.

1.03 References

- .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (29th edition/2024).
- .3 CSA C22.2 No. 5-16 (R2021), Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.
- .4 NEMA AB1 - Molded Case Circuit Breakers, Molded Case Switches, and Circuit - Breaker Enclosures.
- .5 NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).

1.04 Submittals

- .1 Submit product data in accordance with Section 01 33 00.
- .2 Include time-current characteristic curves for breakers with ampacity of 400 A and above, or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.
- .3 Include termination temperature rating in degrees C.
- .4 Certificate of Origin
 - .1 Prior to any installation of circuit breakers in either a new or existing installation, Contractor must submit three (3) copies of a certificate of origin from the manufacturer, duly signed by the factory and the local manufacturer's representative, certifying that all circuit breakers come from this manufacturer, they are new, and they meet standards and regulations. These certificates must be submitted to the Consultant for review.
 - .2 A delay in the production of the certificate of origin won't justify any extension of the contract and additional compensation.
 - .3 Any work of manufacturing, assembly or installation should begin only after acceptance of the certificate of origin by the Consultant. Unless complying with this requirement, Consultant reserves the right to mandate the manufacturer listed on circuit breakers to authenticate all new circuit breakers under the contract, and that, to Contractor's expense.
 - .4 In general, the certificate of origin must contain:

- .1 The name and address of the manufacturer, and the person responsible for authentication. The responsible person must sign and date the certificate;
- .2 The name and address of the licensed dealer, and the person of the distributor responsible for the Contractor's account.
- .3 The name and address of the Contractor, and the person responsible for the project.
- .4 The name and address of the local manufacturer's representative. The local representative must sign and date the certificate.
- .5 The name and address of the building where circuit breakers will be installed:
 - .1 Project title.
 - .2 End user's reference number.
 - .3 The list of circuit breakers.

1.05 Closeout Submittals

- .1 Documentation on operating any means to reduce the arcing fault cleaning time for breakers so equipped (i.e. rated 1200 A or higher).

2 Products

2.01 General

- .1 Molded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters, Fused circuit breakers, and Accessory high-fault protectors: to CSA C22.2 No. 5.
- .2 Bolt-on Molded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .3 Plug-in Molded case circuit breakers: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.
- .4 Common-trip breakers: with single handle for multi-pole applications.
- .5 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
 - .1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.
- .6 Circuit breakers with interchangeable trips.

2.02 Interrupting Capacity

- .1 Protective devices shall be fully rated, for required available fault current. Series rated shall not be used on this installation.
- .2 Refer to Section 26 24 13, and Section 26 24 16.

2.03 Molded Case Circuit Breakers – General

- .1 Molded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.
- .2 NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

- .3 Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
- .4 1-, 2-, or 3-pole bolt on, single-handle common trip voltage as indicated on drawings.
- .5 Overcentre toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.
- .6 Calibrate for operation in 40 degree C ambient temperature.

2.04 Molded Case Circuit Breakers – Up to 150 Ampere

- .1 Permanent trip unit containing individual thermal and magnetic trip elements in each pole, unless noted otherwise on drawings.

2.05 Molded Case Circuit Breakers – 151 to [224] [399] Ampere

- .1 Variable magnetic trip elements. Provide push-to-trip button on cover of breaker for mechanical tripping.

2.06 Molded Case Circuit Breakers – [225] [400] Ampere and Above

- .1 Electronic trip type with adjustments for long-time, instantaneous, and short-time functions.
- .2 Provide ground fault function for breakers greater than [400] [1000] Amps.
- .3 1000 Amp and above:
 - .1 Modbus Communications
 - .1 Breaker status.
 - .1 Open.
 - .2 Closed.
 - .3 Tripped.
 - .2 Cause of trip.
 - .3 Time of trip.
 - .4 Current at time of trip.
 - .5 RMS currents per phase and ground.
 - .6 Peak demand.
 - .7 Present demand.
 - .8 Energy consumption.
- .4 1200 Amp and above:
 - .1 Provide handle mechanisms that are lockable in the open (off) position.
 - .2 Provided with means to reduce the arc fault clearing time.

2.07 Additional Features

- .1 Provide as indicated on drawings:
 - .1 Shunt trip.

- .2 Auxiliary switch.
- .3 Motor-operated mechanism.
- .4 Under-voltage release.
- .5 On-off locking device.
- .6 Handle mechanism.

2.08 Molded-Case Switches

- .1 Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.
- .2 Accessories:
 - .1 Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
 - .2 Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.

2.09 Enclosed Breakers and Enclosed Molded-Case Switches

- .1 Molded case, front operated, automatic circuit breakers sized as specified on drawings each secured in a CSA type 2 enclosure, flush wall mounting enclosure with steel front panel suitable for sprinklered areas.
- .2 Voltage rating suitable for circuit phase to phase voltage as indicated on drawings.
- .3 Units to include solid state adjustable trip units and contactors. Contactors to be of rating and type to suit application.

2.10 [Circuit Breakers for Existing Distribution Equipment]

- .1 Products to be of types from existing equipment manufacturers.
- .2 Additional breakers for existing panelboards are to match existing device standards and be completely compatible to equipment in which they are installed.
- .3 During Bidding period, check and verify exact requirements of existing equipment to ensure that additional devices are accommodated.
- .4 Make necessary modifications to equipment to accommodate device and feeder installation.
- .5 Provide suitable engraved lamacoid identification nameplate on additional components.
- .6 Revise typed circuit directory cards on branch circuit panelboards.
- .7 Mount additional devices to standards of existing equipment manufacturer.
- .8 Refer to notes on drawings.
- .9 Provide additional retrofit work to existing equipment as noted on drawings.

3 Execution

3.01 Installation

- .1 Install circuit breakers as per related sections.

End of Section

1 General

1.01 Section Includes

- .1 Fusible and non-fusible enclosed low-voltage disconnect switches from 30 amps to 800 amps.

1.02 Related Requirements

- .1 Section 26 28 13 – Fuses.

1.03 References

- .1 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
 - .3 CSA C22.2 No. 4:16 (R2020), Enclosed and Dead-Front Switches.
 - .4 CSA C22.2 No. 248 series, Low-voltage fuses.
- .2 NETA (International Electrical Testing Association) ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.04 Submittals

- .1 Product Data: Provide switch ratings, and enclosure dimensions.

1.05 Closeout Submittals

- .1 Record actual locations of enclosed switches in project record documents.

2 Products

2.01 Manufacturers

- .1 Eaton Cutler-Hammer.
- .2 Siemens.
- .3 Square D by Schneider Electric.

2.02 Regulatory Requirements

- .1 Products: Listed and classified by CSA or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

2.03 Disconnect Switches

- .1 Provide dedicated disconnect switches at electrical equipment.
- .2 Fused or un-fused disconnect or safety switches: Type "A", quick-make, quick-break construction with provision for padlocking switches in either "ON" or "OFF" position.
 - .1 Quick-make, quick-break.
 - .2 Heavy duty industrial type.

- .3 Lockable with up to 3 padlocks.
- .4 Cover interlocked with switch mechanism.
- .5 Viewing window for viewing blades.
- .3 Fused switches equipped with fuse clips designed for Class "J" fuses and designed to reject standard NEC fuses.
- .4 Enclosure: CSA Type 2 sprinkler-proof, or as noted.
- .5 Switches throughout project of same manufacturer.

3 Execution

3.01 Installation

- .1 Provide fused or un-fused safety or disconnect switches as shown and as required by Code.
- .2 Install disconnect switches complete with fuses, if applicable, to CSA C22.1.
- .3 Apply neatly typed adhesive tag on inside door of each fusible switch indicating NEMA fuse class and size installed.
- .4 Provide disconnect switches for connection to equipment as described in Section 26 05 83.
- .5 Coordinate fuse ampere rating with installed equipment. Fuse ampere rating variance between original design information and installed equipment, size in accordance with Bussmann Fusetron 40 degree C recommendations. Do not provide fuses of lower ampere rating than motor starter thermal units.

End of Section

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1 General

1.01 Summary

- .1 Section Includes
 - .1 These specifications describe pertinent material requirements and installation practices for externally mounted, Low Voltage AC Power Panel Surge Protective Devices (SPDs). Furnish and install the SPDs equipment having the electrical characteristics, ratings and modifications as specified herein and as shown on the contract drawings.
 - .2 The specifications in this section describe the electrical and mechanical requirements for a protection system provided by high-energy Surge Protective Devices. The specified system shall provide effective, high-energy surge current diversion and be suitable for application in ANSI/IEEE C62.41 Category A, B, and C environments (as tested by ANSI/IEEE C62).
- .2 Applicability
 - .1 SPDs shall be fully applicable for the purpose of protecting all facility AC electrical circuits from the hazardous effects of transient voltages. These transients may be generated externally by lightning induced energies, utility load factor corrections, and substation switching, or they can be internally generated due to inductive and/or capacitive load switching.
- .3 Suitability
 - .1 SPDs shall be suitable for all service entrance switchboards, panelboards and motor control centres as indicated on the electrical layouts and single line diagrams. Products are to be configured for parallel installation - no series designs shall be considered acceptable. Design products to allow installation as a stand-alone device allowing mounting adjacent to switchboards, panelboards, and motor control centres. Installation is to be accomplished by a qualified electrical contractor.

1.02 Related Requirements

- .1 Section 26 24 13 – Switchboards.
- .2 Section 26 24 16 – Panelboards.
- .3 [Section 26 24 19 – Motor Control Centres.]
- .4 Section 26 28 16.02 – Molded Case Circuit Breakers.

1.03 References

- .1 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
 - .3 CSA C22.2 No. 269.2:17 (R2022) – Surge Protective Devices - Type 2 - Permanently Connected.
- .2 Institute of Electrical and Electronics Engineers (IEEE):
 - .1 IEEE C62.41.1-2002 - IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.

- .2 IEEE C62.41.2-2002 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.
- .3 IEEE C62.45-2002, Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.
- .4 IEEE C62.62-2010, Standard Test Specifications for Surge Protective Devices.
- .5 IEEE 142-2007, Recommended Practice for Grounding of Industrial and Commercial Power Systems - Green Book.
- .6 IEEE 1100-2005, Recommended Practice for Powering and Grounding Electronic Equipment - Emerald Book.
- .3 National Electrical Manufacturers Association (NEMA):
 - .1 NEMA LS-1. Document rescinded in entirety August 19, 2009. No replacement document has been issued.
- .4 Ontario Building Code and its referenced standards.
- .5 Underwriters Laboratories Inc. (UL):
 - .1 ANSI/UL 1449, (4th Edition), Standard for Safety, Surge Protective Devices.
 - .2 UL 1283 (4th Edition) - 2005, Standard for Electromagnetic Interference Filters.
- .6 Other relevant standards:
 - .1 MIL-STD-220C, Method of Insertion-Loss Measurement.

1.04 Definitions

- .1 Surge Protective Device: A device composed of at least one non-linear component and intended for limiting surge voltages on equipment by diverting or limiting surge current and is capable of repeating these functions as specified. SPDs were previously known as Transient Voltage Surge Suppressors (TVSS) or secondary surge arresters.
- .2 SPD Types:
 - .1 Type 1 – Permanently connected device installed before or after the service disconnect overcurrent device and intended to be installed with no external overcurrent protective device.
 - .2 Type 2 – Permanently connected Type 2 SPDs are intended for installation on the load side of the service equipment overcurrent device, including SPDs located at the branch panel.
 - .3 Type 3 – Point of use SPDs that are installed with a minimum of 9.1 m (30 ft) of conductor length from the service panel. This 9.1 m (30 ft) of conductor length does not include conductors used to attach the SPD. Some examples of Type 3 SPDs are cord connected, direct plug-in and receptacle type SPDs.
 - .4 Type 4 – component assemblies.
 - .5 Type 5 – components.
- .3 L-G: measurements from phase to equipment grounding conductor as line terminals of utilization equipment.

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- .4 L-L: measurements from phase to phase in a polyphase system, or from one line to another line in a single-phase system.
- .5 L-N: measurement from phase(s) to neutral for both single and three phase systems.
- .6 N-G: measurements from neutral to equipment grounding conductor at line terminal of utilization equipment.
- .7 Externally mounted SPD: Surge Protective Device (SPD) mounted outside of the power panel as a separate component.

1.05 Submittals

- .1 Submit in accordance with Section 01 33 00.
- .2 Shop Drawings:
 - .1 Line drawings or catalog sheets detailing dimensions and weight of enclosure, lifting and support points, and enclosure details.
 - .2 Internal wiring diagram illustrating all modes of protection in each type of SPD required.
 - .3 Wiring diagram showing all field connections and manufacturer's recommended wire size, recommended circuit breaker or fuse size, required overcurrent protection type, and maximum lead length.
- .3 Provide the following product data:
 - .1 Voltage Protection Ratings (VPRs), I-nominal ratings, Short Circuit Current Ratings, SPD type designations, dimensions showing construction, per mode and per phase peak surge current, modes of discrete suppression circuitry, warranty period, and replacement terms.
 - .2 List and detail all protection systems such as fuses, disconnecting means, and protective features.
- .4 Submit product data for all components and accessories.
- .5 Manufacturer's Installation Instructions:
 - .1 Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.
 - .2 Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- .6 Test reports:
 - .1 Submit cover sheet of test report from a recognized independent testing laboratory certifying compliance with CSA C22.2 No. 269.2.
 - .2 Provide verification that the SPD complies with CSA C22.2 No. 269.2.
 - .3 Provide spectrum analysis of each unit based on MIL-STD-220C test procedures between 10 kHz and 100 kHz verifying the devices noise attenuation equals or exceeds values indicated in this section.
 - .4 Documentation verifying Short Circuit Current Rating (SCCR).
 - .5 Proof of UL 1283 listing for EMI filters.

- .7 Upon request, present unencapsulated but complete SPD for visual inspection; proprietary technology included. MOV type and quantity shall reflect kA ratings on cut sheets, verification of monitoring, thermal, overcurrent protection, etc.
- .8 Include the following information:
 - .1 Data for each suppressor type indicating conductor sizes, conductor types, and connection configuration and lead lengths.
 - .2 Manufacturer's certified test data indicating the ability of the product to meet or exceed requirements of this specification.
 - .3 Drawings, with dimensions, indicating SPD mounting arrangement and lead length configuration, and mounting arrangement of any optional remote diagnostic equipment and assemblies.
 - .4 List and detail all protection systems such as fuses, disconnecting means and protective materials.
 - .5 Indicate SPD wiring, bonding, and grounding connections on wiring diagrams for each system. Include installation details demonstrating mechanical and electrical connections to equipment to be protected.
 - .6 Wiring diagram of SPD diagnostic indicators.

1.06 Closeout Submittals

- .1 Maintenance data: submit operation and maintenance data, and engineering data for incorporation into manual specified in Section 01 78 00.
- .2 Warranty document.

1.07 Environmental Requirements

- .1 Operating temperature range: -40°C to 70°C (-40°F to 160°F).
- .2 Elevation: Operation up to 3 658 m (12 000 ft) above sea level.
- .3 Generate no appreciable magnetic fields.

1.08 Delivery, Storage, and Handling

- .1 Deliver, store, and handle in accordance with Section 01 61 00.
- .2 Store materials in dry, secure location and protect from weather.
- .3 Protect from moisture and humidity.
- .4 Store in accordance with manufacturer's written instructions.
- .5 Waste management and disposal in accordance with Section 01 74 00.

1.09 Manufacturer Warranty

- .1 Five-year warranty.
- .2 Since "Acts of Nature" or similar statements typically include the threat of lightning to which the SPD shall be exposed, any such clause limiting warranty responsibility in the general conditions of this specification shall not apply to this section. This is, the warranty shall cover the effects of lightning, single phasing, and

all other electrical anomalies. The warranty shall cover the entire device, not just various components, such as modules only.

1.10 Manufacturer Qualifications

- .1 Manufacturer regularly engaged in the design, manufacturing and testing of SPD's of the types and ratings required for a period of not less than five years. Manufacturers requesting product approval must meet or exceed the written specification contained herein. Manufacturers requesting approval must receive written verification of product acceptance by the Consultant ten days prior to the bid date.

1.11 Quality Assurance

- .1 All SPDs manufactured by a single ISO 9001 registered company normally engaged in the design, development, and manufacture of such devices for electrical and electronic system equipment protection.
- .2 Manufacturer regularly engaged in the manufacture of surge suppression products for the specified categories for minimum of ten years.
- .3 Manufacturer shall offer repair or replacement service for all materials and components incorporated in the Surge Protective Devices.
- .4 Technical assistance (no cost to customer) provided by manufacturer through a factory representative or a local distributor and a factory staffed toll-free technical hotline.
- .5 Manufacturer shall provide a toll-free customer service phone number to facilitate all inquiries regarding product returns, warranty claims, purchasing requirements and payment or credit issues.
- .6 Listed to most recent edition of CSA C22.2 No. 269.2.
- .7 Products certified by a recognized testing agency accredited by the Standards Council of Canada, and bear a certification mark from that agency indicating acceptance to Canadian standards.
 - .1 Equipment certification by one of the following bodies:
 - .1 Listed by Underwriters Laboratories, Inc. and exhibit the cUL Listing Mark for the category "Surge Protective Devices" or SPD. Provide UL Listing Card under category VZCA7 (SPDs certified for Canada) to confirm compliance to CSA C22.2 No. 269.2, and assigned Voltage Protection Ratings.
 - .2 Listed by ETL.
 - .3 Certified by CSA Group.
 - .2 SPD to be labeled with no less than a 100 kA Short Circuit Current Rating (SCCR).

2 Products

2.01 Outdated and Defunct Specification Criteria

- .1 Selection of SPD is not be made, solely, or in part, based upon any of the following ambiguous specifications, and obsolete terminology. These terms are no longer recognized by ANSI, NEMA, IEEE, or IEC standards as bonafide suppressor performance parameters. Submittals bearing reference to any of the following will be rejected.
 - .1 A1 ringwave: removed in 2002 revisions of IEEE C62 documents.
 - .2 Joule ratings: there is no recognized standard for SPD joule ratings.

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- .3 NEMA LS-1: document rescinded by NEMA.
- .4 Response time: not endorsed by IEEE, NEMA, or UL as a valid SPD rating parameter.
- .5 Suppressed Voltage Ratings (SVR): terminology deprecated with UL 1449 third and subsequent editions.

2.02 Manufacturers

- .1 Manufacturer List
 - .1 Citel.
 - .2 Current Technology.
 - .3 [Eaton.]
 - .4 Mersen.
 - .5 Raycap Electrical Protection Systems.
 - .6 Schneider Electric.
 - .7 [Siemens.]
 - .8 [Total Protection Solutions.]
- .2 Substitution Limitations:
 - .1 No unit will be accepted as an “approved equal” unless it meets the warranty, strength, safety features, performance ratings, and all other requirements of this specification.
 - .2 Internally mounted Surge Protective Devices: [Not permitted.] [Permitted for switchboards in accordance with Section 26 24 13.] [Permitted for panelboards in accordance with Section 26 24 16.]
- .3 Product Options:
 - .1 The inclusion of a manufacturer in the following list does not indicate the manufacturer meets all the requirements in this specification. Likewise, the omission of a manufacturer is not indicative of any lack of qualification. The manufacturer and product must meet all the requirements of this specification.
 - .2 The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Consultant ten (10) days prior to bid date.

2.03 Surge Protection Devices – General

- .1 Obtain all surge suppression devices through one source from a single manufacturer.
- .2 SPD separate from panelboards. Integral SPDs not acceptable.
- .3 The SPD listed by recognized testing agency accredited by the Standards Council of Canada, and bear a certification mark from that agency indicating acceptance to Canadian standards, and to UL’s 1283 and

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- UL's 1449 standards (latest edition, latest revision), and not merely the components or modules. Label all SPDs as a Type 2 for use in Type 1 and Type 2 locations.
- .4 Protect all modes L-G, L-N, L-L, and N-G, have discrete suppression circuitry in L-G, L-N, and N-G, and have bidirectional, positive, and negative impulse protection. Line-to-neutral-to-ground protection is not acceptable where line-to-ground is specified, and accordingly reduced mode units with suppression circuitry built into only four modes are not acceptable. In delta systems, line-to-ground-to-line protection is not acceptable where line-to-line is specified.
 - .5 If a disconnect switch is specified, the disconnect switch and the SPD as a system shall be capable of interrupting up to a minimum 100 kA symmetrical fault current with 600 VAC applied.
 - .6 Suppression Components:
 - .1 Metal Oxide Varistors (MOVs).
 - .2 Gas tubes, silicon avalanche diodes, or selenium cells: not permitted.
 - .3 Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls, such as through the use of Thermally Protected MOVs (TPMOVs).
 - .4 Where SPD is not equipped with overtemperature controls, pack all surge components, current carrying paths and fusing in fuse grade silica sand or epoxy potting for arc quenching capability, minimization of smoke and contaminants in the event of failure.
 - .7 Internal Fusing - Overcurrent Protection
 - .1 Individually fuse each suppression component for safety and performance.
 - .2 Fusing shall be present in every mode, including Neutral-to-Ground.
 - .3 All overcurrent protection must be included within the device, and not require external overcurrent protection.
 - .8 Surge Current Rating
 - .1 Service Entrance: 200 kA per phase.
 - .2 Distribution: 100 kA to 200 kA per phase.
 - .3 Point of Use: 100 kA per phase.
 - .9 Short Circuit Current Rating (SCCR), sometimes referred to as fault current rating: minimum 100 kA.
 - .10 Nominal Discharge Current (In, or I-nominal):
 - .1 UL labelled with a minimum 10 kA I-nominal.
 - .11 Maximum Continuous Operating Voltage (MCOV): The maximum continuous operating voltage (MCOV) of all components not less than 125 per cent for a 120 V system, 120 per cent for 220 and 240 V systems, and 115 per cent for 347 and 600 V systems.
 - .1 277 V systems: 320 V MCOV.
 - .2 480 V systems: 552 V MCOV.

- .12 Voltage Protection Ratings (VPRs) to not exceed the following:

Voltage	L-N	L-G	N-G
208Y/120	800 V	800 V	800 V
480Y/277	1200 V	1200 V	1200 V
600Y/347	1500 V	1500 V	1500 V
Voltage	L-L	L-G	
480 Delta	1800 V	1800 V	
600 Delta	2500 V	2500 V	

- .13 Minimum EMI/RFI filtering of -50 dB at 100 kHz.
- .14 SPD enclosure:
- .1 Minimum NEMA type 12 rating in indoor applications.
 - .2 Minimum NEMA type 4 in outdoor applications.
- .15 Diagnostics and Monitoring:
- .1 Visual LED diagnostics to indicate failure of a suppression component. Monitor every suppression component of every mode, including N-G.
 - .2 Form C dry contacts (NO or NC) for remote monitoring capability to indicate the failure of any MOV in the unit.
 - .3 [Surge event counter with backup power source.]

2.04 Service Entrance and Transfer Switch SPDs

- .1 CSA certified and labeled as a Type 2 device.
- .2 SPDs relying on an external breaker or fuse as supplemental overcurrent protection do not meet the intent of this specification and will be rejected.
- .3 CSA certified listed and labeled with a minimum I-nominal rating of 20 kA.
- .4 An approved disconnect switch provided as a means of service disconnect if a 60 A breaker is not available.
- .5 Connect SPD using the manufacturer's breaker/wire recommendations. If recommendations are not available, use a 60 A breaker and 6 AWG cable with full size ground.
- .6 Minimum Surge Current Rating: 200 kA per phase (100 kA per mode).

2.05 Distribution Panelboard and Motor Control Centre SPDs

- .1 CSA certified listed and labeled as a Type 2 device.
- .2 SPDs relying on an external breaker or fuse as supplemental overcurrent protection do not meet the intent of this specification and will be rejected.
- .3 CSA certified listed and labeled with a minimum I-nominal rating of 20 kA.

- .4 SPD connected using the manufacturer's breaker/wire recommendations. If recommendations are not available a 60 A breaker and 6 AWG with full size ground will be used.
- .5 Minimum Surge Current Rating: 100 kA per phase (50 kA per mode).

2.06 Lighting and Receptacle Branch Circuit Panelboard SPDs

- .1 CSA certified listed and labeled as a Type 2 device.
- .2 SPDs relying on an external breaker or fuse as supplemental overcurrent protection do not meet the intent of this specification and will be rejected.
- .3 CSA certified listed and labeled with a minimum I-nominal rating of 10 kA.
- .4 SPD connected using the manufacturer's breaker/wire recommendations. If recommendations are not available a 60 A breaker and 6 AWG will be used.
- .5 Minimum Surge Current Rating: 100 kA per phase (50 kA per mode).

3 Execution

3.01 Pre-Installation Meetings

- .1 Pre-installation meetings: conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to verify project requirements, substrate conditions and co-ordination with other building sub-trades, to review manufacturer's installation instructions and warranty requirements.

3.02 Field Quality Control

- .1 Have manufacturer of products supplied under this Section review Work involved in the handling, installation, application, protection, and cleaning of its products. Submit written reports in acceptable format to verify compliance of Work with Contract in accordance with Section 01 33 00 and Section 01 78 00.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits to review work at stages listed:
 - .1 After delivery and storage of products, and when preparatory work on which the work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of work at 66 per cent and 99 per cent complete.
 - .3 Upon completion of the work, after cleaning is carried out.
- .4 Obtain reports within three (3) days of review and submit immediately to the Consultant.

3.03 Examination

- .1 Verify service and separately derived system Neutral to Ground bonding jumpers.

3.04 Installation

- .1 Do complete installation in accordance with CSA C22.1, CSA C22.2 No. 0, ANSI/IEEE C62.41, and all other applicable codes.
- .2 Manufacturer's instructions:

- .1 Install SPD in accordance with manufacturer's installation instructions with lead lengths as short and as straight as practically possible. Lead lengths no greater than 600 mm (24 in). Gently twist conductors together.
- .2 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage, and installation instructions.
- .3 Connect SPD to service panel being protected via a circuit breaker for each phase, based on the number of poles and the connecting wire size, with a 100 A maximum.
- .4 Follow the SPD manufacturer's recommended installation practice as outlined in the equipment installation manual. Ensure that all neutral conductors are bonded to the system ground at the service entrance or the serving isolation transformer prior to installation of the associated SPD.
- .5 Installation position of SPD:
 - .1 Locate SPD adjacent to the panelboard, in a position as close as possible to the neutral and ground lugs. Rearrange breaker positions for SPDs to minimize the length of the phase, neutral, and ground conductors.
 - .2 Mount SPD as close as possible to panel being protected in a position that will minimize lead lengths between suppressor and control breaker(s) to which suppressor connects. Utilize conduit, preferably metallic, to accomplish these connections with a recommended minimum wire size of 10 AWG, a maximum wire size of 4 AWG (for ease of dressing), or as noted on the single line diagram. Do not extend suppressor leads beyond manufacturer's recommended maximum length without specific engineering approval. The rationale for this is the longer connecting leads between the SPD and the power panel, the higher the residual transient voltage.
 - .3 Locate surge suppressors as indicated and mount securely, plumb, true, and square to adjoining surfaces.
 - .4 Install surface mounted surge suppressors on fire-retardant plywood backboards as recommended in manufacturer's written instructions. Where practical, group SPDs on common backboard with other equipment.
 - .5 Mount housings and enclosures on fire-retardant plywood backboard with top not higher than 1.8 m (6 ft) above finished floor.
- .6 Wiring:
 - .1 Install units on a breaker, sized, where indicated, that meets or exceeds the fault current rating of the switchgear or panelboard.
 - .2 Connect SPD to service panel being protected via a circuit breaker for each phase, based on the number of poles and the connecting wire size. Connect SPD using the manufacturer's breaker/wire recommendations.
 - .1 If recommendations are not available, a 60 A breaker and 6 AWG phase, neutral, and ground conductors will be used.
 - .2 If the SPD is supplied with lead wires, match the overcurrent protection to the 75°C ampacity of the wiring as described in Ontario Electrical Safety Code, Table 2; i.e. a 30 A breaker to suit 10 AWG lead wires.
 - .3 Install SPD in a neat, workmanlike manner. Dress leads as short and as straight as possible and be consistent with recommended industry practices for the application on which these units are installed. Bind phase, neutral, and ground conductors tightly (one twist per 30 cm) over entire run,

from suppressor to service panel, and always use the shortest length of connecting cable possible.

- .4 If the SPD is supplied by the manufacturer with lead wires, cut excess lead length.

End of Section

1 General

1.01 Section Includes

- .1 Solid state, light emitting diode (LED) source interior luminaires.
- .2 New, fully integrated luminaires for indoor applications.

1.02 Related Requirements

- .1 Section 26 09 23 – Lighting Control Devices.
- .2 Section 26 52 13.13 – Emergency Lighting.

1.03 References

- .1 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
 - .3 CSA C22.2 No. 250.0 - Luminaires (Bi-National Standard, with UL 1598).
- .2 DesignLights Consortium (DLC):
 - .1 Solid-State Lighting Technical Requirements v5.1, or latest edition.
 - .2 Where the specifications do not explicitly call for DLC qualified LED luminaires, the technical criteria provided in the DLC Technical Requirements provide the basis of the requirements for this section of the Specification.
- .3 Energy Star:
 - .1 Program Requirements for Luminaires - Eligibility Criteria, Version 1.2, or latest edition.
- .4 Illuminating Engineering Society (IES):
 - .1 IES HB-10-11 – The Lighting Handbook, 10th Edition.
 - .2 IES LM-79-08 – Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.
 - .3 IES LM-80-08 – IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.
 - .4 IES TM-21-11 – IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.
 - .5 IES TM-30-15 – IES Method for Evaluating Light Source Color Rendition.
- .5 IEEE 1789-2015 – IEEE Recommended Practices for Modulating Current in High-Brightness LEDs for Mitigating Health Risks to Viewers.
- .6 National Electrical Manufacturer's Association (NEMA):
 - .1 SSL-1-10 – Electronic Drivers for LED Devices, Arrays, or Systems.
 - .2 WD 6 - Wiring Devices - Dimensional Requirements.

1.04 Definitions

- .1 CCT: Correlated colour temperature.
- .2 CRI: Colour-rendering index.
- .3 LED: Light Emitting Diode.
- .4 Lumen: Measured output of lamp and luminaire, or both.
- .5 Luminaire: Complete lighting fixture, including ballast housing if provided.

1.05 Action Submittals

- .1 Refer to Section 01 33 00.
- .2 Manufacturer reports: Provide a point-by-point photometric analysis of all areas, in accordance with the procedures laid out in IES recommended practices to demonstrate compliance with OBC and LTC design manual illumination requirements as described in 2012 OBC 3.11.10.1.(3)(a)(i).]
- .3 Manufacturer reports: Provide a point-by-point photometric analysis of all areas of the Long-Term Care home], in accordance with the procedures laid out in IES recommended practices to demonstrate compliance with OBC illumination requirements as described in 2012 OBC 3.11.10.1.(3)(a)(i) and the LTC Design Manual.
- .4 Product submittals shall be accompanied by product specification sheets or other documentation that includes the designed parameters as detailed in this specification. These parameters include (but not limited to):
 - .1 Maximum power in Watts.
 - .1 If a transformer is used in conjunction with a driver (for example on some 347 volt lighting circuits), the maximum power shall include the transformer losses.
 - .2 L70 in hours, when extrapolated for the worse case operating temperature. TM-21 report shall be submitted to demonstrate this.
 - .3 Product submittals shall be accompanied by performance data that is derived in accordance with appropriate IESNA testing standards and tested in a laboratory that is NVLAP accredited for Energy Efficient Lighting Products.

1.06 Informational Submittals

- .1 Installation instructions.

1.07 Closeout Submittals

- .1 Section 01 78 00: Submittals for project closeout.
- .2 Submit manufacturer's operation and maintenance instructions for each product.
- .3 Warranty information.

1.08 Qualifications

- .1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.09 Regulatory Requirements

- .1 Products shall be listed and classified by CSA (Canadian Standards Association), ULC (Underwriter's Laboratories of Canada), or certified by recognized independent testing organizations that test to CSA standards.
- .2 Products shall be certified by a recognized testing agency accredited by the Standards Council of Canada and bear a certification mark from that agency.
- .3 All luminaires shall be listed and labeled for installation in fireproof or non-fireproof construction, dry, damp, or wet locations as required.
- .4 Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.

1.10 Delivery, Storage, and Handling

- .1 Deliver, store and handle materials in accordance with Section 01 61 00.
- .2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.11 Extra Stock Materials

- .1 Refer to Section 01 78 00.
- .2 Provide the following additional equipment as listed herein.
 - .1 Provide an additional 2 per cent spare luminaires of each new type to be provided.
 - .2 Provide 1 per cent of each plastic lens type.
 - .3 Provide three of each type of any special tools required for system use and maintenance.

1.12 Warranty

- .1 Refer to Section 01 78 00 and Section 26 05 00.
- .2 The manufacturer shall provide a warranty against loss of performance and defects in materials and workmanship for the luminaires for a period of 5 years after acceptance of the luminaires. Warranty shall cover all components comprising the luminaire.
- .3 All warranty documentation shall be provided to customer prior to the first shipment.
- .4 LED Luminaires shall have a manufacturer's warranty for a period of not less than five years.
- .5 LED boards, drivers and associated components shall have a warranty of 5 years on the LEDs, 5 years on the driver, 10 years on the paint finish.

2 Products

2.01 Manufacturers

- .1 As noted on Lighting Fixture Schedule.

2.02 Indoor LED Luminaires, General

- .1 Initial delivered lumens – thermal losses should be less than 10 per cent when operated at a steady state at an average ambient operating temperature of 25 degrees C, and optical losses should be less than 15 per cent.

- .2 Average Delivered Lumens – Average delivered lumens over 50 000 hours should be minimum of 85 per cent of initial delivered lumens.
- .3 All luminaires shall be tested per IES LM-79 and IES LM-80, and include published L70 data.
- .4 Colour rendition:
 - .1 Interior luminaires with a CRI greater than or equal to 90, or as indicated on the lighting fixture schedule.
 - .2 Where minimum 90 CRI is indicated, the following may be considered acceptable in lieu, subject to confirmation with the Consultant by means of a Request for Interpretation during the bid period:
 - .1 CRI (Ra) $\geq$ 90.
 - .2 CRI (Ra) $\geq$ 80 and R9 (R9) $\geq$ 50.
 - .3 IES Rf $\geq$ 78, IES Rg $\geq$ 100, $-1\% \leq$ IES Rcs, h1 $\leq$ 15%.
- .5 Accessibility and Maintenance:
 - .1 All LED luminaires shall be field serviceable, with LED arrays, LED modules, drivers, etc. fully serviceable and easily accessible. In the case of recessed ceiling mounted, and in the case of surface mounted ceiling fixtures, these components must be accessible from below. Luminaires in which any of these components are accessible only from above are not acceptable.
 - .2 Ballasts, drivers, LED arrays, LED modules, and lamps shall be serviceable while the fixture is in its normally installed position. Ballasts or drivers shall not be mounted to removable reflectors or wireway covers unless so specified. In the case of ceiling mounted luminaires, the serviceable components must be accessible from below.
- .6 Housings:
 - .1 Formed to prevent warping and sagging. Housing, trim, and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.
 - .2 Sheet steel housings to be minimum 20 gauge.
 - .3 Wireways and fittings: free of burrs and sharp edges, and shall accommodate internal and branch circuit wiring without damage to the wiring.
 - .4 When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.
 - .5 Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.
 - .6 Drivers shall not be mounted to removable reflectors or wireway covers unless so specified.
- .7 Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.
- .8 Metal Finishes:
 - .1 Fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

- .2 All metal components of fixtures shall be painted after fabrication to mitigate raw metal edges, and thus prevent premature corrosion.
- .3 The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt, and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping, or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.
- .4 Interior light reflecting finishes shall be white with not less than 85 per cent reflectance, except where otherwise shown on the drawing.
- .9 Wiring:
 - .1 Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.
 - .2 Supplied complete with a luminaire disconnect plug.
- .10 Control of Visual Perceptions of Temporal Light Modulation (flicker):
 - .1 All electric lights (except decorative lights, emergency lights and other special-purpose lighting) used in regularly occupied spaces meet at least one of the following requirements for flicker:
 - .1 A minimum frequency of 90 Hz at all 10% intervals from 10% to 100% light output.
 - .2 LED products with a "low risk" level of flicker (light modulation) of less than 5%, especially below 90 Hz operation as defined by IEEE standard 1789-2015 LED.

2.03 Drivers, General

- .1 Electronic LED drivers shall be integral to the luminaire, and be designed to be accessible in the field for replacement and servicing.
- .2 Input Voltage:
 - .1 Driver with a voltage range of (120-277) $\pm 10\%$ or (347-480) $\pm 10\%$.
 - .2 Refer to lighting fixture schedule.
 - .3 For luminaires connected to a 347 volt circuit and utilizing a natively 120-277 volt driver, provide an appropriately sized step down transformer.
- .3 Input frequency 60 Hz.
- .4 Load regulation: ± 1 per cent from no load to full load.
- .5 Output ripple less than 10 per cent.
- .6 Output should be isolated.
- .7 Case temperature: rated for -40°C through $+80^{\circ}\text{C}$.
- .8 Overheat protection, self-limited short circuit protection and overload protected.
- .9 Primary fused.
- .10 Driver life rating not less than 50 000 hours

- .11 Power Factor and Total Harmonic Distortion
 - .1 Power factor of greater than or equal to 0.9 at full load.
 - .2 THD of less than or equal to 20 per cent at full load.
- .12 Dimming Control:
 - .1 Coordinate with Section 26 09 23.
 - .2 0-10 V dimming control typical for all fixtures unless otherwise noted.
 - .3 Control range: 10 per cent to 100 per cent typical, unless noted otherwise.
 - .4 Provide a mock-up to demonstrate the luminaire is free of flicker throughout the dimming range when used with the dimming controllers described in related sections.

2.04 Interior Wall-Wash LED Luminaires

- .1 Minimum Light Output: 575 lm.
- .2 Zonal lumen density:
 - .1 Minimum 60 per cent between 0 degrees and 90 degrees from nadir.
 - .2 Minimum 60 per cent of the lumens must be produced in the "forward" hemisphere, towards the wall.
- .3 Minimum luminaire efficacy: 45 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K.
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with IES LM-80 testing data and IES TM-21 extrapolation.

2.05 Track or Mono-Point Directional LED Luminaires

- .1 Minimum Light Output: 250 lm.
- .2 Zonal lumen density:
 - .1 Minimum 85 per cent between 0 degrees and 90 degrees from nadir.
- .3 Minimum luminaire efficacy: 45 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K.
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with IES LM-80 testing data and IES TM-21 extrapolation.

2.06 Downlight Luminaires

- .1 Minimum Light Output: 500 lm.
- .2 Zonal lumen density: Minimum 75 per cent between 0 degrees and 60 degrees from nadir.

- .3 Minimum luminaire efficacy: 45 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K.
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with IES LM-80 testing data and IES TM-21 extrapolation.

2.07 Nominal 610 mm by 610 mm (2 ft by 2 ft) Luminaires for Ambient Lighting of Interior Spaces

- .1 Minimum Light Output: 2 000 lm.
- .2 Zonal lumen density:
 - .1 Minimum 75 per cent between 0 degrees and 60 degrees from nadir.
- .3 Spacing Criteria:
 - .1 0 degrees to 180 degrees: 1.0 to 2.0
 - .2 90 degrees to 270 degrees: 1.0 to 2.0
- .4 Minimum luminaire efficacy: 85 lumens per watt.
- .5 Correlated Colour Temperature (CCT): 3500 K.
- .6 Colour Rendition Index (CRI): 80 CRI minimum.
- .7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with IES LM-80 testing data and IES TM-21 extrapolation.

2.08 Nominal 305 mm by 1220 mm (1 ft by 4 ft) Luminaires for Ambient Lighting of Interior Spaces

- .1 Minimum Light Output: 1 500 lm.
- .2 Zonal lumen density:
 - .1 Minimum 75 per cent between 0 degrees and 60 degrees from nadir.
- .3 Spacing Criteria:
 - .1 0 degrees to 180 degrees: 1.0 – 2.0
 - .2 90 degrees to 270 degrees: 1.0 – 2.0
- .4 Minimum luminaire efficacy: 85 lumens per watt.
- .5 Correlated Colour Temperature (CCT): 3500 K.
- .6 Colour Rendition Index (CRI): 80 CRI minimum.
- .7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with IES LM-80 testing data and IES TM-21 extrapolation.

2.09 Nominal 610 mm by 1220 mm (2 ft by 4 ft) Luminaires for Ambient Lighting of Interior Spaces

- .1 Minimum Light Output: 3 000 lm.
- .2 Zonal lumen density:

- .1 Minimum 75 per cent between 0 degrees and 60 degrees from nadir.
- .3 Spacing Criteria:
 - .1 0 degrees to 180 degrees: 1.0 – 2.0
 - .2 90 degrees to 270 degrees: 1.0 – 2.0
- .4 Minimum luminaire efficacy: 85 lumens per watt.
- .5 Correlated Colour Temperature (CCT): 3500 K.
- .6 Colour Rendition Index (CRI): 80 CRI minimum.
- .7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with IES LM-80 testing data and IES TM-21 extrapolation.

2.10 Linear Ambient Luminaires: Indirect

- .1 Minimum Light Output: 500 lm per foot.
- .2 Zonal lumen density:
 - .1 Minimum 50 per cent between 90 degrees and 150 degrees from nadir.
- .3 Minimum luminaire efficacy: 85 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K.
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with IES LM-80 testing data and IES TM-21 extrapolation.

2.11 Linear Ambient Luminaires: Indirect/Direct

- .1 Minimum Light Output: 500 lm per foot.
- .2 Zonal lumen density:
 - .1 Minimum 25 per cent between 0 degrees and 60 degrees from nadir.
 - .2 Minimum 50 per cent between 90 degrees and 150 degrees from nadir.
- .3 Minimum luminaire efficacy: 85 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K.
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with IES LM-80 testing data and IES TM-21 extrapolation.

2.12 Linear Ambient Luminaires: Direct/Indirect

- .1 Minimum Light Output: 500 lm per foot.
- .2 Zonal lumen density:
 - .1 Minimum 40 per cent between 0 degrees and 60 degrees from nadir.

- .2 Minimum 35 per cent between 90 degrees and 150 degrees from nadir.
- .3 Minimum luminaire efficacy: 85 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K.
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with IES-LM-80 testing data and IES TM-21 extrapolation.

2.13 Linear Ambient Luminaires: Direct

- .1 Minimum Light Output: 375 lm per foot.
- .2 Zonal lumen density:
 - .1 Minimum 40 per cent between 0 degrees and 60 degrees from nadir.
- .3 Minimum luminaire efficacy: 85 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 3500 K.
- .5 Colour Rendition Index (CRI): 80 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with IES LM-80 testing data and IES TM-21 extrapolation.

2.14 High-Bay Luminaires for Commercial and Industrial Buildings

- .1 Minimum Light Output: 10 000 lm.
- .2 Zonal lumen density:
 - .1 Minimum 30 per cent between 20 degrees and 50 degrees from nadir.
- .3 Minimum luminaire efficacy: 80 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 4000 K.
- .5 Colour Rendition Index (CRI): 70 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 35 000 hours in accordance with IES LM-80 testing data and IES TM-21 extrapolation.

2.15 Low-Bay Luminaires for Commercial and Industrial Buildings

- .1 Minimum Light Output: 5 000 lm.
- .2 Zonal lumen density:
 - .1 Minimum 30 per cent between 20 degrees and 50 degrees from nadir.
- .3 Minimum luminaire efficacy: 80 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 4000 K.
- .5 Colour Rendition Index (CRI): 70 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 35 000 hours in accordance with IES LM-80 testing data and IES TM-21 extrapolation.

2.16 High-Bay Aisle Luminaires

- .1 Minimum Light Output: 10 000 lm.
- .2 Zonal lumen density:
 - .1 Minimum 30 per cent between 0 degrees and 20 degrees from nadir.
 - .2 Minimum 50 per cent between 20 degrees and 50 degrees from nadir.
- .3 Minimum luminaire efficacy: 80 lumens per watt.
- .4 Correlated Colour Temperature (CCT): 4000 K.
- .5 Colour Rendition Index (CRI): 70 CRI minimum.
- .6 Minimum L70 lumen maintenance to occur at 35 000 hours in accordance with IES LM-80 testing data and IES TM-21 extrapolation.

3 Execution

3.01 Verification of Conditions

- .1 Coordinate the lighting system installation with the relevant trades so as to eliminate interferences with hangers, mechanical ducts, sprinklers, piping, steel, etc.

3.02 Installation

- .1 Install lighting equipment, including but not limited to luminaires, controls, auxiliary devices and the integration of same in strict conformance with all manufacturers' recommendations and instructions the securing of which shall be the responsibility of the Contractor.
- .2 Integrate luminaires with controls in accordance with respective luminaire manufacturers' and controls manufacturers' recommendations and instructions and to provide a complete, trouble-free operation without compromising safety, code and CSA requirements.
- .3 Seal all luminaires for wet locations (i.e. all knock-outs, all pipe and wire entrances, etc.) as is standard industry practice to prevent water from entering luminaires.
- .4 Luminaire Alignment:
 - .1 Locate recessed ceiling luminaires as indicated on reflected ceiling plan. Install recessed luminaires to permit removal from below. Include accessories and materials to meet applicable codes and regulatory requirements.
 - .2 Align luminaires mounted in continuous rows to form straight uninterrupted line.
 - .3 Align luminaires mounted individually parallel or perpendicular to building grid lines.
 - .4 Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.
 - .5 Locate and install luminaires as indicated. Mounting heights and configuration of the luminaires shall be as specified in the Luminaire Schedule portion of the Specification or indicated on the drawings, and where conflicts exist, as approved by the Consultant.
 - .6 Installed all luminaires plumb and true and level as viewed from all directions unless specifically identified otherwise in the Lighting Fixture Schedule. Luminaires shall remain plumb and true

without continual adjustment or visibly obvious means beyond what is shown on luminaire submittal drawings.

- .7 For installation in suspended ceilings, ensure that the luminaires are supported such that there is no resultant bowing or deflection of the ceiling system greater than 1/360 of the length of the total span of the ceiling member.
- .5 Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.
- .6 Whenever a luminaire or its hanger canopy is installed directly to a surface mounted junction box, use a finishing ring painted to match the ceiling to conceal the junction box.
- .7 Suspended Luminaires:
 - .1 Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.
 - .2 Suspended luminaires shall be installed plumb and true and level unless specifically identified otherwise in the Luminaire Schedule portion of this Specification and at a height from finished floor as specified on the drawings, details and Luminaire Schedule. In cases where this is impractical, refer to the Consultant for a decision. All appurtenances shall be consistently organized for a neat, uniform appearance.
- .8 Accessories:
 - .1 Reflector cones, louvers, baffles, lenses, trims and other decorative elements shall be installed after completion of ceiling tile installation, plastering, painting and general cleanup.
 - .2 Install accessories provided with each luminaire.
 - .3 All accessories shall be properly installed and adjusted by Contractor in accordance with specification and installation instructions. Any spare items shall be clearly labeled (indicate type of accessory and associated luminaire types).

3.03 Testing and Adjustment

- .1 As required, all adjustable luminaires shall be aimed, focused, locked, etc., by the Contractor under the observation of the Consultant. As aiming and adjusting is completed, locking setscrews and bolts and nuts shall be tightened securely by the Contractor.
- .2 For luminaires with field selectable lumen output and/or CCT, ensure the correct setting matches the intended set points.
- .3 All ladders, scaffolds, lifts, etc. required for aiming and adjusting luminaires shall be furnished by the Contractor.
- .4 Where possible, units shall be focused during the normal working day. However, where daylight interferes with seeing lighting effects, aiming shall be accomplished at night.

3.04 Luminaire Supports

- .1 Provide adequate support to suit ceiling system.
- .2 Support luminaires independently of ceiling framing, unless ceiling is certified by the manufacturer to support weight of installed devices. Confirm if T-bar ceilings are metric or imperial and provide luminaires to suit ceiling dimensions.
- .3 Provide chain hangers for new and existing luminaires.

- .4 Install clips to secure recessed grid-supported luminaires in place.
- .5 Fixtures supported by suspended ceiling systems shall be securely fastened to the ceiling framing member by mechanical means, such as bolts, screws, or rivets. Ceiling framing members must be securely attached to each other and to the building structure as required by all applicable codes and standards. Use of integral clips is not acceptable.

3.05 Wiring

- .1 Use SPC90 conductors for final connections to luminaires (including 0-10 V dimming conductors for applicable luminaires).
- .2 Install luminaire disconnect plugs on all new luminaires not provided as such from the manufacturer.
- .3 Connect luminaires to branch circuit outlets provided under Section 26 05 33.13 using flexible conduit.
- .4 Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- .5 Bond products and metal accessories to branch circuit equipment grounding conductor.

3.06 Field Quality Control

- .1 Operate each luminaire after installation and connection. Inspect for proper connection and operation.
- .2 Make wiring connections to the branch circuit using building wire with insulation suitable for temperature conditions within luminaire.
- .3 Occupancy Sensors.
 - .1 Locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas.
 - .2 Rooms shall have 90 per cent to 100 per cent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room.
 - .3 Exercise proper judgment in executing the work to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.

3.07 Cleaning

- .1 Thoroughly clean all luminaires and accessories after installation. All fingerprints, dirt, tar, smudges, drywall mud, dust, etc. shall be removed by the Contractor from the luminaire bodies, reflectors, trims, and lens or louvers prior to final acceptance. All reflectors shall be free of paint other than factory-applied, if any. All reflectors, cones and lenses shall be cleaned only according to manufacturers' instructions.
- .2 Clean electrical parts to remove conductive and deleterious materials.
- .3 Remove dirt and debris from enclosures.
- .4 Clean photometric control surfaces as recommended by manufacturer.
- .5 Clean finishes and touch up damage.
- .6 Luminaire finishes which are disturbed in any way during construction shall be touched up or refinished in a manner satisfactory to the Consultant.

3.08 Commissioning

- .1 In accordance with Section 26 08 50.

End of Section

1 General

1.01 Summary

- .1 This section includes general luminaires connected to emergency lighting circuits.
- .2 Battery unit requirements for selected spaces as required by CSA C282.

1.02 Related Requirements

- .1 Section 26 32 13.13 – Diesel-Engine-Driven Generator Sets.
- .2 Section 26 32 13.16 – Gas-Engine-Driven Generator Sets.
- .3 Section 26 36 23.13 – Bypass-Isolation Automatic Transfer Switches.
- .4 Section 26 36 23.16 – One-Way Bypass-Isolation Automatic Transfer Switches.
- .5 Section 26 51 19 – LED Interior Lighting.
- .6 Section 26 52 13.16 – Exit Signs.

1.03 References

- .1 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
 - .3 CSA C22.2 No. 141:15 (R2020), Emergency lighting equipment.
 - .4 CSA C282:19 – Emergency Electrical Power Supply for Buildings.
 - .5 CSA Z32:21, Electrical safety and essential electrical systems in healthcare facilities.
- .2 Ontario Building Code.
- .3 Underwriters Laboratories, Inc. (UL):
 - .1 UL 924 – Standard for Safety of Emergency Lighting and Power Equipment.

1.04 Definitions

- .1 Unit equipment for emergency lighting: equipment that is:
 - .1 Intended to provide automatically, in response to a failure of the power supply to which it is connected, a specified light output and a specified amount of power for illumination purposes, for a specified period of time, but in any case, not less than 30 min;
 - .2 Comprises, in a unit construction:
 - .1 a storage battery;
 - .2 a charging means to automatically maintain the battery in a charge condition;
 - .3 lamps or output terminals to which specially listed lamps can be connected;
 - .4 a means to energize the lamps when the normal power supply fails and to de-energize the lamps when the normal power supply is restored; and

- .5 a means to indicate and test the operating condition of the equipment;
- .3 Is designed for use in applications in which the provision of emergency illumination is required by a governmental or other agency having jurisdiction; and
- .4 Has a maximum capacity of 1.44 kW.

1.05 Submittals

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for emergency lighting and include product characteristics, performance criteria, physical size, finish, and limitations.

1.06 Closeout Submittals

- .1 Operation and Maintenance Data: submit operation and maintenance data for emergency lighting for incorporation into manual.
- .2 Perform a lighting level test (lux readings) of the emergency lighting system.

1.07 Quality Assurance

- .1 Manufacturer Qualifications: Products free of defects in material and workmanship.
- .2 Furnished products are listed and/or certified by third party agencies as suitable for the intended purpose.
- .3 All units will be certified that they have been tested prior to shipping.

1.08 Delivery, Storage, and Handling

- .1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and acceptance requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and handling requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect emergency lighting from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

2 Products

2.01 Manufacturers

- .1 Lumacell.
- .2 Aimlite.
- .3 BeLuce (formerly Beghelli).
- .4 Emergilite.

- .5 Lithonia (Acuity Brands Lighting).
- .6 Stanpro.

2.02 Emergency Battery Units ("Unit Equipment") required by CSA C282

- .1 Provide Emergency Battery Units in the following locations with sufficient capacity to provide run time of 2 hours duration in the following locations in accordance with CSA C282 clause 6.11.1:
 - .1 Generator room or generator enclosure, as applicable.
 - .2 Automatic Transfer Switch rooms.
- .2 Minimum illumination in the noted areas to be 50 lx.
- .3 Include automatic self-diagnostic circuitry, and a transient voltage surge suppressor on the supply site of power to the unit.
- .4 Feed the battery unit from the emergency power panel.
- .5 Lamps: 2 lamps, minimum 540 lumen LED, maximum 6 watts per lamp.

3 Execution

3.01 Examination

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

3.02 Installation

- .1 Installation in accordance with the electrical code and manufacturer's instructions.

3.03 Identification

- .1 Provide red adhesive indicator on fixture, or immediately adjacent to fixture to suit site conditions, to identify luminaires connected to emergency power.
- .2 For luminaires installed in lay-in acoustic ceilings, provide indicator on nearest tee intersection.

3.04 Cleaning

- .1 Progress Cleaning: Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools, and equipment.

3.05 Protection

- .1 Protect installed products and components from damage during construction.

- .2 Repair damage to adjacent materials caused by emergency lighting installation.

3.06 Verification

- .1 Perform a lighting level test (lux readings) of the emergency lighting system.
- .2 Submit report with closeout documents.

3.07 Testing and Commissioning

- .1 When installation of emergency lighting system is complete, contractor shall commission and test the entire system and adjust if necessary.
- .2 Contractor is responsible for providing a verification test of emergency illumination levels.
 - .1 Verification test shall be performed with a lux/footcandle meter at 1 m intervals along all paths of egress throughout the space, and record light level readings on floor plans provided by the consultant.
 - .2 The contractor shall also provide consultant with a letter stating the recorded emergency lighting levels meet the OBC requirements of 10 lx (1 fc) average with minimum readings not less than 1 lx (0.1 fc) on the path of egress.
- .3 Testing shall be performed during non-daylight hours. Contractor shall aim all remotes to optimise illumination on the floor and stair.
- .4 Contractor shall certify in writing to the Consultant that the system is complete, installed per CSA C282, has been tested.
- .5 Contractor shall notify the Owner and the Consultant at least ten days prior to proposed testing date and schedule testing at time and date acceptable to the Owner.
- .6 Installation shall be in accordance with the electrical code.
- .7 The Contractor is to submit a letter on Contractor's letterhead confirming the criteria specified above is met, including light levels, and include a copy of the plans with light levels recorded.

3.08 Testing, Maintenance, and Warranty Service

- .1 Provide complete instructions for the operation and care of the emergency power supply or unit equipment that shall specify testing at least once every month to ensure security of operation. Instructions to be framed under glass.
- .2 OBC testing obligations: Owner's facility maintenance personnel are required to document one manual test of the battery units each month and conduct one full discharge test once a year per OBC / CSA C22.2 No. 141 requirements.
- .3 Annual Maintenance: The manufacturer recommends maintenance to be performed by a qualified service provider. Contact the manufacturer for any warranty service.

End of Section

1 General

1.01 Section Includes

- .1 Emergency lighting units with battery back-up for emergency illumination of remote emergency fixtures and internally illuminated exit signs.
- .2 Remote emergency fixtures.

1.02 Related Requirements

- .1 Section 26 51 19 – LED Interior Lighting.
- .2 Section 26 52 13.16 – Exit Signs.

1.03 References

- .1 CSA Group:
 - .1 CSA C22.2 No. 141:15 (R2020), Emergency lighting equipment.
 - .2 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .3 Ontario Electrical Safety Code (29th edition/2024).
- .2 Ontario Building Code.
- .3 National Building Code of Canada.
- .4 Underwriters Laboratories, Inc. (UL):
 - .1 UL 924 – Standard for Safety of Emergency Lighting and Power Equipment.

1.04 Submittals

- .1 Submit in accordance with Section 01 33 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for emergency lighting and include product characteristics, performance criteria, physical size, finish, and limitations.

1.05 Closeout Submittals

- .1 Submit in accordance with Section 01 78 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for emergency lighting for incorporation into manual.

1.06 Extra Materials

- .1 Allow the cost for material and for installation of the following to be installed as directed by the Consultant during construction:
 - .1 An additional five single head emergency remote units.
 - .2 An additional five dual head emergency remote units.

- .3 An additional one battery unit, based on the maximum battery capacity as specified.

1.07 Quality Assurance

- .1 Manufacturer Qualifications: Products shall be free of defects in material and workmanship.
- .2 Furnished products are listed and/or certified by third party agencies as suitable for the intended purpose.
- .3 All units will be certified that they have been tested prior to shipping.

1.08 Delivery, Storage, and Handling

- .1 Deliver, store, and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect emergency lighting from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 00.

1.09 Warranty

- .1 Product is warranted free of defects in material and workmanship.
- .2 Product is warranted to perform the intended function within design limits.
- .3 For batteries in this Section, 12 month warranty period is extended to 24 months.

2 Products

2.01 Emergency Battery Units

- .1 Manufacturers:
 - .1 Lumacell RG12S series.
 - .2 Aimlite.
 - .3 BeLuce (formerly Beghelli).
 - .4 Emergi-Lite.
 - .5 Lithonia (Acuity Brands Lighting).
 - .6 Stanpro.
- .2 Battery Unit Features:

- .1 Self-contained unit equipment for LED emergency lighting shall be manufactured and labeled as certified to meet CSA C22.2 No. 141.
- .2 Housing: Constructed of formed and welded 18 gauge cold rolled steel with knockouts for conduit, finished in baked white enamel. Cabinet suitable for direct or shelf mounting to wall. Removable or hinged front panel for easy access to batteries.
- .3 Charger:
 - .1 Solid-state micro-controller PCB, Pulse-Guard charger, features include; auto-equalized, temperature compensated, current limited, short circuit and reverse polarity protected.
 - .2 Recharges battery within 24 hours in accordance with CSA requirements.
- .4 Transfer: Upon failure of the power supply, or voltage dip below 75 per cent of nominal, a sealed relay automatically and instantaneously connects the battery to the emergency lighting load and disconnects when battery discharge reaches 87.5 per cent expectancy.
- .5 Batteries: seal lead calcium, maintenance free, and 10 year pro-rated service life.
- .6 Auto-test: Unit to perform self-test for 1 minute ever 30 days, 10 minutes on the 6th month, and 30 minutes every 12 months.
- .3 Battery Electrical Features:
 - .1 Input Voltage: 120-347 VAC universal input:
 - .1 Provided with plug and receptacle when connected to 120 volt source panelboard.
 - .2 direct connected to 347 volt source panelboard.
 - .2 Output Voltage: 12 VDC; balance loads to battery unit terminals.
 - .1 Normally "Off" output: wattage capacity as indicated for emergency remotes and internally illuminated exit signs.
 - .2 Battery Run Time at full load: must meet OBC minimum, 120 minutes.
 - .3 Voltage regulation: $\pm 5\%$ of nominal maximum.
 - .3 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.
- .4 Lamp heads:
 - .1 Integral on unit, 345 degrees horizontal and 180 degrees vertical adjustment.
 - .2 Lamp type:
 - .1 Two 12 V, 6 W MR16 LED lamps mounted on top of the battery cabinet, shall be injection molded thermoplastic, white finish.
 - .2 Average lamp lumens: 170 lm.
 - .3 Centre Beam Candlepower: 440 cd.
 - .4 Beam angle: 30 degrees.
 - .5 Lamp efficacy: 42.5 lm/W.
- .5 Auxiliary equipment:

- .1 Ammeter.
- .2 Voltmeter.
- .3 Test switch.
- .4 Time delay relay.
- .5 Battery disconnect device.
- .6 AC input and DC output terminal blocks inside cabinet.
- .7 Shelf Bracket.
- .8 Cord and single twist-lock plug connection for AC.
- .9 RFI suppressors.
- .10 Voltage Sensing Relay:
 - .1 Up to six inputs for line voltage detection from different normal lighting zone. The wire connection from each zone circuit shall be made with terminal blocks.
 - .2 Operation Sequence: In the case of power failure of one or several circuits feeding normal lighting, the output circuit will open and transfer the battery unit(s) in emergency lighting mode.
 - .3 Provide "push to test" push button and a pilot light for each zone circuit for manual testing and service.

2.02 Battery Unit Equipment Internal VSR Zone Sensing Control

- .1 When specified, the equipment shall have six inputs for line voltage detection from different building zones (Note that in addition to the VSR zone sensing, the unit equipment charging circuit functions as a 7th input zone). The wire connection from each zone circuit shall be made with terminal blocks. The value of each zone voltage shall match the battery unit input voltage.
- .2 In the case of a power failure of one or several zones the circuit will transfer the battery unit to emergency lighting mode for minimum 30 minutes.
- .3 The equipment shall include a 'push to test' push button and/or a pilot light for each zone circuit for manual testing and service.
- .4 The unit shall be certified to CSA C22.2 No.141.
- .5 Basis of design: Lumacell RGS-Z-VSR-6Z-1-PB-PL (part number for accessory based on RGS series battery unit).

2.03 Voltage Sensing Relay (VSR) Zone Control Stand-Alone Extension Module

- .1 The equipment shall have an adequate quantity of inputs (up to 24 inputs) for line voltage detection from different building zones. The wire connection from each zone circuit shall be made with terminal blocks. The output circuit shall be a dry-contact relay, normally closed and shall be accessible for connection on a terminal block. The output circuit shall be connected at installation in series with the AC line supplying the battery unit equipment.
- .2 Operation Sequence: In the case of power failure of one or several circuits feeding normal lighting, the output circuit will open and transfer the battery unit(s) in emergency lighting mode.
- .3 Include a "push to test" push button and a pilot light for each zone circuit for manual testing and service.

- .4 Basis of design: Lumacell -VSR-8Z-1-U1-B-BL-PL (basis of design).

2.04 Emergency Lighting Emergency Remote Heads

- .1 Refer to drawings and lighting schedule.
- .2 One or two lamps, shall be injection molded thermoplastic, white finish, lamps shall be MR16 LED 12 V, 540 lumen, 25 degree beam angle, 6 watt.
- .3 Remote heads to be mounted not less than 2100 mm (6'-10") AFF.
- .4 LED MR16 lamps:
 - .1 Lumacell MQM-x-12V4W-LD10 series.
 - .2 Equal by Emergi-Lite.
 - .3 Equal by Stanpro.
 - .4 Equal by Beluce (formerly Beghelli).

3 Execution

3.01 Examination

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

3.02 Installation

- .1 Install emergency lighting in compliance with local inspection authorities.
- .2 Wiring:
 - .1 Connect battery input to source panelboard. Balance the emergency lighting loads connected to battery output terminal blocks. Provide and connect remote fixtures and internally illuminated exit signs as specified and as required for system performance in compliance with OBC minimum egress illumination requirements. Install remotes in locations as shown on the drawings. Connect all remotes to normally "Off" output from battery units.
 - .2 Contractor is responsible for revisions to system, including relocations, aiming and additional remote heads as determined by testing results. All wiring shall be in accordance with manufacturer's recommendations.
 - .3 Use minimum #10 gauge or heavier if needed to provide a maximum voltage drop of 5 per cent. Consult manufacturer's table for sizing the minimum gage and length of wire runs permitted for connected loads to ensure a maximum voltage drop of 5 per cent from the battery unit to the farthest emergency remote, in accordance with OBC and local inspection authorities.
- .3 Mounting: Suitable for wall mounting, complete with bracket from manufacturer lighting heads, test switch and diagnostic LED indicator shall be visible.

- .4 Provide Voltage Sensing Relays internal or external to battery units to meet the intent of OESC Rule 46-304 (4). Unit equipment shall be installed in such a manner that it will be automatically actuated upon failure of the power supply to the normal lighting in the area covered by that unit equipment.

3.03 Testing and Commissioning

- .1 When installation of emergency lighting equipment is complete, contractor shall commission and test the entire system and adjust if necessary.
- .2 Contractor is responsible for arranging and cost of a verification test of emergency illumination levels by the manufacturer's representative.
 - .1 Verification test shall be performed with a lux/footcandle meter at 1 m intervals along all paths of egress throughout the space, and record light level readings on floor plans provided by the consultant.
 - .2 The contractor shall also provide consultant with a letter stating the recorded emergency lighting levels meet the OBC requirements of 10 lx (1 fc) average with minimum readings not less than 1 lx (0.1 fc) on the path of egress.
 - .3 The manufacturer is to provide a letter of verification confirming testing and operation of all emergency lighting as well as installation to all applicable codes.
- .3 Contractor is to indicate in the letter the duration of emergency lighting run time that was observed.
- .4 Testing shall be performed during non-daylight hours. Contractor shall aim all remotes to optimise illumination on the floor and stair.
- .5 Contractor shall certify in writing to the Consultant that the system is complete, installed per CSA C22.2 No. 141, has been tested, and operates for the specified battery run time.
- .6 Contractor shall notify the Owner and the Consultant at least ten days prior to proposed testing date and schedule testing at time and date acceptable to the Owner.
- .7 Installation shall be in accordance with the electrical code and manufacturer's instructions.
- .8 The Contractor is to submit a letter on Contractor's letterhead confirming the criteria specified above is met, including light levels, and run time, and include a copy of the plans with light levels recorded.
- .9 Provide breaker lock on emergency lighting circuit at source panelboard.

3.04 Protection

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by emergency lighting installation.

3.05 Testing, Maintenance, and Warranty Service

- .1 Provide complete instructions for the operation and care of the emergency power supply or unit equipment that shall specify testing at least once every month to ensure security of operation. Instructions to be framed under glass.
- .2 OBC testing obligations: Owner's facility maintenance personnel are required to document one manual test of the battery units each month, and conduct one full discharge test once a year per OBC and CSA C22.2 No. 141 requirements.

- .3 Annual Maintenance: The manufacturer recommends maintenance to be performed by a qualified service provider. Contact the manufacturer for any warranty service.

End of Section

1 General

1.01 Section Includes

- .1 Internally illuminated "Running Man" exit sign units for ordinary location use.

1.02 Related Requirements

- .1 Section 26 52 13.13 – Emergency Lighting: Emergency Battery Units.

1.03 References

- .1 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
 - .3 CSA C22.2 No. 141:15 (R2020), Emergency lighting equipment.
 - .4 CAN/CSA-C860-11 (R2020), Performance of Internally Lighted Exit Signs.
- .2 International Organization for Standardization (ISO):
 - .1 ISO 7010:2011 – Graphical symbols – Safety colours and safety signs.
 - .2 ISO 3864-1:2011 – Graphical symbols -- Safety colours and safety signs -- Part 1: Design principles for safety signs and safety markings
- .3 Ontario Building Code.
- .4 Underwriters Laboratories of Canada (ULC):
 - .1 ULC/ORD-924-02, Standard for Emergency Lighting and Power Equipment.
 - .2 CAN/ULC-S572-10, First Edition Standard for Photoluminescent and Self-Luminous Exit Signs and Path Marking Systems.

1.04 Submittals

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Product Data: Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish, and limitations.
- .3 Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures and maintenance.

1.05 Extra Materials

- .1 Allow the cost for material and for installation of an additional five exit signs, single face or dual face, to be installed as directed by the Consultant during construction. Include 15.24 m (50 feet) of wire and conduit per exit sign.

1.06 Quality Assurance

- .1 Exit signs units shall be ULC Listed and/or CSA Certified to CSA C22.2 No. 141 and CSA C860.
- .2 Furnished products are listed and/or certified by third party agencies as suitable for the intended purpose.

- .3 Manufacturer Qualifications: Products shall be free of defects in material and workmanship.
- .4 All units will be certified that they have been tested prior to shipping.

1.07 Delivery, Storage, and Handling

- .1 In accordance with Section 01 61 00.

1.08 Waste Management and Disposal

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 00.

1.09 Warranty

- .1 Product is warranted free of defects in material and workmanship for a minimum of one year from substantial completion.

2 Products

2.01 Exit Signs, General

- .1 Manufacturers
 - .1 Aimlite.
 - .2 BeLuce (formerly Beghelli).
 - .3 Emergi-Lite.
 - .4 Lithonia (Acuity Brands Lighting).
 - .5 Lumacell.
 - .6 Stanpro.
 - .7 Other manufacturers as indicated in Section 26 52 13.13.
- .2 Substitution Limitations:
 - .1 Manufacturer of exit signs to be the same as manufacturer of emergency lighting battery units and remote heads specified in Section 26 52 13.13.
 - .2 No manufacturer substitutions.
- .3 Description
 - .1 Green and White LED Pictogram "Running Man" exit sign.
 - .2 The pictogram sign shall be certified as CSA C22.2 No. 141, and meet ISO 3864-1 and ISO 7010.
 - .3 The pictogram legend shall have a minimum illuminated dimension of 5.9" high and 11.13" with ISO 3864-1 and ISO 7010 pictogram printed on a pure-acrylic panel.
 - .4 The sign shall include a standard single face with optional double-faceplate included.
 - .5 Not acceptable:
 - .1 Red LED EXIT signs.

- .2 Externally illuminated photoluminescent, or non-electrical radioluminescent type of pictogram signs are unacceptable.
- .4 Mounting
 - .1 The canopy shall universal to allow for wall, end, or ceiling mount.
- .5 Electrical
 - .1 The LED light source shall be long-life white Light-Emitting Diodes and shall provide uniform illumination of the pictogram in normal and emergency operation.
 - .2 The sign shall operate with universal 2-wire AC input voltage of 120 to 347 Vac at less than 3 Watts, and universal 2-wire DC input voltage from 6 to 24 Vdc at less than 2.5 Watts for single and double face legends with a single arrow either left or right.
 - .3 If arrow left and arrow right is required for T intersection, the contractor shall supply and install two separate pictogram signs.
 - .4 The pictogram edge-lit exit sign where indicated on the plans in a self-powered configuration shall use a sealed Nickel-Cadmium battery of 2.4 V nominal voltage and shall stay illuminated during emergency operation for at least two hours upon AC failure.

2.02 All-Plastic Pictogram Exit Sign, Commercial Grade

- .1 Manufacturers
 - .1 Lumacell LP Series
 - .2 Equivalent products from manufacturers as described in Article 2.01 of this section.
- .2 Materials
 - .1 The sign shall come standard with a canopy and shall be suitable for wall, end, or ceiling mounting. The frame, faceplates, back plate and canopy shall each be constructed of a one-piece UV-stabilized thermoplastic material colored factory white.

2.03 All-Climate, Harsh Environment Pictogram Exit Sign

- .1 Manufacturers
 - .1 Lumacell LN Series
 - .2 Equivalent products from manufacturers as described in Article 2.01 of this section.
- .2 Materials
 - .1 The equipment shall be certified for NEMA-4X and designed specifically for high abuse areas, wet location, and cold weather applications.
 - .2 The equipment frame shall be of industrial grade polyvinyl chloride with a gasket around lenses and canopy. The faceplate(s) shall be constructed of heavy-duty vandal resistant polycarbonate and feature an even illuminated legend.
 - .3 Finish colour: white.

3 Execution

3.01 Installation

- .1 Install exit lights to manufacturer's recommendations, listing requirements, CSA standard and local regulatory requirements.
- .2 Ensure exit signs are not obscured. Where an exit sign is to be installed in an area with no ceiling, provide a suitable pendant mount.
- .3 Connect fixtures to exit light circuits normal power supply and emergency battery units specified in Section 26 52 13.13.

3.02 Field Quality Control

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

3.03 Cleaning

- .1 Proceed in accordance with Section 01 74 00.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.04 Testing and Commissioning

- .1 When installation of emergency lighting equipment is complete, contractor shall commission and test the entire system and adjust if necessary.
- .2 Contractor shall certify in writing to the consultant that the system is complete, installed per CSA C22.2 No. 141, has been tested, and operates for the specified battery run time.
- .3 Contractor shall notify owner and consultant at least ten days prior to proposed testing date and schedule testing at time and date acceptable to the owner.
- .4 Installation shall be in accordance to the electrical code and manufacturer's instructions.
- .5 Provide breaker lock on emergency lighting circuit at source panelboard.

3.05 Protection

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by exit sign installation.

End of Section

1 General

1.01 Section Includes

- .1 Provide a complete system of conduits, pull boxes, outlets, sleeves, and all components for a complete working system.
- .2 Existing PA System is Dukane.

1.02 Related Requirements

- .1 Section 26 05 33.13 – Conduit for Electrical Systems.
- .2 Section 26 05 33.16 – Boxes for Electrical Systems.
- .3 Section 10 25 19 – Classroom Control Panels.

1.03 References

- .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (29th edition/2024).
- .3 CAN/CSA-C22 No. 214-M90, Communications Cables.
- .4 CAN/CSA-T530, Commercial Building Standards for Telecommunications Pathways and Spaces.
- .5 CAN/CSA-T529-95, Commercial Buildings Telecommunications Standards.
- .6 CAN/CSA-T527, Grounding and Bonding Requirements for Telecommunications in Commercial Buildings.
- .7 CAN/CSA-T528, Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
- .8 Ontario Building Code.

1.04 Allowances

- .1 Connections at main PA rack will be under electrical contract.

1.05 Submittals

- .1 Product Data.

2 Products

2.01 Outlet Boxes

- .1 Wall outlets shall be 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted.

2.02 Conduit

- .1 Conduit size shall be in accordance with recommended standard for conduits in Building as published by BICSI.
- .2 Minimum conduit size shall be 21 mm (3/4") diameter.

- .3 Plywood backboards shall be minimum 1200 mm x 2400 mm, 19 mm thick, painted with 2 coats of fire retardant light grey enamel.

2.03 Cabling

- .1 Provide twisted pair shielded cabling by Belden to building standard for each device.
- .2 Plenum cables are permitted in accessible ceilings. Provide 'J' hooks in these locations for cable installation.

2.04 Equipment

- .1 Handset: Dukane model PCS821, black cyclac, dynamic transmitter, standard magnetic receiver, 6 ft (1.8 m) coiled cord, c/w two-gang stainless steel face plate, chromed steel two-pole hookswitch/cradle, rocker (PVCY and CALL) switch, and standard two-gang electrical back box.
- .2 Speakers: McBride series 8224 (recess mounted in Modular Control Panel (MCP)), pre-assembled "call-in" speaker complete with 8" dual cone speaker with magnet, 12.5" square steel baffle (MC25A), 24 V or 70 V to match existing, 4 watt transformer and suitable back box.

3 Execution

3.01 Installation

- .1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.
- .2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install 12 gauge galvanized soft iron pull wire, or 1/8" nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.
- .3 Conduit bonds shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.
- .4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30 000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by Cash Allowance installer to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.
- .6 Install new devices in modular control panels.

3.02 Terminations

.1 Connections at main PA rack will be under Cash Allowance by Owner.

End of Section

1 General

1.01 Conditions and Requirements

- .1 Refer to the General Conditions, Supplementary General Conditions, and General Requirements.
- .2 Provisions of this Section shall apply to all Sections of Division 27.
- .3 Refer to Consultant's drawings for exact location of electrical equipment and devices. Refer to Designer drawings for additional notes which complement these specifications.
- .4 The Division 26 specification documents shall be followed in conjunction with the specification in this section.

1.02 Related Requirements

- .1 Division 25 – Integrated Automation.
- .2 Division 26 – Electrical.
- .3 Division 28 – Electronic Safety and Security.

1.03 Intent

- .1 Include all material, labour, equipment, and plant construction as necessary to make a complete installation as shown and specified hereinafter. Sections of this specification are not intended to delegate functions nor to delegate work and supply to any specific trade. Ensure that the systems specified hereafter are complete and operative.

1.04 Specifications Language and Style

- .1 These specifications are written in the imperative mood and in streamlined form. The imperative language is directed to Contractor, unless stated otherwise.
- .2 Complete sentences by reading "shall", "Contractor shall", "shall be", and similar phrases by inference. Where a colon (:) is used within sentences and phrases, read the words "shall be" by inference.
- .3 Fulfill and perform all indicated requirements whether stated imperatively or otherwise.
- .4 When used in the context of a Product, read the word "provide" to mean "supply and install to result in a complete installation ready for its intended use."

1.05 Reference Standards

- .1 The equipment, material and installation shall conform to the latest version of the applicable codes, standards (including technical service bulletins and addenda), and regulations of authorities having jurisdiction.
- .2 BICSI
 - .1 Telecommunications Distribution Methods Manual.
 - .2 BICSI G1-17 – Outside Plant Manual.
- .3 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).

- .3 CSA T529 – Commercial Building Telecommunications Cabling Standard (ANSI/EIA/TIA-568-B).
- .4 CSA T530 – Commercial Building Standard For Telecommunications Pathways And Spaces (TIA/EIA 569-A).
- .5 CSA T528 – Administration Standard For The Telecommunications Infrastructure Of Commercial Buildings (ANSI/EIA/TIA-606).
- .6 CSA T527 – Commercial Building Grounding And Bonding Requirements For Telecommunications (ANSI/EIA/TIA-607).
- .7 CSA C22.2 No. 214 – Communications Cables.
- .8 CSA C22.2 No. 232-M – Fibre Optic Cables.
- .9 CSA C22.2 No. 182.4-M90 – Plugs, Receptacles, and Connectors for Communication Systems.
- .4 TIA
 - .1 TIA/EIA-568-B.1 – Commercial Building Telecommunications Cabling Standard
 - .2 TIA/EIA-568-B.2 – Balanced Twisted Pair Cabling Components
 - .3 TIA/EIA-568-B.3 – Optical Fibre Cabling Components Standard
- .5 ISO
 - .1 ISO/IEC IS 11801A – Generic Cabling for Customer Premises.
- .6 CENELEC EN 50173 – Performance Requirements for Generic Cabling Schemes.
- .7 IEC
 - .1 IEC 603-7, PART 7 – Detailed Specification For Connectors, 8-Way, Including Fixed And Free Connectors With Common Mating Features.
 - .2 IEC 807-8 – Rectangular Connectors For Frequencies Below 3 MHz, Part 8: Detailed Specification For Connectors, Four-Signal Contacts And Earthing Contacts For Cable Screens, First Edition.
- .8 FIPS PUB 174 – Commercial Building Telecommunications Wiring Standard. Federal Information Standard Publication.
- .9 UL 444 and 13 – Adopted Test and Follow-Up Service Requirements For the Optional Qualification of 100Ω Twisted-Pair (Cables).
- .10 NEMA WC 63 – Performance Standard For Field Testing Of Unshielded Twisted-Pair Cabling System.
- .11 ANSI/EIA/TIA
 - .1 ANSI/EIA/TIA-492AAAA – Detailed Specification For 62.5µm Core Diameter / 125µm Cladding Diameter Class 1a Multimode, Graded-Index Optical Waveguide fibres.
 - .2 ANSI/EIA/TIA-492BAAA – Detailed Specifications For Class Iva Dispersion-Unshifted Singlemode Optical Waveguide Fibres Used In Communication Systems.
 - .3 ANSI/EIA/TIA-472CAAA – Detailed Specifications For All Dielectric (Construction 1) Fibre optic Communications Cable For Indoor Plenum Use, Containing Class 1a, 62.5µm Core Diameter / 125µm Cladding Diameter Fibre optic(s).

- .4 ANSI/EIA/TIA-472DAAA – Detailed Specifications For All Dielectric Fibre optic Communications Cable For Outdoor Plant Use, Containing Class 1, 62.5µm Core Diameter / 250µm Cladding Diameter Fibre optic(s).
- .5 ANSI/EIA/TIA-455 – Test Procedures For Fibre optics, Cables And Transistors.
- .6 ANSI/EIA/TIA-598 – Colour Coding of Fibre Optic Cables.
- .7 ANSI/EIA/TIA-604-3 – FOCIS 3 Fibre Optic Connector Intermateability Standard.
- .8 ANSI/EIA/TIA-606 – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.
- .9 ANSI/EIA/TIA-607 – Commercial Building Grounding and Bonding Requirements for Telecommunications.
- .12 ANSI Z136.2 – American Standards For The Safe Operation of Fibre optic Communication Systems Utilizing Laser Diode And LED Sources.
- .13 ANSI/CEA
 - .1 ANSI/ICEA S-83-640 – Fibre Optic Outside Plant Communications Cable.
 - .2 ANSI/ICEA S-83-596 – Fibre Optic Premises Distribution Cable.

1.06 Submittals

- .1 Before delivery to site of any item of equipment, submit shop drawings c/w all data, pre-checked and stamped accordingly, for review to the Consultant. Indicate project name on each brochure or sheet. Submit shop drawings within 1 week after award of contract.

1.07 Record Documentation

- .1 To Section 01 78 00.
- .2 Red lines, mark-ups by this contractor.

1.08 Operation and Maintenance Manuals

- .1 Refer to Division 01.

1.09 Inspections

- .1 The Consultant will carry out inspections and prepare deficiency list for action by the Contractor, during and on completion of project.

1.10 Drawings and Specifications

- .1 The drawings and specifications are complementary each to the other and what is called for by one to be binding as if called for by both. Should any discrepancy appear between the drawings and specifications which leaves the Contractor in doubt as to the true intent and meaning of plans and specifications, a ruling is to be obtained from the Engineer in writing before submitting Tender. If this is not done, the maximum, the most expensive alternate or option will be provided in base tender bid.
- .2 All drawings and all Divisions of these specifications shall be considered as a whole and work of this Division shown anywhere therein shall be furnished under this Division.
- .3 Drawings are diagrammatic and indicate the general arrangement of equipment and pathways. Most direct routing of cabling is not assured. Exact requirements shall be governed by architectural, structural, and mechanical conditions of the job. Consult all other drawings in preparation of the bid. Extra lengths of

wiring or addition of pull and junction boxes, etc. necessitated by such conditions shall be included in the bid. Check all information and report and apparent discrepancies before submitting the bid.

- .4 Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pathways so as to best fit the layout of the job.
- .5 Scaling off the drawings will not be sufficient or accurate for determining these locations. Where job conditions require reasonable changes in indicated arrangement and locations, such changes shall be made by the Contractor at no additional cost to the Owner.
- .6 Before ordering any conduit, cable tray, cables, fittings, etc., this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.

1.11 Material

- .1 This contractor is responsible to ensure that all items submitted meet all requirements of the drawings and specification, and fits in the allocated space. The final determination of a product being acceptable shall be determined by the Engineer.

1.12 Testing Data

- .1 The contractor shall provide a complete testing report utilizing a testing device as specified in the applicable TIA/EIA standard with the correct adapter and test. All copper tests shall be compliant to the current TIA/EIA standards: Perm Link or Channel.
- .2 The Summary report shall provide be provided to the end user in a universal format so that there is no need to purchase any software to read and print the report.
 - .1 Utilizing Adobe Acrobat is an acceptable manner.

1.13 Painting and Finishes

- .1 Minor damages to finish on factory finished equipment shall be touched up to the Engineer's satisfaction. Items suffering major damage to finish shall be replaced at the direction of the Engineer. Protect work so that finishes will not be damaged or marred during construction. Maintain the necessary protection until completion of the work.

1.14 Safety

- .1 The Contractor shall be responsible for the safety of his workmen and the equipment on the project in accordance with all applicable safety legislation passed by Federal, Provincial, and local authorities governing construction safety. The more stringent regulations shall prevail.

1.15 Warranty

- .1 Submit a written performance warranty to the Owner for one year for the complete installation for a period of no less than five years from the date of testing and acceptance. The system warranty shall be based on industry standards.
- .2 The contractor shall also provide a one year labour warranty on the installation.

2 Products

2.01 Material Approval

- .1 The design, manufacture and testing of electrical equipment and materials shall conform to or exceed the latest applicable CSA, IEEE, and ANSI standards.

- .2 All materials must be new and be ULC or CSA listed. Any materials not covered by the aforementioned listing standards shall be tested and approved by an independent testing laboratory, Technical Inspection Services, or other government agency.

3 Execution

3.01 Workmanship and Contractor's Qualifications

- .1 Only first class workmanship will be accepted, not only in regards to durability, efficiency and safety, but also in regards to neatness of detail. Present a neat and clean appearance on completion to the satisfaction of the Engineer. Any unsatisfactory workmanship will be replaced at no extra cost.
- .2 Conform to the best practices applicable to this type of work. Install all equipment and systems in accordance with the manufacturer's recommendations, but consistent with the General Requirements of this Specification. This Contractor will be held responsible for all damage to the work of his own or any other trade, resulting from the execution of his work. Store all equipment and materials in dry locations.
- .3 Provide foreman in charge of this work at all times.
- .4 The contractor shall be fully liable to provide and maintain in force during the life of this Contract, such insurance, including Public Liability Insurance, Product Liability Insurance, Auto Liability Insurance, Worker's Compensation, and Employer's Liability Insurance.

3.02 Work Sequence

- .1 Prior to start of each work period in occupied area, temporary protection shall be installed to prevent damage to any personal property or furnishing. Coordinate with Owner's representative if any furniture must be relocated to facilitate work.
- .2 Owner's representative shall approve temporary protection plan prior to use.
- .3 Necessary steps shall be taken by contractor to ensure that required fire fighting apparatus is accessible at all times. Flammable materials shall be kept in suitable places outside the building.

3.03 Coordination

- .1 Coordinate work with other trades.
- .2 Verify equipment dimensions and requirements with provision specified under this Section. Check actual job conditions before fabricating work. Report all necessary changes in time to prevent needless work. Changes or additions subject to additional compensation, which are made without written authorization and an agreed price, shall be at Contractor's risk and expense.
- .3 Read specifications and drawings of other trades and conform with their requirements before proceeding with any work specified in this Division related to other trades. Cooperate with all other trades on the job, so that all equipment can be satisfactorily installed, and so that no delay is caused to any other Trades.

3.04 Manufacturers' Instructions

- .1 Where the specifications call for an installation to be made in accordance with Manufacturer's recommendations, a copy of such recommendations shall be at all times be kept on the job site and be available to the Owner's Representative.
- .2 Follow manufacturer's instructions where they cover points now specifically indicated on the drawings and specifications. If they are in conflict with the drawings and specifications obtain clarification from the Consultant before starting work.

3.05 Quality Assurance

- .1 See General Provisions of the Contract.
- .2 The specifications contained herein are set forth as the minimum acceptable requirements. This does not relieve the Contractor from executing other quality assurance measures to obtain a complete operating system within the scope of this project.
- .3 The Contractor shall ensure that all workmanship, all materials employed, all required equipment and the manner and method of installation conforms to accepted construction and engineering practices, and that each piece of equipment is in satisfactory working condition to satisfactorily perform its functional operation.
- .4 Provide quality assurance tests and operational check on all components of the electrical distribution system, all lighting fixtures, and communication systems.

3.06 Labels and Signs

- .1 Labelling shall be as per TIA/EIA-606.

3.07 Adjust and Clean-Up

- .1 The Contractor and associated sub trades, at all times during construction, to keep the site free of all debris, boxes, packing, etc., resulting from work of this Trade. At the completion of this work, the installation is to be left in a clean and finished condition to the satisfaction of the Engineer.

3.08 Tests and Acceptance

- .1 The operation of the equipment does not constitute an acceptance of the work by the Owner. The final acceptance is to be made after the Contractor has adjusted his equipment and demonstrated that it fulfils the requirements of the drawings and the specifications.
- .2 Testing of all systems shall be performed in the presence of the Owner's designated representative. The contractor shall give 72 hours advance notice to the Owner before beginning the tests.
- .3 Upon completion of the installation, the Contractor shall furnish certificates of approval from all authorities having jurisdiction, as applicable. Contractor shall demonstrate that work is complete and in perfect operating condition. In the presence of the Owner, the Contractor shall demonstration the proper operation of all miscellaneous systems.

End of Section

1 General

1.01 Summary

- .1 Section Includes:
 - .1 Demolition and removal of selected portions of building or structure.
 - .2 Demolition and removal of selected site elements and/or Information Technology (IT), Security or other special systems or infrastructure.
 - .3 Salvage of existing items to be reused or recycled.
- .2 Contractor shall include in the Bid all labour, materials, tools, plant, transportation, storage costs, equipment, insurance, temporary protection, permits, inspections, taxes, and all necessary and related items required to provide complete demolition and cutover of existing telecommunication systems shown and described in the Specifications.
- .3 The Contractor is responsible for providing and coordinating phased activities and construction methods that minimize disruption to Terminal operations and provide complete and operational systems.
- .4 The Contractor shall coordinate interfaces to existing systems that are being demolished in order to minimize disruption to the existing systems operations. Any systems outages shall be approved in advance and scheduled with Owner.
- .5 The Contractor shall coordinate specialty electronic, IT data networks, common use, CCTV, public address, and any other IT infrastructure systems.

1.02 Related Requirements

- .1 Section 02 41 19 – Selective Demolition.

1.03 Definitions

- .1 Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or removed and reinstalled.
- .2 Remove and Salvage: Carefully detach from existing construction, in a manner to prevent damage, and deliver to Owner.
- .3 Remove and Reinstall: Detach items from existing construction, prepare for reuse, and reinstall where indicated.
- .4 Existing to Remain: Existing items of construction that are not to be permanently removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.04 Administrative Requirements

- .1 Pre-Demolition Meeting
 - .1 Conduct a pre-demolition meeting at Project Site with Owner and all affected stakeholders.
 - .1 Inspect and discuss condition of construction to be selectively demolished.
 - .2 Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.

- .3 Existing telecommunications rooms that have demolition work may involve electrical, mechanical, and architectural demolition. Review and coordinate requirements of work performed by other trades.
- .4 Review areas where existing construction is to remain and requires protection.
- .5 Review procedures to be followed when critical systems are inadvertently interrupted.

1.05 Submittals

- .1 Action Submittals
 - .1 Comply with all submittal procedures given in other Sections.
 - .2 Submit a Schedule of selective demolition and cutover activities which indicates the following as a minimum:
 - .1 Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's and tenants' on-site operations are uninterrupted.
 - .2 Duration of how long IT and security services will be interrupted and when systems cannot be disabled and temporary parallel service is required submit how this is proposed to be accomplished.
 - .3 The contractor's plan for coordination of shutoff, capping, and continuation of IT and all other utility services.
 - .4 Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.
 - .3 Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.
 - .4 Pre-demolition Photographs or Video: Submit before Work begins.
 - .5 Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.
- .2 Closeout Submittals
 - .1 Submit a list of items that have been removed and salvaged.
 - .2 Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
 - .3 Submit as-built documentation of all remaining IT and security systems conduit and cabling that remains.

1.06 Material Ownership

- .1 Unless otherwise indicated, demolition waste becomes property of Contractor.

1.07 Field/Site Conditions

- .1 Owner will occupy portions of building immediately adjacent to selective demolition area.
 - .1 Conduct selective demolition so Owner's operations will not be disrupted.
- .2 Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.

- .1 Before selective demolition, Owner will remove their equipment from the space.
- .3 Notify Consultant of discrepancies between existing conditions and Drawings before proceeding with selective demolition.
- .4 Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
 - .1 Hazardous materials will be removed by Owner before start of the Work.
 - .2 If suspected hazardous materials are encountered, do not disturb; immediately notify Engineer. Hazardous materials will be removed by Owner under a separate contract.
- .5 Storage or sale of removed items or materials on-site is not permitted.
- .6 Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1.08 Warranty

- .1 Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

2 Products – Not Used

3 Execution

3.01 Examination

- .1 Verify that utilities have been disconnected and capped per Owner approved procedures before starting selective demolition operations.
- .2 Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.
- .3 Survey existing condition of all IT related conduits and cables from origin to destination and correlate with requirements indicated to determine extent of selective demolition required.
- .4 Label all conduits and cables with origin, destination and what system they serve.
- .5 Consult with Owner to determine whether systems can be disabled or whether a new parallel system needs to be installed.

3.02 Removal of Communications Cabling and Equipment

- .1 Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
 - .1 Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level. Remove all abandoned cables from origin to destination.
 - .2 Dispose of demolished items and materials promptly.
- .2 Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Engineer, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

- .3 For existing equipment cabinets with active components in them, provide an airtight dust seal around the cabinet and circulate cooling air with a portable air conditioning unit or other means to ensure equipment does not overheat.
- .4 If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
- .5 When removing communications outlets, remove all conductors back to patch panel in communications closet or IT rack. Provide blank faceplates where outlets are removed from walls or partitions to remain.
- .6 Where communications cabling is to be re-used, coil the communications outlet cabling in the ceiling space for re-use.

3.03 Disposal of Demolished Materials

- .1 General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in accordance with the requirements of the Authority Having Jurisdiction.
 - .1 Do not allow demolished materials to accumulate on-site.
 - .2 Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 - .3 Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.
- .2 Burning: Do not burn demolished materials.
- .3 Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.04 Cleaning

- .1 Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

End of Section

1 General

1.01 Summary

- .1 This Section covers the Specification and requirements for the grounding and bonding of communications systems and structured cabling infrastructures.
- .2 Contractor shall provide all services, labor, materials, tools, and equipment required for the implementation of a complete and effective grounding and bonding System, as specified this Section.
- .3 Contractor shall comply with all the requirements of Specification, Design Drawings, and all applicable Telecommunications Standards and Electrical Codes.
- .4 Grounding and bonding System shall be designed, engineered, and installed to suit the Client's premises, communications systems, and cabling infrastructure.
- .5 Grounding electrode system refers to all electrodes required by Electrical Code, including, telecommunications system grounding electrodes.
- .6 The terms "connect" and "bond" are used interchangeably in this Specification and have the same meaning.

1.02 Definitions

- .1 AWG – American Wire Gauge – The standardized system for gauging the diameter of round, solid, non-ferrous, electrically-conducting wire.
- .2 BBC – Bonding Backbone Conductor – A telecommunications bonding connection which interconnects telecommunications bonding backbones. Formerly known as the grounding equalizer.
- .3 BN – Bonding Network – A set of interconnected conductive structures that provides a low impedance path for the associated telecommunications infrastructure.
- .4 EF – Entrance Facility – An entrance to a building for both public and private network service cables, including wireless, that includes the entrance point of the building and continues to the entrance room or space.
- .5 ESD – Electrostatic Discharge – The sudden flow of electricity between two electrically-charged objects caused by contact, an electrical short, or dielectric breakdown.
- .6 Mesh-BN – Mesh Bonding Network – A bonding network to which all associated equipment, such as cabinets, frames, racks, trays, and pathways, are connected using a bonding grid that is connected to multiple points on the common bonding network.
- .7 PBB – Primary Bonding Busbar – A busbar placed in a convenient and accessible location and bonded, by means of the Telecommunications Bonding Conductor (TBC), to the building's service equipment (power) ground. Formerly known as the Telecommunications Main Grounding Busbar (TMGB).
- .8 RBB – Rack Bonding Busbar – A busbar within a cabinet, frame, or rack.
- .9 RBC – Rack Bonding Conductor – A bonding conductor from the rack or Rack Bonding Busbar (RBB) to the Telecommunications Equipment Bonding Conductor (TEBC).
- .10 SBB – Secondary Bonding Busbar – A common point of connection for telecommunications system and equipment bonding to ground, located in the distributor room. Formerly known as the Telecommunications Grounding Busbar (TGB).
- .11 TBB – Telecommunications Bonding Backbone – The conductor that interconnects the Primary Bonding Busbar (PBB) to the Secondary Bonding Busbar (SBB).

- .12 TBC – Telecommunications Bonding Conductor – A conductor that interconnects the telecommunications bonding infrastructure to the building's service equipment (power) ground. Formerly known as the bonding conductor for telecommunications.
- .13 TEBC – Telecommunications Equipment Bonding Conductor – A conductor that connects the Primary Bonding Busbar (PBB) or Secondary Bonding Busbar (SBB) to equipment racks or cabinets.
- .14 TR – Telecommunications Room – An enclosed space for housing telecommunications equipment, cable terminations, and cross-connect cabling. It is the recognized location of the cross-connect between the backbone and horizontal facilities.
- .15 UBC – Unit Bonding Conductor – A bonding conductor from equipment or a patch panel to a Rack Bonding Conductor (RBB) or a Rack Bonding Busbar (RBB).

1.03 References

- .1 Publications listed below (including amendments, addenda, revisions, supplements, and errata) form a part of this Specification to the extent referenced. Publications are referenced in the text by the basic designation only.
- .2 American Society for Testing and Materials (ASTM):
 - .1 ASTM-B1-13(2018) – Standard Specification for Hard-Drawn Copper Wire.
 - .2 ASTM B8-11(2017) – Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft.
- .3 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - .1 IEEE 81-2012 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System.
- .4 Canadian Standards Association (CSA):
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024).
- .5 Telecommunications Industry Association (TIA): Latest Revision of Standards
 - .1 TIA-606 – Administration Standard for Telecommunications Infrastructure
 - .2 TIA-607 – Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises.
- .6 BICSI:
 - .1 Information Technology Systems Installation Methods Manual (ITSIMM), Recommended Testing Procedures and Criteria – Latest Revision
 - .2 Telecommunications Distribution Methods Manual (TDMM) – Latest Revision
- .7 Underwriters Laboratories, Inc. (UL):
 - .1 UL 44 (19th Edition, 2018) – UL Standard for Safety Thermoset-Insulated Wires and Cables.
 - .2 UL 83 (16th Edition, 2017) – UL Standard for Safety Thermoplastic-Insulated Wires and Cables.
 - .3 UL 467 (11th Edition, 2022) – UL Standard for Safety Grounding and Bonding Equipment.

.4 UL 486A-486B (3rd Edition, 2018) – UL Standard for Safety for Wire Connectors.

.8 International Annealed Copper Standard (IACS)

1.04 Submittals

.1 Submit in accordance with Section 01 33 00 and Section 27 05 00.

.2 Action Submittals: Product Data for each type of product (PBB, SBB, RBB, 2-Hole Lugs, etc.)

.3 Shop Drawings:

.1 Sufficient information, clearly presented, shall be included to determine compliance with latest TIA-607 Standard and this Specification.

.2 Include the location of system grounding electrode connections and the routing of aboveground and underground grounding electrode conductors.

1.05 Closeout Submittals

.1 Submit closeout documents in accordance with Section 27 05 00.

.2 As-Built Data: Submit plans showing as-built locations of grounding and bonding infrastructure, including the following: PBB, SBB, RBB and routing of their bonding conductors.

.3 Test Reports: Provide test reports of ground resistance to each primary or secondary bonding busbar (PBB/SBB) located in each telecommunications space impacted by the work.

2 Products

2.01 Manufacturers

.1 Hubbell.

.2 nVent Erico.

.3 Panduit.

.4 Thomas & Betts.

2.02 General Requirements

.1 Contractor shall provide a comprehensive and effective telecommunications grounding and bonding infrastructure for the protection of personnel and equipment, in compliance with the current Canadian Electrical Code, the latest TIA-607 Standard, and all applicable codes of Authority Having Jurisdiction (AHJ).

.2 Grounding and bonding infrastructure shall follow the latest TIA-607 design methodology, whereby within a building the generic telecommunications bonding infrastructure originates at the facility's electrical entrance ground and extends throughout the building. The infrastructure shall comprise the following major components:

.1 Primary bonding busbar (PBB).

.2 Telecommunications bonding conductor (TBC).

.3 Telecommunications bonding backbone (TBB).

.4 Secondary bonding busbar (SBB).

- .5 Backbone bonding conductor (BBC).
- .3 All cables shall be plenum rated FT6.
- .4 External Grounding Electrodes:
 - .1 The grounding electrode system shall be designed to have a resistance to earth of 25 ohms or less for a single grounding electrode.
 - .2 For sites that are critical in nature (e.g., public safety facilities, military installations, data centers, web hosting facilities, central offices) the grounding electrode system shall be designed to have a resistance of less than 10 ohms – ideally less than 5 ohms.

2.03 Bonding Busbars

- .1 Bonding busbars shall be provided in each telecommunications space (room/closet) and in each equipment rack/cabinet, as specified in this Section. Bonding busbars shall provide connection or termination points for the telecommunications space's bonding conductors.
- .2 The types of bonding busbars specified in the infrastructure comprise:
 - .1 Primary Bonding Busbar (PBB).
 - .2 Secondary Bonding Busbar (SBB).
 - .3 Rack Bonding Busbar (RBB).

2.04 Primary Bonding Busbar (PBB)

- .1 The PBB shall be placed in a convenient and accessible location in the telecommunications entrance room or space. Typically, there should be a single PBB per building.
- .2 The PBB shall be bonded, by means of the telecommunications bonding conductor (TBC), to the building's service equipment (electrical) ground.
- .3 The PBB serves as the dedicated extension of the building grounding electrode system for the telecommunications infrastructure. It also serves as the central attachment point for the Secondary Bonding Busbars (SBB) through the Telecommunications Bonding Backbone (TBB).
- .4 The PBB shall be:
 - .1 Pre-drilled with mounting holes to accommodate matched listed lugs and hardware.
 - .2 Made of copper, or copper alloys having a minimum of 95% conductivity when annealed as specified by the International Annealed Copper Standard (IACS).
 - .3 Of minimum dimensions of 6.35 mm (0.25 in) thick x 100 mm (4 in) wide and variable in length to accommodate design requirements.
 - .4 UL Listed.
 - .5 Cleaned with an antioxidant applied prior to fastening connectors to the busbar.
 - .6 Insulated from its support using an insulator that is listed for the purpose by a nationally recognized testing laboratory (NRTL).
 - .7 Installed a minimum of 50 mm (2 in) from the finished wall to allow access to the rear of the busbar.
 - .8 Sized for current applications and future growth.

- .5 The primary protector grounding conductor shall be connected to the PBB. This conductor is intended to conduct lightning and AC fault currents from the telecommunication primary protectors.

2.05 Secondary Bonding Busbar (SBB)

- .1 The SBB shall be placed in a convenient location of the telecommunications room/closet. The SBB shall form a common bonding connection point for telecommunications systems and equipment in the area served by the telecommunications room/closet.
- .2 The SBB shall be:
 - .1 Pre-drilled with mounting holes to accommodate matched UL Listed lugs and hardware.
 - .2 Made of copper, or copper alloys having a minimum of 95% conductivity when annealed as specified by the International Annealed Copper Standard (IACS).
 - .3 Of minimum dimensions of 6.35 mm (0.25 in) thick x 50 mm (2 in) wide and variable in length.
 - .4 cUL Listed.
 - .5 Cleaned with an antioxidant applied prior to fastening connectors to the busbar.
 - .6 Insulated from its support using an insulator that is listed for the purpose by a nationally recognized testing laboratory (NRTL).
 - .7 Installed at a minimum of 50 mm (2 in) from the finished wall to allow access to the rear of the busbar.
 - .8 Sized for current applications and future growth.

2.06 Rack Bonding Busbar (RBB)

- .1 The RBB is a grounding busbar within a cabinet, rack, or frame.
- .2 The RBB shall be provided in cabinets and racks that support multiple equipment bonding conductors to serve as an extension of the PBB or SBB for the equipment in the cabinet.
- .3 The RBB shall meet the following requirements:
 - .1 Manufactured from copper alloy.
 - .2 cUL Listed.
 - .3 Horizontal Busbars shall be at least 19 mm (0.75 in) wide, 483 mm (19 in) long, and 5 mm (0.1875 in) thick.
 - .4 Have a minimum of 14, factory-provided #12–24 threaded holes.
 - .5 Have pre-punched EIA 310 D standard rack mounting holes.
 - .6 Vertical Busbars shall be at least 17 mm (0.67 in) wide, 2 m (78.65 in) long, and 1.27 mm (0.05 in) thick, and shall come in threaded rail and cage nut versions.

2.07 Bonding Conductors

- .1 The following common requirements apply to all types of bonding conductors specified in this Section:
 - .1 All bonding conductors shall be made of stranded copper wire with a green jacket (or per CE Code depending on size), run as a continuous conductor.

- .2 Bonding conductors may be insulated. If insulated they shall be cUL Listed for the application.
- .3 Bonding conductors shall be protected from physical and mechanical damage.
- .4 Bonding conductors shall be sized to meet the ANSI/TIA-607-D requirements.
- .2 Telecommunications Bonding Backbone (TBB)
 - .1 The TBB is a conductor that bonds the Secondary Bonding Busbars (SBB) to the Facility's Primary Bonding Busbar (PBB).
 - .2 The TBB shall meet the following requirements:
 - .1 The TBB shall be sized to meet the requirements of ANSI/TIA-607-D and shall be as straight as practicable avoiding bends. The TBB minimum conductor size shall be AWG 6.
 - .2 Bonding and grounding conductors may be insulated or un-insulated and shall not decrease in size as the grounding path moves closer to earth.
 - .3 Connections (bonds) between the telecommunications grounding network and associated electrical panels shall be done by a qualified electrician in accordance with guidelines in the latest TIA-607 and applicable electrical codes.
 - .4 Bonding Conductors should be continuous (splices not allowed) and routed in the shortest possible straight-line path, avoiding changes in elevation and sharp bends.
 - .5 TBB grounding conductors routing through ferrous metal conduit should be avoided, but if it is necessary due to building constraints, any grounding conductor running through ferrous conduit longer than 3 feet shall be bonded at the end using appropriately sized conduit grounding clamps as described TIA-607.
 - .6 Bonding the TBB to the PBB and each SBB shall be performed with a UL listed irreversible compression (crimp) dual-lug connector.
 - .7 Metallic cable shield(s) and cabling pathways, including metallic conduits, shall not be used as a TBB.
 - .8 Whenever two (2) or more TBBs are used within a multistory building, the TBBs shall be bonded together with a BBC at every third floor as a minimum, and at the top floor.
 - .9 Conductor sizing depends upon the Project specification, and shall be determined based on the TBB length as stipulated in TIA-607. Contractor shall ensure TBB sizing complies with the TIA-607 guidelines outlined in the Table below:

Sizing of the TBB	
TBB Length in Linear Meters (Feet)	TBB Size (AWG)
Less than 4 (13)	6
4-6 (14-20)	4
6-8 (21-26)	3
8-10 (27-33)	2
10-13 (34-41)	1

Sizing of the TBB	
TBB Length in Linear Meters (Feet)	TBB Size (AWG)
13-16 (42-52)	1/0
16-20 (53-66)	2/0
20-26 (67-84)	3/0
26-32 (85-105)	4/0
32-38 (106-125)	250 kcmil
38-46 (126-150)	300 kcmil
46-53 (151-175)	350 kcmil
53-76 (176-250)	500 kcmil
76-91 (251-300)	600 kcmil
Greater than 91 (301)	750 kcmil

- .3 Telecommunications Bonding Conductor (TBC)
 - .1 The TBC connects the telecommunications bonding infrastructure to the building's service equipment (power) ground (formerly known as the bonding conductor for telecommunications).
 - .2 The TBC shall have at a minimum the same size as the largest TBB.
 - .3 The TBC shall bond the PBB to the service equipment (power) ground.
- .4 Backbone Bonding Conductor (BBC)
 - .1 The BBC (formerly known as the grounding equalizer) is a bonding conductor which interconnects telecommunications bonding backbones.
 - .2 The BBC shall have at a minimum the same size as the largest TBB to which it is bonded.
- .5 Telecommunications Equipment Bonding Conductor (TEBC)
 - .1 The TEBC is a bonding conductor which connects the cabinets and racks in a telecommunications room/closet to the local primary or secondary bonding busbar (PBB or SBB).
 - .2 The TEBC shall have a minimum size of AWG 6.
 - .3 Metallic objects and pathways shall not be used as a replacement for the TEBC.
 - .4 The TEBC may be routed inside cable trays. It shall be secured at maximum intervals of 0.9 m (3 ft).
 - .5 The TEBC shall be separated a minimum of 50.8 mm (2 in) from other cable groups, such as power or telecommunications cables.
 - .6 The TEBC shall be connected to the cabinets/racks, to a Rack Bonding Conductor (RBC) or to a vertical/horizontal Rack Bonding Busbar (RBB).

- .7 Connections to the TEBC shall be made with UL Listed irreversible compression connectors, suitable for multiple conductors, and with the rack bonding conductors (RBCs) routed toward the PBB/SBB.
- .6 Rack Bonding Conductor (RBC)
 - .1 The RBC is a bonding conductor from the cabinet or Rack Bonding Busbar (RBB) to the Telecommunications Equipment Bonding Conductor (TEBC).
 - .1 The RBC shall have a minimum size of AWG 6.
 - .2 The RBC shall be bonded to the Telecommunications Equipment Bonding Conductor (TEBC) using UL Listed irreversible compression (crimp) connectors.
 - .1 Where connected to a server cabinet, the RBC extends to the bottom of the server cabinet allowing Equipment Bonding Conductors to be attached at any point in the cabinet.
 - .2 Where connected to a network rack/cabinet, the Rack Bonding Conductor (RBC) is bonded to the Rack Bonding Busbar (RBB) via a UL Listed two-hole compression lug.
 - .2 Unit Bonding Conductor (UBC)
 - .1 The Unit Bonding Conductor (UBC) connects individual equipment in a cabinet or rack to the Rack Bonding Conductor (RBC) or Rack Bonding Busbar (RBB).
 - .2 The UBC shall also be used for bonding cable tray sections to the Telecommunications Equipment Bonding Conductor (TEBC).
 - .3 The UBC shall have a minimum size of AWG 6.
 - .4 Bonding.
 - .1 Where used in a server cabinet, UBC shall be bonded to the Rack Bonding Connector (RBC) using UL Listed irreversible compression (crimp) connectors and to IT equipment via a UL Listed two-hole compression lug. (Some IT equipment may require one-hole lugs.)
 - .2 Where used in a network cabinet/rack, UBC shall be bonded to the Rack Bonding Busbar (RBB) via a UL Listed two-hole compression lug and to IT equipment via a UL Listed two-hole compression lug. (Some IT equipment may require one-hole lugs.)
 - .3 Where used as a cable tray bonding conductor connecting cable tray sections, UBC shall be bonded to each adjoining section of the cable tray using UL Listed two-hole compression lugs.
 - .4 Where used as a cable tray bonding conductor connecting cable tray sections to the Telecommunications Equipment Bonding Conductor (TEBC), UBC shall be bonded to the TEBC using UL Listed irreversible compression (crimp) connectors and to the cable tray via a UL Listed two-hole compression lug.

3 Execution

3.01 General

- .1 Ground in compliance with the CE Code, the latest TIA-607 Standard, and as specified in this Section and the Drawings.
- .2 Components of the telecommunications bonding system shall be installed and connected using materials and techniques as specified in the latest TIA-607 Standard.
- .3 Follow equipment manufacturer's grounding instructions.

3.02 Examination

- .1 Contractor shall check the AC grounding electrode system and equipment grounding for compliance with the requirements for maximum ground-resistance level, and other conditions affecting performance of grounding and bonding of the telecommunications system.
- .2 Inspect the test results of the AC grounding system.
- .3 Prepare written report listing all conditions detrimental to the performance of the Work.
- .4 Proceed with Work only after unsatisfactory conditions have been corrected.

3.03 Corrosion Inhibitors

- .1 When making ground and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.
- .2 PBB and SBB shall always have tinned surfaces to restrain oxidation and shall be cleaned and have an antioxidant paste applied to both bonding surfaces prior to fastening conductors.

3.04 Telecommunications System Grounding

- .1 Bond the telecommunications grounding system to the electrical grounding electrode system.
- .2 Provide dedicated telecommunications grounding busbars for the following locations/spaces:
 - .1 Telecom entrance facility rooms
 - .2 Server rooms
 - .3 IT rooms/closets
- .3 Provide bonding to all telecom cabinets, racks, metallic cable shields, junction/pull boxes, enclosures, and communications/security equipment, as required by Standards and Code.
- .4 Provide bonding to all metallic cable trays and conduits to building ground.
- .5 Bond incoming carrier armor sheath to building ground.
- .6 Furnish and install all busbars and bonding conductors required to properly ground and bond all communications raceways, cable trays, metallic cable shields, and equipment, in compliance with design, Codes and Standards.
- .7 Bonding jumpers/conductors shall be continuous with no splices. Use the shortest possible length of bonding jumper.

- .8 Provide ground paths that are permanent and continuous with a resistance of 1 ohm or less from raceway, cable tray, and equipment connections to the building grounding electrode. The resistance across individual bonding connections shall be 10 milliohms or less.
- .9 Above-Grade Grounding Connections: When making bolted or screwed connections to attach bonding conductors, remove paint to expose the entire contact surface by grinding where necessary; thoroughly clean all connector, plate and other contact surfaces; and apply an appropriate corrosion inhibitor to all surfaces before joining.
- .10 Bonding Conductors:
 - .1 Use insulated ground wire of the size and type shown on the Drawings or use a minimum of #6 AWG insulated copper wire.
 - .2 Assemble bonding jumpers using insulated ground wire terminated with compression connectors.
 - .3 Use compression connectors of proper size for the specified conductors. Use connector manufacturer's compression tool.
- .11 Bonding Jumper Fasteners:
 - .1 Conduit: Fasten bonding jumpers using screw lugs on grounding bushings or conduit strut clamps, or the clamp pads on push-type conduit fasteners. When screw lug connection to a conduit strut clamp is not possible, fasten the plain end of a bonding jumper wire by slipping the plain end under the conduit strut clamp pad; tighten the clamp screw firmly. Where appropriate, use zinc-plated external tooth lockwashers.
 - .2 Wireway and Cable Tray: Fasten bonding jumpers using zinc-plated bolts, external tooth lockwashers, and nuts. Install protective cover, e.g., zinc-plated acorn nuts on any bolts extending into wireway or cable tray to prevent cable damage.
 - .3 Ground Plates and Busbars: Fasten bonding jumpers using two-hole compression lugs. Use tin-plated copper or copper alloy bolts, external tooth lockwashers, and nuts.
 - .4 Strut Channel and Raised Floor Stringers: Fasten bonding jumpers using zinc-plated, self-drill screws and external tooth lockwashers.

3.05 Raceway Grounding

- .1 Conduit: Use insulated #6 AWG bonding jumpers to ground metallic conduit at each end and to bond at all intermediate metallic enclosures.
- .2 Cable Tray: Use insulated #6 AWG bonding jumpers to ground metallic cable tray at:
 - .1 Each end
 - .2 All intermediate metallic enclosures/boxes
 - .3 All cable tray section junctions

3.06 Identification and Administration

- .1 Provide complete grounding system labeling in accordance with the requirements of:
 - .1 ANSI/TIA-606, Latest Revision.
 - .2 Section 27 05 53 – Identification for Communications Systems.
- .2 Primary Bonding Busbar (PBB): Label with "PBB".

- .3 Secondary Bonding Busbar (SBB): Label with "SBB".
- .4 Telecommunications Bonding Backbone (TBB): Label with "WARNING! TELECOMMUNICATIONS BONDING BACKBONE. DO NOT REMOVE OR DISCONNECT" Labels shall be affixed at both ends and at accessible intermediate points.

3.07 Testing

- .1 Perform tests as specified in BICSI Information Technology Systems Installation Methods Manual (ITSIMM), Recommended Testing Procedures and Criteria.
- .2 Perform two-point bond testing to be preformed by qualified technicians.
- .3 Conduct continuity tests to verify that all metallic pathways and pathway sections are bonded to PBB or SBB.
- .4 Conduct electrical continuity test to verify that PBB is effectively bonded to the facility grounding electrode conductor.
- .5 Perform resistance tests to ensure rack and cabinet bonding connection resistance measures less than 4 Ω to PBB or SBB.
- .6 Provide a complete test report to Consultant and Owner.

End of Section

1 General

1.01 Summary

- .1 Provide a complete system of empty conduit, pull boxes, outlets, and sleeves for enclosure of communications cabling.

1.02 Related Requirements

- .1 Section 26 05 33.13 – Conduit for Electrical Systems.
- .2 Section 26 05 33.16 – Boxes for Electrical Systems.

1.03 References

- .1 BISC I Telecommunications Distribution Methods Manual, 14th Edition.

1.04 Closeout Submittals

- .1 Record documentation:
 - .1 Records of underground utility locates.
 - .2 Record as-constructed location of all underground conduits and telecommunications pathways on as-built drawings regardless of conduit size.

2 Products

2.01 Outlets

- .1 Wall outlets shall be 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted.
- .2 Provide 53 mm conduit through walls as noted.

2.02 Conduits

- .1 Conduit size shall be in accordance with recommended standard for conduits in Building as published by BICSI.
- .2 Minimum conduit size shall be 21 mm diameter.
- .3 Minimum space requirements in pull boxes for 90 degree pulls, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .4 Plenum cables are permitted in accessible ceilings. Provide 'J' hooks in these locations [for later cable installation by others].

- .5 Plywood backboards shall be minimum 1200 mm by 2400 mm, 19 mm thick, painted with 2 coats of fire retardant light grey enamel.
- .6 Provide a minimum of two 5-15R duplex receptacles on separate circuits at each backboard.

3 Execution

3.01 Installation

- .1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.
- .2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 3.2 mm (1/8") nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.
- .3 Conduit shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.
- .4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30 m in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by future installer to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.

End of Section

1 General

1.01 Section Includes

- .1 Provide a complete system of empty conduits, pull boxes, outlets, and sleeves for enclosure of wiring by other under [Cash Allowance]. Refer to General Requirements.

1.02 Related Requirements

- .1 Section 26 05 33.13 – Conduit for Electrical Systems.
.2 Section 26 05 33.16 – Boxes for Electrical Systems.
.3 Section 28 46 13 – Fire-Alarm Systems.

1.03 References

- .1 BISC I Telecommunications Distribution Methods Manual, 13th Edition (2014).

2 Products

2.01 Outlets

- .1 Wall outlets shall be 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted.

2.02 Conduits

- .1 Conduit size shall be in accordance with recommended standard for conduits in Building as published by BICSI.
.2 Minimum conduit size shall be 21 mm diameter.
.3 Minimum space requirements in pull boxes for 90 degree pulls, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .4 Plenum cables are permitted in accessible ceilings. Provide 'J' hooks in these locations for later cable installation [by others].
.5 Plywood backboards shall be minimum 1200 mm by 2400 mm, 19 mm thick, painted with two coats of fire retardant light grey enamel.
.6 Provide a minimum of two duplex receptacles on separate circuits at each backboard.
.7 Provide fire alarm over-ride feature at fire alarm control panel (FACP) to deactivate public address system when Fire Alarm System is in alarm.

3 Execution

3.01 Installation

- .1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.
- .2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 3.2 mm (1/8") nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.
- .3 Conduit bonds shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.
- .4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30 000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, for use by [Cash Allowance] installer to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.

End of Section

1 General

1.01 Summary

- .1 Provide a complete system of empty conduits, terminal cabinets, plywood backboards, pull boxes and outlets for enclosure of wiring by Security Contractor under Cash Allowance.

1.02 Related Requirements

- .1 Section 26 05 33.13 – Conduit for Electrical Systems.
.2 Section 26 05 33.16 – Boxes for Electrical Systems.

2 Products

2.01 Outlets

- .1 Wall and door outlets shall be single boxes, or 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted. Coordinate with Security Contractor.

2.02 Conduits

- .1 Provide conduit in all walls, exposed areas, and inaccessible ceilings. All conduit work shall be concealed.
.2 Minimum conduit size shall be 21 mm diameter.
.3 Provide J hooks in accessible ceilings for plenum rated wiring.
.4 Minimum space requirements in pull boxes for 90 degree pulls, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .5 Plywood backboards shall be minimum 1200 x 2400 mm, 19 mm thick, painted with 2 coats of fire retardant light grey enamel.
.6 Provide a minimum of 2 duplex receptacles on separate circuits at each backboard.

3 Execution

3.01 Installation

- .1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.

- .2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 3.2 mm (1/8") nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.
- .3 Conduit bonds shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.
- .4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30 m in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, **for use by Security installer** to facilitate wiring and equipment installation. Include above noted information on final record drawings at project completion.

End of Section

1 General

1.01 Summary

- .1 Provide a complete system of empty conduits, terminal cabinets, plywood backboards, pull boxes and outlet boxes for enclosure of cabling.

1.02 Related Requirements

- .1 Section 26 05 33.13 – Conduit for Electrical Systems.
- .2 Section 26 05 33.16 – Boxes for Electrical Systems.

2 Products

2.01 Video Surveillance Equipment

- .1 Video Surveillance equipment shall be based on IP cameras. Size conduits based on industry practices based on Category 6 communications cabling.

2.02 Outlets

- .1 Wall and door outlets shall be single boxes, or 115 mm square boxes with plaster rings to suit single gang devices unless otherwise noted. Coordinate with Owner's video surveillance contractor.

2.03 Conduits

- .1 Provide conduit in all walls, exposed areas, and inaccessible ceilings. All conduit work shall be concealed.
- .2 Minimum conduit size shall be 21 mm diameter.
- .3 Provide J hooks in accessible ceilings for plenum rated wiring.
- .4 Minimum space requirements in pull boxes for 90 degree pulls, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .5 Plywood backboards shall be minimum 1200 mm by 2400 mm, 19 mm thick, painted with 2 coats of fire retardant light grey enamel.
- .6 Provide a minimum of two duplex receptacles on separate circuits at each backboard.

3 Execution

3.01 Installation

- .1 Vertically mount outlet boxes, unless noted otherwise, 300 mm to centre above floor, or 150 mm above counter top where shown at counters or benches.
- .2 Fish conduit, clear blockages and outlet and clean out pull boxes at completion of installation. Leave conduit free of water or excess moisture. Install No. 12 gauge galvanized soft iron pull wire, or 3.2 mm (1/8") nylon pull cord continuously from outlet to outlet, through conduit and fasten at each box.
- .3 Conduit bonds shall have a bending radius of not less than nine times conduit diameter. Ream out conduit and identify ends with green paint.
- .4 Install additional steel pull boxes in such a manner that, throughout entire system, there shall be not more than two 90 degree or equivalent bends or more than 30 000 mm in each run, so that wire or cables may be pulled in or withdrawn with reasonable ease. Minimum space requirements in pull boxes having one conduit each in opposite ends of the box, shall be as follows:

Maximum conduit size	Size of pull boxes in millimetres			For each additional conduit size increase width by:
	Width	Length	Depth	
21 mm	150 mm	300 mm	100 mm	50 mm
27 mm	200 mm	400 mm	150 mm	75 mm
35 mm	250 mm	450 mm	200 mm	75 mm
41 mm	300 mm	600 mm	250 mm	100 mm
53 mm	350 mm	750 mm	300 mm	125 mm

- .5 Show as-installed conduit routing and location of all pull boxes on the record drawings, prior to project completion, **for use by Security installer to facilitate wiring and equipment installation**. Include above noted information on final record drawings at project completion.

End of Section

1 General

1.01 Summary

- .1 The work covered under this section consists of the furnishing of all necessary labour, supervision, materials, equipment, and services to completely execute the system of non-continuous cable supports ("J-Hooks") as described in this specification.

1.02 Scope

- .1 Non-continuous cable supports.
- .2 Adjustable non-continuous cable support sling.
- .3 Multi-tiered non-continuous cable support assemblies.
- .4 Non-continuous cable support assemblies from tee bar.
- .5 Non-continuous cable support assemblies from drop wire/ceiling.
- .6 Non-continuous cable support assemblies from beam, flange.
- .7 Non-continuous cable support assemblies from C & Z Purlin.
- .8 Non-continuous cable support assemblies from wall, concrete, or joist.
- .9 Non-continuous cable support assemblies from threaded rod.
- .10 Raised floor non-continuous cable support assemblies.
- .11 Cantilever-Mounted Option for non-continuous cable supports.
- .12 Installation accessories for non-continuous cable supports.

1.03 Definitions

- .1 UTP: Unshielded twisted pair.
- .2 ANSI: American National Standards Institute.
- .3 ASTM: American Society for Testing and Materials.
- .4 EIA: Electronic Industries Alliance.
- .5 TIA: Telecommunications Industry Association.
- .6 cULus: Listed by Underwriters Laboratories based on both Canadian and US (United States) standards requirements.

1.04 Submittals

- .1 Submit product data on non-continuous cable support devices, including attachment methods. Product data to include, but not limited to materials, finishes, approvals, load ratings, and dimensional information.

1.05 Quality Assurance

- .1 Non-continuous cable supports and cable support assemblies shall be listed by Underwriters Laboratories for both Canadian and US standards (cULus).

- .2 Non-continuous cable supports shall have the manufacturers name and part number stamped on the part for identification.
- .3 Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of five years documented experience in the industry, and certified ISO 9000.

2 Products

2.01 Manufacturers

- .1 ERICO, Inc.
- .2 Approved equal.

2.02 References

- .1 ASTM B633 Standard Specification for Electro-deposited Coatings of Zinc on Iron and Steel
- .2 ASTM B 695-90 Standard Specification for coatings of Zinc Mechanically Deposited on Iron and Steel
- .3 ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- .4 ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
- .5 ASTM A109 Standard Specification for Steel, Strip, Carbon, Cold-Rolled
- .6 ASTM A167 Standard Specification for Stainless and heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
- .7 ASTM A480/A480M Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.
- .8 ASTM A568 Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy Hot-Rolled and Cold-Rolled
- .9 A653 G60-Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip process
- .10 ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
- .11 ASTM A682 Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled, Spring Quality
- .12 ASTM A879 Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface
- .13 ASTM B117 Standard Method of Salt Spray (Fog) Testing
- .14 ASTM D610 Standard test Method for Evaluating Degree of Rusting on Painted Steel Surfaces UL 2043 - Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.
- .15 ANSI/ TIA/ EIA 568 Commercial Building Telecommunications Cabling Standard, current revision level.
- .16 ANSI/ TIA/ EIA 569 Commercial Building Standard for Telecommunications Pathways and Spaces, current revision level.
- .17 NFPA 70 National Electrical Code.

2.03 Non-Continuous Cable Support Systems

- .1 Non-continuous cable supports
 - .1 Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables; cULus Listed.
 - .2 Non-continuous cable supports shall have flared edges to prevent damage while installing cables.
 - .3 Non-continuous cable supports sized 1 5/16" and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.
 - .4 Non-continuous cable supports shall have an electro-galvanized or G60 finish and shall be rated for indoor use in non-corrosive environments.
 - .5 Stainless Steel non-continuous cable supports are intended for indoor and outdoor use in non-corrosive environments or where only mildly corrosive conditions apply.
 - .6 Non-continuous cable supports shall be ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64, CAT21SS, CAT32SS, CAT64SS; CAT-CMTM Double J-Hook CAT100CM; CAT-CMTM U-hook series CAT200CMLN, CAT300CMLN; and CAT-CMTM retainer CATRT200CM, CATRT300CM or approved equal.
- .2 Adjustable non-continuous cable support sling
 - .1 Constructed from steel and woven laminate; sling length can be adjusted to hold up to 425 4-pair UTP; rated for indoor use in non-corrosive environments. Rated to support Category 5 and higher cable, or optical fiber cable; cULus Listed.
 - .2 Adjustable non-continuous cable support sling shall have a static load limit of 100 lbs.
 - .3 Adjustable non-continuous cable support sling shall be suitable for use in air handling spaces.
 - .4 If required, assemble to manufacturer recommended specialty fasteners including beam clips, flange clips, C and Z purlin clips.
 - .5 Acceptable products: ERICO CADDY CableCat™ CAT425; or approved equal.
- .3 Multi-tiered non-continuous cable support assemblies
 - .1 Multi-tiered non-continuous cable support assemblies shall be used where separate cabling compartments are required. Assemblies may be factory assembled or assembled from pre-packaged kits. Assemblies shall consist of a steel angled hanger bracket holding up to six non-continuous cable supports, rated for indoor use in non-corrosive environments; cULus Listed.
 - .2 If required, the multi-tier support bracket may be assembled to manufacturer recommended specialty fasteners including beam clamps, flange clips, C and Z purlin clips.
 - .3 The multi-tiered support bracket shall consist of ERICO CADDY CATHBA and CableCat™ J-Hooks with screws; or approved equal.
- .4 Non-continuous cable support assemblies from tee bar
 - .1 Tee bar support bracket with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.
 - .2 Acceptable products: ERICO CADDY CAT12TS, CAT21528, CAT32528; or approved equal.
- .5 Non-continuous cable support assemblies from drop wire/ceiling

- .1 Fastener to wire/rod with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.
- .2 Acceptable products: ERICO CADDY CAT124Z34, CAT126Z34, CAT214Z34, CAT216Z34, CAT324Z34 or CAT326Z34; or approved equal.
- .6 Non-continuous cable support assemblies from beam, flange
 - .1 Fastener to beam or flange with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.
 - .2 Acceptable products: ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY beam clamps and CADDY flange clips; or approved equal.
- .7 Non-continuous cable support assemblies from C & Z Purlin
 - .1 Fastener to C or Z purlin with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus Listed.
 - .2 Acceptable products: ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY Purlin hangers; or approved equal.
- .8 Non-continuous cable support assemblies from wall, concrete, or joist
 - .1 Fastener to wall, concrete, or joist with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus Listed.
 - .2 Acceptable products: ERICO CableCat™ J-hook series CAT12, CAT21, CAT32, CAT64, with CADDY angle bracket; or approved equal.
- .9 Non-continuous cable support assemblies from threaded rod
 - .1 Fastener to threaded rod with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments, cULus Listed.
 - .2 The multi-tiered support bracket shall have a static load limit of 300 lbs.
 - .3 U-hooks and Double J-hook shall attach directly to threaded rod using standard nuts.
 - .4 Acceptable products: ERICO CableCat™ J-hook, CAT12, CAT21, CAT32, CAT64 with CADDY CATHBA series; CAT-CMTM Double J-hook CAT100CM, CAT-CMTM Direct mount U-hook CAT200CMLN, CAT300CMLN; or AFAB series; or approved equal.
- .10 Raised floor non-continuous cable support assemblies
 - .1 Fastener to raised (access) floor pedestal with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments; cULus Listed.
 - .2 Acceptable products: ERICO CADDY CAT12CD1B, CAT21CD1B or CAT32CD1B; CAT64CD1B; or approved equal.
- .11 Cantilever-Mounted cable supports
 - .1 U-hook shall be able to be assembled to a wide variety of wall mount brackets.
 - .2 Spacing of individual U-hooks as needed, max of 4' to 5' apart.
 - .3 U-hooks may have the optional attachment of a cable roller for ease in pulling cables.

- .4 Acceptable products: ERICO CAT-CMTM U-hooks CAT200CMLN, CAT300CMLN; CAT-CM roller assemblies CATRL200CM, CATRL300CM; CATWMCM bracket; or approved equal.
- .12 Installation accessories for non-continuous cable supports
 - .1 Cable Pulley
 - .1 Non-continuous cable supports may be used as an installation tool when a removable pulley assembly is included. The pulley shall be made of plastic and be without sharp edges. The pin and bail assembly must be able to be secured to the J-Hook during cable installation. The pulley must remain secured while cables are being pulled.
 - .2 The pin and roller assembly must be removed after cables are installed.
 - .3 Acceptable products: ERICO CADDY CAT32PLR, CAT64PLR, or approved equal.
 - .2 Cable Protector
 - .1 The protective steel tube shall fit over threaded rod and be at least 4" in length.
 - .2 The tube shall prevent damage to cables placed in or pulled through CAT-CMTM U-hooks. The tube shall not inhibit the pulling of cables.
 - .3 Acceptable products: ERICO CAT-CMTM CATTBCM, or approved equal.

2.04 Finishes

- .1 ASTM B633 Standard Specification for Electro-deposited Coatings of Zinc on Iron and Steel
- .2 ASTM B 695 Standard Specification for coatings of Zinc Mechanically Deposited on Iron and Steel
- .3 ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- .4 ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process
- .5 Non-continuous cable supports used where only mildly corrosive conditions apply shall be stainless steel, AISI type 304.

3 Execution

3.01 Installation

- .1 Installation and configuration shall conform to the requirements of the current revision levels of ANSI/EIA/TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.
- .2 Install cables using techniques, practices, and methods that are consistent with Category 5 or higher requirements and that supports Category 5 or higher performance of completed and linked signal paths, end to end.
- .3 Install cables without damaging conductors, shield, or jacket.
- .4 Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.
- .5 Pull cables without exceeding cable manufacturer's recommended pulling tensions. Use pulling means that will not damage media.

- .6 Do not exceed load ratings specified by manufacturer.
- .7 Adjustable non-continuous support sling shall have a static load limit of 100 lbs.
- .8 Follow manufacturer's recommendations for allowable fill capacity for each size non-continuous cable support.

End of Section

1 General

1.01 Section Includes

- .1 Cable trays, including ladder rack, wire mesh, optical fibre trough, and accessories.

1.02 Related Requirements

- .1 Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- .2 Section 26 05 29 – Hangers and Supports for Electrical Systems.

1.03 References

- .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (29th edition/2024).
- .3 CSA C22.2 No. 126.1-17 (CSA/NEMA) - Metal Cable Tray Systems (Binational standard with NEMA VE 1-2017).

1.04 Action Submittals

- .1 Product Data: Provide data for fittings and accessories.
- .2 Shop Drawings: Indicate tray type, dimensions, support points, and finishes.

1.05 Informational Submittals

- .1 Manufacturer's Instructions:
 - .1 Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements.
 - .2 Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06 Closeout Submittals

- .1 Project Record Documents: Record actual routing of cable tray and locations of supports.

1.07 Regulatory Requirements

- .1 Products: Listed and classified by CSA (Canadian Standards Association as suitable for the purpose specified and indicated.

2 Products

2.01 Ladder Rack-Type Cable Tray

- .1 Description: CSA C22.2 No. 126.1, Class ladder type tray.
- .2 Material: Aluminum.
- .3 Inside width: As indicated.
- .4 Inside depth: As indicated.
- .5 Straight section rung spacing: 152 mm (6 in) on centre.

- .6 Inside Radius of Fittings: As indicated.
- .7 Unless otherwise noted, provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.
- .8 Refer to drawings for details.
- .9 Manufacturers:
 - .1 Hubbell Nextframe Ladder Rack.
 - .2 Canadian Electrical Raceways "Telecom Cable Rack".
 - .3 Approved equal.

2.02 Wire Basket Cable Tray

- .1 Description: CSA C22.2 No. 126.1, Class Basket type tray.
- .2 Material: Carbon Steel, Hot Dipped Galvanized to ASTM A 123.
- .3 Inside Width: As indicated.
- .4 Inside Depth: As indicated.
- .5 Straight Section Rung Spacing: refer to drawings.
- .6 Inside Radius of Fittings: As indicated.
- .7 Unless otherwise noted, provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.
- .8 Refer to drawings for details.
- .9 Rung spacing 152 mm (6 in).
- .10 Radius for tees 305 mm (12 in) minimum. Exact size to be verified on site.
- .11 Do not employ tray elbows. Use Tees to permit future extension of tray.
- .12 Radius for the dropouts 125 mm (5 in) minimum. Exact size to be verified on site.
- .13 Manufacturers:
 - .1 Cablofil.
 - .2 Canadian Electrical Raceways Inc.
 - .3 Hubbell.
 - .4 Thomas & Betts.

2.03 Optical Fibre Routing System (Fibre Tray)

- .1 The optical fiber routing system shall be used to route, segregate, and protect fiber optic communication cabling.
- .2 ULC Listed (UL2024A)
- .3 Size:

- .1 100 mm x 100 mm (4 in x 4 in).
- .2 As otherwise indicated on drawings.
- .4 50 mm (2") minimum bend radius through-out pathway.
- .5 Impact resistant and flame-retardant material (UL94-V0 Flammability).
- .6 Color: Black.
- .7 Will include all mounting hardware, waterfalls, directional fittings, and other accessories required for installation.
- .8 Manufacturers:
 - .1 Panduit Fiberrunner series.
 - .2 ADC FiberGuide series.
 - .3 Commscope SpeedPRO series.

3 Execution

3.01 Installation

- .1 Trays to be sized to 40 per cent maximum capacity.
- .2 Install metallic cable tray to CSA C22.1 SB-02 and C22.2 No. 126.1.
- .3 Install fibreglass cable tray to CSA C22.1 SB-02 and C22.2 No. 126.2.
- .4 Support trays to Section 26 05 29. Provide supports at each connection point, at the end of each run, and at other points to maintain spacing between supports.
- .5 Use expansion connectors where required.

End of Section

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1 General

1.01 Section Includes

- .1 Firestopping through penetrations in fire rated assemblies.

1.02 Related Requirements

- .1 Section 07 84 00 – Firestopping.

1.03 References

- .1 ASTM E 84, “Surface Burning Characteristics of Building Materials”.
- .2 ASTM E 119, “Fire Tests of Building Construction and Materials”.
- .3 ASTM E 814, “Fire Tests of Penetration Firestop Systems”.
- .4 ANSI/UL263, “Fire Tests of Building Construction and Materials”.
- .5 ANSI/UL723, “Surface Burning Characteristics of Building Materials”.
- .6 ANSI/UL1479, “Fire Tests of Through Penetration Firestops”.
- .7 Underwriters Laboratories Inc. (UL) – Fire Resistance Directory

1.04 Performance Requirements

- .1 Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur, such devices shall:
 - .1 Meet the hourly rating of the floor or wall penetrated.
 - .2 Permit the allowable cable load to range from 0% to 100% visual fill thereby eliminating the need to calculate allowable fill ratios.
 - .3 Not require any additional action on the part of the installer to open or close the pathway device or activate the internal smoke and fire seal, such as, but not limited to:
 - .1 Opening or closing of doors.
 - .2 Twisting an inner liner.
 - .3 Removal or replacement of any material such as, but not limited to, sealant, caulk, putty, pillows, bags, foam plugs, foam blocks, or any other material.
 - .4 Permit multiple devices to be ganged together to increase overall cable capacity.
 - .5 Allow for retrofit to install around existing cables.
 - .6 Include an optional means to lengthen the device to facilitate installation in thicker barriers without degrading fire or smoke sealing properties or inhibiting ability of device to permit cable moves, add-ons, or changes.
- .2 Where single cables (up to 7 mm (0.27 in) diameter) penetrate gypsum board/stud wall assemblies, a fire-rated cable grommet may be substituted. Acceptable products shall be molded from plenum-grade polymer and conform to the outer diameter of the cable forming a tight seal for fire and smoke. Additionally, acceptable products shall lock into the barrier to secure cable penetration.

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- .3 Where non- mechanical products are utilized, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water, or other forms of moisture characteristic during or after construction.
- .4 Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate telecommunications and data cabling shall be provided with re-enterable products that do not cure or dry.
- .5 Cable trays shall terminate at each barrier and resume on the opposite side such that cables pass independently through fire-rated pathway devices. Cable tray shall be rigidly supported independent from fire-rated pathway devices on each side of barrier.

1.05 Submittals

- .1 Submit under provisions of Section 01 33 00.
- .2 Product Data: Provide manufacturer's standard catalog data for specified products demonstrating compliance with referenced standards and listing numbers of systems in which each product is to be used.
- .3 Shop Drawings: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.
- .4 Certificates: Product certificates signed by firestop system manufacturer certifying material compliance with applicable code and specified performance characteristics.
- .5 Installation Instructions: Submit manufacturer's printed installation instructions.

1.06 Quality Assurance

- .1 Products/Systems: Provide firestopping systems that comply with the following requirements:
 - .1 Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop system acceptable to authorities having jurisdiction.
 - .2 Firestopping products bear the classification marking of qualified testing and inspection agency.
- .2 Installer Qualifications: Experience in performing work of this section who is qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products in accordance with specified requirements.

1.07 Delivery, Storage, and Handling

- .1 Delivery:
 - .1 Manufacturer's original, unopened, undamaged containers, identification labels intact identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instruction for multicomponent products.
 - .2 Handle and store products according to manufacturer's recommendations published in technical materials. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.
- .2 Storage and Protection:

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- .1 Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

1.08 Project Conditions

- .1 Do not install firestopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer.
- .2 Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.
- .3 Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.
- .4 Do not use materials that contain flammable solvents.
- .5 Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.
- .6 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.
- .7 Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

2 Products

2.01 Manufacturers

- .1 Specified Technologies Inc.
200 Evans Way, Somerville, NJ 08876. Tel: (800) 992-1180, Fax: (908) 526-9623, Email: specseal@stifirestop.com, Website: www.stifirestop.com.
- .2 Substitutions: as approved by the Consultant prior to tender closing.
- .3 Single Source: Obtain firestop systems for each type of penetration and construction condition indicated only from a single manufacturer.

2.02 Materials

- .1 General: Use only firestopping products that have been tested for specific fire resistance rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate instance.

2.03 Fire Rated Cable Pathways

- .1 Steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:
 - .1 Specified Technologies Inc. (STI) EZ-PATH Fire Rated Pathway.

3 Execution

3.01 Examination

- .1 Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of firestopping in accordance with manufacturer's installation instructions and technical information.

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- .2 Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellants, and any other substances that may inhibit optimum adhesion.
- .3 Provide masking and temporary covering to protect adjacent surfaces.
- .4 Do not proceed until unsatisfactory conditions have been corrected.

3.02 Installation

- .1 General: Install through-penetration firestop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.
- .2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of firestopping products.

3.03 Field Quality Control

- .1 Inspections: Engage qualified independent inspection agency to inspect through-penetration firestop systems.
- .2 Keep areas of work accessible until inspection by authorities having jurisdiction.
- .3 Where deficiencies are found, repair firestopping products so they comply with requirements.

3.04 Adjusting and Cleaning

- .1 Remove equipment, materials, and debris, leaving area in undamaged, clean condition.
- .2 Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.

End of Section

1 General

1.01 Section Includes

- .1 Labelling and identification requirements for communications systems.

1.02 References

- .1 ANSI/TIA/EIA-606-A – Administration Standard for Commercial Telecommunications Infrastructure.
- .2 UL 969 – Marking and Labeling Systems.

2 Products

2.01 Summary

- .1 Adhesive cable labels to meet the legibility, defacement, and adhesion requirements specified in UL 969 (Ref. D-16). In addition, the labels shall meet the general exposure requirements in UL 969 for indoor use.
- .2 Self-laminating vinyl construction cable labels with a white printing area and a clear tail that self laminates the printed area when wrapped around a cable. The clear area should be of sufficient length to wrap around the cable at least one and one-half times.
- .3 ANSI/EIA/TIA-606 for colour codes shall be followed. Labels are to be mechanically printed using a laser printer. Hand written labels will not acceptable.

2.02 Label Printer

- .1 Thermal Transfer Printer shall print high quality, industrial labels on a wide variety of materials for electrical and network applications such as wire/cable, components, safety, and facility identification.
- .2 Laminated Adhesive Label Cassettes:
 - .1 For flat label applications.
 - .2 Polyester material.
- .3 Non-Laminated Adhesive Label Cassettes:
 - .1 For marking wire and cable and flat label applications.
 - .2 Polyester material
- .4 Example Products:
 - .1 Panduit LS7 series hand-held printer.
 - .2 Panduit LS8 series hand-held printer.

2.03 Nameplates

- .1 Engraved three-layer laminated plastic, letters on contrasting background:
- .2 Rack and Cabinet ID labels: 25 mm (1") high White Text on Black Background

3 Execution

3.01 Installation

- .1 Cable identification labels should appear at the following locations with the numbers indicated on the cable schedule and drawings:
 - .1 300 mm (12 inches) from each end of the cable – after termination.
 - .2 Front of patch panels.
 - .3 Front of IDC termination blocks.
 - .4 Front of workstation/communications outlet faceplates.
 - .5 Each end of each Telecommunications Conduit.
- .2 Fibre Optic safety labels shall appear at the following locations:
 - .1 Along the length of the conduit or innerduct at 3 m (10 foot) intervals.
 - .2 At all junction boxes
 - .3 At all pull boxes.
 - .4 On all fibre optic patch panels.
- .3 Provide 25 per cent additional labels to be left in each telecommunications room on site for future growth.
- .4 Provide two Rack/Cabinet nameplates. Mount one on the front, and one on the rear of the rack.

3.02 Identification Conventions

- .1 All cabling will be labelled with the closet letter, followed by a dash and the wire number (i.e. A-001 would be the first wire in closet A).
- .2 Labelling for backbone wiring will be preceded with BB followed by the wire number (i.e. BB-001 would be the first backbone).

End of Section

1 General

1.01 Section Includes

- .1 Commissioning Requirements.

1.02 References

- .1 Refer to Section 27 05 00 for references.

1.03 Closeout Submittals

- .1 The Telecommunications Cabling Contractor is required to submit test results in native tester format or a format which can be read with a text reader (i.e. ".txt" extension). Paper results shall not be submitted for projects with 100 or more horizontal cable drops and/or fibre cables.
- .2 The Telecommunications Cabling Contractor is required to provide the software required to view the results.
- .3 The report should be divided into sections by Telecommunications Room.
- .4 The report should indicate for each cable when it was tested successfully, the result, and the length.
- .5 The Telecommunications Cabling Contractor shall sign off on the entire test report prior to submitting to the Consultant.
- .6 The test result documentation is to be submitted to the Consultant for review no later than 10 working days following the completion of the installation.
- .7 All deficiencies must be corrected before the Consultant will provide a certificate to release the Holdback on the project.

2 Products – Not Used

3 Execution

3.01 Installation

- .1 Testing of all horizontal copper cables are to be completed in accordance with the follow test criteria:
 - .1 Basic Link
 - .2 Grounds
 - .3 NEXT
 - .4 ELFEXT
 - .5 Continuity
 - .6 correct polarity
 - .7 PSNEXT
 - .8 PSELFEXT
 - .9 Shorts
 - .10 Length

- .11 ACR
- .12 Return Loss
- .13 Opens
- .14 Attenuation
- .15 PSACR
- .16 Resistance
- .2 Fibre strands in excess of 122 m (400 ft) shall be tested with an Optical Time Domain Reflectometer for length and attenuation.
- .3 Test each stand of fibre, bi-directionally, with a Power Meter / Light Source combination operating at wavelengths of 850 nm and 1300 nm for multimode fibres.
- .4 Maximum multi-mode passive link loss (including patch cords) is not to exceed -2.35 dB.
- .5 Maximum single-mode passive link loss (including patch cords) is not to exceed -1.0 dB.

3.02 Record Drawings

- .1 The Telecommunications Cabling Contractor is required to maintain one set of correct and accurate record drawings on-site at all times. These drawings are to be made available to the General Contractor/Construction Manager or the Consultant for review during the project.
- .2 The Telecommunications Cabling Contractor is required to provide record drawings of the telecommunication cabling installation in relation to the drawings provided in this specification.
- .3 The record drawings shall be updated electronically and include, but are not limited to;
 - .1 Horizontal cable numbers on the floor plans
 - .2 Horizontal Cable Routing on the floor plans
 - .3 Changes on the floor plans
 - .4 Backbone cable Routing between Telecommunications Rooms
 - .5 Paging Speaker Locations including daisy chain cable run
 - .6 Wireless Access Points and Cell coverage
 - .7 Cabinet/Rack Elevation drawings
 - .8 Backboard Elevation Drawing
- .4 The Telecommunications Cabling Contractor shall provide one soft copy in AutoCAD 2007 and one plotted copy for the Consultant to review prior to complete substantial performance and close-out documentation submission.
- .5 After approval, the Telecommunications Cabling Contractor shall submit one plotted copy of the drawings for;
 - .1 The Main Computer Room
 - .2 Each Telecommunications Room

- .6 All close-out documentation must be submitted to the General Contractor/Construction Manager or The Consultant within 10 working days of the completion of the project before the documentation holdback will be released.

End of Section

1 General

1.01 Summary

- .1 Supply, install and test complete data cabling system and accessories, based on physical star wiring topology, and as specified herein and indicated on drawings [for the new addition].
- .2 Include data cabling system the following sub-systems:
 - .1 Backbone Terminal Systems, located in Communications Closets, to serve as connection points between backbone cables and horizontal distribution cables.
 - .2 Horizontal distribution system links backbone terminal system to telecommunications outlets.
 - .3 Contractor is to submit details on equipment types and locations for review and approval prior to installation.

1.02 Related Requirements

- .1 Active electronics, including servers, hubs, routers, switchers, and, PCs are by Owner and are not part of this contract.

1.03 Abbreviations and Acronyms

- .1 MTER Main Telecommunication Equipment Room.
- .2 TC Telecommunications Closet.
- .3 TCs Telecommunications Closets.
- .4 RCDD Registered Communications Distribution Designer.
- .5 BICSI Building Industry Consulting Service International.
- .6 MDTS Main Distribution Terminal System.
- .7 IDC Insulation Displacement Connection.
- .8 OTDR Optical Time-Domain Reflectometer.
- .9 BCS Backbone Cabling System.
- .10 IDT Intermediate Distribution Terminal.
- .11 BTS Backbone Terminal System.

1.04 Reference Standards

- .1 Conform to CAN/CSA-T530 for new buildings and areas of substantial renovations of telecommunications, spaces, and pathways.
- .2 Ensure that cabling system shall conform to current issue of industry standard CAN/CSA-T529. This standard is currently being revised and is available as document EIA/TIA SP-2840A (future CAN/CSA-T529). All requirements of this new document must be followed including: Structural Return Loss (section 10.2.4.5), Power Sum Testing (section 10.3.4.7) and End to End Link Performance and continuity, attenuation, cable open and shorts, NEXT; mutual capacitance, pair polarity and cable impedance, S/N ratio, and Pass/Fail status. Tests are to be conducted and recorded using a Penta Scanner. Fibre optic cables shall be tested in conformance to ISO/IEC IS 11801 standards using an EXFO Optical Time Domain Reflectometer. Test results such as; dB loss, cable length and fibre deficiencies (if any) shall be conducted. Verification, documentation, and warranty shall be provided.

- .3 Where applicable, have performance of Category 5e cabling components used, verified by nationally recognized testing laboratory. Submit test results upon request.
- .4 Conform to applicable Building and Electrical Safety Codes.

1.05 Submittals

- .1 Shop Drawings
 - .1 Provide submittals in accordance with Section 01 33 00 prior to commencing installation.
 - .2 Submit complete cabling system layout for Consultant review for data, cable routing summary and cable outlet designation. Have cabling system layout performed by accredited RCDD (Registered Communications Distribution Designer) as defined by BICSI (Building Industry Consulting Service International). The Data Cabling system will not be accepted without this submission.
 - .3 Documentation proving compliance to End-to-End Link Performance test, as specified in Annex E of EIA/TIA SP-2840A shall be provided prior to structured cabling being installed.
 - .4 Submit detailed layout drawings, including termination racks prior to commencing this installation.
 - .5 Manufacturer's product information documents on all components of the cabling system, including horizontal and vertical cable management systems and all auxiliary components/devices and equipment prior to commencing this installation.
 - .6 The following documentation shall be submitted with a following cover letter listing attachments prior to commencement of work.
 - .1 A list of personnel for the project that will include the name of the Project Manager, Site Manager(s), Lead Hands, and Installers.
 - .2 Permits and notifications as may be required for the project.

1.06 Closeout Submittals

- .1 Provide manufacturer's certificate at completion of installation certifying the installation.
- .2 Prepare and submit "As-built" drawings reviewed by an RCDD.
- .3 "As-built" drawings are to detail the exact location of equipment indicating wiring runs and raceways, pull, junction and terminal boxes. Also to include outlet locations, cable numbers and equipment rack profiles.
- .4 Upon completion of work and prior to final acceptance, the contractor will submit to the Owner the required copies of Network Certification and Documentation in the form of manuals that will include the following:
 - .1 Detailed information on types of materials and equipment used and their locations including: distribution frame equipment (rack), equipment types and locations; a detailed listing of cable and outlet types and locations.
 - .2 Accurately and neatly recorded test results.
 - .3 Accurately and neatly record locations including room numbers, of all network components in list form for easy reference.
 - .4 Identify drawings as 'Project Record Copy' and maintain in new condition making available for inspection by Owner.

- .5 Bind all items listed above in a 3-ring hard covered binder suitably labelled with the names of each site/project.

1.07 Quality Assurance

- .1 Qualifications of Manufacturer
 - .1 Supply equipment manufactured by experienced reputable manufacturer, whose installations have rendered satisfactory service for at least 2 years and who would provide factory trained technicians fully experienced in telecommunications wiring. Submit information regarding number of employees, and proof of VAR/CSV certification, including length of time Contractor or employee(s) have been certified to install Cable systems.
 - .2 Provide certification that cabling solution offered will perform as a system as is defined in standards documents such as EIA-TIA SP-2840A and T568A configuration for Category 5E system standards. Provide certification supported by manufacturer of cabling components used.
 - .3 In addition to certificate of assurance, evidence of support by manufacturer for above items shall be provided upon request in writing with bidding response.
 - .4 Use components sourced completely from single manufacturer.
- .2 Qualifications of Installer
 - .1 Provide installation and supervision work supervised by telecommunications technicians qualified to install voice and data cabling system and to perform related tests as required by manufacturer. Installers/company must have valid certification.
 - .2 Provide fully qualified telecommunications technicians, trained and certified by manufacturer in installation and testing of equipment specified. Provide evidence upon request in writing prior to work commencement of manufacturer's certification of supplier's ability to properly install structured cabling for building.
 - .3 Submit proven track record in cabling projects of similar size. Include details of minimum 3 projects of similar size involving category 5E cabling, Multimode and Single-mode fibre optic cabling which have been completed in last 2 years. Include names, addresses, and phone numbers of references for 3 projects.
- .3 Certifications
 - .1 UTP network wiring shall conform to T568A configuration, Category 5e system standards. All UTP cables shall provide minimum signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination at each end. The following tests will be conducted and recorded using a Penta Scanner:
 - .2 End to end continuity, attenuation, cable open and shorts; NEXT; mutual capacitance; pair polarity and cable impedance; S/N ratio and pass/fail status.

1.08 Warranty

- .1 The structured cabling systems shall be warranted for 25 years, covering all system products manufactured and provided by the single source supplier. The warrantor shall guarantee the following:
 - .1 All passive system components, e.g. patch panels, UTP cable and outlet jacks are free from manufacturing defects in material or workmanship
 - .2 Approved cabling systems exceed the specifications of the T1A-568A standards and ISO/IEC IS 11801, if applicable.

- .3 The installation exceeds attenuation and near end cross talk, loss and bandwidth requirements TIA Bulletin TIA TSB-67 and ISO/EIC IS 11801.
- .2 General workmanship and apparatus installed under this contract shall be warranted against defects of workmanship and material for a period of one year after final acceptance of work by the Owner, unless otherwise specified. The contractor will make good any defects developed as a result of their work during such time without expense to the Owner.

2 Products

2.01 Manufacturers

- .1 Manufacturer List
 - .1 Belden.
 - .2 Commscope.
 - .3 Panduit.
 - .4 TE.
 - .5 Wirewerks.
 - .6 Approved equal.
- .2 Substitution Limitations
 - .1 Copper cabling installation shall be of one manufacturer.

2.02 UTP Cabling

- .1 100 ohm 4 pair UTP, compliant with TIA/EIA-568-C.2
- .2 Category 3 cabling for telephone communication.
- .3 Category 5e for data communication, security cameras.
 - .1 Unshielded twisted pair, 4 pair twisted, #24AWG, FT-6/CMP plenum rated, blue outer insulation,
- .4 CMP (FT6) Plenum rated.
- .5 No splicing of any data network cabling will be permitted.

2.03 Data Outlets

- .1 All data jacks must meet specifications.
- .2 Computer outlets complete with termination jacks shall be single, duplex or quad flush faceplates complete with Category 5e, 8-position jacks.
- .3 Supply and install one – 4 pair cable to the single outlet, two – 4 pair cables to the duplex outlet, and three – 4 pair cables to quad outlet.

2.04 Patch Panels/Equipment Racks

- .1 All data UTP, 4 pair, Category 5e horizontal cables are to be terminated on cabinet or rack mounted 24/48 port panels wired.

- .1 PS5 HD-BIX Patch panel, 1U, 24 Port (Belden AX100465 or equal)
- .2 PS5 HD-BIX Patch panel, 2U, 48 Port (Belden AX100473 or equal)
- .2 Network rack must have the following features:
 - .1 Free standing.
 - .2 Standard 19" module compatible.
 - .3 Lockable door.
 - .4 Maximum dimensions of 22"w x 36"d x 85" h.
 - .5 Acceptable products:
 - .1 RF Mote Cat. #RFM-1944-RHD c/w hinged lockable door.
 - .2 Anixter Cat. #175419 c/w hinged lockable door.
- .3 Distribution panels must be category 5E rated BIX punchdown style with capacities as follows;
 - .1 24 port Belden AX100465
 - .2 48 port Belden AX100473
 - .3 96 port Belden AX100485
- .4 In addition to the above, provide all necessary ancillary equipment such as cable management, label holders, and patch cords.

2.05 Patch Cords

- .1 Provide Category 5e patch cords, consisting of 4 pair stranded cable rated FT4 or higher and stamped accordingly. They must conform to EIA/TIA 568A and meet or exceed the EIA/TIA TSB-36 specifications for cordage.
- .2 Patch cords at the workstation end shall be 3050 mm in length, one per data cable.
- .3 Patch cords at the TC end shall be 2133 mm in length, one per data cable.

3 Execution

3.01 Pathways for Communications

- .1 Conduit to Section 26 05 33.13. J-Hooks: as described in Section 27 05 29.
- .2 Cabling between cable tray/j-hooks and data outlets to be enclosed in EMT conduit.
- .3 Cables/data outlets may be enclosed in pre-finished non-metallic raceways computer labs, classrooms, etc. where indicated.
- .4 Data network cables shall be installed in cable tray. Data network cables shall not be tie-wrapped to electrical conduits, mechanical piping, etc. and shall be run as far as possible from fluorescent lighting fixtures, transformers and electrical power service conduits.

3.02 Installation

- .1 Each equipment rack shall be anchored securely to the floor and grounded to the building ground with a #6 AWG Insulated Ground Wire in accordance with applicable code requirements (refer to CAN/CSA T5238).
- .2 Ground all data cables shields and associated equipment in Telecommunications rooms to meet applicable code requirements.
- .3 Supply vertical cables and backbone cabling using cable clamps or wiring harnesses.
- .4 Conform to Telecommunications Industry Standards (refer to EIA/TIA 568A) for all cable termination and pinning assignments.
- .5 Utilize cable trays in MTER and TCs to manage cable in orderly fashion.
- .6 All sleeves containing cable or unused shall be fire sealed. Coordinate with Section 07 84 00 for provision and installation of fire barriers.
- .7 Cabling is to be run at 90 degrees to the building grid except where the distance would exceed 90m in length if installed in this manner.
- .8 The maximum horizontal run length is not to exceed 90 metres. If the 90 metre constraint cannot be met, the Cabling Contractor is to notify the Owners Designee of any cables that exceed 90 metres, prior to the installation.
- .9 Ensure all grounding conductors are rated FT-6. Tie into bundles and support using j-hooks outside of tray or conduit and fasten to under-slab at intervals not to exceed 1500 mm.
- .10 Route all cable in such a way as to ensure minimum separations are maintained from sources of EMI as defined in EIA/TIA SP-2840A.
- .11 Place all exposed cabling in TC in neat and professional manner and route as per specifications and drawings. Cables are to be combed, bundled, and routed in a neat and organized manner. Tie-wrap all exposed cable bundles at maximum of every 200 mm using black 'hook-and-loop' fastening ties.
- .12 Securely mount voice outlets at all work area locations and locate so that cable required to reach work area equipment will be no more than 3 m long.
- .13 Ensure that optical fibre splices, fusion or mechanical, do not exceed maximum optical attenuation of 0.3 dB when measured in accordance with EIA/TIA 455-34 and CSA Standard C22.2 No. 232.
- .14 All cables must be properly handled and installed in accordance with the manufacturer's specification. Undue pulling tension, abrasion or rough handling must be avoided to ensure that the cables will permit transmission of the intended information with no impairment or degradation of signal quality. Cable runs between the wiring closets and wall plates must be performed with no splices or cuts to ensure the elimination of reflections, discontinuities, impedance, mismatches, and egress/ingress of undesired signals. Cables must be installed at a specified distance (shown below) from any electrical equipment such as radios, televisions, fluorescent lights or fixtures, motors, transformers, or other significant sources of RFI/EMI interference
- .15 Label all cables in accordance with Industry Standards and CAN/CSA T528 specifications. Number cables as per drawings.
- .16 In cases where the routing may bring the cable in close proximity to the above mentioned sources of disruption, the following minimum distances must be maintained:
 - .1 125 mm (5 inches) from power lines of 2 kVA or less.

- .2 305 mm (12 inches) from lighting (including fluorescent).
- .3 914 mm (36 inches) from power lines of 5 kVA or greater
- .4 40 inches from transformers and motors
- .17 As well, cables must be routed to avoid direct contact with steam pipes or other heat sources so as to avoid thermal degradation of the cable insulation or other undesired effects.
- .18 Cables shall be located in ceiling spaces neatly, tied in bundles and installed in cable management "trays", J-hooks, and conduit as indicated on the drawings.
- .19 All cables entering the wiring closets must be neatly dressed in bundles and run to the appropriate terminating location.
- .20 Each cable sheath must be clearly and permanently identified with a labelling scheme acceptable to the owner. Each patch panel port must be clearly and indelibly marked with a structured, user friendly numbering scheme. This numbering scheme must be capable of accepting cable additions so as not to disrupt the logical flow of the scheme. All testing documentation is to reference this numbering scheme.
- .21 NOTE: The faceplate identification numbers/tags MUST be added to the electronic versions of the floor plans. This will be considered part of the As Built contract closeout submittals. The electronic version of the floor plan will be provided in ACAD 14 format by the consultant.
- .22 The wiring closets shall be labelled C1 etc.
- .23 Fibre optic cable installation procedures shall be as follows:
 - .1 All cables must be properly handled and installed in accordance with the manufacturer's specification. Undue pulling tension, abrasion or rough handling must be avoided to ensure that the cables will permit transmission of the intended information with no impairment or degradation of signal quality. Cable runs between the wiring closets and must be performed with no splices or cuts to ensure the elimination of reflections, discontinuities, excess signal loss, or other undesirable problems.
 - .2 All fibre cables shall be installed in conduits from end-to-end.
 - .3 If, during the course of cable installation, it is necessary to bore holes through a firewall, the holes must be sealed with an acceptable sealing material of compound once the cables are in place.
 - .4 All cables entering the computer room must be neatly dressed in bundles and run to the appropriate terminating location.
 - .5 Cable runs shall be free of tension at both ends as well as over the length of the run.
 - .6 Each cable sheath must be clearly and permanently identified at each end using an appropriate labelling scheme accepted by the Owner.

3.03 Cable Identification and Labels

- .1 To Section 27 05 53.
- .2 All adhesive cable labels shall meet the legibility, defacement, and adhesion requirements specified in UL 969 (Ref. D-16). In addition the labels shall meet the general exposure requirements in UL 969 for indoor use.
- .3 Cable labels shall be of self-laminating vinyl construction with a white printing area and a clear tail that self laminates the printed area when wrapped around a cable. The clear area should be of sufficient length to wrap around the cable at least one and one-half times.

- .4 All labels must be mechanically printed using a laser printer. Hand written labels are not permitted.
- .5 Labels are to be attached to:
 - .1 front of the IDC connector or communication outlet faceplate
 - .2 each patch panel jack
 - .3 each end of the horizontal cable at maximum distance of 50mm from the end of the sheath
- .6 Affix faceplate label printed with Workstation Identification number to faceplate cover of in-tile service box.

3.04 Site Tests and Inspections

- .1 All UTP distribution cabling must be tested with a specialized UTP cable tester to measure the following characteristics:
 - .1 DC Resistance
 - .2 Characteristic Impedance
 - .3 Cable Length
 - .4 Pair Sequence Testing
 - .5 Hardcopy checklists indicating room number and faceplate ID, should be prepared, These results should be documented and form part of the Certification Report, Any documentation supplied in hardcopy form should also be supplied in electronic format (suitable word processing file, spread sheet, graphics file (e.g. AutoCAD, etc.).
 - .6 In addition to the above UTP testing, each cable and termination must be tested to 100 MBS standards.
 - .7 The specific tests to be performed, after all jack plates are mounted on boxes and labelled, are as follows,
 - .1 Mutual Capacitance
 - .2 Attenuation
 - .3 Near End Cross Talk
- .2 Fibre Optic Cable Testing Procedure
 - .1 System acceptance tests must be performed to verify that the cable plant can be certified fully operational. All optical fibre strands must be properly measured with approved optical fibre test equipment for the following characteristics:
 - .1 End to end attenuation loss in dB as measured by a calibrated optical power meter.
 - .2 Splice loss (if any)
 - .3 Cable length
 - .2 The above results are to be obtained by the following test procedures:
 - .1 Power meter and light source.
 - .2 OTDR - provide hard copy of signature trace in report.

- .3 Detailed results of these tests must be included as part of a Certification Report.
- .4 No connector should exceed 0.5 dB loss. Splices shall not exceed 0-3 dB loss. Total attenuation of link including fibre cable, connectors and splices shall not exceed 5 dB.
- .3 These test results must be documented and form part of the Certification Report.

End of Section

1 General

1.01 Section Includes

- .1 Communication Cabinets.
- .2 Racks.
- .3 Frames and Enclosures.

1.02 Related Requirements

- .1 Related Work **by Other Trades**
 - .1 Division 23 (HVAC)
 - .1 Section 23 81 23 – Computer-Room Air-Conditioners: In Row CRAC units.
 - .2 Division 26 (Electrical)
 - .1 Permanent Power at Racks
- .2 Related Work in Other Sections
 - .1 Section 27 05 26 – Grounding and Bonding for Communications Systems.
 - .1 Bonding of racks and cabinets.
 - .2 Section 27 05 36 – Cable Trays for Communications Systems.
 - .1 Cable Tray.
 - .2 Fibre Optic Tray.
 - .3 Section 27 11 19 – Communications Termination Blocks and Patch Panels.
 - .1 Rack mounted horizontal patch panels.
 - .4 Section 27 11 26 – Communications Rack Mounted Power Protection and Power Strips.
 - .1 Installation of rack mounted power distribution units and power strips.

1.03 References

- .1 Refer to Section 27 05 00 for references.

1.04 Submittals

- .1 Conform with the requirements of Section 01 33 00.
- .2 Product Data: Provide manufacturers catalogue information.

1.05 Delivery, Storage, and Handling

- .1 Refer to Section 01 61 00.

2 Products

2.01 Manufacturers

- .1 Panduit (selection is based on Owner's standard).
- .2 Substitution Limitations: [No other manufacturers will be accepted.]

2.02 General

- .1 Keying
 - .1 Unless otherwise noted, key all racks and cabinets identically.
- .2 Blank Panels
 - .1 Fill unused rack openings with blank panels, as specified elsewhere herein below.

2.03 Net-Access Switch Cabinets

- .1 The 32" x 40" Net-Access Switch Cabinets shall consist of welded metal frames available in 31.5" (800 mm) widths, 40.0" (1016 mm) depths, and 42 RU or 45 RU heights. Cabinet equipment rails shall be adjustable up to 25.9" (657 mm). Top panels shall include multiple openings with molded edge protection for cable entry. Cabinets shall include front dual hinge doors with 63% open perforation and rear split doors. Cabinets shall include front and rear cable management fingers. The entire cabinet shall be fully electrically bonded, including equipment rails, doors and side panels. Single point bonding locations shall be available at the top and bottom of each cabinet. Cabinets shall have a UL listed 2500 lbs. load rating.
- .2 Cabinet:
 - .1 Cabinet frame with top panel.
 - .2 Dual hinge perforated front door opens to the left or right.
 - .3 Split perforated rear doors open in the middle to minimize door swing footprint.
 - .4 Two sets of #12-24 threaded equipment mounting rails – numbered up.
 - .5 45 RU cable management on front and rear of front posts.
 - .6 Dimensions: 84.0"H x 31.5"W x 41.1"D (2134 mm x 800 mm x 1044 mm)
 - .7 Acceptable Manufacturer: Panduit CN2NU series.
- .3 Side Panels:
 - .1 Removable solid side panel with lockable push button latches.
 - .2 Acceptable Manufacturer: Panduit CNPS series.

2.04 Mounting Screws

- .1 #12-24 x .5" mounting screws, quantity 100 per lot.
- .2 Panduit S1224C.

3 Execution

3.01 General Installation

- .1 Install cabinet side panels to cabinets at end of rows, or to cabinets not immediately adjacent (for example where separated by a column).
- .2 Install hot aisle containment panels at locations for future racks.
- .3 Install hot aisle containment doors at end of hot aisles.
- .4 Provide Rack Bonding Jumpers.

3.02 2-Post Racks and Vertical Cable Management

- .1 Install 200 mm (8 inch) Vertical Cable Managers (Front and Rear) c/w doors to the side of 2-Post Racks.
- .2 Install 300 mm (12 inch) Vertical Cable Managers (Front and Rear) c/w doors between adjacent 2-Post Racks.

3.03 Server Cabinets

- .1 Install Patch Panels and Horizontal Cable Managers at rear of server cabinets.

End of Section

1 General

1.01 Section Includes

- .1 Data Centre Aisle Containment.
- .1 Vertical containment curtains.
- .2 Rigid vertical containment panels

1.02 Related Requirements

- .1 Section 27 11 16 – Communications Cabinets, Racks, Frames, and Enclosures.
- .2 Section 27 11 17.01 – Aisle Containment - End of Row Doors.

1.03 Related Work By Other Trades

- .1 Section 23 81 23 – Computer-Room Air-Conditioners: In Row CRAC units.

1.04 Submittals

- .1 Conform with the requirements of Section 01 33 00.
- .2 Product Data: Provide manufacturers catalogue information.

1.05 Delivery, Storage, and Handling

- .1 Refer to Section 01 61 00.

1.06 Warranty

- .1 The aisle containment system shall be covered by a 1 year warranty.

2 Products

2.01 Manufacturers

- .1 Legrand Ortronics Mighty Mo Air Control Solutions.
- .2 Simplex Isolation Systems.
- .3 APC.
- .4 Chatsworth.
- .5 Eaton.
- .6 Tate.
- .7 Equal, as approved by Consultant.

2.02 Containment Curtains

- .1 General
 - .1 The curtains and strip doors can be hanged via strut channel or from the dropped ceiling support frame where allowed.

- .2 Vertical containment shall come in a kit that includes all the necessary hangers, tracks and panels to cover the specific area.
- .3 Available in three configurations:
 - .1 Hanging Vinyl Strip Doors, used to close the end of the aisle or to contain desired areas down to the floor.
 - .2 Hanging Vinyl Panels, used to contain the area on top of the cabinets.
 - .3 Hanging Vinyl Corner Panels, used to facilitate the installation of the containment around the corners of the rectangular area being contained.
- .2 Aluminum Track
 - .1 Clear anodized with an ultimate tensile strength of at least 22,000 psi.
- .3 Electromagnetic Fusible Link
 - .1 Reusable Electromagnetic Fusible Link Used For Fire Protection
 - .2 Listed by Underwriters Laboratories, Inc.
 - .1 Reusable fusible link will cause curtain to drop on fire event.
 - .3 Minimum Load = 3 lbs. (1.36 kg.)
 - .4 Corrosion Resistant Construction
- .4 Vinyl Strip Doors & Curtains
 - .1 All vinyl curtains and strip doors are considered fire resistant.
 - .2 Meets requirements of CPAI-84
 - .3 Meets requirements of NFPA-701
 - .4 1,000 Hours U.V. - ASTM Weatherometer
- .5 Ceiling Attachment:
 - .1 Spring steel. Twist-on to lock securely onto the ceiling grid. 7/16 inch diameter loop. 1 ½ inch long.

2.03 Rigid Containment Panels

- .1 To span gaps in rows of cabinets
 - .1 Where cabinets do not directly abuts one another.
 - .2 Where cabinets do not directly abuts end partitions.
- .2 Dimensions:
 - .1 Width: per drawings.
 - .2 Height: to match adjacent server cabinets.
- .3 Construction:
 - .1 Prefabricated solid panels consisting extruded aluminum frames.

- .2 Finish: black, or to match server cabinets.
- .3 Panels to be complete with appropriate hardware and mounting brackets to secure to adjacent cabinets and partitions.
- .4 Cold aisle panels to match server cabinet doors in appearance.

3 Execution

3.01 Installation

- .1 Install containment curtains in accordance with manufacturer's instructions.
- .2 Cut vinyl curtains to suit top of cabinets.
- .3 Provide corner units at each corner of contained aisle.
- .4 Connection to the ceiling grid will be made with a cold steel twist connector.
- .5 Connection to the aluminum track will be with a UL/FM rated fire suppression link that releases at 135F/57.2C and a 360-degree ball joint.
- .6 The vinyl drop-down material will have a 2 inch extension so as to overlap with adjacent vinyl drop down material. This will ensure a seamless partition.
- .7 The ceiling connection system shall allow for a 1-½ inch space between the aluminum track and the drop ceiling.
- .8 The aluminum tracks shall be connected with a splicer so as to form a continuous track system.
- .9 The containment system will be shipped in kits of 1 foot-6 foot lengths and drop down lengths to exceed the distance from the ceiling grid to the top of the lowest rack.

End of Section

1 General

1.01 Section Includes

- .1 Termination Blocks, Patch Panels, and Connectors.

1.02 Related Requirements

- .1 Section 27 13 13 – Communications Copper Backbone Cabling.

1.03 Submittals

- .1 Product Data: Provide manufacturers catalogue information.

2 Products

2.01 Copper Termination Blocks

- .1 Refer to Section 27 13 13.
- .2 Copper IDC termination block to be wall mounted BIX type, 300 Pair, c/w wire management and cross-connect jumper wires.

2.02 Copper Patch Panels and Termination Blocks

- .1 Copper patch panel to be 19" rack mount, 24/48 port, Category 5e [6] [6A], 8 pin modular jack (RJ45) with labels and icons, icon color to match field outlet color. Patch panel to have 2 types, angled type for the cabling rack and flat type for equipment cabinets and remote wall mounted telecom cabinets.

2.03 Category 6 1U-48 Port Flat Patch Panels

- .1 Suitable for mounting to any standard 19" or 23" EIA rack or cabinet.
- .2 Horizontal termination for data circuits shall consist of category 6 flat patch panels, which shall be 1U high and provide either 48 modular jack ports, as indicated on the drawings. Patch panels shall be configured with individually replaceable jacks.
- .3 Each modular jack shall be provided with a bend-limiting strain relief. The strain relief shall provide cylindrical support to limit the bend radius at the point of termination.
- .4 The front of each 6-port module shall be capable of accepting labels to TIA requirements.
- .5 Each port shall be capable of accepting an icon to indicate its function. Patch panels shall meet the Category 6 performance requirements of ANSI/TIA-568-C.2.
- .6 Panduit CPP48FMWBLY.

2.04 Fibre Patch Panels

- .1 Fiber patch panel to be 19" rack mount enclosure (in all 19" rack/cabinet) or wall mount enclosure, supporting optical fiber connector adapter panels (duplex LC Type), rear cable retention loops, entry cable strain relief supports, cable strength member clamps, D- grommets at cable entry, removable rear panel cover, accommodation and support for splice trays, removable front access cover, front space for patch cable storage, patch cable bend radius controls and identification labeling.

3 Execution

3.01 Installation

- .1 Refer to Section 27 13 13 Copper Backbone Cabling.
- .2 Refer to Section 27 15 13 Copper Horizontal Cabling.

End of Section

1 General

1.01 Section Includes

- .1 Cable Management.

1.02 Submittals

- .1 Product Data: Provide manufacturers catalogue information.

2 Products

2.01 Network Cabinet Cable Management Finger Kit

- .1 Network cabinet cable management finger kit, nine RU sections. Kit includes five left and five right finger sections to complete 45 RU on one side of post.
- .2 Panduit CNBRFK.

2.02 Slack Spool Set

- .1 Network Cabinet and 4 post rack end channel slack spools. Package includes one left and one right slack spool and mounting brackets.
- .2 Panduit CNSPE.

2.03 3U Horizontal Cable Manager

- .1 Horizontal Cable Manager High Capacity Front and Rear 3 Rack Units. 5.2"H x 19.0"W x 13.1"D (133 mm x 482 mm x 332 mm).
- .2 Panduit NM3.

3 Execution

3.01 Installation

- .1 Refer to Section 27 13 13 – Copper Backbone Cabling.
- .2 Refer to Section 27 15 13 – Copper Horizontal Cabling.

End of Section

1 General

1.01 Section Includes

- .1 Cabling requirements for IP based CCTV cameras.

1.02 Related Requirements

- .1 Division 27 – Communications.

2 Products

2.01 Owner-Furnished Products

- .1 New IP cameras, and associated equipment shall be supplied and installed by electrical contractor.
- .2 This contractor shall be responsible for coordinating rough-in requirements.

2.02 Cabling

- .1 Plenum rated Category 6 cabling in accordance with Division 27.

3 Execution

3.01 Installation

- .1 In accordance with sections of Division 27.

End of Section

1 General

1.01 Section Includes

- .1 Communications conductors and cables for fire detection, suppression, and alarm systems.
- .2 Conduit for fire detection, suppression, and alarm systems.

1.02 Related Requirements

- .1 Section 28 46 13 – Fire-Alarm Systems.
- .2 Section 28 46 31 – Fire-Alarm Initiating Devices.
- .3 Section 28 46 21.51 – Fire Detection and Suppression Releasing Panels.

1.03 Definitions

- .1 ULC-S524: CLASS A CIRCUIT (Return Loop Circuit) – A circuit having one continuous path connecting all components on the circuit and terminating through an alternate connection path in the source enclosure.
- .2 ULC-S524: CLASS B CIRCUIT (Terminated Circuit) – A circuit having one continuous path connecting all devices on the circuit and terminating at an end-of-line device.

1.04 References

- .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
- .2 Ontario Electrical Safety Code (29th edition/2024).
- .3 CSA C22.2 No. 208-14 – Fire Alarm and Signal Cable.
- .4 CAN/ULC-S139:2017 – Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control, and Data Cables.
- .5 CAN/ULC-S524:2019 – Standard for the Installation of Fire Alarm Systems.

1.05 Delivery, Storage, and Handling

- .1 In accordance with Section 01 61 00.

1.06 Warranty

- .1 All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one year from the date of acceptance.

2 Products

2.01 Conduit and Wire for Fire Alarm System

- .1 Conduit:
 - .1 In accordance with Section 26 05 33.13.
 - .2 All wiring shall be installed in conduit or raceway.
- .2 Terminal Boxes, Junction Boxes and Cabinets:

- .1 All boxes and cabinets shall be listed for their purpose and use.

2.02 Fire Alarm Cable

- .1 Wiring shall be in accordance with local, provincial, and national codes and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as outlined in the Ontario Electrical Safety Code, and as recommended by the fire alarm system manufacturer.
- .2 All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signalling system, as outlined in the Ontario Electrical Safety Code.
- .3 Certified by CSA as fire alarm and signal cable type FAS 105 to CSA C22.2 No. 208.
- .4 Conductors:
 - .1 300 V rated multiconductor, insulated, colour coded, copper conductor.
 - .1 Use solid conductors unless noted otherwise.
 - .2 Use stranded conductors for connections between closest junction box and vibrating equipment i.e. generator set supervisory connection.
 - .2 Minimum 16 AWG for initiation circuits.
 - .3 Minimum 12 AWG for strobe signal circuits.
 - .4 Minimum 14 AWG for horn signal circuits.
 - .5 Minimum 12 AWG for bell signal circuits.
- .5 Non-Fire resistive cable:
 - .1 Insulation: 105°C flame retardant PVC.
 - .2 Outer Jacket: 105°C flame retardant PVC Red.
 - .3 Armour: Interlocking aluminum without overall Jacket. For drops to devices in suspended ceilings from conduit system.
- .6 Fire resistive fire alarm cable:
 - .1 Pentair Pyrotenax 1850 series mineral insulated (MI) cable with 2 hour fire rating to ULC-S139 and to meet Ontario Building Code Rule 3.2.7.10.
 - .2 Substitution: VITALink CIC Type FAS105, manufactured by Comtran (listed by ULC under ULC category code 'FHIT7' and 'FHJR7', dated 19 May 2015), installed in EMT conduit.
 - .3 Substitutions such as "Lifeline" installed in conduit may only be considered if listed by ULC under ULC Category Code 'FHIT7'.

3 Execution

3.01 Installation

- .1 All conduit, junction boxes, conduit supports and hangers shall be concealed in finished areas and may be exposed in unfinished areas. Smoke detectors shall not be installed prior to the system programming and test period. If construction is ongoing during this period, measures shall be taken to protect smoke detectors from contamination and physical damage.

- .2 The entire system shall be installed in accordance with the latest edition of CAN/ULC-S524 and the approved manufacturer's manuals and wiring diagrams.
- .3 The contractor shall furnish all labour, conduit, wiring, outlet boxes, junction boxes, cabinets, and similar devices necessary for installation of system devices.
- .4 Provide all necessary power supply, interconnecting and remote signal wire in dedicated conduit throughout and installed in accordance with the manufacturer's wiring diagrams and the requirements of the Ontario Electrical Safety Code and the Inspection Authority.
- .5 All penetration of floor slabs and fire walls shall be fire stopped in accordance with all local fire codes.
- .6 Install all wiring in metal raceways.
- .7 Provide wiring suitable for fire alarm circuits.
 - .1 Class [A] wiring for initiating circuits.
 - .2 Class [B] wiring for signalling circuits.
- .8 Fire resistive conductors:
 - .1 Install fire resistive conductors in accordance with the manufacturer's installation guidelines.
 - .2 Install 2 hour fire resistive cables for fire alarm circuits as required by the building code where transponders (data gathering panels) or annunciators are installed in a separate fire compartment from the main FACP CPU.
 - .3 Install 2 hour fire resistive cables for fire alarm system branch circuits where the transponder or DGP is not within the same storey as the first initiation, signalling, or voice communication device in the loop for that storey.
 - .4 In lieu of fire resistive cables for the above noted cases, Contractor may, when reviewed beforehand by the Consultant, install non rated conductors in be located in a service space that is separated from the remainder of the building by a fire separation that has a fire resistance rating of not less than 2 hours.

3.02 Site Tests and Inspections

- .1 The manufacturer's representative shall perform an inspection of the fire alarm equipment. The inspection shall comprise an examination and test of such equipment for the following:
 - .1 That the type of conductors and cables installed are that designated by the specifications.
 - .2 That the specified equipment has been installed in accordance with the manufacturer's recommendations.
 - .3 That the supervisory wiring of all devices connected to a supervised circuit is operating and that the wiring has been met to the satisfaction of the inspecting officials.
- .2 Testing to be done in the presence of the local building inspector, and the local fire inspector.

End of Section

1 General

1.01 Summary

- .1 This Section covers the supply and installation of a complete Communications Copper Horizontal Cabling system. The scope of work includes, but is not limited to, the following tasks, as well as all tasks specified by the Consultant or the Owner, stipulated in the Contract Documents, or required for proper completion and commissioning of the system.
 - .1 Supply, delivery, supervision, coordination, installation, testing and commissioning of a complete horizontal copper cabling system, as specified in the present document, the Contract Documents, and the Drawings.
 - .2 Submittal of complete documentation, including, certifications, test reports, progress reports, warranty certificates, manuals, as-built drawings, as specified in the present document and the Contract Documents, and as requested by the Consultant and the Owner for the purpose of proper completion of the project.
- .2 Contractor shall examine, and is responsible for complying with, the Contract Documents in their entirety, including all relevant Drawings and Specification presented in other Sections and Divisions, regardless of whether such Drawings and Specification are referenced in this Section.
- .3 Contractor shall provide, install and test a complete Communications Copper Horizontal Cabling system as follows.
 - .1 Contractor shall furnish and install all horizontal cabling system equipment, including:
 - .1 Horizontal Cables (Permanent links, patch cords and equipment cables).
 - .2 Termination Hardware.
 - .3 Telecom Outlets.
 - .4 Patch Panels.
 - .5 Device Connection.
 - .6 Testing (Including cable and channel verification, qualification and certification).
 - .7 Administration and Identification.
 - .2 Contractor shall furnish and install all miscellaneous items, accessories, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation, without claim for additional payment, even if such work or components are not specifically mentioned in the Specification or the Drawings.
 - .3 Contractor shall provide system testing and demonstration, proper commissioning, system documentation, as-built drawings, training and installation manuals, and adequate training for the Owner's personnel, without claim for additional payment.
- .4 Errors, Omissions and Conflicts:
 - .1 Contractor shall notify the Consultant no later than ten (10) days prior to submitting the bid of any errors or omissions encountered in the Drawings, Specification, or other Contract Documents.
 - .2 Contractor shall use the more expensive material or method whenever a conflict is encountered between or within Drawings and Specification, unless Contractor has requested received a written response (addendum) as to which material or method is suitable.
- .5 Related Requirements:

- .1 Section 07 84 00 – Firestopping.
- .2 Section 26 05 26 – Grounding and Bonding for Electrical Systems.
- .3 Section 27 08 11 – Testing of Structured Cabling Systems.
- .4 Section 27 11 16 – Communications Cabinets, Racks, Frames, and Enclosures.
- .5 Section 27 11 19 – Communications Termination Blocks and Patch Panels.
- .6 Section 27 11 23.13 – Communications Cable Management.
- .7 Section 27 11 26 – Communications Rack Mounted Power Protection and Power Strips.
- .8 Section 27 15 43 – Communications Faceplates and Connectors.

1.02 Acronyms and Abbreviations

- .1 ANSI - American Northern Standards Institute.
- .2 AWG - American Wire Gauge.
- .3 BICSI - Building Industry Consulting Service International.
- .4 TDMM - Telecommunications Distribution Methods Manual (BICSI).
- .5 EIA - Electronics Industry Alliance.
- .6 IEEE - Institute of Electrical and Electronics Engineers.
- .7 ISO - International Standards Organization.
- .8 OESC – Ontario Electrical Safety Code.
- .9 NFPA - National Fire Protection Agency.
- .10 NRTL - Nationally Recognized Testing Laboratory.
- .11 TIA - Telecommunications Industry Association.
- .12 UL - Underwriters Laboratories.

1.03 References

- .1 Most recent editions and addenda of the following documents:
 - .1 ANSI/TIA-568 - Commercial Building Telecommunications Cabling Standard Set
 - .2 ANSI/TIA-569 - Telecommunications Pathways and Spaces
 - .3 ANSI/TIA-606 - Administration Standard for Telecommunications Infrastructure
 - .4 ANSI/TIA-607 - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises
 - .5 ANSI/TIA-862 - Structured Cabling Infrastructure Standard for Intelligent Building Systems
 - .6 ANSI/TIA-942 - Telecommunications Infrastructure Standard for Data Centers.
 - .7 ANSI/TIA-1179 - Healthcare Facility Telecommunications Infrastructure Standard.

- .8 ANSI/TIA-4966 - Telecommunications Infrastructure Standard for Educational Facilities.
- .9 BICSI/TDMM - Telecommunications Distribution Methods Manual.
- .10 TIA-TSB-162 - Telecommunications Cabling Guidelines for Wireless Access Points.
- .11 CSA C22.1 - Canadian Electrical Code Part 1.
- .12 UL 444 - Standard for Safety of Communications Cable.
- .13 UL 1666 - Standard for Safety of Flame Propagation Height.
- .14 Local Authority Having Jurisdiction (AHJ).
- .15 Anywhere cabling standards conflict with one another or with electrical or safety codes, Contractor shall defer to the OESC and any applicable local codes or ordinances, or default to the most stringent requirements listed by either.

1.04 System Description

- .1 The Contractor shall provide, install, test, label and document a complete horizontal structured cabling system, spanning from a centralized telecom room(s) (TR) to the telecom outlets (TO), in a star network topology. The main components of the system are specified below.
- .2 Horizontal Cabling
 - .1 The horizontal cabling system extends from the telecom room (TR) or telecom enclosure (TE) to the work area telecom outlet (TO). It includes horizontal cable, hardware terminations, jumpers, patch cords, and may incorporate multiuser telecommunications outlet assemblies (MUTOAs) and consolidation points (CPs).
 - .2 Maximum horizontal cable length shall be 90 m (295 ft.), independently of media type. Where an MUTOA is deployed, the maximum horizontal copper cable length shall be adjusted accordingly.
- .3 Telecom Room / Enclosure (TR / TE)
 - .1 Telecom Room (TR) is a dedicated and controlled space on each building floor, used for housing telecommunications equipment, cable terminations, and cross-connect hardware serving that particular floor. TR constitutes the recognized connection point between horizontal and backbone cabling systems. The telecom standards (ANSI/TIA, BICSI TDMM, etc.) require a minimum of one telecom room, closet, or enclosure per floor.
 - .2 Telecom Enclosure (TE) usage is project-specific rather than a standard requirement. TE is intended to serve relatively smaller floor area, and is often used to extend the space and reach of a TR.
- .4 Pathways and Raceways
 - .1 Pathways and raceways are conveyance and routing systems for distributing, supporting and protecting telecom infrastructure cabling systems. Pathway system type and installation method shall be suitable for the media being supported and the environment being traversed.
 - .2 Pathway and raceway systems shall conform to the standards specified and referenced in Section 27 05 28 and Section 27 05 36.
 - .3 Pathway design shall combine continuous cable trays and non-continuous cable supports. Cable trays should, nonetheless, form the main horizontal cabling pathway, and should be located over the main corridors, to facilitate access and maintenance tasks.

- .4 In low cable density areas, non-continuous supports shall be used in lieu of a cable tray system, unless otherwise specified in the design documents.
- .5 In open-ceiling spaces where the cable is exposed, a conduit or a surface raceway shall be used in lieu of non-continuous supports, to enhance cable protection and aesthetic appearance.

1.05 Submittals

- .1 Provide submittals in accordance with Section 01 33 00.
- .2 Shop Drawings
 - .1 Contractor shall submit shop drawings for all components and equipment used in the project, including, the items listed below.
 - .1 Modular Connectors.
 - .2 Telecom Outlet Faceplates.
 - .3 Horizontal Cable.
 - .4 Patch Panels.
 - .5 Patch Cables and Equipment Cords.
 - .6 Telecommunications Enclosures and Racks.
 - .7 Cable Management Components.
 - .8 Pathways and Raceways (Cable Trays, Cable Supports, Conduits, etc.).
 - .9 Firestopping Material.
- .3 General Component Data
 - .1 Contractor shall submit the information and documents outlined below, with respect to all components and products covered under this Section or installed as part of communications copper horizontal cabling:
 - .1 Product Name, Manufacturer Name, Model Number and Part Number.
 - .2 Product Datasheets and Specifications.
 - .1 Complete specification, including but not limited to, standards compliance, Category type, fire rating, environmental rating, number and color code of pairs, conductor size and material, insulation type and material, performance and attenuation parameters, near-end cross talk (NEXT), cable diameter and weight, jacket type and material, cable color, etc.
 - .3 Product Manuals (Installation Instructions, User Manuals, Maintenance Manuals).
- .4 Deviations
 - .1 Contractor shall be responsible for any deviation from Contract Documents, regardless of whether such deviation or associated drawings and samples have been reviewed by the Consultant, unless deviation has been approved in writing by the Consultant and the Owner.
 - .2 Contractor shall submit an indexed sheet detailing all deviations from Contract Documents, and shall be responsible for all such deviations, unless these have been expressly approved in writing by the Consultant and the Owner.

- .3 Contractor shall not assume that an approval of an item's shop drawing or sample is equivalent to an approval of the item itself. Deviations shall be treated specifically, and shall be approved separately as such, in writing by the Consultant and the Owner.
- .4 Contractor shall be responsible for all deviations, errors and omissions in the submittal documents and process, regardless of whether such deviations, errors and omissions have been reviewed by the Consultant or the Owner.

1.06 Closeout Submittals

- .1 Testing and Test Results
 - .1 Refer to Section 27 08 11.
 - .2 Specification and calibration sheets for all test equipment.
 - .3 Contracting firm qualifications and certifications.
 - .4 Installation team qualifications (by person).
 - .5 Test results (Intermediate and final test results, as specified in Part 3 - Execution).
- .2 Contractor shall submit final closeout documents as required by the Consultant and the Owner. These shall include, but are not limited to, the following items.
 - .1 Test results covering all cable segments and links, in native tester and PDF formats, or as otherwise specified by the Consultant.
 - .2 Manufacturer and contractor warranties.
 - .3 Complete project manual set, including, product datasheets, material submittals, training manuals, user manuals, maintenance manuals and preventive maintenance plan.
 - .4 Spare parts recommendation list.
- .3 Contractor shall submit a complete set of as-built drawings in an accessible AutoCAD format, as specified by the Consultant and the Owner. As-built drawings shall cover the following.
 - .1 Precise location and identification (labels) of all equipment, including, all data outlets, cables, cable trays, patch panels, racks, telecom rooms and enclosures, and all other equipment which is part of the horizontal cabling system.
 - .2 Detailed floor plans of all telecom rooms and spaces.
 - .3 Detailed layout of all racks, patch panels, cable trays, pathways, conduits.
 - .4 Detailed layout of all pathways, cable trays, and cable routes.
- .4 Contractor shall submit and mount on the wall of each telecom space or room, detailed as-built drawings depicting the floorplan, floor area, TO points, and cabling layout, for that space or room. Drawings shall be printed on ANSI C paper size or larger, shall be laminated, and shall be approved and wall-mounted in coordination with the Consultant and the Owner.

1.07 Quality Assurance

- .1 Standards for Materials and Equipment
 - .1 Contractor shall provide all materials, equipment, and installations, in compliance with the latest applicable standards.

- .2 Installer Qualifications
 - .1 Refer to Section 27 05 00 – Common Work Results for Communications.

1.08 Warranty

- .1 Contractor shall ensure each piece of equipment installed including wiring is warranted by the manufacturer to be free of defects in operation, material, and workmanship for a period of 15 years from date of Substantial Completion.

2 Products

2.01 Manufacturers

- .1 CommScope Systemax [Commscope Uniprise].
- .2 Panduit TX6000 [Panduit TX6].
- .3 Belden DataTwist [Belden MediaTwist].

2.02 Category 6 Data Communications Horizontal Cable

- .1 Category 6 (Class E) cable shall meet ANSI/TIA-568.2-D Category 6 component standard. Cable conductors shall consist of 23 AWG copper wires and shall be twisted in pairs. In addition, Category 6 cable shall comply with the following specifications and standards.
- .2 General Requirements
 - .1 Cable shall consist of 4 unshielded twisted pairs with no outer shielding (Cat 6 U/UTP), unless otherwise specified in the design and expressly approved by the Owner.
 - .2 Cable used in data networking systems shall have a blue color jacket.
 - .3 Cable conductor insulations shall be color coded in compliance with the TIA-568 standard.
 - .4 Cable individual conductors shall be 23 AWG copper wires. Special applications requiring the use of the thinner 24 AWG conductor shall be specified and expressly approved by the Owner.
 - .5 Permanent links horizontal cable extending from the telecom enclosure/room to the telecom outlet shall have solid conductors.
 - .6 Equipment cable and patch cords shall have stranded conductors.
 - .7 Cable shall be properly rated for its use application and its installation environment (Outdoor/OSP, Plenum/CMP, Riser/CMR, LSZH, Industrial/Armored, Direct Burial, etc.), as required by the local and national codes.
- .3 Standards Compliance and Technical Specification
 - .1 Category 6 cable shall satisfy the following compliance and technical specification.
 - .2 Cable shall exceed requirements of ANSI/TIA-568.2-D Category 6 and ISO 11801 2nd Edition Class E channels standard.
 - .3 Cable shall exceed requirements of ANSI/TIA-568.2-D and IEC 61156-5 Category 6 components standard.
 - .4 Cable shall meet requirements of IEEE 802.3af, IEEE 802.3at and IEEE 802.3bt for Power over Ethernet (PoE) applications.

- .5 Cable shall meet TIA TSB-184-A / IEEE 802.3bt cable requirements, and UL listed CMP-LP (0.5A).
- .6 Cable shall be characterized up to 550 MHz, 300 MHz above the range specified in the standard.
- .7 Cable shall be third-party tested and verified for compliance with ANSI/TIA-568.2-D, Category 6.
- .8 Cable shall support IEEE 802.3 for 1000BASE-T (Gigabit Ethernet), 100BASE-T (fast Ethernet), and 10BASE-T applications up to 100 metres.
- .4 Safety Standards
 - .1 Category 6 cable shall strictly meet the following specification to achieve compliance with the local and national (CSA) safety codes and standards:
 - .2 Cable deployed in the plenum and/or raised floor space (whether partly or entirely) shall be plenum CMP rated and shall comply with the CSA FT6 or NFPA 262 (UL-910) fire test standards.
 - .3 Cable running between floors in non-plenum area shall be riser CMR rated and shall comply with the CSA FT4 and UL-1666 fire test standards.
 - .4 Plenum CMP rated cable (CSA FT6 or NFPA 262) may be used in riser applications, if needed. Riser CMR rated cable, however, is not approved for use and shall not be deployed in plenum space.
- .5 Temperature Rating
 - .1 Installation Temperature Range: 32°F to 122°F (0°C to 50°C)
 - .2 Operating Temperature Range: - 4°F to 167°F (- 20°C to 75°C)

2.03 [Category 6A] Data Communications Horizontal Cable

- .1 Category 6A (Class EA) cable shall meet ANSI/TIA-568.2-D Category 6A component standard. Cable conductors shall consist of 23 AWG copper wires and shall be twisted in pairs. In addition, Category 6A cable shall comply with the following specifications and standards:
- .2 General Requirements
 - .1 Cable shall consist of 4 unshielded twisted pairs with no outer shielding (Cat 6A U/UTP), unless otherwise specified in the design and expressly approved by the Owner.
 - .2 Cable used in data networking systems shall have a blue color jacket.
 - .3 Cable conductor insulations shall be color coded in compliance with the TIA-568 standard.
 - .4 Cable individual conductors shall be 23 AWG copper wires. Special applications requiring the use of the thinner 24 AWG conductor in patch cords (short length, max 2 m) shall be specified and expressly approved by the Owner. Note: Only Category 6A cable with 23 AWG solid conductors is permitted in Permanent Link.
 - .5 Cable deployed as horizontal permanent link extending from the telecom enclosure/room to the telecom outlet shall have solid conductors.
 - .6 Equipment cable and patch cords shall have stranded conductors.
 - .7 Cable shall be properly rated for its use application and its installation environment (Outdoor/OSP, Plenum/CMP, Riser/CMR, LSZH, Industrial/Armored, Direct Burial, etc.), as required by the local and national codes.

- .8 Cable weight shall not to exceed 30 lbs./1000 ft.
- .3 Standards Compliance and Technical Specification
 - .1 Category 6A cable shall satisfy the following compliance and technical specification.
 - .2 Cable shall exceed requirements of ANSI/TIA-568.2-D Category 6A and ISO 11801 2nd Edition Class EA channels standard.
 - .3 Cable shall exceed requirements of ANSI/TIA-568.2-D and IEC 61156-5 Category 6A components standard.
 - .4 Cable shall meet requirements of IEEE 802.3af, IEEE 802.3at and IEEE 802.3bt for Power over Ethernet (PoE) applications up to 100 watts (IEEE 802.3bt Type 4, 4PPoE).
 - .5 Cable shall meet TIA TSB-184-A / IEEE 802.3bt cable requirements, and UL listed CMP-LP (0.7A).
 - .6 Cable shall be characterized up to 500 MHz or higher, as specified in the ANSI/TIA-568.2-D, Category 6A standard.
 - .7 Cable shall be third-party tested and verified for compliance with ANSI/TIA-568.2-D, Category 6A.
 - .8 Cable shall support IEEE 802.3 for 10GBASE-T (10 Gigabit Ethernet), 1000BASE-T (Gigabit Ethernet), 100BASE-T (Fast Ethernet), and 10BASE-T applications up to 100 metres.
- .4 Safety Standards
 - .1 Category 6A cable shall strictly meet the following specification in order to achieve compliance with the local and national (CSA) safety codes and standards.
 - .2 Cable deployed in the plenum and/or raised floor space (whether partly or entirely) shall be plenum CMP rated and shall comply with the CSA FT6 or NFPA 262 (UL-910) fire test standards.
 - .3 Cable running between floors in non-plenum area shall be riser CMR rated and shall comply with the CSA FT4 and UL-1666 fire test standards.
 - .4 Plenum CMP rated cable (CSA FT6 or NFPA 262) may be used in riser applications, if needed. Riser CMR rated cable, however, is not approved for use in plenum space and shall not be deployed therein.
- .5 Temperature Rating
 - .1 Installation Temperature Range: 32°F to 122°F (0°C to 50°C)
 - .2 Operating Temperature Range: -4°F to 167°F (- 20°C to 75°C)

3 Execution

3.01 General

- .1 Comply with the design requirements and industry standards, and with the applicable local and national codes.
- .2 Follow best practices guidelines and applicable industry standards for the installation of the cable and all horizontal channel components.

- .3 Ensure that patch panels, connectors, and all structured cabling components are compatible with the Category rating of the cable. For example, if Category 6A cable is used; then, all structured cabling components shall be Category 6A compatible.
- .4 Ensure that all materials, components and equipment being installed are properly rated (Plenum or Riser), as required by local and national codes.
- .5 Install all cables and horizontal channel components (connectors, outlets, faceplates, jacks, etc.) as instructed in the manuals and specified in the Drawings.
- .6 Provide all installation and mounting accessories and components, such as, screws, anchors, clamps, hooks and loops, grounding and support hardware, etc., as required to carry out the installation of the cabling system.
- .7 Furnish all special installation equipment or tools, as needed to properly complete the installation.
- .8 Provide appropriate underlay for storage of cable reels. Rolling of cable reels is not permitted.
- .9 Provide all additional material and labour required to rectify a situation arising from their failure to comply with applicable standards and best practices guidelines. This equally applies to all damage inflicted to cables by Contractor during the installation process.
- .10 Provide fire blocking material at all fire rated penetrations, as required by design, standards, and codes.
- .11 Seal all conduits where cabling has been installed with re-enterable duct sealing system, as required by design, standards, and code.
- .12 Provide and install bushings on all conduit ends.
- .13 Ensure means and methods promote ease of access to cables for maintenance and testing purposes.
- .14 The pathways shown on the Drawings are an approximate representation, and should not be interpreted as an absolute and accurate layout. Conduct site surveys, and coordinate with other trades, as required, in order to determine the exact final pathway layout.

3.02 Horizontal Cabling Guidelines

- .1 Comply with best practices guidelines for horizontal cabling systems.
- .2 Install horizontal cabling in a continuous run, from the TR patch panel to the peripheral telecom outlet. Spliced copper cable is not permitted.
- .3 Group and bundle all cables by power level and cable type. Use "hook and loop" fasteners for bundling cables.
- .4 Do not exceed the maximum cable pulling tension specified by the manufacturer.
- .5 Terminate and test all cables.
- .6 Install all patch panels inside the data racks, at the specified telecom spaces. Coordinate with the Owner for installation of network switches.

- .7 Mitigate electromagnetic interference (EMI) by maintaining the recommended separation between telecom and power (EMI) sources, as specified by ANSI/TIA-569 and shown in the table below.

Minimum Separation Distance Between Power and Data Cables (ANSI/TIA-569)			
	Minimum Separation Distance		
Condition	< 2 kVA in (mm)	2 - 5 kVA in (mm)	> 5 kVA in (mm)
Unshielded power lines or electrical equipment in proximity to open or nonmetal pathways	5 (127)	12 (305)	24 (610)
Unshielded power lines or electrical equipment in proximity to a grounded metal conduit pathway	2.5 (64)	6 (152)	12 (305)
Power lines enclosed in a grounded metal conduit (or equivalent shielding) in proximity to a grounded metal conduit pathway		3 (76)	6 (152)
Electrical motors and transformers			48 (1,220)

- .8 Do not install telecom cables and power cables in the same pathways, cable trays, or conduits.
- .9 Provide vertical cable support for all cables installed in vertical cable trays, using properly sized vertical cable supports on every third floor. Use of nylon cable ties is not permitted.

3.03 Cable Installation in Conduit and Duct

- .1 Apply best practices when pulling cable inside conduits and ducts.
- .2 Ensure that pulling tension never exceeds the manufacturer's specification.
- .3 Ensure that cable bending during installation conforms to the manufacturer's specifications.
- .4 Use a pull mandrel one size smaller than the conduit.
- .5 Use cable pulling lubricant to reduce friction and tension during cable pulling.
- .6 Use a dynamometer to measure pulling tension in the case of long or difficult installations.
- .7 Use pulling grips suitable for copper cable installations. Contractor shall consult the cable manufacturer to determine the suitable pulling grip and method of attachment.
- .8 Seal loose cable ends using cable caps (heat-shrinking type) to protect them until they are terminated.
- .9 Use corner blocks to facilitate the bending of cable. Contractor should use 45° cable block for bends between 5° and 45°, and 90° corner block for bends between 45° and 90°.

3.04 Cable Bundling Material

- .1 Contractor shall use the appropriate cable bundling and securing material, in line with industry and best practices standards, to ensure cable runs are securely held in place, both vertically and horizontally.
- .2 Contractor shall not tighten bundling and securing ties and straps around cables, to avoid deforming cable geometry, and as a result, cable performance.

- .3 Contractor shall only use safe and soft cable fasteners to bundle or secure cable, such as, “hook and loop” cable fasteners. The use of regular plastic cable ties is strictly forbidden.
- .4 Contractor shall not attach or secure cable runs to other building systems (such as, electrical or mechanical conduits, HVAC ducts, sprinkler pipes, ceiling suspension members, etc.).
- .5 Contractor shall strictly use plenum rated cable bundling components inside suspended ceilings, raised floors, and air-handling spaces.

3.05 System Administration

- .1 Refer to Section 27 05 53 – Identification for Communications Systems.
- .2 Conform to the system administration guidelines of ANSI/TIA-606, Administration Standard for Telecommunications Infrastructure.
- .3 Propose a consistent and comprehensive system administration scheme in coordination with the Consultant, the Owner and all stakeholders. Contractor shall seek the Consultant’s or the Owner’s written approval of the proposed scheme ahead of implementation.
- .4 Uniquely identify all components of the installed system by location, function, unit, and sub-unit.
- .5 Identify each location, telecom space, telecom room or enclosure in the building with a unique alphanumeric identifier.
- .6 Identify each system component, including but not limited to, adapter modules, connectors, cables, patch panels, patch and equipment cords, cable management devices, grounding system components, power cords, faceplates, outlets, cable trays and pathways, racks, enclosures, etc. with a unique alphanumeric identifier.
- .7 Contractor shall supply all the required records and documentation in compliance with ANSI/TIA 606.
- .8 Contractor shall provide an ODBC-compliant database (Open Database Connectivity), for administration of the cabling system described in this Section.

3.06 Identification

- .1 Contractor shall seek the =Consultant’s and the Owner’s approval of the project’s labeling plan, ahead of cable installation.
- .2 Labeling Cables
 - .1 Mark each cable at each endpoint and at all intermediate pull and access points, and junction boxes with labels that indicate the origin and destination identifiers, the sheath identifier, and the strand or pair range.
 - .2 Contractor shall mark each horizontal cable on the sheath at each end with the TR, patch panel, and panel port where cable is terminated.
- .3 Labeling Conduits and Pathways
 - .1 Contractor shall label conduits and pathways within 0.5 m (18 inches) of each end, on an exposed and accessible spot.
 - .2 Contractor should apply additional labeling, where possible, at every 3 m (10 feet) of exposed length.

3.07 Cable Testing

- .1 Refer to Section 27 08 11 for cable testing procedures.
- .2 Ensure all testing procedures and field-test instruments comply with the requirements of:
 - .1 ANSI/TIA-1152-A, Requirements for Field Test Instruments and Measurements for Balanced Twisted-Pair Cabling
 - .2 ANSI/TIA-568.0-D, Generic Telecommunications Cabling for Customer Premises
 - .3 ANSI/TIA-568.1-D, Commercial Building Telecommunications Cabling Standard
 - .4 ANSI/TIA 568.2-D, Balanced Twisted-Pair Telecommunications Cabling and Components Standards
- .3 Provide all labor, materials, tools, field-test instruments and equipment required for the complete testing of the work.
- .4 Test all horizontal UTP cables as instructed below.
- .5 Perform tests using a level IV accuracy cable tester, updated with latest firmware.
- .6 Provide all test records in both "native" and pdf formats, as part of the as-built package.
- .7 Unless otherwise specified by the Consultant or the Owner, all horizontal links and channels shall be tested for the following:
 - .1 Wire Map.
 - .2 Length.
 - .3 Propagation Delay.
 - .4 Delay Skew.
 - .5 DC Loop Resistance.
 - .6 Insertion Loss.
 - .7 NEXT (Near-End Crosstalk).
 - .8 PS NEXT (Power Sum Near-End Crosstalk).
 - .9 ACR-N (Attenuation to Crosstalk Ratio Near-End).
 - .10 PS ACR-N (Power Sum Attenuation to Crosstalk Ratio Near-End).
 - .11 ACR-F (Attenuation to Crosstalk Ratio Far-End).
 - .12 PS ACR-F (Power Sum Attenuation to Crosstalk Ratio Far-End).
 - .13 Return Loss.
- .8 All horizontal links and channels shall pass the test requirements for respective cable Category, as specified in ANSI/TIA-568.2-D. Category 6 and 6A cables shall be tested up to 250 MHz and 500 MHz, respectively.
- .9 Any cable or link that fails the requirements shall be identified and corrected.

3.08 Firestopping

- .1 Comply with the requirements of Section 07 84 00 – Firestopping.
- .2 Comply with the requirements of the latest TIA/EIA-569, Annex A, Firestopping.
- .3 Comply with the requirements of the latest BICSI TDMM, Chapter 7, Firestop Systems.
- .4 Firestop systems shall meet the requirements of ULC Standard CAN/ULC-S115.

End of Section

1 General

1.01 Section Includes

- .1 HDBaseT adaptors.

1.02 Informational Submittals

- .1 Coordinate with Owner for manufacturer's submittal package, including:
 - .1 Cut sheets of all components.
 - .2 Installation instructions.

2 Products

2.01 HDMI Patch Cords

- .1 Manufacturers:
 - .1 Cables 2 Go (C2G) (basis of design).

2.02 HDBaseT Cabling

- .1 Solid Conductor Category 6 UTP cabling to Section 27 10 00.

2.03 HDBaseT Extenders (HDMI Over Cat6)

- .1 Basis of Design: C2G 29269 kit.

3 Execution

3.01 Installation

- .1 Install all components as directed by manufacturer's representative, and installation instructions.

3.02 Field Quality Control

- .1 Manufacturer's Services
 - .1 Test operation of equipment under supervision of Manufacturer's representative.

End of Section

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1 General

1.01 Section Includes

- .1 Twisted Pair Patch Cords.
 - .1 Schedule of copper patch cords to be supplied.
- .2 Fibre Optic Patch Cords.
- .3 Related Cross-connect components.
- .4 Cross-connection and patching.

1.02 Related Requirements

- .1 Section 27 13 23 – Communications Optical Fiber Backbone Cabling.
- .2 Section 27 13 13 – Communications Copper Backbone Cabling.
- .3 Section 27 11 19 – Communications Termination Blocks and Patch Panels.

1.03 Submittals

- .1 Product Data: For each type of product indicated.
 - .1 For Category-6 patch cords, include the following installation data for each type used:
 - .1 Nominal OD.
 - .2 Minimum bending radius.
 - .3 Maximum pulling tension.
 - .2 For Fiber Optic patch cords, include the following installation data for each type used:
 - .1 Nominal OD.
 - .2 Minimum bending radius.
 - .3 Maximum pulling tension.
- .2 Source quality-control reports.
- .3 Field quality-control reports.

1.04 Quality Assurance

- .1 Electrical Components, Devices, and Accessories: Listed and labeled by a qualified testing agency, and marked for intended location and application.
- .2 Warranty: see Section 27 05 00.

1.05 Delivery, Storage, and Handling

- .1 Test cables upon receipt at Project site.
 - .1 Test optical fiber cables to determine the continuity of the strand end to end. Use optical loss test set.

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- .2 Test each pair of UTP cable for open and short circuits.

1.06 Project Conditions

- .1 Environmental Limitations: Do not deliver or install cables and connecting materials until wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

2 Products

2.01 Manufacturers

- .1 Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include the following:
 - .1 Panduit [selection based on Owner's standard].
 - .2 No alternative will be accepted.

2.02 Patch Cables

- .1 General Requirements: Comply with TIA/EIA-569-C.
- .2 Category 6 Copper Patch Cords:
 - .1 Factory-made, four-pair cables terminated with eight-position modular plug at each end in lengths as indicated in pricing sheet.
 - .2 Patch cords shall have bend-relief-compliant boots to ensure Category 6 performance.
 - .3 UTP Patch Cords will be supplied in the following lengths:

Quantity	Length	Colour	Use	Panduit Part Number
450	5'	White	Desks	UTP28SP5
150	7'	White	Cabinet	UTP28SP7
150	10'	White	Cabinet	UTP28SP10
75	7'	Yellow	Internet	UTP28SP7YL
75	10'	Yellow	Internet	UTP28SP10YL

- .3 Fibre Optic Patch Cords: Factor-made, dual-fibre cables with LC duplex connectors.
 - .1 Fibre patch cords will be available in the following lengths.
- .4 Estimated Quantities
 - .1 The estimate of cable counts and lengths is given for bid purposed only; the final count and lengths will be provided in the integration phase of the project.
 - .2 Pricing should include single cable pricing and quantity discount pricing.
- .5 Cable Connecting Hardware:

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- .1 Comply with Optical Fiber Connector Intermateability Standards (FOCIS) specifications of TIA/EIA-604-2, TIA/EIA-604-3-A, and TIA/EIA-604-12. Comply with TIA/EIA568-C.3.
- .2 Quick-connect, simplex and duplex, Type LC connectors. Insertion loss not more than 0.75 dB.

2.03 Identification Products

- .1 Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, and inks used by label printers.
- .2 Comply with requirements in Section 26 05 53 "Identification for Electrical Systems."

2.04 Source Quality Control

- .1 Factory test UTP cables according to TIA/EIA-568-C.2.
- .2 Factory test multimode optical fiber cables according to TIA/EIA-526-14-A and TIA/EIA-568-C.3.
- .3 Provide test and inspection reports.

3 Execution

3.01 Field Quality Control

- .1 Perform tests and inspections.
 - .1 Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling connections for compliance with TIA/EIA-568-C.1.
 - .2 Visually confirm Category 6a, marking of patch cables.
 - .3 Visually confirm Fiber patch cable marking.
 - .4 Visually inspect cable placement, and patch cords, and labeling of all components

3.02 Supply of Patch Cords

- .1 Patch cords included in contract; all patch cords to be supply only, installation by the Owner.
 - .1 Supply two (2) copper patch cords per each telecom field outlet.
 - .1 7'-0" length at telecom room.
 - .2 10'-0" length at workstation.
 - .2 Supply one (1) duplex Fiber patch cord for every 12 strand fiber backbone cable.
 - .3 Supply one (1) duplex Fiber patch cord for every 2 strand fiber horizontal distribution cable.
- .2 Patch cord colour to match colour of system cabling.

End of Section

1 General

1.01 Section Includes

- .1 Wireless Access Points for Wi-Fi network communications.

2 Products

2.01 Owner-Supplied Products

- .1 WAP (Wireless Access Points).
 - .1 Free issued by Owner to this Contractor for installation at locations as indicated on the drawings.
- .2 Power Over Ethernet (PoE) powered.

3 Execution

3.01 Installation

- .1 Allow for site wireless survey for the final locations of WAPs.
- .2 Allow for 5 m cable slack at WAP outlets end for final location adjustment.

End of Section

1 General

1.01 Section Includes

- .1 Table boxes for power, communications and A/V connectivity.
- .2 Cable retractors.
- .3 Under table cable management kit.
- .4 Transition channel.

1.02 Related Requirements

- .1 Division 26 - Electrical: Electrical systems and components.
- .2 Division 27 - Communications: Communications and audio-video systems and components.
- .3 Division 28 - Electronic Safety and Security: Security systems and components.

1.03 Submittals

- .1 Submit under provisions of Section 01 33 00.
- .2 Product Data: Submit for table boxes, cable retractors, under table cable management, and transition channel.
- .3 Samples: Submit three (3) with required color and finish. Show standard color ranges available.

1.04 Quality Assurance

- .1 Manufacturer Qualifications: Firms regularly engaged in manufacture of electrical table boxes, fittings, cable retractors, under table cable management, and transition channel of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 10 years. Provide electrical table boxes, fittings, cable retractors, under table cable management kit, and transition channel produced by a manufacturer listed in this section.
- .2 Source Limitations: Obtain each type of table box, fitting, cable retractor, under table cable management kit, and transition channel through one (1) source from a single manufacturer.
- .3 Electrical Boxes and Fittings: Comply with requirements of applicable local codes, NEC, UL, ETL, and NEMA Standards pertaining to boxes and fittings.

1.05 Delivery, Storage, and Handling

- .1 Deliver table boxes, fittings, cable retractors, under table cable management kits, and transition channels in factory labeled packages.
- .2 Store and handle in strict compliance with manufacturer's written instructions and recommendations.
- .3 Protect from damage due to weather, excessive temperature, and construction operations.

2 Products

2.01 Manufacturers

- .1 Basis-of-Design Product: The design for table boxes, fittings, cable retractors, under table cable management kits, and transition channels is based on InteGreat products manufactured by Legrand/Wiremold.

- .2 Substitutions:
 - .1 Crestron.

2.02 Table Boxes

- .1 Classification and Use: Table boxes shall be cETLus listed furniture power distribution units.
- .2 Table Boxes, General: InteGreat A/V Table Boxes shall provide convenience outlets for power, data, and A/V services.
 - .1 Table Boxes are designed to fit together with other InteGreat products providing cable protection and organization.
- .3 Table Boxes: InteGreat A/V Table Boxes Catalog No TB672APBK.
 - .1 Cover: Brushed, anodized aluminum cover in a black finish with beveled edges and "soft-touch" handle.
 - .1 Cover contains a "pocket" door which fully recesses into the box when open, giving access to connections without obstructing work surface. A finishing plate hides hardware on activation surface and permits labeling of the AVIP plates.
 - .2 Cover flange allows for 6.4 mm (1/4 inch) of forgiveness in the cut out opening.
 - .2 Activation Surface: Adjustable downward in 12.7 mm (1/2-inch) increments, from one 25 mm (1 inch) to 102 mm (4 inch) to allow cover to close even when large style connectors are used.
 - .3 Provide table boxes with a 12 foot SJT cord for easy connection to electrical infrastructure.
 - .4 Supply tables boxes with a cable grommet kit that can accommodate up to eight pull out connections. Boxes shall also be capable of accepting up to five Wiremold AVIP or Extron MAAP connectors.
 - .5 Provide table boxes with two 15 amp receptacles in top compartment and one 15 amp receptacle on underside of box.

2.03 Cable Retractors

- .1 Cable Retractors: InteGreat Series cable retractors; mounts directly to InteGreat Series A/V Table Box or underside of conference room table using a horizontal mounting bracket.
 - .1 Cable Retractors with Category 6 Cable: Catalog No. TBCRCAT6; loaded with 3660 mm (12 feet) of Cat6 cable that extends out 1520 mm (5 feet) from retractor. Supply retractor with a female input from building infrastructure and a male connector on the output side.
 - .2 Cable Retractors with VGA Cable: Catalog No. TBCRVGA; loaded 3660 mm (12 feet) of VGA cable that extends out 1520 mm (5 feet) from retractor. Supply retractor with a female input from building infrastructure and a male connector on the output side.
 - .3 Cable Retractors with HDMI Cable: Catalog No. TBCRHDMI; loaded with 3660 mm (12 feet) of HDMI cable that extends out 1520 mm (5 feet) from retractor. Supply retractor with a female input from building infrastructure and a male connector on the output side. Provide input side with mounting tab that allows installer to cable tie HDMI to retractor to minimize chances of loose connections.
 - .4 Cable Retractors with 3.5 mm Audio Cable: Catalog No. TBCR3.5 mm; loaded with 3660 mm (12 feet) of audio cable that extends out 1520 mm (5 feet) from retractor. Supply retractor with a female input from building infrastructure and a male connector on the output side.

- .2 Cable Retractor Horizontal Mounting Brackets: Catalog No. TBCRHMK; permits retractor to mount horizontally under conference room table, enabling cable access through a table grommet. Multiple retractors can be mounted to each other by attaching the mounting brackets to each other.

2.04 Under Table Cable Management Kit

- .1 Under Table Cable Management Kit: InteGreat Series under table cable management kit provides clean cable management for power, communication and A/V cables on horizontal underside of table.
 - .1 Under Table Cable Management Kit: Catalog No. UTCM5; includes 1524 mm (5 feet) length of divided base, 1524 mm (5 feet) length of mounting hinge rail and four latching clips; black, non-metallic construction.

2.05 Transition Channels

- .1 Transition Channels: InteGreat Series transition channels continue cable management and protection from underside of the table to the floor, where cables can gain access to building infrastructure. Channel fits directly into under table cable management kit on underside of table and mates with poke-thru device or over floor raceway for smooth transition to building infrastructure.
 - .1 Transition Channels: Catalog No. MRTC; consists of aluminum center spline with steel mounting plate and four (4) screws, black aluminum side channels, black non-metallic bottom boot and two (2) black non-metallic transition covers.

3 Execution

3.01 Examination

- .1 Examine conditions under which table boxes, cable retractors, under table cable management kit, and transition channels are to be installed. Notify the Consultant in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.02 Installation

- .1 Strictly comply with manufacturer's installation instructions and recommendations. Coordinate installation with adjacent work to ensure proper clearances and to prevent electrical hazards.

3.03 Cleaning and Protection

- .1 Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer.
- .2 Protect products until acceptance.

End of Section

1 General

1.01 Section Includes

- .1 The specifications for the visual nurse call system are a description of the various components with the minimum operational sequence requirements. System shall comply with all applicable codes.
- .2 When all systems are completely installed and ready to be used, the successful supplier shall thoroughly instruct those appointed by the Owners in the complete operation of all systems provided by him for a minimum time of 4 hours (Two 2 hour sessions at times as directed by Owner to suit staff's requirements) unless in the opinion of the Consultant a longer instruction period is necessary.
- .3 System as provided by the manufacturers will include the following:
 - .1 Supply and installation of control equipment including auxiliary power supplies.
 - .2 Supply and installation of all system equipment and devices.
 - .3 Supply and installation of all wiring required for complete system operation.
 - .4 All required system programming, testing and verification.
 - .5 Complete layout, wiring and installation diagrams for overall system design.
 - .6 Complete instruction to Owner on system operation.
 - .7 Technical data on each product, including finishes.
 - .8 Description of system operation.
 - .9 Riser diagrams and system data.
 - .10 Equipment design considerations for future expansion when indicated.
 - .11 Materials list and backbox schedule (including unique backboxes).
 - .12 Factory prepared operation and service manual for each system, operation details, schematics, wiring diagrams, colour coding, terminal numbers, and component values for printed circuit boards.

2 Products

2.01 Manufacturers

- .1 The systems shall be as manufactured by:
 - .1 Cintel – Advance Care IP series.
 - .2 Austco - Tacera series.
 - .3 Aatel - Rauland Responder 5000 series.
 - .4 Ascom – Telligence series
- .2 Provide complete start-up verification report by manufacturer and include cost in tender price.

2.02 Nurse Call System

- .1 The specifications for this system are a description of the various components with the minimum requirements of the operations sequence, facilities and features required.
- .2 Nurse Call scope of work will include for provision of:
 - .1 Co-ordination of system work to clearly identify responsibilities of system vendor and Electrical Contractor;
 - .2 All required conduits and boxes, power feeders, to suit system requirements and as per requirements of Section 26 05 33.13 and as per system manufacturer's requirements;
 - .3 Installing all nurse call system components, wiring, wiring accessories, identification and labelling of each wiring run;
 - .4 All required nurse call system programming;
 - .5 All nurse call system testing, inspection and verification work upon completion;
 - .6 Testing and verification reports signed by manufacturer's authorized representative and by Electrical Contractor;
 - .7 Nurse call vendor's provision of technical assistance and supervision of Electrical Contractor with regards to conduit, wiring and component installation requirements.
 - .8 All required software programming; Coordinate with owner where the alarms are to be displayed.
 - .9 Resident bed stations with 5 levels of call;
 - .10 Washroom pull cord stations with staff assist;
 - .11 Exterior Emergency stations;
 - .12 Corridor (Dome) Lights 32 programmable alerts, flashes and colors types;
 - .13 Staff Console 19" touch screen;
 - .14 Annunciator Corridor Displays;
 - .15 Call cords (as required);
 - .16 Integration software;
 - .17 Wireless nurse call portable phones;
- .3 Dome lights shall be complete with transparent dome, stainless steel trim, backbox and lamps, white, red, blue and yellow.
- .4 Cabling shall be Cat5e or Cat 6 in accordance with manufacturer's requirements. All cabling shall be installed in a cable tray, raceway or with minimum $\frac{3}{4}$ " (19mm) conduit unless otherwise noted.
- .5 All wiring to be tested for continuity, shorts and grounds before system activation.
- .6 The system meet or exceed UL 1069 listed as a Nurse Communications Network. The system to be capable of interconnecting with the facilities' LAN (Local Area Network). This connection to be minimal and utilize only one Ethernet 1 Gb connection to accomplish all information exchange. Coordinate with owner the HL-7 standard for the facility.

- .7 Components and the system as a whole to meet or exceed the minimal standards issued by CSA, EEMAC and ULC. Work in conjunction with this installation to meet the provisions of the local governing electrical code, edition of CSA Z32 enforced by local governing authority and any applicable local codes.
- .8 Each major component to bear the manufacturer's name, catalogue number, place of manufacture and CSA/ULC label.
- .9 The system to be compatible and include provisions to integrate fully to systems such as asset tracking, and patient wandering systems, Real Time Locating System (RTLS), access control and video surveillance systems such that the central station display annunciates and displays alarm information available from each integrated system, such as the unique address of alarm transmitter, exact location of alarm, patient's bed number, etc. In addition the system performs required responses to alarms, system alarm resets, and basic controlling features of the integrated systems. Features and functions to be programmable to suit Owner's specific requirement. Include selectively programmable system features as confirmed with Owner's Project Manager in writing prior to system programming.
- .10 Priority level names to be displayed as alpha characters, and the room numbers to be user-programmable.
- .11 The room numbers to be numeric with alpha characters for descriptions.
- .12 Visible annunciation to be by corridor and zone lights associated with each call.
- .13 System to use RJ-45 connectors, requiring no unique wiring on a per station basis.
- .14 System to have automatic supervision of associated bedside patient stations, emergency stations, staff stations, zone lights, dome lights and consoles, with an indication at the console of which station or stations failed.
- .15 System to provide for transfer of one or more individual or groups of stations from one console to another without mechanical switches or additional predetermined wiring of the stations.
- .16 System user features and programmable access to make system changes to be password protected to ensure that only authorized personnel can make changes.
- .17 The system to contain built-in diagnostics to monitor and diagnose system operation.
- .18 The system to have the capability to program/create a list of staff, for the purpose of individual assignment to each patient/bed as a primary or alternate caregiver. Once assigned by shift, calls placed by the patient may be automatically directed to the assigned staff currently on duty, alerting them of the pending call and subsequent care givers if necessary.
- .19 Ability to program individual staff to patient assignments easily from work station terminal at the beginning of each shift by selecting the staff's name and changing their personal assignment screen. The staff-to-patient assignments are established directly using the patient's room and bed. Additionally the staff may receive all call priorities or only a selected subset of call priorities.
- .20 Capabilities for the nurse follow feature to be included. The basic nurse follow function, when activated from the master station, to allow a staff member to leave the master station and be notified of a call at a designated room and bed.
- .21 The system to be provided with the activity reporting and management system interface software program to record all patient calls and related time-based activities and to provide for recall, summary reporting and printing of statistical information from a computer station provided with system. System software to perform automatically daylight saving time adjustments to the Eastern Time Zone.
- .22 The system to be of modular construction. Components used in signal control to be plug-in for easy replacement and maintenance. A solid-state plug-in flasher to be incorporated to provide the steady and interrupted alerting tones and indicating lights.

- .23 The normal and emergency call tones generated at the console and duty stations to be preprogrammed at different rates for easy identification. The alerting tones to be electronically generated. Tone level to be adjustable or turned off as required during night hours.
- .24 Patient stations, emergency stations, and staff/duty stations to be installed into standard electrical backboxes.
- .25 The system sequence of operation to be confirmed with Owner. This sequence is generally for pricing purposes and exact sequence of operation to be programmable to suit Owner's exact requirements. Confirm exact sequence with Owner and Consultant, in writing prior to start of work.

2.03 Functional Requirements

- .1 System to be interfaced with the following communication systems:
 - .1 Wireless Phones
 - .2 Facility telephone System
 - .3 Patient Wandering RTLS System
 - .4 Door access controls
 - .5 Fire Alarm System
- .2 Nurse call system shall provide all necessary connectivity between points and shall be an isolated labelled installation independent of IT network.
- .3 A minimum call history of 2 years which can be retrieved at any time.
- .4 All call points and all other in room devices, including patient station washroom, emergency pull cords stations shall have its own unique address.
- .5 Resident Bed Stations
 - .1 Removal of the call cord / auxiliary alarm shall generate a cord out call.
 - .2 Stations shall be configurable for custom call types up to five levels of call without custom ordering devices from the manufacturer or replacing devices.
 - .3 Stations shall have a dedicated LED to indicate call and communication status.
 - .4 Each button shall have a dedicated LED to indicate that the button has been pressed or is actively indicating a call.
 - .5 Stations shall be hot swappable and not require system shutdown.
 - .6 Must be capable of connecting a call bell cord with bed alarm.
 - .7 Must be capable of connecting a wireless bed alarm, wireless floor mat alarm and wireless chair alarm.
 - .8 Calls can only be cancelled/shut off at the point of call/originating station.
 - .9 All stations shall be supervised.
- .6 Pull Cord (Washroom) Stations
 - .1 Each station shall have a dedicated LED to indicate that the button has been pressed or is actively indicating a call.

- .2 Stations shall be configurable for custom call types up to five levels of call without custom ordering devices from the manufacturer or replacing devices.
- .3 All stations shall have the ability to be individually numbered to represent a separate and distinct location.
- .4 Respondents are asked to also provide alternatives to the pull cord and products designed for use in high humidity areas (e.g. tub rooms).
- .5 Stations shall be hot swappable and not require system shutdown.
- .6 Stations must be user friendly.
- .7 Stations must have Staff Assist that residents can not activate by multiple pulls of the cord station or direct button activation.
- .8 Respondents are encouraged to provide options for the pull cord.
- .9 Calls can only be cancelled/shut off at the point of call/originating station.
- .10 All stations must be fully supervised.
- .7 Exterior Emergency Stations
 - .1 Each exterior emergency station shall be suited for exterior use.
 - .2 Stations shall be configurable for custom call types up to five levels of call without custom ordering devices from the manufacturer or replacing devices.
 - .3 Pressing the emergency button shall cause an emergency alarm to be displayed on the respective master station.
- .8 Dome Lights
 - .1 Provide bright easy to see annunciation to speed response time and increase caregiver efficiency.
 - .2 Each dome light shall utilize RGB Technology LEDs for displaying colours.
 - .3 Dome lights requiring the replacement filter caps or lenses to provide requested corridor light colours for any priority are not acceptable.
- .9 Staff Console
 - .1 The staff console shall alpha-numerically display incoming calls from stations and connected equipment and provide a means for the operator to prioritize and respond to selected events.
 - .2 Provide audible signaling functions.
 - .3 Provide visual identification of the calling station(s) by room number, bed identification, priority, station type or call type.
 - .4 Audible annunciation shall provide priority level.
 - .5 Call pending screen shall allow 5 calls to display at a time and provide a simple scrolling function to view additional calls when more than 6 pending calls are present.
 - .6 Pending call shall be displayed in priority order regardless of the order in which they are received.

- .7 Ability to “automatically select” incoming calls in order of priority or allow the user to select from the pending calls list.
- .8 Ability to adjust the volume of incoming call tones.
- .9 Ability to restrict selected functions/buttons to approved users.
- .10 Staff console and annunciators to be programmable to receive and display selected call priorities by area, or to delay selected calls for a programmable interval.
- .10 Annunciator Corridor Display
 - .1 Must be high resolution, double –sided alphanumeric LED display.
 - .2 Audio / visual annunciation of active calls by means of text messages with accompanying alert tones based on priority.
- .11 Call Cords
 - .1 Bed call cord shall have a heavy duty molded connector, flexible PVC jacket cable and a molded flame retardant ABS switch housing.
 - .2 Switch to be the momentary contact type.
 - .3 Cord to be 3 meters in length with and integrated sheet clip and be suitable for ethylene oxide sterilization.
 - .4 Calls can only be cancelled/shut off at the point of call/originating station.
 - .5 Pull cord stations should be user friendly. Respondents are encouraged to also provide alternatives to the pull cord.
- .12 Wireless Telephone system and Interface
 - .1 The facility will be utilizing an NEC telephone system with Spectra link portable phones. The nurse call system shall be fully integrated with the NEC telephone system, complete with all necessary interfacing units and provisions.
 - .2 The nurse call system shall be capable of integrating with up to 100 wireless devices. Sixty (60) nurse call wireless devices are to be included as part of the nurse call system.

2.04 Management Reporting / Software

- .1 Respondents should describe the Management Reporting system that they are proposing.
- .2 Systems should be user friendly and be able to report and summarize all nurse call system events and related activities. The reporting database should have the flexibility to generate reports for facility wide efficiency analysis, unit performance statistics, incident reports/details and performance/device failures. Device failures should be messaged out via text, email or pager.
- .3 The management reporting system should provide all necessary software for reporting and management and directly integrate to the secondary systems listed, without the need for a 3rd party application.
- .4 Systems must have a minimum call history of 2 years which can be retrieved at any time.
- .5 The reporting database should allow up to 15 user logins for reporting and software management.
- .6 Users should be able to create user-defined reports that can be saved as templates.

3 Execution

3.01 Installation

- .1 Coordinate work of each trade for scheduling, demolition, rough-in, power and conduit requirements, installation and testing.
- .2 Provide complete visual nurse call systems as shown on Drawings and as specified.
- .3 Provide specified various nurse call systems components in areas as shown and as required. Programme system on servers/terminals. Obtain Owner's approval of room nomenclature prior to start of programming. Customize software to suit Owner's specific applications. Program sequence of operation and user information as required. Include for system manufacturers authorized representative to program systems. Programme exact programming requirements as confirmed with Consultant and/or Owner in writing prior to start of Work. Utilize manufacturer's recommended configuration chart during installation and record respective device names, serial number, room name and number and comments, as outlined on sheets.
- .4 Provide control units and stations and install into locations. Install components at the mounting heights as noted on drawings and as required and confirmed with Consultant. Generally, wall mounted devices onto recessed boxes. Provide suitable conduits and backboxes to accommodate device installations. Confirm back box requirements with system vendor prior to roughing-in.
- .5 Generally, install dome lights located between doorframe and underside of suspended ceiling. Interconnect patient room smoke detectors to dome lights and remote communicators. Coordinate work with fire alarm system technicians of fire alarm system vendor. Install zone lights to ceilings on recessed boxes in locations confirmed with Consultant and coordinated with other systems and equipment. Confirm colours for dome lights with Consultant prior to ordering.
- .6 Provide minimum $\frac{3}{4}$ " (19mm) conduit from each device to the ceiling and provide deep back boxes as specified.
- .7 Provide system wiring. Cabling to be minimum Cat 5E, colour coded, and in accordance with the system manufacturer's recommendations and instructions. Connect equipment in accordance with the system manufacturer's certified wiring diagrams and instructions and under direct supervision of the manufacturer. Provide and arrange for authorized system manufacturer's representative to make all final equipment connections. Run conductors in conduit or in cable tray, as identified on drawings. Use of cable hangers system such as J hooks are not acceptable unless approved in writing from Consultant and/or unless such use is specifically noted on drawings.
- .8 Obtain required training from manufacturer's representative on any special installation procedures. Install devices and perform work in accordance with the manufacturer's instructions and requirements and in accordance to applicable codes of the governing authorities having jurisdiction.
- .9 Confirm locations of devices with Consultant prior to roughing-in.
- .10 Perform system integration connections to various systems as required. Include costs for systems service vendors to perform required integration and programming requirements.
- .11 Ground and bond system as required by local governing electrical code and authority and system manufacturer.
- .12 Provide a lamacoid identification nameplate for each enclosure. Confirm wording of identification nameplates and colour finishes of devices with Owner prior to ordering.
- .13 When work is complete, arrange for attendance at the site of the system manufacturer's authorized representative to make final equipment connections and provide inspection, testing, adjusting and verification requirements.

- .14 Turn over to Consultant/Owner, specified loose accessories.

3.02 System Training

- .1 Provide to Owner's designated staff, onsite training sessions to Owner's designated personnel on the operation and maintenance procedures with regards to the system. Each session may be held on different days and locations, at Owner's discretion. Exact times and dates to be coordinated with and approved by Owner.
- .2 The following are required from Nurse Call System supplier, one week before each training session:
 - .1 an easy to read manual describing the features, providing trouble-shooting guidelines;
- .3 Schedule
 - .1 Training on the operation of the Nurse Call System for Maintenance staff:
 - .1 Two sessions, 1-hour duration for up to ten (10) people each session.
 - .2 There should be enough copies of printout regarding repair of parts, for each participant.
 - .2 Training on the operation and managing software for Nurse Managers, Program Service Managers, Program Director, Operations Directors, VP Programs, Director of Organizational effectiveness and Risk Management and designate, Program Assistant:
 - .1 Two sessions, 1-hour duration for up to ten (10) people each session.
 - .2 There should be enough copies of handouts on summary of training, for each participant.
 - .3 Training for Nurses will be for the operation only. Allow for four (4) training days. At each training day, the training schedule to include:
 - .1 minimum four (4) - 1 hour sessions spread out over the day at times directed by Owner;
 - .2 the number of nurses to be accommodated to be as later directed.
 - .4 Provide training/coordination on access and networking issues for Owner's computer network for one session, one hour duration for up to 8 people. There should be enough copies of handouts for technical information for networking and edit access.
- .4 Include for professional recording of and copying onto USB memory or digital video disk of operation and maintenance procedures.

End of Section

1 General

1.01 Section Includes

- .1 Modifications to existing access control system, including provision of new hardware, software licences, etc. to make a complete and functional system.

1.02 Related Requirements

- .1 Section 28 10 00 – Access Control.

1.03 Warranty

- .1 All new material and equipment furnished under this section shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance.

2 Products

2.01 Existing Systems

- .1 The existing video surveillance system is based upon a [Lenel] [CCure] platform, software version [].

3 Execution

3.01 Installation

- .1 Install new components in accordance with manufacturer's instructions.
- .2 Maintain operation of the existing system at all times.

End of Section

1 General

1.01 Section Includes

- .1 Modifications to existing video surveillance, including provision of new hardware, software licences, etc. to make a complete and functional system.

1.02 Related Requirements

- .1 Section 28 21 00 – Surveillance Cameras.
- .2 Section 28 23 00 – Video Management System.

1.03 Warranty

- .1 All new material and equipment furnished under this section shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance.

2 Products

2.01 Existing Systems

- .1 The existing video surveillance system is based upon a [Lenel] [Milestone] [] platform, software version.

3 Execution

3.01 Installation

- .1 Install new components in accordance with manufacturer's instructions.
- .2 Maintain operation of the existing system at all times.

End of Section

1 General

1.01 Section Includes

- .1 Modifications to existing fire alarm system, including provision of new zones as indicated, relocating and new fire alarm devices as indicated on the drawings, and system verification. Complete systems shall be left ready for continuous and efficient satisfactory operation.
- .2 Update annunciators passive & active graphic to include additions and renovated areas, as applicable.
- .3 New devices connected directly to the existing fire alarm system shall of the manufacturer's current product selection, and to match the existing system.
- .4 Provide additional amplifiers & battery pack as required to accommodate new devices.

1.02 Related Requirements

- .1 Section 21 12 00 – Fire-Suppression Standpipes.
- .2 Section 21 13 00 – Fire-Suppression Sprinkler Systems.
- .3 Section 26 05 33.13 – Conduit for Electrical Systems.
- .4 Section 26 05 33.16 – Boxes for Electrical Systems.
- .5 Latest fire alarm verification or annual inspection report.

1.03 Unit Prices

- .1 Refer to Document 00 43 00.26.
- .2 Submit with Tender unit prices to provide the following:
 - .1 Provide manual station complete with wiring and conduit based on 10 metre distance.
 - .2 Provide fire alarm horn/strobe complete with wiring and conduit, based on 10 metre distance.
 - .3 Provide smoke detector complete with wiring and conduit, based on 10 metre distance.
 - .4 Provide duct type smoke detector complete with wiring and conduit on a separate zone, based on 30 metre distance.
 - .5 Provide unit rate cost of new conduit and wire for initiation or signal circuits based on 10 metre length.
 - .6 Provide unit rate cost to replace existing heat detector.
 - .7 Provide unit rate cost to replace existing manual station.
 - .8 Provide unit rate cost to replace existing end of line resistors.

1.04 Alternates

- .1 Refer to Document 00 43 00.26.
- .2 Base bid design entails the provision of new fire alarm initiation and signal circuit wiring, unless noted otherwise on plans.

- .3 Submit with Tender as an alternate (separate) price to delete the removal of all existing fire alarm wiring, and delete the replacement of same with new wiring in existing conduits. This price will be actioned as a Change Order if it is determined during construction that the existing wiring can be re-used.

1.05 References

- .1 The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only. Comply with latest edition/amendment referenced Code/Publication.
 - .1 2024 Ontario Building Code.
 - .2 2007 Ontario Fire Code.
 - .3 CAN/ULC-S524:2019, Standard for Installation of Fire Alarm Systems.
 - .4 CAN/ULC-S537:2019, Standard for Verification of Fire Alarm Systems.
 - .5 CAN/ULC-S1001-11, Integrated Systems Testing of Fire Protection and Life Safety Systems.
 - .6 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .7 Ontario Electrical Safety Code (29th edition/2024).
 - .8 All requirements of the Authority Having Jurisdiction (AHJ).

1.06 Submittals

- .1 Provide submittals to the Consultant for review in accordance with Section 01 33 00.
- .2 Submit to the Fire Department, drawings showing bells, manual stations, complete wiring diagrams and annunciator details and obtain their approval.
- .3 Shop Drawings
 - .1 Include sufficient information, clearly presented, to determine compliance with drawings and specifications.
 - .2 Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, and device arrangement.
 - .3 Show annunciator layout and main control panel module layout, configurations and terminations.
 - .4 Show device layout, complete riser diagram, and auxiliary functions.
 - .5 The supplier of the system shall prepare a complete zoning schedule and artwork layout for active graphic to be included with submittal package.
- .4 Manuals
 - .1 Submit complete operating and maintenance manuals listing the manufacturer's name(s) including technical data sheets (with model numbers to be used indicated).
 - .2 Wiring diagrams indicating terminals and the interconnections between the items of equipment.
 - .3 Provide a clear and concise description of operation which gives, in detail, the information required to properly operate the equipment.

1.07 Closeout Submittals

- .1 Fire Alarm Verification Report.
- .2 Operation and Maintenance Manual.
- .3 Training session attendance list.

1.08 Quality Assurance

- .1 Approvals
 - .1 The system shall have proper listing and/or approval from the following nationally recognized agencies:
 - .1 ULC Underwriters Laboratories Canada.
 - .2 The fire alarm control, panel shall meet the modular listing requirements of ULC. Each subassembly of the FACP, including all printed circuit boards, shall include the appropriate ULC modular label.
- .2 All devices/components shall be suitable for the locations, environment, temperatures in which they are to be installed.

1.09 Warranty

- .1 All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least one (1) year from the date of acceptance.

2 Products

2.01 Existing System

- .1 The existing Fire Alarm System is as indicated on drawings Edwards EST series two-stage fire alarm system.
 - .1 The location of the Fire Alarm Control Panel is as indicated on the drawings.
 - .2 There is one passive graphic annunciator to be updated, location as indicated on the drawings.

2.02 Manufacturers

- .1 The system components shall be selected so as to match and be compatible with the existing Fire Alarm system.

2.03 Equipment and Material, General

- .1 Review latest verification report, and review existing system during tender walkthrough and note all required modifications.
- .2 All equipment and components shall be new, and the manufacturer's current model.
- .3 All equipment and components shall be installed in strict compliance with manufacturers' recommendations.
- .4 All Equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.04 Conduit and Wire

- .1 Existing conventional zone wiring is existing to remain.
- .2 New conduit and wire for new zones and new devices to Section 27 15 01.19.
- .3 Conduit
 - .1 Conduit shall be in accordance with the Electrical Safety Authority (ESA), local and provincial requirements.
 - .2 All wiring shall be installed in conduit or raceway to Section 26 05 33.13 and Section 26 05 33.23.
- .4 Wire
 - .1 All fire alarm system wiring to suit new devices shall be new.
 - .2 Wiring shall be in accordance with local, provincial and national codes and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as outlined in the Ontario Electrical Safety Code and as recommended by the fire alarm system manufacturer.
 - .3 All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signalling system, as outlined in the Ontario Electrical Safety Code.
- .5 Terminal Boxes, Junction Boxes and Cabinets:
 - .1 All boxes and cabinets shall be listed for their purpose and use.]

2.05 Main Fire Alarm Control Panel

- .1 Add new zones, zone modules, etc., for new work as required, and connect all new devices to Fire Alarm Control Panel.
- .2 Remote Annunciator and Passive Graphic
 - .1 Connect all new zones for the new work to annunciators.
 - .2 Provide new passive graphic, multicolour, under plexiglass with anodized frame and concealed tamperproof mounting.

2.06 Components

- .1 Programmable Electronic Sounders:
 - .1 Electronic sounders shall match existing system.
 - .2 Shall be flush mounted as required.
- .2 Audible/Visual Combination Devices:
 - .1 Shall meet the applicable requirements of sounders listed above for audibility.
 - .2 Shall have a built-in strobe, 15 candela.
- .3 Strobe Synchronizing Modules:
 - .1 Synchronize strobes at 1 Hz and horns at temporal over single wire pan.
- .4 Manual Fire Alarm Stations

- .1 Manual fire alarm stations shall be non-coded, non-breakable glass type.
- .2 Stations must be designed such that after an actual activation, they cannot be restored to normal without the use of a special tool.
- .3 An operated station shall automatically condition itself so as to be visually detected, as operated, at a minimum distance of 30.5 m (100 ft) front or side.
- .4 Manual stations constructed of metal, with operating instructions provided on the cover. The word FIRE shall appear on the manual station in letters 12.7 mm (1/2 in) in size or larger.
- .5 Manual stations shall be c/w polycarbonate vandal covers.
- .5 Conventional Photoelectric Area Smoke Detectors
 - .1 Photoelectric smoke detectors shall be two wire, ceiling-mounted, light scattering type using an LED light source.
 - .2 Each detector shall contain a remote LED output and a built-in test switch.
 - .3 Detector shall be provided on a twist-lock base.
 - .4 It shall be possible to perform a calibrated sensitivity and performance test on the detector without the need for the generation of smoke. The test method shall test all detector circuits.
 - .5 A visual indication of an alarm shall be provided by dual latching Light Emitting Diodes (LEDs), on the detector, which may be seen from ground level over 360 degrees. These LEDs shall flash every 10 seconds, indicating that power is applied to the detector.
 - .6 The detector shall not go into alarm when exposed to air velocities of up to 914.4 m (3000 ft) per minute.
 - .7 The detector screen and cover assembly shall be easily removable for field cleaning of the detector chamber.
 - .8 All field wire connections shall be made to the base through the use of a clamping plate and screw.
- .6 Duct Smoke Detectors
 - .1 Duct smoke detectors shall be complete with visual alarm and power indicators, and a reset switch. Each detector shall be installed upon the with properly sized air sampling tubes.
- .7 Automatic Conventional Heat Detectors
 - .1 Automatic heat detectors shall have a combination rate of rise and fixed temperature rated at 135 degrees F (57.2 degrees C) for areas where ambient temperatures do not exceed 100 degrees F (37.7 degrees C), and 200 degrees F (93.33 degrees C) for areas where the temperature does not exceed 150 degrees F (65.5 degrees C).
 - .2 Automatic heat detectors shall be a low profile, ceiling mount type with positive indication of activation.
 - .3 The rate of rise element shall consist of an air chamber, a flexible metal diaphragm, and a factory calibrated, moisture-proof, trouble free vent, and shall operate when the rate of temperature rise exceeds 15 degrees F (9.4 degrees C) per minute.
 - .4 The fixed temperature element shall consist of a fusible alloy retainer and actuator shaft.

- .5 Automatic heat detectors shall have a smooth ceiling rating of 2 500 square feet (762 square metres).

2.07 Operation Sequences

- .1 The fire alarm system shall be as defined in the Ontario Building Code.
- .2 Basic Performance:
 - .1 Initiation Device Circuits (IDC) shall be wired Class A.
 - .2 Notification Appliance Circuits (NAC) shall be wired Class B (NFPA Style Y).
 - .3 Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.
- .3 Basic System Functional Operation:
 - .1 An alarm is caused by actuation of any one of the following devices:
 - .1 Actuation of a manual station.
 - .2 Operation of an automatic fire alarm detector.
 - .3 Operation of a sprinkler flow switch.
 - .4 Operation of a smoke detector.
 - .2 If, in any area of the building, an alarm is caused by actuation of the aforementioned devices, the following shall occur:
 - .1 Signals in the building shall sound.
 - .2 Annunciators shall indicate exact zone where alarm originated
 - .3 Fans shall be automatically turned off.
 - .3 Central station shall be automatically alerted via telephone lines connected for fire alarm system.
 - .4 If, in any area of the building, supervised valves of the sprinkler, systems are operated or exhibit short or open circuits, the following shall occur:
 - .1 The annunciator shall identify, as a separate zone, the item causing the trouble signal.
 - .2 The trouble buzzer on the annunciator(s) shall sound.
 - .3 The signals in the building shall not be sounded.

3 Execution

3.01 Examination

- .1 Do not disturb any existing devices unless absolutely necessary to facilitate installation of a new device. No existing devices are to be disturbed without specific authorization by the Project Manager.
- .2 Conduct an impedance test of initiation and signal circuits, and submit report to the Consultant. Report any discrepancies in circuit loading.

3.02 Installation

- .1 Maintain continuity of the existing fire alarm system at all times. In the event that a shutdown is required of the fire alarm system, provide a fire watch.
- .2 Install fire alarm system devices in accordance with applicable codes, and manufacturer's instructions.
- .3 Entire installation shall be done under supervision of manufacturer. Upon completion of installation, check entire system to approval and correct any malfunction immediately.
- .4 Standpipe System Connections.
 - .1 Refer to Section 21 12 00.
 - .2 Connect contact of supervisory switches to fire alarm zones indicated.
- .5 Sprinkler System Connections.
 - .1 Refer to Section 21 13 00.
 - .2 Connect contact of sprinkler flow switches and supervisory switches to fire alarm zones indicated.
- .6 Align alarm devices and signals, where grouped together, one above the other.
- .7 Mount devices at the following heights unless otherwise shown:
 - .1 Signal devices:
 - .1 300 mm below finished ceiling
 - .2 2050 mm above floor in unfinished areas.
 - .2 Manual stations:
 - .1 1200 mm above finished floor level.
 - .3 In areas with separate signal devices for fire suppression and/or pre-action, provide a lamacoid nameplate for base building signalling devices.
- .8 Manufacturer shall examine Drawings and Specifications prior to award of Contract to ensure that detectors, control panels and miscellaneous devices being supplied will provide a satisfactory working installation.

3.03 Field Quality Control

- .1 Testing and Verification
 - .1 Test each automatic detector to ensure correct wiring and zoning by setting off its rate of rise component and sounding the bells or by ringing it out. Test each smoke detector, sprinkler system and standpipe valves to ensure correct wiring.
 - .2 Provide the service of a competent, factory trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with CAN/ULC-S537.
 - .3 Check for correct connections and test for short circuits, ground faults, continuity, and insulation.
 - .4 Perform audibility test of space and provide annunciation devices to suit ambient sound levels. Ensure coverage for fire alarm signalling devices on base building fire alarm system. Provide

- audible test of signaling devices after other systems have been commissioned to verify operation at computer room ambient sound level.
- .5 Verify activation of all relocated devices, including flow switches, trouble, and supervisory signals from the relocated pre-action assembly.
 - .6 Provide the service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system.
 - .7 All initial testing shall be in accordance with CAN/ULC-S537. A representative of the electrical contractor shall be present to participate and assist the manufacturer representative during the course of the verification. The electrical contractor shall make good any deficiencies discovered during the verification. All devices, new and existing, shall be verified. The electrical contractor shall provide one person for assistance with the verification.
 - .8 Include associated costs in Tender Price.
 - .9 Carry out a complete audibility test and submit report.
 - .10 On completion of the verification the manufacturer shall supply a certificate, together with detailed inspection record sheets showing location of each device and certifying the test results per unit, confirming that the system is installed, supervised and operational.
 - .11 Provide functional testing of interconnected systems in accordance with CAN/ULC-S1001.
- .2 Manufacturer Services
- .1 The manufacturer(s) of the fire alarm shall make a complete inspection of all existing and new components installed for system(s), such as manual stations, horns, and annunciators and sprinkler and standpipe valves and smoke detectors to ensure the following:
 - .1 That the system is complete in accordance with Specifications.
 - .2 That the system is connected according to ULC requirements.
 - .3 That the system is connected in accordance with the Manufacturer's recommendations.
 - .4 That the regulations concerning the supervision of components have been adhered to (e.g. stations, detectors, supervised valves, bells), and are properly wired and supervised.
 - .5 That all valves are properly connected and displayed correctly on each annunciator.
 - .6 That any subsequent changes necessary to conform to the above will be carried out with technical advice supplied by the manufacturer.
 - .7 That all thermal detectors, smoke detectors and manual stations have been operated and are in good working order.
 - .8 That all sprinkler system and standpipe system valves have been operated and are in good working order.
 - .9 That all annunciators correctly pinpoint the origin of any fire alarm.
 - .10 That actual smoke concentration of sufficient density, have been applied to each smoke detector to cause the detector to be set off and that the sensitivity of each smoke detector has been set.

- .11 That all existing devices are in good working order. Include for replacement of any defective/damaged devices at no extra cost to Owner.
- .12 That signal audibility is acceptable in all areas. Submit audibility readings for every room.
- .13 If existing audible signal devices have been discontinued by the manufacturer (for example mechanical horns), allow for replacement of all audible devices so that all devices generate similar sounds and sound patterns when activated.

3.04 Closeout Activities

- .1 At the final inspection a factory trained representative of the manufacturer of the major equipment shall demonstrate that the systems function properly in every respect.
- .2 Provide instruction as required to the building personnel and fire and safety personnel. "Hands-on" demonstrations of the operation of the system shall be provided.

End of Section

1 General

1.01 Intent

- .1 Include all material, labour, equipment, and plant construction as necessary to make a complete installation as shown and specified hereinafter. Sections of this specification are not intended to delegate functions nor to delegate work and supply to any specific trade. Ensure that the systems specified hereafter are complete and operative.

1.02 Specifications Language and Style

- .1 These specifications are written in the imperative mood and in streamlined form. The imperative language is directed to Contractor, unless stated otherwise.
- .2 Complete sentences by reading "shall", "Contractor shall", "shall be", and similar phrases by inference. Where a colon (:) is used within sentences and phrases, read the words "shall be" by inference.
- .3 Fulfill and perform all indicated requirements whether stated imperatively or otherwise.
- .4 When used in the context of a Product, read the word "provide" to mean "supply and install to result in a complete installation ready for its intended use."

1.03 Reference Standards

- .1 CSA Group:
 - .1 CSA C22.1:24, Canadian Electrical Code, Part 1 (26th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (29th edition/2024), and all bulletins.
- .2 UL:
 - .1 UL 294-2018, Standard for Safety for Access Control System Units.
 - .2 UL 1076-2018, Standard for Safety for Proprietary Burglar Alarm Units and Systems.
- .3 ULC:
 - .1 CAN/ULC-S316-14 (R2019), Standard for Performance of Video Surveillance Systems.
 - .2 CAN/ULC-S301:2018, Standard for Signal Receiving Centres Configurations and Operations.
- .4 ANSI/TIA/EIA-568-B.1 and its addendum.
- .5 ANSI/TIA/EIA-568-B.3 and its addendum.
- .6 BICSI Telecommunications Distribution Methods Manual – Most current Edition.
- .7 BICSI Network Design Reference Manual – Most current Edition.
- .8 BICSI Information Transport Systems Installation Manual – Most current Edition.
- .9 Department of State (DOS).
 - .1 Publication SD-STD-02.01, Revision A, dated March 2003 for Vehicle Crash Testing of Perimeter Barriers and Gates.
- .10 American Concrete Institute (ACI)

- .1 301 Standard Specifications for Structural Concrete.
- .11 American Society of Testing Materials (ASTM)
 - .1 C 33 - Standard Specification for Concrete Aggregates.
 - .2 C 94 - Standard Specification for Ready-Mixed Concrete.
 - .3 C150 - Standard Specification for Portland cement.
 - .4 F2656 – Crash Testing Vehicle Barriers.
- .12 Underwriters Laboratories (UL) Cable Certification and Follow Up Program.
- .13 American Society for Testing Materials (ASTM).
- .14 Institute of Electrical and Electronic Engineers (IEEE).
- .15 UL Testing Bulletin.
- .16 Applicable local Building Codes
- .17 Manufacturer's specifications, latest issue.

1.04 Definitions

- .1 The following are definitions of important terms specific to this specification and on related drawings.
 - .1 DVR – Digital Video Recorder.
 - .2 CCTV – Closed Circuit Television.
 - .3 DGP – Data Gathering Panel.
 - .4 ACS – Access Control System.
 - .5 REX – Request to Exit Motion Detector.
 - .6 RXP – Request to Exit Push Button.
 - .7 LAN – Local Area Network.
 - .8 COTS – Commercial Off The Shelf.
 - .9 4CIF – Image resolution of 740 x 480 pixels.
 - .10 GUI – Graphical User Interface.
 - .11 IPS – Images Per Second.
 - .12 BTU - British Thermal Unit.
 - .13 RU – Rack Unit.
 - .14 UTP – Unshielded Twisted Pair.
 - .15 IP – Internet Protocol.
 - .16 RAM – Random Access Memory.
 - .17 UPS – Uninterruptible Power Supply.

- .18 KVM – Keyboard, Video, Mouse console.
- .19 VDU – Visual Display Unit.
- .20 MTBO – Mean Time Between Outages.
- .21 MTTR – Mean Time to Recovery.
- .22 MTBF – Mean Time Between Failures.
- .23 DPU – Distributed Processing Unit.
- .24 NVR – Network Video recorder.
- .25 PoE – Power Over Ethernet.
- .26 PoE+ - Power Over Ethernet +.
- .27 OBC – Ontario Building Code.
- .28 LED – Light Emitting Diode.

1.05 General Requirements

- .1 Section Includes
 - .1 This specification will outline the requirements for the configuration, system operating requirements, products, components, and materials for the Access Control System (ACS), Video Surveillance System (VSS), all Bollards, Intercom and VIP/ Help Assistance systems.
 - .2 This document details the required submittals, testing procedures and installation procedures for all parts of the security system.
 - .3 The Security Systems Contractor shall have the following qualifications:
 - .1 Be an authorized approved vendor of the proposed solution having a minimum three (3) years' experience with the installation and maintenance of Access Control and CCTV systems. Vendors must be in good standing with the manufacturer and must have all up to date certifications.
 - .2 Have a minimum of three (3) years' experience with the installation and maintenance of information technology networks and network components.
 - .3 Upon request, provide a list of previous successfully completed projects of similar installation, size and scope and provide name of contact person at each site for verification. Additionally, upon request, the Owner may request an onsite visit or photographs of similar jobs to verify vendor workmanship.
 - .4 Confirm explicitly that the personnel to be employed on the contract are suitably trained in the installation and maintenance of equipment of the type and model being provided so as to be able to carry out all work in a competent manner.
- .2 General
 - .1 Provide documentation and training for all systems as detailed in this specification.
 - .2 System components to comply with all relevant requirements of Underwriter's Laboratories Inc.
 - .3 Security System Contractor to verify all raceways, related to this scope, on site.

- .4 Provide additional conduits and raceways where required, provide stainless steel cover plates for back boxes that are not being used.
- .5 The Security Contractor shall examine all project documents in order to determine whether there are any impediments to the installation of a fully functioning system. At the time of tendering the supplier shall provide written notification to the Owner or Owner's Representative of any omission, irregularities, errors, or ambiguities. Failure to supply notification shall not relieve the Security Contractor of the responsibilities for providing a fully functional system at the Tender Price.
- .6 Identify all critical interdependencies with the Owner or any third parties that would require addressing during the project.
- .7 Identify (tabulate) consecutive rack unit (RU) space requirements (including free space or blanks) for all rack mounted equipment.
- .8 Identify (tabulate) total BTU generation for each equipment room being utilized.
- .9 Provide all technical information required to evaluate the solution, including proposed equipment, diagrams, layout, and functional / operational benefits.
- .10 Submit a summary bill of materials and catalogue cut sheets for all major active and passive components for the project. Include model numbers, revision numbers for hardware and software as applicable. Although not expected as part of the Proposal, a complete bill of materials shall be required to be in place and agreed upon with the Owner prior to Contract signing.
- .11 Provide a statement of guarantee that all required equipment and materials will be available for timely delivery of the project.
- .12 Submit a security and backup plan for all documentation and system data related to this project. The plan should outline how the project related information (hardcopy and electronic) will be safeguarded against loss or damage.
- .13 System Programming
 - .1 The Security System Contractor shall attend meetings with the Owner's Representatives and key staff to identify the specifics of the system programming. The Security System Contractor shall be responsible to record all decisions and parameters discussed during these meetings. The Security System Contractor shall submit in a document all configurations, parameters and receive approval for all programming parameters prior to implementation.
 - .2 The Security System Contractor shall ensure that the operation of the system matches and meets the programming requirements determined in the pre-installation meetings.
- .14 Work shall be of professional quality and shall not detract from the aesthetic qualities of the facility.
- .15 Follow established guidelines for installation and termination of all cabling and equipment as established by EIA/TIA-568-A, EIA/TIA-569, EIA-TIA-606, TSB-36 and TSB-40, BICSI Telecommunications Distribution Methods Manual, and applicable local electrical and building codes, IBC and NEC.
- .3 Substitutions
 - .1 The Technical specifications are meant to outline the minimum requirements and are not meant to limit or inhibit the Proponents from submitting enhanced or alternative solutions.

- .2 Enhanced or alternative solutions may be proposed, stipulating all variations from the Specification, and clearly identifying any cost savings and operational benefits of the proposed alternative approach.
- .4 Omissions
 - .1 Omissions in the Proposal of any provision herein described shall not be interpreted as to relieve the Proponent of their responsibility or obligation to the complete and satisfactory delivery of the Owner's intent for the project.
- .5 Bid Responses shall include:
 - .1 Detailed itemized Bill of Material with Quantity, Make, and Model, Manufacturer part numbers, quantity, and unit prices.
 - .2 Manufactures Authorization Certificates
 - .3 Resumes indicating project experience of Project Manager/s and Lead technicians with copies of certificates.
 - .4 Compliance Statement to Security and IT Specifications.
 - .5 Project plan with timeline to complete Security System.

1.06 Submittals

- .1 All submitted drawings and documentation shall become property of the Owner. Contractor shall have no rights over the entire documentation package or any parts of the documentation package.
- .2 The drawings and documentation shall be considered confidential documents and shall not be disclosed or distributed to any other party except the Owner's personnel directly involved in the work.
- .3 Documentation is to be provided in both hard and electronic format for each project deliverable. (4 Hard, 4 Soft) The electronic format shall include for each document editable files (in its raw format, .xlsx, .docx, .DWG, .vsd, etc.)
- .4 Along the course of design and implementation the Security System Contractor shall submit to the Owner standards, as-built documentation, and other supporting documents. The Security System Contractor shall provide a schedule for the following document submissions within one (1) week of contract award for review and approvals by the Owner or Owner's Representative. All submittals shall be in accordance with this Section unless stated otherwise.
 - .1 Work Breakdown Structure (WBS) indicating all relevant milestones.
 - .2 Shop Drawings.
 - .1 Each drawing shall include all changes and be upgraded to reflect the latest configuration.
 - .2 The first drawings submitted by the Security System Contractor will be reviewed for conformance to the requirements herein. Once approval is given, the Security System Contractor shall use this approved drawing as the standard, and prepare subsequent drawings to a quality equal to or better than the approved standard.
 - .3 Each drawing prepared and submitted for review shall have in the lower right hand corner, just above the title block, a five-inch square blank space in which the Consultant may indicate the action taken.
 - .4 All final approved drawings and catalogue cuts shall be submitted to the Consultant.

- .5 Shop drawings shall be prepared and submitted in the native (editable) electronic format (.vsd, .dwg, .xlsx, .docx). All documents produced shall be property of the client and the Security System Contractor shall have no rights over the entire documentation package or any parts of the documentation package.
- .6 All Shop Drawings must be submitted as follows:
 - .1 Cover Sheet - Job Name, Date.
 - .2 Table of Contents with following columns
 - .1 Device Name.
 - .2 Model #.
 - .3 Symbol Name on Drawings.
- .7 All Shop drawings shall include as a minimum:
 - .1 Details necessary for the procurement, installation, maintenance, and repair of all components or facilities equipment provided.
 - .2 List of equipment to be installed organized by location and including the part number and the manufacturer.
 - .3 Manufacturer specification sheet for each new piece of equipment.
 - .1 Each sheet should clearly identify the particular model number of the hardware being provided. Where such information is not provided, at the discretion of the Owner or Owner's Representative, the most expensive option will be assumed.
 - .4 Wiring diagrams for each location.
 - .5 Point allocation tables for each control panel.
 - .6 Digital pictures for all cameras displaying the camera's waveform signal, and field of views. Show all presets for PTZ cameras.
 - .7 Digital pictures of all camera installations, communications room DGP's and equipment cabinets.
 - .8 Software configuration parameters.
- .3 Integration Document for each interface to be implemented or configured.
- .4 Testing and commissioning plan.
- .5 Testing procedures for each functional module.
- .6 Quantifiable test parameters and the expected/acceptable results for each procedure.
- .7 Detailed System Architecture Diagrams.
- .8 Installation Procedures.
- .9 Quality Assurance Plan.
- .10 Safety Plan.

- .11 Software Documentation and VDD (Version Description Document)
 - .1 Shall include, but not be limited to listing all application specific programs, modules, interfaces, and drivers to include programming languages, operating systems, applications code, compilers, editors, build process files and executables, directories, parameters and variables, block diagrams and flow charts.
- .12 Software Materials Licenses.
- .13 Operator Manuals and Procedures.
- .14 System Administrator's Manuals and Procedures.
- .15 Training Course Outline and Materials.
- .16 Operator/Maintenance Manuals.

1.07 Security Systems Testing Procedure

- .1 General: Overall testing algorithm shall consist of three phases per system and final Integrated Test(s) of all subsystems.
 - .1 Field devices (Field Layer).
 - .2 Telecomm room equipment, including system servers (Distribution Layer).
 - .3 Monitoring locations, integrated system functionality – within the system (Core Layer).
- .2 Exact testing schedule on day by day basis (including exact list of devices that should be tested during allocated time period) should be submitted two weeks prior to commencement of testing.
- .3 The test shall be conducted according to the following algorithm:
 - .1 Verify prerequisites.
 - .1 Verify presence of all required witnesses of the test in accordance with the Contract Specification.
 - .2 Verify presence of a test plan, test description.
 - .3 Verify presence of all test forms and checklists for proper test recording and documenting.
 - .4 Verify presence of all test objects: field devices, panels, racks, equipment, components, cables, hardware, software, programming devices, AC power, etc.
 - .5 Verify presence of programming and/or configuration settings, manufacturer's recommended test procedures for every device, predetermined parameter ranges and expected test results. This information may vary and depends on the actual location of testing and commissioning activity.
 - .6 Shop and Record Drawings(s).
 - .7 Programming/configuration settings.
 - .8 Verify presence of prototype documentation package.
 - .9 Prototype inspection forms and checklists.
 - .10 Shop and Record Drawings(s).

- .11 Programming/configuration settings.
 - .12 Digital images of all CCTV cameras shall be taken by the Security System Contractor. The digital image shall include the field of view of the camera along with a "picture in picture" inset of the camera's waveform signal.
 - .2 Conduct the Test
 - .1 Verify record drawings with the site location and the prototype package.
 - .2 Verify programming sheets with the prototype and active settings(s).
 - .3 Verify installation, workmanship, wiring, cabling, grounding, shielding, etc.
 - .4 Verify functionality.
 - .3 Document the Test
 - .1 Complete all test forms and checklists.
 - .2 Record all required and applicable information.
 - .3 Compare obtained test results with expected results.
 - .4 Provide test report.
- .4 Dealing with Deficiencies
 - .1 In general, every deficiency is considered to be within the Contract specification, or outside of the Contract. In both cases an actual action to correct any specific deficiency should be treated on an individual basis, confirmed, and approved by the Owner or Owner's Representative.
 - .2 A proper line of command(s) based on specific contract shall be followed.
 - .3 Identify deficiencies and record them in system's log.
 - .4 Each and every deficiency should be corrected in a prompt manner. All deficiencies shall be identified with proper correction schedule, dates, responsible parties, and names.
 - .5 It is the sole responsibility of the Security System Contractor to schedule any re-test in the event that the previous test has not been successful. A new test shall follow the same steps described within this document.
- .5 The following test forms shall be created by the Security System Contractor and approved by the consultant and shall be used during Testing/Commissioning and Acceptance.
 - .1 Video Surveillance System Tests:
 - .1 Camera Test.
 - .2 Camera Power Supply Test (if applicable).
 - .3 Video Control Display Test.
 - .4 Video Storage Test.
 - .5 Application Client Test.
 - .6 System Server Diagnostic Test.

- .7 System fail Over Test.
- .8 Overall CCTV Functionality Test.
- .9 Video Surveillance-Intercom cross reference table.
- .10 Video Surveillance – Access Control System reference table.
- .11 System Management Server(s)/Application(s) Test.
- .12 Camera Field of View Checklist.
- .2 Access Control System Tests:
 - .1 Door Electronic Hardware Test.
 - .2 Door Functionality Test.
 - .3 Door Control Unit Test.
 - .4 Distributed Processing Unit Test.
 - .5 Auxiliary Devices Power Supply Test.
 - .6 System Server Diagnostic Test.
 - .7 System Server Fail Over Test.
 - .8 Workstation Client Test.
 - .9 Overall Card Access System Functionality Test.
- .3 Intercom System Tests
 - .1 Intercom Station Checklist.
 - .2 Intercom Exchange Checklist.
 - .3 Intercom Commissioning List.
- .4 Integrated Functionality Tests
 - .1 Card Access System – Video Surveillance System.
 - .2 Intercom System – Card Access System.
 - .3 Intercom System – Video Surveillance System.

1.08 Warranty

- .1 Security System Contractor shall warranty the completed Security System including all equipment, computer software, documentation and latent defects delivered shall perform in accordance with and conform to all applicable standards, requirements, specifications, descriptions, and other requirements included in their proposal and shall be without defects in materials, workmanship, and design. The warranty shall commence upon Substantial Completion as defined by the Consultant.
- .2 Include 2 Year all-inclusive parts and labour with two (2) year warranty as part of the tender price. This should, include all required software and firmware maintenance for the warranty period of two (2) years.

- .3 As a minimum during the warranty period and at no extra cost to the owner, the Security System Contractor shall include a guaranteed response time of two (2) hours for a major system failure and eight (8) hours for a minor system failure on a twenty-four (24) hours per day, seven (7) days per week basis. A major system failure shall be defined as the failure of any operator controls as well as any system controller, processor or communication link which renders more than 10% of a specific security subsystem of systems inoperative. A minor system failure shall be defined as the failure of a single security device such as a card reader, egress device, camera, intercom unit, etc.
- .4 Provide one preventative maintenance service inspection prior to the end of the two (2) year warranty period.
- .5 As part of the submission, provide a complete list of recommended spare parts with the prices to the owner.
- .6 Preventive and corrective maintenance performed by a maintenance contractor other than this Security System Contractor after or during the warranty period shall not void warranty on labor, hardware and software provided by this Security System Contractor.

1.09 Maintenance and Service Level Agreement

- .1 The Security System Contractor shall provide a Service Level Agreement (SLA) for scope and cost for stand alone maintenance services (schedules, remedial and preventative maintenance) for one (1) year following commissioning. The maintenance services proposal may or may not be included in the contract. Non- procurement of such services shall not void the warranty terms.
- .2 The Security System Contractor shall implement the preventative maintenance procedures as specified by the systems manufacturer and as noted elsewhere in this specification package. This includes all such items produced by Security System Contractor s or procured as off-the-shelf. This SLA shall include the provision and implementation of all software upgrades.
- .3 The proposed SLA shall include breakdown in cost and services for the following response times:
 - .1 Two (2) hours;
 - .2 Eight (8) hours; and
 - .3 Twenty-four (24) hours.
 - .4 Such costs shall remain in effect for one (1) year.
 - .5 The term of the maintenance contract will commence from the time of system acceptance.
 - .6 The Security System Contractor shall provide hot-line engineering help desk telephone support to answer any questions and provide any assistance as required for the owner.
 - .7 Security System Contractor shall provide application specific (non-COTS) software and firmware updates, upgrades, enhancements and modifications.
 - .8 Security System Contractor shall provide application specific (non-COTS) "bug fixes" support.
 - .9 Security System Contractor shall provide updated documentation and operational procedures and manuals software changes and enhancements services.
 - .10 Security System Contractor shall maintain in-house all software tools and development environment to the latest configuration.
 - .11 Security System Contractor shall guarantee the continuous availability of spare parts as are required by the availability and performance, deployed quantities, MTBF, MTTR, MTBO, redundancy and mission-critical requirements.

- .12 Special tools and test equipment support shall be provided.
- .13 Security System Contractor shall demonstrate during the design reviews the provisions incorporated into the design in order to support adequate life cycle cost (LCC) (e.g. selection of parts, sole source avoidance if possible, obsolescence and discontinued items handling including migration path, MTBF, MTTR, MTBO etc.).
- .14 Throughout the maintenance period the Security System Contractor shall conduct as may be required failure analysis for failure modes including cause, failure count, downtime, MTBF, MTTR, and MTBO.
- .15 A master schedule for preventative maintenance work for a one (1) year all with all forms as required shall be submitted electronically by the Security Contractor five (5) days after system acceptance.
- .16 The master schedule shall be a computerized bar-chart type. The chart will clearly show the date, time, location, and name of the technician(s) attending.
- .17 The Security System Contractor (technicians and Subcontractors) shall comply with the owner's preventative maintenance standards.
- .18 The preventative maintenance inspections shall be scheduled to occur during business hours. At the commencement of this contract, the Security System Contractor is to carry out an initial thorough inspection/cleaning of all systems and respective components/equipment to identify and correct any deficiencies.
- .19 The Security System Contractor shall provide a preventative maintenance schedule for regular maintenance checks/service, including initial inspection/cleaning as per the owner's Maintenance Standards that will be performed during the entire contract term as well as a full description of the work to be carried out. Any variations from the schedule must be pre-approved by the Owner.

1.10 License Fees

- .1 Provide licenses for every application installed on a workstation and server for all machines that would require the software such that there are enough licenses for each software application to run on all machines, with an installation of the software application, concurrently at the time of commissioning.
- .2 All firmware and software shall be guaranteed for up to five (5) years, during which period any patches, bug fixes or related upgrades shall be implemented without additional cost to the Owner.
- .3 All software, firmware and installer or programming codes installed and delivered as part of this Contract shall become the property of the Owner. The Owner's right to use all software and firmware delivered for this project shall not expire, regardless of other upgrade and warranty arrangements agreed with the Owner.

2 Products – Not Used

3 Execution

3.01 General

- .1 Working Conditions
 - .1 The Work shall be scheduled to avoid and/or minimize the impact on business operations. Portions of the Work including portions of the inspection of the Work will be required to be performed outside regular working hours.

- .2 The Owners Security Regulations shall be followed at all times during the performance of the Work.
- .2 Examination
 - .1 Verify that critical dimensions are correct and conditions are acceptable. Proceed with installation only after unsatisfactory conditions have been coordinated.
 - .2 Examine surfaces, substrates, and conditions for compliance with requirements of other Sections in which that related work is specified, and determine if surfaces, substrates, and conditions affecting performance of the work of this Section are satisfactory. Do not proceed with work of this Section until unsatisfactory conditions have been corrected in a manner acceptable to the Installer. Starting installation constitutes acceptance of surfaces, substrates, and conditions.
 - .3 Prior to commencement of Work, examine current site conditions and inform the owner of any unusual existing conditions that may affect Work.
- .3 Preparation
 - .1 Cooperate and coordinate with the owner for the location of all mechanical, plumbing, electrical rights-of-way and access/egress to any area required to remain accessible for maintenance and removal of equipment or related components.
 - .2 Coordinate with the Owner or the Owner Representative, the overall project schedule, the equipment, and system equipment layout in relation to the facility, work aisle or equipment removal paths and drive aisles to avoid any conflicts.
- .4 Workmanship
 - .1 All work shall be performed to standards and best practices as governed by the reference standards mentioned earlier.
 - .2 Equipment shall be mounted in accordance with manufacturer's recommended/supplied hardware and fasteners.
 - .3 Cabling shall be mounted in accordance with manufacturer's recommended/supplied hardware and fasteners.
- .5 Installation
 - .1 Comply with manufacturer's instructions and recommendations for installation of products in the applications indicated. Anchor each device securely in place, accurately located and aligned with other Work. Conflicts between the manufacturer's instructions and the Specification shall be, promptly brought to the attention of the Consultant or Construction Manager by the Contractor prior to the initiation of any related Work.
 - .2 For the products overhead, installation such as outside cameras that are subject to strong winds provide adequate backup safety mechanisms to prevent higher equipment damage.
 - .3 The Security System Contractor shall be responsible for the installation of all the equipment, units, sub-systems etc. at the required site in order to meet all requirements specified in this document and as per all applicable standards.
 - .4 All installation materials, accessories and special equipment, services, personnel team, test equipment and tools required for installation of the equipment shall be provided by the Security System Contractor.
 - .5 The Security System Contractor shall ensure that installation workmanship complies with the best industry quality standard levels.

- .6 The Security System Contractor shall be responsible for the shipment, in country storage, transportation, installation, testing, commissioning of all material and equipment.
- .7 Any spare parts supplied within the scope of this project, but used to replace the faulty items during the installation, testing and commissioning phases until final acceptance of the system, shall be replaced by the Security System Contractor free of charge, within thirty (30) days.
- .8 The Security System Contractor shall specify the estimated periods, personnel requirement and costs for the installation and commissioning of the equipment. The cost of travel, accommodation, and subsistence, as well as any related insurance costs during the installation and commissioning phase shall be borne by the Security System Contractor.
- .9 The Security System Contractor shall individually identify all installation personnel in terms of qualifications, experience and designation.
- .10 The Security System Contractor shall be responsible of obtaining work permits or visas for all its personnel.
- .11 At least forty-five (45) days prior to installation, the Security System Contractor shall submit for approval to the Owner or Owner's Representative a detailed site installation plan. The plan shall contain all necessary information required to install the equipment and set it for operation.
- .12 The installation plan shall be updated to reflect changes made to the equipment layout, cabling drawings, installation instructions and test procedures during the installation. A marked-up installation plan shall be provided.
- .13 Final As-Built documents shall be provided within forty- five (45) days after completion of Site Acceptance Tests.
- .14 The Security System Contractor shall be responsible for cleaning the sites after completion of the Site Acceptance Tests.

3.02 Mechanical and Electrical Requirements

- .1 Power:
 - .1 Supply and install all additional conduit as well as power supplies, wire, and cable for distribution of 120 V power to security devices as required. Refer to electrical specifications for more details regarding electrical conduit requirements.
 - .2 All AC and DC power wiring shall conform to ANSI/NFPA 70, OHESC, IBC2003, and other applicable Local and National Codes. Guards shall be provided over high voltage or high current terminators.
- .2 Wire and Cable:
 - .1 All wires and cables shall be formed, neatly laced or tie wrapped, and clamped in position. No adhesive or stick-on clamps are permitted. The use of masking tape or electrical tape is not acceptable.
 - .2 All wire and cable is to be installed by the Security Systems Contractor, as well as additional conduit extensions or relocations, necessary to achieve the specified security system.
- .3 Slack:
 - .1 Sufficient slack shall be provided to:
 - .1 Prevent undue stress and strain on connectors and cables.

- .2 Allow easy disconnection of equipment.
- .3 Allow a minimum of three re-terminations of each cable or wire in the event of breakage.
- .4 In the case of CCTV cameras three (3) m of slack cable in flexible conduit shall be provided to enable future relocation at each and every camera location.
- .4 Grommets:
 - .1 Where wires run through holes or conduit, they shall be protected by suitable grommets.
- .5 Conduit and Boxes:
 - .1 Wires and cables external to equipment and enclosures shall be run in conduit. PVC conduit may be used underground. Where free movement of equipment is required, flexible conduit shall be employed. Once installed in the conduit, all cable shall be tested for continuity, insulation breakdown (skinning) and ground faults.
 - .2 Refer to electrical specifications for more details regarding electrical conduit requirements.
 - .3 All Conduits is to be supplied and installed by the Electrical Contractor.
- .6 Connectors and Splices:
 - .1 Wires and cables shall be continuous between termination and connection points. Connectors and splices shall be located within secure enclosures and are not permitted inside conduit.
- .7 Cable Positioning:
 - .1 Wires and cables shall be located so that inductive and capacitive effects do not degrade system operation.
- .8 Outdoor Cabling:
 - .1 Outdoor cabling shall have drip loops at the point of entry into enclosures, junction boxes, etc. and all entries shall have a weather tight seal. Where a cable connection is exposed to outdoor elements, it shall be protected with heat shrink material.
- .9 Solid or Stranded:
 - .1 Only stranded wire shall be used. All shielded wiring shall be jacketed with PVC and shall have the shield braid terminated so that the insulation is not damaged by soldering, heat, or mechanical pressure.
- .10 Wire Termination:
 - .1 All wires shall be terminated by the use of solder-less terminals. Crimp lug terminals shall only be used on stranded wire. For devices utilizing solid wire, the solid wire shall be soldered to the terminal and the soldered portion insulated. No more than one wire per lug is permitted.
- .11 Terminal Lugs:
 - .1 Terminal lugs shall be suitably electroplated or treated by commercially acceptable methods to ensure good electrical contact and prevent corrosion.
- .12 Terminal Blocks:
 - .1 Terminal and connecting blocks shall be of the screw type. As a minimum, all terminal blocks shall have 10% spare capacity. A barrier shall separate each termination. No more than two terminal lugs shall be clamped under each terminal screw. Solder, wire wrap and pressure

termination type terminal blocks shall only be used with prior approval and where the need for this type of device has been demonstrated. No more than one wire may be connected to each terminal, except in permanent daisy chaining requirements.

.13 Cable Connectors:

- .1 No more than one wire shall be connected to each pin of a cable connector unless that pin has been designed to accept more than one wire. All strands of the wires shall fit into the pin receptacle. All cable connectors shall be field replaceable. Provision shall be made to fix the cable connector covers to a chassis or to each other by means of screws.

.14 Cable and Equipment Labelling:

- .1 Functional or alpha-numerical mechanically printed labelling shall be installed on all equipment including racks and cabinets. All visible wires and cables typically accessed for service shall be labelled at both ends. As well, all connecting strips, terminal blocks, plugs and sockets shall be labelled. The marking on the labels shall be consistent with the As-Built Drawings.
- .2 Approved materials for labels include alphanumeric labels protected by clear heat shrink material, tie-wrap labels, lamacoid strips, etched metal, or indelible ink. The use of Dymo tape (or equivalent) labelling is not permitted.
- .3 The Security System Contractor is required to submit their cable and equipment labelling standard to the Owner or Owner's Representative for prior approval.

.15 Fasteners:

- .1 Panels, doors, and access shields shall be fastened with a suitable style of fastening compatible with the degree of security required for each enclosure and the frequency of access. There shall be no sign of cross-threading or mutilation on any screws or fasteners. All nuts shall be of standard size and preferably of hexagonal design. All threaded parts shall be secured by the use of lock washers except under counter sunk screw heads, coaxial plugs and similar connectors, terminal binding screws, etc.

.16 Replaceable Parts:

- .1 Parts and components that may require replacing or removal for servicing shall not be affixed by rivets, welds, metal tags on other similar means that would prevent ready removal.

.17 Materials:

- .1 Materials used in installations shall be selected with due regard to the intended use, durability, safety, retention of appearance and avoidance of corrosion or other chemical effects. The use of wood, natural rubber, toxic materials, and other materials capable of supporting fungus or insects is not allowed. The use of electrical tape or masking tape is prohibited.

.18 Soldering:

- .1 No soldered joints are permitted.

.19 Enclosures:

- .1 All enclosures shall be firmly fixed to floor or wall, be positioned for ease of maintenance, be lockable and properly grounded. As well, outdoor enclosures shall be dust tight and weatherproof. They shall be sized to allow easy access to work on any equipment or wiring contained within them.

.20 Communication Rooms:

- .1 Space has been allocated in the building for the installation of distributed processing equipment associated with the Access Control, Video Surveillance, and Intercom equipment. Where equipment is to be wall mounted provide lockable wall mounted cabinets to house equipment. Where equipment is to be rack mounted, equipment cabinets shall be supplied by others.
- .2 Ensure that all equipment cabinets or racks are of the same manufacturer with the same features.

3.03 Commissioning

- .1 Project Schedule
 - .1 The Tenderer shall submit a complete project schedule and milestones as a pre-condition to contract award.
 - .2 The schedule shall include the scheduled commencement date for each major activity, the duration of each activity, the proposed sequence of activities, dependencies between internal activities and milestone, dependencies between external activities and milestones, identification of the critical path and related milestones.
 - .3 The schedule shall be progressively updated as the Contract progresses and enable the Owner or Owner's Representative to readily identify activities by location, resources, or WBS.
 - .4 The schedule shall clearly identify completion dates and shall clearly identify schedule contingencies, free floats, and critical path.
 - .5 The schedule information shall be sufficiently detailed to enable integration of all interface activities by the Owner or Owner's Representative.
 - .6 The proponent shall develop and submit to the Owner or Owner's Representative for approval, project design review and audit Schedule.
 - .7 The schedule shall be presented in weekly segments and include the following as a minimum:
 - .1 Site surveys or pre-bid meeting (as required).
 - .2 Submission and approval of installation, design, and drawings; Design Reviews.
 - .3 Equipment manufactures.
 - .4 Factory Acceptance Tests (FAT).
 - .5 Shipping of equipment.
 - .6 Equipment installation.
 - .7 Equipment integration and dry-run.
 - .8 On-the-job training (OJT).
 - .9 Factory training.
 - .10 Site Acceptance Tests (SAT).
 - .11 Commissioning and hand-over.
 - .8 The Security System Contractor shall submit, on a monthly basis, a progress report to the Owner or Owner's Representative including percentage complete and deliverables of scheduled work. Reports shall provide comparison of actual progress versus baseline and in accordance with the WBS and report any variation from the master schedule. Progress reporting shall include as a minimum:

- .1 Summary of changes since the prior schedule.
- .2 Actual dates for activities started during the period.
- .3 Actual dates for activities completed during the period.
- .4 Actual human resource allocation during the period.
- .5 Estimate of percent complete for activities in progress.
- .6 Duration for remaining activities.
- .7 Activities behind schedule.
- .8 Critical path.
- .9 Deliverables.
- .2 Factory Acceptance Tests (FAT)
 - .1 The Commissioning Phase of the project, which includes (FAT), shall begin upon approval of the Shop Drawings.
 - .2 The Security System Contractor shall be required to assemble, integrate, and test the entire system at their own premises prior to shipment. This FAT shall be performed in accordance with a prepared Factory Acceptance Test Plan incorporating specific test procedures which will clearly demonstrate compliance of the equipment with the technical specification in all general, operational, and technical aspects.
 - .3 The Security System Contractor shall undertake to submit for the Owner or Owner's Representatives approval at least thirty (30) days prior to the scheduled commencement of the FAT, the FAT Procedures together with the proposed acceptance certificate format. The Owner or Owner's Representative shall notify the Security System Contractor of its decision within thirty (30) days thereafter, and after an agreement has been reached, the procedures shall form part of the eventual contract. Any changes in the procedures initiated by the Security System Contractor will be without cost to the Owner or Owner's Representative and subject to their approval.
 - .4 All test procedures shall contain step-by-step instructions with a concise but comprehensive explanation of each test, including test scenario and objective. Equipment interconnection shall be explicitly described in graphical and textual form as necessary.
 - .5 All test equipment used for the factory tests shall be standard commercial equipment and shall not be modified and all ancillary equipment required for testing shall be furnished by the Security System Contractor for the duration of the tests.
 - .6 Factory Acceptance shall be required for all equipment, both hardware and software, before shipping. The Factory Acceptance shall verify all equipment functional and operational capabilities.
 - .7 All results of the Factory Acceptance Test shall be duly recorded and shall be signed by the Security System Contractor and Owner or Owner's Representative.
 - .8 All observations agreed on and discrepancies noted during the inspection are to be corrected by the Security System Contractor prior to shipment of the equipment.
 - .9 The Security System Contractor shall arrange for one (1) FAT Session, to run consecutively for all equipment instead of fragmented sessions.
 - .10 The Owner or Owner's Representative shall be entitled to witness all FAT phases.

- .11 Notwithstanding any inspection or test conducted at factory prior to shipment, all equipment shall be subject to acceptance on site subject to the Owner or Owner's Representative right of rejection.
 - .12 The Factory Acceptance Tests shall be performed at the Security System Contractor's factory in accordance with the approved procedures, the intent of which shall be that those systems accepted at factory shall be functionally installed and integrated on-site.
 - .13 Following the satisfactory completion of the tests, the Owner or Owner's Representative shall sign and issue a Factory Acceptance Certificate.
 - .14 With the exception of minor failures and discrepancies at the sole discretion of the Owner or Owner's Representative, which do not adversely affect the performance or operation of the equipment for the purpose intended and subsequently subject to modification by the Security System Contractor at no extra cost, shall not be deemed as items preventing the Owner or Owner's Representative Factory Acceptance.
 - .15 In case of non-acceptance, the Security System Contractor shall provide a recovery plan to the Owner or Owner's Representative on how it intends to rectify the equipment in order that testing may be repeated to which the equipment did not initially comply, and also the tests in respect of those parts of the equipment affected by the rectification. The Security System Contractor shall bear all costs associated with the re-testing (e.g. travel, accommodation and subsistence costs for Owner or Owner's Representative re-participation.)
 - .16 If the equipment, or any part thereof, is not accepted by the anticipated final Factory Acceptance date for the systems, the Owner or Owner's Representative shall have the right to request that the accepted component equipment be shipped, provided that the use of the equipment, or any part thereof, for any purpose by the Owner or Owner's Representative under such conditions shall not imply Final Acceptance in any way and the Security System Contractor shall be afforded the earliest possible opportunity of taking such steps as may be necessary to obtain Final Acceptance.
 - .17 In the event the Owner or Owner's Representative fails to be present at the time and place appointed by the Security System Contractor for Factory Acceptance Tests, the Security System Contractor may proceed with the tests which shall be deemed to have been made in the presence of the Owner or Owner's Representative. The Security System Contractor shall then sign the Factory Acceptance Certificate for corresponding purposes which shall have the same meaning and value as if it had been signed by the Owner or Owner's Representative. A copy of the production test results shall be submitted to the Owner or Owner's Representative for review prior to shipment. Tests shall be conducted in the presence of qualified Quality Assurance personnel.
 - .18 The equipment shall be considered factory accepted by the Owner or Owner's Representative upon satisfactory completion of each Factory Acceptance Test as certified by the relevant test records signed by the Security System Contractor's appointed representative and counter-signed by the Owner or Owner's Representative and QA personnel. Three copies of the said records shall be sent to the Owner or Owner's Representative.
 - .19 The Security System Contractor shall insure that all the equipment included under the eventual Contract, as well as spare parts, tools, test equipment, accessories and documentation are present at the Factory Acceptance, for inspection, review and approval by the Owner or Owner's Representative.
 - .20 The Security System Contractor shall include in the FAT cost, Daily Subsistence Allowance, and air fare for two Owner or Owner's Representative personnel to witness the FAT until the FAT is successfully concluded.
- .3 Acceptance Test Procedures

- .1 A minimum of thirty (30) days prior to on-site testing, prepare and submit two (2) copies of the Acceptance Test Procedures for review by the Owner or Owner's Representative. As a minimum the tests as described in [Paragraph 1.4.5] of this Section shall be included.
 - .2 The Owner or Owner's Representative reserves the right to request that tests completed as part of the FAT be repeated or to request any additional tests required to demonstrate compliance with the specifications.
 - .3 The ATP shall be approved when all issues and comments identified by the Owner or Owner's Representative have been satisfactorily addressed.
 - .4 Upon approval of the ATP and completion of the FAT, installation, and integration on-site, perform all tests and forward the documented results to the Owner or Owner's Representative.
- .4 Site Acceptance Tests (SAT)
- .1 After a review of the preliminary tests as outlined in the ATP, a Site Acceptance Test date shall be established. A date will not be established until all equipment is available for testing. The Owner shall be entitled to witness testing on the agreed date.
 - .2 The Security System Contractor shall provide and include all costs as a part of his proposal for a Manufacturer's Engineer to be present at all testing and commissioning of the system. The Security System Contractor is to provide the Manufacturer's Engineer access to all points of the installation. The Security System Contractor to provide all test and access equipment required for the inspection.
 - .3 On the date of Site Acceptance the Security System Contractor shall be present to perform testing. The Owner, Owner's Representative, and manufacturers Engineer shall be present to witness all tests performed including tests performed to confirm door functionality.
 - .4 In the event that the Owner, Owner's Representative, and manufacturer's engineer proceed to the site for Site Acceptance Testing, on the agreed date, and find the system incomplete or not operational the Security System Contractor shall cover all costs associated with Owner, Owner's Representative, and manufacturer's engineer returning for repeat testing.
 - .5 The purpose of a SAT is to ensure that the CCTV, Access Control and Intercom Systems are constructed, assembled, integrated and verified for performance to be in full compliance to the requirements and standards and are fully functional and operational for the intended use.
 - .6 SAT commencement is subject to the full conformance to its As-Built drawings, parameters, and production COTS, application specific hardware, software, and QA / QC approvals.
 - .7 SAT inspection and functional testing shall be conducted on the basis of preapproved SAT procedures.
 - .8 SAT infrastructure, performance, and functional requirements and/or specifications compliance which can not be demonstrated or met will require a pre approved waiver by the Owner or Owner's Representative and will require retest. With the exception of pre-approved waivers, the SAT shall comply with a full Pass as per the pre-defined Pass / Fail criteria.
 - .9 SAT documents shall be under full configuration management and QA supervision as per the Quality Assurance Plan (QAP).
 - .10 At least thirty (30) days prior to the scheduled commencement of the Site Acceptance Tests, the Security System Contractor shall submit a Site Acceptance Test Plan and Procedures to the Owner or Owner's Representative for approval.
 - .11 The test procedures shall contain step-by-step instructions with a precise and comprehensive explanation of each test, including test scenario and objective. The procedures shall contain a

cross-reference matrix where the requirements, methods of testing and the tolerances shall be listed. Equipment interconnection shall be explicitly described in graphical and textual form as may be required.

- .12 The Security System Contractor shall demonstrate that all the CCTV, Access Control and Intercom equipment is compliant to the technical specification and requirements. All deficiencies identified shall be corrected by the Security System Contractor prior to the Final System Acceptance phase.
 - .13 Perform all operational and performance tests in the presence of the Owner or Owner's Representative. In addition, the Owner or Owner's Representative shall perform a visual and mechanical inspection of the installation, with the Security System Contractor present as a witness.
 - .14 There shall be a thirty (30) day period between the SAT and FSA phases. During this period of thirty (30) days, the Owner's operation and maintenance personnel shall operate the system normally in order to identify any equipment defects, software defects, hardware defects, modifications required, adjustments required, infrastructure enhancements and upgrades etc. which shall be corrected by the Security System Contractor prior to the FSA.
- .5 Final System Acceptance
- .1 After successful completion of the SAT, the Owner or Owner's Representative shall prepare a deficiency list. The Security System Contractor shall correct all deficiencies and notify the Owner or Owner's Representative when all on-site work is completed.
 - .2 The Owner or Owner's Representative will conduct a final acceptance of the work only when all requirements of this specification have been fulfilled, the hand over report has been received and all noted deficiencies have been corrected.
 - .3 The Owner or Owner's Representative will perform a spot check to verify that all deficiencies have been corrected.
 - .4 Upon verifying that all the deficiencies have been corrected, the Owner or Owner's Representative will issue a letter of Technical Acceptance signifying that the equipment has been accepted. Final System Acceptance shall be given when all the terms of this section have been met.

3.04 Training

- .1 The Training Phase of the project begins upon approval of the Shop Drawings. This phase is made up of three (3) milestones.
 - .1 Training Course Outline Approval.
 - .2 Operator Training.
 - .3 Administrative Training.
- .2 Prepare and submit three (3) copies of the training course outlines for review. As a minimum, this outline shall list all material to be covered, the time required to cover it, the organization and personnel conducting the training, any training aids or equipment to be used for demonstration and expected training outcome (i.e.: Certification).
- .3 Course outlines shall be approved when all comments by the Owner and/or Owner's Representative have been satisfactorily addressed.

- .4 Training shall be provided on site and conducted by both the Security System Contractor and system manufacturer. All associated cost shall be carried by the Security System Contractor under his cost. Training shall consist of the following minimum requirements:
 - .1 Operator Training
 - .1 Access Control
 - .1 The Security System Contractor shall provide a custom training course for ten (10) system Operators/Basic Administrators conducted by the system manufacturer's engineer / training personnel. The custom training course shall focus primarily on daily operations, system integration, and customization.
 - .2 Successful completion of the training shall result in each trainee receiving a certification certificate.
 - .2 Video Surveillance Training
 - .1 The Security System Contractor shall provide ten (10) Operators/Basic Administrators Certification training conducted by the system manufacturer's training personnel.
 - .2 Successful completion of the training shall result in each trainee receiving a certification certificate.
 - .3 Intercom System Training
 - .1 The Security System Contractor shall provide ten (10) Operators/Basic Administrators Certification training conducted by the system manufacturer's training personnel.
 - .2 Successful completion of the training shall result in each trainee receiving a certification certificate.
 - .4 The Security System Contractor shall provide technical Certification training conducted by the system manufacturer's engineer / training personnel.
 - .5 Successful completion of the training shall result in each trainee receiving a technical certification certificate.
 - .2 Administrative Training
 - .1 Access Control System
 - .1 The Security System Contractor shall provide technical System Administrator Certification training conducted by the manufacturer for six (6) Administrators.
 - .2 Successful completion of the training shall result in each trainee receiving a certification certificate from the manufacturer. The training shall focus on the following areas:
 - .1 System Components.
 - .2 Operation and Administration.
 - .3 Software and PC Control.
 - .4 System Lifecycle Maintenance.
 - .2 Video Surveillance Training

- .1 The Security System Contractor shall provide technical System Administrator Certification training conducted by the manufacturer for six (6) Administrators.
- .2 Successful completion of the training shall result in each trainee receiving a certification certificate from the manufacturer. The training shall focus on the following areas:
 - .3 System Components
 - .1 Operation and Administration.
 - .2 Software & PC Control.
 - .3 System Lifecycle Maintenance.
 - .3 Intercom System Training
 - .1 The Security System Contractor shall provide technical system Certification training conducted by the system manufacturer. The training shall focus on the following areas:
 - .1 System Components
 - .2 Operation and Administration
 - .3 Software and PC Control
 - .4 System Lifecycle Maintenance
- .5 The training shall be performed in three (3) stages:
 - .1 Stage I: Integrator conducted training certification courses. Time allocated for this training shall conform to recommended durations required by the manufacturer issuing the certification.
 - .2 Stage II: on-site, hands-on training each for ten (10) operators and six (6) administrative personnel groups using the previously approved Training Course Outline and conducted by the Security System Contractor.
 - .3 Stage III: follow-up on-site training conducted by the Security System Contractor, at a time convenient to both parties to reinforce the Stage I training and answer any questions that may arise in the interim. A portion of this training may take the form of telephone support during the first few months of operation.
- .6 The Security System Contractor shall supply all training aids and manuals and equipment necessary for training.
- .7 The Security Contractor shall include a minimum of sixteen (16) hours of on-site training in their bid for sixteen (16) persons. Additional re-training shall be conducted as necessary until the completion of the two (2) year warranty at no additional charge.

3.05 Documentation

- .1 The Final Documentation Phase of the project begins upon approval of the Shop Drawings. This phase contains three (3) major milestones:
 - .1 Operator Manual Approval.
 - .2 Maintenance Manual Approval.
 - .3 As-built and Turnover Documentation Approval.

- .2 Prepare and submit two (3) hard and soft copies of the Operator and Maintenance Manuals for review by the Owner and/or Owner's Representative within three (3) months of Shop Drawing Approval. Manuals shall be approved when all comments have been satisfactorily addressed.
- .3 Deliver three (3) hard and soft copies of each manual within one (1) month of receiving Operator and Maintenance Manual approval from the Owner and/or Owner's Representative.
- .4 Prepare and submit (3) hard and soft copies of the As-built Drawings and Turnover Documentation for review by the Owner or Owner's Representative within one (1) month of on-site commissioning. As-built and Turnover Documentation shall be taken to site for accuracy verification against the installation. The As-built Drawings and Turnover Documentation will be approved by the Owner and/or Owner's Representative when all comments have been satisfactorily addressed.
- .5 Deliver three (3) hard and soft copies sets of revised As-built Drawings and Turnover Documentation within one (1) month of receiving approval from the Owner and/or Owner's Representative.
- .6 Final documentation soft copies shall be prepared and submitted in the native (editable) electronic format (.vsd, .dwg, .xlsx, .docx). All documents produced shall be property of the owner and the Security System Contractor shall have no rights over the entire documentation package or any parts of the documentation package.

3.06 Protection

- .1 After installing clean-finished surfaces, touch up shop-applied finishes as required to restore damaged areas.
- .2 Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, which ensure equipment is without damage or deterioration at the time of Initial Acceptance.

3.07 Clean Up

- .1 Remove all unnecessary tools and equipment, unused materials, packing materials, and debris from each area where work has been completed unless designated for storage.
- .2 Clean up all areas around system equipment and ensure that internal equipment component area is free from debris.
- .3 Remove protective coverings from accessories and components.
- .4 Adjust all components for correct function.
- .5 Clean housings and system components, free from marks, packing tape, and fingerprints, in accordance with manufacturer's written cleaning recommendations.
- .6 Clean all components free from dirt and fingerprints.

3.08 Contract Closeout

- .1 Testing shall be 100% passed before substantial performance is awarded.
- .2 Even though the equipment shall be inspected and accepted, the Substantial Performance and Project Closeout shall not occur before all contractual obligations are completed including delivery of all digital "as- built" drawing, software code, maintenance documents, operations, and spare parts manuals.

End of Section

1 General

1.01 Summary

- .1 Provide commissioning of fire alarm and interconnected systems to verify that installations are in accordance with project requirements, and to ensure proper system operation.

1.02 Related Requirements

- .1 Section 01 91 13 – General Commissioning Requirements.
- .2 Section 01 91 26.13 – Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.03 References

- .1 CAN/ULC-S1001-11 – Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.04 Submittals

- .1 Commissioning plan.

1.05 Closeout Submittals

- .1 Final commissioning and functional test report.

1.06 Qualifications

- .1 Commissioning Organizations:
 - .1 Certified member of Electrical Contractors Association of Ontario (ECAO) or Canadian Fire Alarm Association (CFAA).

2 Products – Not Used

3 Execution

3.01 Site Tests and Inspections

- .1 Provide labour and material to conduct the integrated systems testing of interconnected life safety systems in accordance with CAN/ULC-S1001-11, and provide written report for Consultant's review. Ensure all required trade contractors are present on site as directed by the Integrated Testing Coordinator during the CAN/ULC-S1001 functional testing. Refer to Section 01 91 26.13.
- .2 Follow manufacturer's recommendations for testing.
- .3 Inspect wiring connections to all devices comprising the system.
- .4 Verify supervision of wiring at every device connection to a supervised circuit.
- .5 Test operation of every device on a system to verify its function.
- .6 Examine equipment for any apparent damage or tampering that may interfere with its intended operation.
- .7 Test equipment with capabilities for field adjustment to establish that it functions as intended under the conditions prevailing at its point of installation.
- .8 Examine devices for evidence of damage or obstructions which may interfere with their operating mechanisms.

- .9 Test automatic devices by simulating an operating condition.
- .10 Wiring:
 - .1 Inspect every device and test to demonstrate that disconnection of the device from the circuit or malfunction of the equipment or wiring activates the required supervisory signals. Inspection shall include verification that:
 - .1 Supervisory signals operate in response to open circuits, short circuits, ground faults and disconnection of plug-in components;
 - .2 Terminations of conductors entering and leaving equipment have been made;
 - .3 Circuit polarities are in accordance with the system design, where applicable.
 - .2 In addition, test to establish that the power supplied to any device is within its recommended operating range and that the required voltage levels are maintained and that the fusing is correct.
- .11 Initiating Devices - Manual:
 - .1 Inspect manual alarm stations in consideration of the following:
 - .1 The device shall be mounted with sufficient clearance to facilitate ease of access and proper operation;
 - .2 Operate each manual alarm station, toggle switch and key switch to verify proper functions.
- .12 Automatic heat detectors:
 - .1 Use a heat source reproducible in its intensity, as recommended by the manufacturer of the device, to initiate an alarm.
 - .2 Test equipment - Heat lamp or Air heater. DO NOT USE AN OPEN FLAME HEAT SOURCE.
 - .3 Apply heat source as to not damage or operate fusible disc parts.
- .13 Automatic heat detectors - non-resettable:
 - .1 Test by simulating its electrical operation by jumpering the wiring points (creating a short) adjacent to its operating mechanism.
- .14 Automatic smoke detectors - area type:
 - .1 Test by introducing smoke into its detecting chamber. This may consist of actual smoke from burning materials or artificially generated smoke aerosol spray as recommended by the manufacturer. The sensitivity should be noted and adjusted if necessary.
- .15 Automatic smoke detectors:
 - .1 Examine the air sampling arrangements of the detectors under actual conditions of balanced air circulation by conducting a check of the field sensitivity and a check of the air velocity in accordance with the manufacturers' recommendations.
 - .2 Test gas to be used similar to Automatic Smoke Detector.
- .16 Alarm signals - audible:
 - .1 Test on main power supply and standby power supply with the maximum expected load on the system.

- .2 The audible signalling appliances shall function as intended and shall be audible throughout the building over the background noise present.
- .3 Decibel recordings in each area covering 100 sq. metres shall be taken.
- .4 The level of sound should usually be 15 dB above ambient noise level.
- .17 Alarm signals - visual:
 - .1 The visual signal appliances shall function as intended and shall be clearly visible.
- .18 Fire suppression supervision:
 - .1 Coordinate with the requirements of Section 21 12 00, and Section 21 13 00.
 - .2 Sprinkler and standpipe trade to activate each sprinkler and standpipe supervisory and alarm device by operating valves and producing flows as required in conjunction with fire alarm technician to observe activation of flow switches, pressure switches, supervised valves, etc.
- .19 Annunciators, printers, and workstations:
 - .1 Inspect and operate to establish that their operation in conjunction with the control equipment and other system components, is as intended. The equipment shall be inspected to ensure:
 - .1 The zone of each alarm initiating device is properly indicated;
 - .2 The legend is clearly visible;
 - .3 Adequate voltage under local conditions is present;
 - .4 Wiring connections have been made in a workmanlike manner.
 - .5 Proper care must be taken to establish that each item is complete and satisfactory.
- .20 Standby power supplies - batteries:
 - .1 Examine batteries for possible damage and consideration of the following:
 - .1 The charging system functions as intended;
 - .2 The installation has not resulted in the bypassing of a fuse or a similar protective device;
 - .3 The installation protects the batteries from accidental or mechanical damage.
 - .4 The batteries must be able to operate the fire alarm system with the charger input disconnected for one rated load cycle.
- .21 Control equipment and transponders:
 - .1 Test to establish that they function as intended. The following examinations and tests shall be performed:
 - .1 A visual and physical inspection of all cables, plug interconnections, plug-in circuit components, lamps, sockets and controls to establish that their mechanical and electrical connections and mounting are as required for intended function and, where applicable, to confirm electrical supervision;
 - .2 Verification that all field wiring is terminated in a workman-like manner;
 - .3 All lamps and indicators shall be tested for operation and intended function;

- .4 All keypad functions shall be tested for operation and intended function;
- .5 All control unit functions shall be operated to verify appropriate response including all software routines and programme functions are simulated;
- .6 Simulation of open circuits, short circuits and ground faults on all relevant internal circuits in order to confirm the appropriate supervisory response;
- .2 Commissioning Report:
 - .1 Provide in accordance with requirements of Section 01 91 13, supplemented as specified herein.
 - .2 Report to include relevant information of the system including:
 - .3 Each system part described.
 - .4 How the system is operated.
 - .5 What functions the system performs.
 - .6 Requirements for tests and service.
 - .7 Itemization of all devices connected on the system, their general location.
 - .8 The date of the performed tests.
 - .9 All pertinent details of the report sheets requested.
- .3 Verification:
 - .1 The Commissioning Report to be submitted to the Commissioning Manager upon completion of commissioning and will be subject to verification by the Commissioning Manager.

3.02 Simulations of Interconnected Systems

- .1 Provide simulations of all interconnected systems in accordance with CAN/ULC-S1001.

End of Section

1 General

1.01 Related Requirements

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 27 05 00 – Common Work Results for Communications.
- .3 Section 27 05 28 – Pathways for Communications Systems.
- .4 Section 27 15 13 – Communications Copper Horizontal Cabling.
- .5 Section 28 23 00 – Video Management System.

1.02 References

- .1 Abbreviations:
 - .1 Electronic Access Control (EAC): control of people through entrances and exits of controlled area. Security utilizing hardware systems and specialized procedures to control and monitor movements within a controlled area.
 - .2 CPVX: Central Station Burglar Alarm Systems.
 - .3 CVSG: Mercantile Burglar Alarm Systems.
 - .4 CVWX: Proprietary Burglar Alarm Systems.
 - .5 DRS: Door Release System.
 - .6 PIN: Personal Identification Number.
 - .7 ICT – Information and Communications Technology
 - .8 CCTV – Closed Circuit Television
 - .9 PTZ – Pan, Tilt, Zoom Camera
 - .10 NVR – Network Video Recorder
 - .11 RTLS – Real-Time Locating System
 - .12 PWS – Patient Wandering System
 - .13 ATS – Asset Tracking System
 - .14 DGP – Data Gathering Point
 - .15 DC – Data Centre
 - .16 ACS – Access control System
 - .17 NTP – Network Time Protocol
 - .18 PoE – Power over Ethernet
 - .19 IP – Internet Protocol
 - .20 REX – Request to Exit Motion Detector
 - .21 RXP – Request to Exit Push Button

- .22 LAN – Local Area Network
- .23 4CIF – An image resolution of 740 x 480 pixels
- .24 GUI – Graphical User Interface
- .25 IPS – Images Per Second
- .26 BTU - British Thermal Unit
- .27 RU – Rack Unit
- .28 UTP – Unshielded Twisted Pair
- .29 RAM – Random Access Memory
- .30 UPS – Uninterruptible Power Supply
- .31 KVM – Keyboard, Video, Mouse console
- .32 VMS – Video Management System
- .33 DPU – Distributed Processing Unit
- .34 SOC – Security Operations Centre, the SOC shall be located at Main Reception
- .35 SCS – Structured Cabling System
- .2 Reference standards:
 - .1 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .2 Underwriters Laboratories of Canada (ULC)
 - .1 ULC-S317-[1996], Installation and Classification of Closed Circuit Video Equipment (CCVC) Systems for Institutional and Commercial Security Systems.
 - .3 Underwriters' Laboratories (UL)
 - .1 UL 827-2008, Central-Station Alarm Services.
 - .2 Underwriters Laboratories (UL) Cable Certification and Follow Up Program.
 - .4 National Fire Protection Association (NFPA)
 - .1 NFPA 70-2011, Article 517, National Electric Code.
 - .2 NFPA 101-2008, Life Safety Code.
 - .5 ANSI/TIA/EIA-568-B.1 and its addendum
 - .6 ANSI/TIA/EIA-568-B.3 and its addendum
 - .7 BICSI Telecommunications Distribution Methods Manual – Most current Edition
 - .8 BICSI Information Transport Systems Installation Manual – Most current Edition
 - .9 American Society for Testing Materials (ASTM).

- .10 Institute of Electrical and Electronic Engineers (IEEE).
- .11 Applicable local Building Codes
- .12 Manufacturer's specifications, latest issue.

1.03 System Description

- .1 The Video Surveillance System shall consist of field and termination equipment necessary to provide a fully automated system.
- .2 The Video Surveillance System shall be designed on a distributed processing architecture employing remote cameras and operator workstations connected to a redundant central server and storage solution.
- .3 As part of this project the contractor will provide a complete IP based video surveillance solution that is scalable from the existing scope of this project to thousands of cameras which can be added on a unit-by-unit basis. This future expansion capacity shall not require significant replacement or upgrading of equipment provided as part of the initial solution.
- .4 The system shall reside on the Owner's network and video shall be viewable on the network on select client workstations.
- .5 The System shall be configured to a maximum of 75% of its input, output and recording capacity.
- .6 Provide general surveillance of exterior buildings and surrounding areas through the use of PTZ cameras. All other areas as noted on the drawings.
- .7 All video streams from cameras shall be digitally encoded using H.264 compression formats for simultaneous monitoring and recording in real time.
- .8 Each camera's bit rate, frame rate and resolution shall be set independently from other cameras in the system, and altering these settings shall not affect the recording and display settings of other cameras.
- .9 The system shall not require proprietary recording hardware, hardware multiplexers or time-division technology for video recording and monitoring.
- .10 The system client and server applications shall be based on a true open architecture that shall allow for use of non-proprietary PC storage hardware that shall not limit the storage capacity and shall allow for incremental upgrades of recording capacity.
- .11 The system shall digitally sign recorded video by way of watermarking to prevent image tampering and to confirm image integrity.
- .12 The system server and client software applications shall be able to operate on separate networks.
- .13 The system shall have the capability of simultaneous live viewing and recording of individual cameras at different frame rates and resolutions.
- .14 The Video Surveillance System must incorporate Self-Monitoring Analysis and Reporting Technology incorporating diagnostics that monitor the internal operation of a drive (including external storage drives) and provide early warning notification to SOC operators for many types of potential problems. This shall allow for the drive to be repaired or replaced before any data is lost or damaged.
- .15 The Video Surveillance System shall utilize a redundant centralized storage topology. All Video System Storage shall be located in Data Centre room.
- .16 The Video Surveillance System shall allow authorized users to save video to a standard recordable DVD. The option to include the player software on the DVD shall be available so that no additional software needs to be purchased.

- .17 Monitoring Locations
 - .1 System monitoring shall be centrally monitored from the from the Main Reception and the Second Floor East Nurses Station.
 - .2 System monitoring shall also be provided at each Nurses Station with the ability to review all only relevant cameras within that floor.
 - .3 System monitoring shall also be provided via web browser accessible from any workstation on the converged network. Access shall require a valid user ID and password.
 - .4 Perimeter Cameras must be viewable via a web browser at workstation designated by the Owner.
- .18 The system shall be capable of operating even in the event that the system management server is unavailable.
- .19 Following the restoration of power after a failure of main or Centralized UPS, the Video Surveillance System shall revert automatically, within 3.5 minutes, to normal service status without the need for operator intervention. The system shall restart in the same state as existed before the power interruption with no loss of functionality or transaction data.
- .20 Telecommunications Rooms
 - .1 All Video termination equipment with the possible exception of non-PoE camera power supplies shall be rack mounted in equipment cabinets.
 - .2 It shall be the responsibility of the contractor to keep all Video equipment clean and free of dust at all times during the installation.
 - .3 The system shall operate over a central communications backbone and reside on the Owner's network. The contractor shall coordinate with Owner's IT for all required network access.
- .21 Power
 - .1 All Source 120VAC power for security equipment shall be Centralized UPS.
 - .2 Provide lockable, hinged covered, terminal cabinets for all power supplies, transformers, and power distribution terminal strips. Provide all conduit and wiring from the 120 VAC facilities to the terminal cabinets.
 - .3 Provide protection against surges, spikes, noise, and other line problems for all system equipment and their components. In addition to generator support,
 - .4 All equipment and system components which are powered by more than 48 volts AC or DC shall be ULC listed for safety. This includes equipment or system components classified as non-power limited.
 - .5 All Video System power supplies shall have battery back and shall be monitored, by the Access Control System, for line failure on a dedicated monitoring input point. Therefore, when an AC line fails, a unique alarm condition will be caused.
- .22 Network
 - .1 Ensure all IP addressing schemes used on the network are coordinated and reviewed by both the Facility and IT Service providers configuring the network.
- .23 Interface with Other Systems
 - .1 Network Time Protocol

- .1 The Video Surveillance System shall be maintained with NTP time. The VSS system shall utilize the Owner's network for NTP time.

1.04 Submittals

- .1 Submit in accordance with Section 01 33 00, and Section 27 05 00.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for devices and equipment and include product characteristics, performance criteria, physical size, finish, and limitations.
 - .2 Submit WHMIS MSDS.
 - .3 Submit:
 - .1 Functional description of equipment.
 - .2 Technical data for all devices.
 - .3 Device location plans and cable lists.
 - .4 Devices mounting location detail drawings.
 - .5 Typical devices connection detail drawings.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Shop drawings to indicate project layout, including details.
 - .1 Shop drawings to indicate, mounting heights and locations, wiring diagrams.
 - .2 Submit zone layout drawing indicating number and location of zones and areas covered.
 - .3 Submit wiring diagrams.
 - .4 Submit complete equipment list.
 - .5 Manufacturer specification sheet for each new piece of equipment. Each sheet should clearly identify the particular model number of the hardware being provided.
 - .6 Software configuration parameters.
- .4 Test and Evaluation Reports:
 - .1 Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.
- .5 Manufacturer's Instructions: submit manufacturer's installation instructions.
- .6 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.
- .7 Integration Document for each interface to be implemented or configured.
- .8 Testing and commissioning plan

- .9 Sustainable Design Submittals:
 - .1 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
- .10 Regional Materials: submit evidence that project incorporates required percentage 10% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.05 Closeout Submittals

- .1 Submit in accordance with Section 01 78 00, and Section 27 05 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for access controls and equipment for incorporation into manual.
 - .1 Include:
 - .1 System configuration and equipment physical layout.
 - .2 Functional description of equipment.
 - .3 Instructions of operation of equipment.
 - .4 Illustrations and diagrams to supplement procedures.
 - .5 Operation instructions provided by manufacturer.
 - .6 Cleaning instructions.

1.06 Delivery, Storage, and Handling

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect access controls and equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Extended warranty period must include warranty against meeting specified performance requirements, for specified time period.
- .5 Manufacturer's Warranty: submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official.

2 Products

2.01 General Requirements

- .1 The entire new Video Surveillance System (VSS) must be based on Axis Communications.

- .2 All VSS components shall be provided with a repair or parts replacement. The repair and parts replacement shall be guaranteed by the manufacturer on warranty and non-warranty items.
- .3 Contractor is fully responsible for the ultimate design and implementation of the system topology (physical and logical) best suited for the project, given identified and recognized physical infrastructure and constraints.

2.02 Indoor Fixed Dome PoE IP Camera

- .1 Shall meet or exceed the following Specifications:
 - .1 Active Pixels: (HxV) 1920 x 1080
 - .2 Vandal Resistant
 - .3 Lens: 5 mm-50 mm, Auto Iris, Varifocal
 - .4 Gain Control: Automatic or Fixed manual setting across 32db range
 - .5 Wide Dynamic Range 90 db
 - .6 Synchronization: Internal
 - .7 Auto-Iris: DC drive lens as standard
 - .8 Operating Voltage: Power over Ethernet (802.3AF) & 24v AC/DC
 - .9 Video Compression: Full frame rate, full color: H.264 (ISO 14496-10); 30fps
 - .10 Video Bit Rate: User configurable bit rates from 32Kbps to 4Mbps
 - .11 Multi-streaming: Dual encoding
 - .12 Transmission Protocols: IP v4/v6, HTTP, HTTPS, RTP/RTCP, TCP, UDP, DHCP, DDNS, QoS (IPTOS & DiffServ), NTP, HTTP, FTP, TFTP, TELNET, ARP,SMTP
 - .13 SNMP Management: v1, 2c & 3 /MIB-2
 - .14 Time: Embedded real-time clock, NTP Client
 - .15 Day/Night: 0.5 lux (Day) / 0.5 lux (Night)
 - .16 Display: Local Date and Time
 - .17 Additional Features: Back Light Compensation (BLC), Digital motion Detection,
 - .18 Network Security: All IP cameras must incorporate on board security to protect them from unauthorized access by supporting the following features:
 - .1 All TCP/UDP network ports not used for normal functionality will be blocked to prevent network hacking.
 - .2 Support password protection to prevent unauthorized administration access.
 - .3 A Firewall will be available on each device to allow access to specified IP addresses only. SSL and other non-IP address specific security measures are deemed insufficient.
 - .4 Devices must support FTP and Telnet for administration but both these services can be disabled if required.

- .19 All units must be CUL listed.

2.03 Outdoor Vandal Proof Dome PoE IP camera

- .1 Shall meet or exceed the following requirements:
 - .1 Active Pixels: (HxV) 1920 x 1080
 - .2 Vandal Resistant housing compliant to IP66 Weather and Dust resistance with IEC60529 measurement standard.
 - .3 Lens: 5 mm-50 mm, Auto Iris, Varifocal
 - .4 Gamma: 0.45
 - .5 Gain Control: Automatic or Fixed manual setting across 32 db range.
 - .6 Wide Dynamic Range 90db
 - .7 Synchronization: Internal
 - .8 Auto-Iris: DC drive lens as standard
 - .9 Operating Voltage: Power over Ethernet (802.3AF) & 24v AC/DC
 - .10 Video Compression: Full frame rate, full color: H.264 (ISO 14496-10); 30fps
 - .11 Video Bit Rate: User configurable bit rates from 32Kbps to 4Mbps
 - .12 Multi-streaming: Dual encoding
 - .13 Transmission Protocols: IP v4/v6, HTTP, HTTPS, RTP/RTCP, TCP, UDP, DHCP, DDNS, QoS (IPTOS & DiffServ), NTP, HTTP, FTP, TFTP, TELNET, ARP,SMTP
 - .14 SNMP Management: v1, 2c & 3 /MIB-2
 - .15 Time: Embedded real-time clock, NTP Client
 - .16 Day/Night: 0.5 lux (Day) / 0.5 lux (Night) Black and White mode in low lighting conditions(User Configurable).
 - .17 Display: Local Date and Time
 - .18 Additional Features: Back Light Compensation(BLC), Digital motion Detection, Adaptive Black Stretch, Digital Aperture Correction
 - .19 Network Security: All IP cameras must incorporate onboard security to protect them from unauthorized access by supporting the following features:
 - .1 All TCP/UDP network ports not used for normal functionality will be blocked to prevent network hacking.
 - .2 Support password protection to prevent unauthorized administration access.
 - .3 A Firewall will be available on each device to allow access to specified IP addresses only. SSL and other non-IP address specific security measures are deemed insufficient.
 - .4 Devices must support FTP and Telnet for administration but both these services can be disabled if required.

- .2 All units must be CUL listed.

2.04 Indoor/Outdoor Pan, Tilt, Zoom (PTZ) Dome PoE IP Camera

- .1 Shall meet or exceed the following requirements:
 - .1 Active Pixels: (HxV) 1920 x 1080
 - .2 Vandal Resistant housing compliant to IP66 Weather and Dust resistance with IEC60529 measurement standard.
 - .3 Wide Dynamic Range 90db
 - .4 Lens: 20x Optical + 10x digital
 - .5 Transmission Protocols: IP v4/v6, HTTP, HTTPS, RTP/RTCP, TCP, UDP, DHCP, DDNS, QoS (IPTOS & DiffServ), NTP, HTTP, FTP, TFTP, TELNET, ARP,SMTP
 - .6 SNMP Management: v1, 2c & 3 /MIB-2
 - .7 Shutter/Iris/Focus: Automatic with manual override
 - .8 Synchronization: Internal
 - .9 Operating Voltage: 24v AC/DC @2.3A
 - .10 Video Compression: Full frame rate, full color: H.264 (ISO 14496-10); 30fps
 - .11 Video Bit Rate: User configurable bit rates from 32Kbps to 4Mbps
 - .12 Multi-streaming: Dual encoding
 - .13 Time: Embedded real-time clock, NTP Client
 - .14 Preset Tours: 100 each with 20 presets
 - .15 Patern/Mimic Tours: 4 each up to 1 minute
 - .16 Pan/Tilt Speed: 0.001 /s to 360 /s
 - .17 Preset move Speeds: 200 /s
 - .18 Privacy Zones: 8 user defined
 - .19 Presets: 100
 - .20 Pan Range: 360° Continuous
 - .21 Tilt Range: 180°
 - .22 Image Stabilizer
 - .23 Day/Night: 0.5 lux (Day) / 0.5 lux (Night) Black and White mode in low lighting conditions(User Configurable)
 - .24 Inputs and Outputs: 4 inputs and 4 opto-isolated outputs
 - .25 Display: Local Date and Time
 - .26 Additional Features: Back Light Compensation (BLC), On Screen Text, Zone ID, Default ID, Coordinates, Autoflip, Scroll Pattern and Control Data

- .27 Network Security: All IP cameras must incorporate onboard security to protect them from unauthorized access by supporting the following features:
 - .1 All TCP/UDP network ports not used for normal functionality will be blocked to prevent network hacking.
 - .2 Support password protection to prevent unauthorized administration access.
 - .3 A Firewall will be available on each device to allow access to specified IP addresses only. SSL and other non-IP address specific security measures are deemed insufficient.
 - .4 Devices must support FTP and Telnet for administration but both these services can be disabled if required.
- .28 Indoor PTZ shall have a smoked bubble, outdoor PTZ's shall have a clear bubble.
- .29 All units shall be CUL listed.

2.05 Enclosures, Mounts, and Supports

- .1 Enclosures
 - .1 Cameras shall be installed in lockable enclosures capable of being pendant or pole mounted, on a wall, in a corner, or fitted into a drop ceiling depending on the specific application.
 - .2 Indoor fixed cameras shall be mounted in low profile ceiling mount enclosures for installations in fixed and drop ceilings, and wall mounted enclosures for installations in service areas.
 - .3 Outdoor enclosures shall be equipped with a thermostatically controlled heater and blower.
 - .4 All connections shall be contained within secure enclosures. If external to equipment and enclosures, cabling shall be run in rigid or flexible conduit.
 - .5 Final mounting locations of enclosures shall be co-coordinated Onsite prior to installation
- .2 Mounts/Supports
 - .1 For outdoor cameras mounted on buildings and structures provide mounts/supports to match the camera enclosures. Incorporate a camera mount with an adjustable head. Video displacement, as viewed on a monitor,
 - .2 Parapet Mount
 - .1 The parapet mount shall be a fixed indoor/outdoor unit.
 - .2 It shall have a load rating of 40 lb (18 kg).
 - .3 The mount may be swivelled inward for servicing.
 - .3 To guard against potential vandalism in low ceiling public areas, the camera assemblies shall be capable of withstanding an 80 kg (180 lbs) person grabbing hold of the enclosure and attempting to pull it free from its mount without the aid of tools or weapons. In addition, it shall not be possible to crack, penetrate or damage an enclosure in any way without the aid of tools or weapons.
 - .4 Provide indoor camera mounts/supports fabricated and finished to match the camera enclosures and equipped with an adjustable head. It shall be possible to lock the position of the head after adjustments are complete.

2.06 Power Supplies

- .1 Indoor CCTV Power supplies
 - .1 All indoor fixed cameras shall be powered by Power over Ethernet (PoE) through owner supplied LAN switches.
- .2 Outdoor Camera Power supplies
 - .1 When ever possible outdoor fixed cameras shall be powered by Power over Ethernet (PoE) through owner supplied LAN switches.
 - .2 Outdoor CCTV power supplies shall be model WCS1-4 as manufactured by Pelco or approved equivalent.
 - .3 All camera power supplies shall be connected to UPS and emergency power.
 - .4 An outdoor rated lock shall be supplied and installed on the power supply cabinet to protect the unit from unauthorized access and tampering.
 - .5 Three sets of keys will be provided for the outdoor power supply lock.
 - .6 If multiple locks are supplied, they should be keyed alike.
 - .7 For outdoor cameras provide local 120V AC emergency power to all camera power supplies and install within 50 feet of the camera. All efforts shall be made to install the power supply on the inside of the building where possible.
- .3 Video Monitors
 - .1 All video monitors shall be supplied by the Owner.

3 Execution

3.01 General

- .1 Programming.
 - .1 Include as part of their solution all associated cost to program the system and ensure all configuration and naming conventions are reviewed by facilities.
 - .2 Attend pre-installation meetings as required with Owner's Representative to identify the specifics of the system programming.
 - .3 Document all decided on software configuration parameters and submit for approval.
 - .4 Once approved, implement, and test all system programming required.
 - .5 Include all approved software configuration parameters in final revisions shop drawings.
 - .6 Building door numbers are not yet final and will change prior to final system programming. Ensure final programming configuration and system documentation match this newest set to be provided by the Architect.

3.02 Field of View (FOV)

- .1 The final field of view for each camera is to be reviewed by facilities prior to camera installation.

- .2 For observation purposes at the farthest target distance a minimum 20 pixels per meter shall be achieved.
- .3 For detection purposes at the farthest target distance a minimum 50 pixels per meter shall be achieved.
- .4 For recognition purposes at the farthest target distance a horizontal pixel count of 100 pixels per meter shall be achieved.
- .5 For identification purposes at the target distance a horizontal pixel count of 500 pixels per meter shall be achieved.
- .6 The cameras for door monitoring shall include entire door in the field of view.

3.03 Examination

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

3.04 Installation

- .1 Install Video Surveillance System units and components in accordance with ULC-S317.
- .2 Conduits and back boxes for devices in walls and doors will be provided by Electrical Trade as noted in Section 27 05 28. Provide all control boxes/equipment and conduit work to tie in to rough-ins.
- .3 Provide tamperproof attachments for each activation unit cover plate to receptacle back box.
- .4 Enclose in conduit or flexible protective armor external cables for associated junction box to remaining system locations, from junction box to above ceiling mounted cable ducts or master conduit routes.
- .5 Securely fasten all components to wall, ceiling, or other substrate or structure.

3.05 Site Tests and Inspections

- .1 Perform verification inspections and test in presence of facility representatives.
 - .1 Provide all necessary tools, ladders and equipment.
 - .2 Ensure appropriate subcontractors manufacturer's representatives are present for verification.
- .2 Performance testing:
 - .1 Test procedure: perform test on a "go-no-go" basis.
 - .1 Make only operator adjustments required to show proof of performance.
 - .2 Test to demonstrate and verify that installed system complies with installation and technical requirements of this specification under operating conditions.
 - .3 Test results to be evaluated by Consultant as either acceptable or unacceptable using following procedures.

- .2 Documentation review:
 - .1 This review will determine if information provided is sufficient to meet requirements of this specification.
 - .2 Provide for review all System manuals, as installed drawings, pretest forms, equipment cabinet pictorials, video equipment details.
- .3 Mechanical inspection:
 - .1 Consultant and Contractor to tour areas to ensure that Systems and Subsystems are installed in place for proof of performance testing.
 - .2 Take system inventory at this time. Verify following items before beginning proof of performance tests:
 - .1 Electrical power circuits designated for system equipment are properly labeled, wired, phased, protected and grounded.
 - .2 Conductor ends are protected by heat shrink wrap; audio spade lugs, barrier strips and punch blocks are used.
 - .3 Dust, debris, solder splatter, etc. are cleaned and removed from site.
 - .4 Equipment is properly labelled.
 - .5 Equipment identified in system's equipment lists are in-place and properly installed.
 - .6 Each System ground method are installed in accordance with manufacturer's instructions and this specification.
- .3 Subsystem functional test:
 - .1 Conduct operational testing after review of documentation and mechanical inspection completed. Proceed as follows.
 - .1 Perform operational test of each Subsystem to verify that all equipment is properly connected, interfaced and is functionally operational to meet requirements of this specification.
 - .2 Safety:
 - .1 Demonstrate with documentation that access control system meets safety requirements specified in UL 294.
- .4 Visual verification: objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
 - .1 Sturdiness of equipment fastening.
 - .2 Non-existence of installation related damages.
 - .3 Compliance of device locations with reviewed shop drawings.
 - .4 Compatibility of equipment installation with physical environment.
 - .5 Inclusion of all accessories.
 - .6 Device and cabling identification.

- .7 Application and location of ULC approval decals.
- .5 Technical verification: purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:
 - .1 Validate cameras, recording and interface with other systems.
 - .2 Connecting joints and equipment fastening.
 - .3 Compliance with manufacturer's specification, product literature and installation instructions.
- .6 Operational verification: purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:
 - .1 Operation of each device individually and within its environment.
 - .2 Operation of each device in relation with programmable schedule and or/specific functions.

3.06 Field Quality Control

- .1 Manufacturer Services:
 - .1 Manufacturer of products, supplied under this Section, to review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
- .2 Manufacturer's Field Services:
 - .1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.
 - .2 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Ensure manufacturer's representative is present before and during critical periods of installation and testing.
 - .4 Schedule site visits to review Work at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.

3.07 Cleaning

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
 - .1 Remove protective coverings from accessories and components.
 - .2 Clean housings and system components, free from marks, packing tape, and finger prints, in accordance with manufacturer's written cleaning recommendations.

- .3 Clean components free from dirt and fingerprints.
- .4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.08 Protection

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by access controls and equipment installation.

End of Section

1 General

1.01 Related Requirements

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 27 05 00 – Common Work Results for Communications.
- .3 Section 28 21 00 – Surveillance Cameras.

1.02 References

- .1 Abbreviations:
 - .1 Electronic Access Control (EAC): control of people through entrances and exits of controlled area. Security utilizing hardware systems and specialized procedures to control and monitor movements within a controlled area.
 - .2 CPVX: Central Station Burglar Alarm Systems.
 - .3 CVSG: Mercantile Burglar Alarm Systems.
 - .4 CVWX: Proprietary Burglar Alarm Systems.
 - .5 DRS: Door Release System.
 - .6 PIN: Personal Identification Number.
 - .7 ICT – Information and Communications Technology
 - .8 CCTV – Closed Circuit Television
 - .9 PTZ – Pan, Tilt, Zoom Camera
 - .10 NVR – Network Video Recorder
 - .11 RTLS – Real-Time Locating System
 - .12 PWS – Patient Wandering System
 - .13 ATS – Asset Tracking System
 - .14 DGP – Data Gathering Point
 - .15 DC – Data Centre
 - .16 ACS – Access control System
 - .17 NTP – Network Time Protocol
 - .18 PoE – Power over Ethernet
 - .19 IP – Internet Protocol
 - .20 REX – Request to Exit Motion Detector
 - .21 RXP – Request to Exit Push Button
 - .22 LAN – Local Area Network
 - .23 4CIF – An image resolution of 740 x 480 pixels

- .24 GUI – Graphical User Interface
- .25 IPS – Images Per Second
- .26 BTU - British Thermal Unit
- .27 RU – Rack Unit
- .28 UTP – Unshielded Twisted Pair
- .29 RAM – Random Access Memory
- .30 UPS – Uninterruptible Power Supply
- .31 KVM – Keyboard, Video, Mouse console
- .32 VMS – Video Management System
- .33 DPU – Distributed Processing Unit
- .34 SOC – Security Operations Centre
- .35 SCS – Structured Cabling System
- .2 Reference standards:
 - .1 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
 - .2 Underwriters Laboratories of Canada (ULC)
 - .1 and Classification of Closed Circuit Video Equipment (CCVC) Systems for Institutional and Commercial Security Systems.
 - .3 Underwriters' Laboratories (UL)
 - .1 Underwriters Laboratories (UL) Cable Certification and Follow Up Program.
 - .4 National Fire Protection Association (NFPA)
 - .1 NFPA 70-2011, Article 517, National Electric Code.
 - .2 NFPA 101-2008, Life Safety Code.
 - .5 ANSI/TIA/EIA-568-B.1 and its addendum
 - .6 ANSI/TIA/EIA-568-B.3 and its addendum
 - .7 BICSI Telecommunications Distribution Methods Manual – Most current Edition
 - .8 BICSI Network Design Reference Manual – Most current Edition
 - .9 BICSI Information Transport Systems Installation Manual – Most current Edition
 - .10 American Society for Testing Materials (ASTM).
 - .11 Institute of Electrical and Electronic Engineers (IEEE).
 - .12 Applicable local Building Codes

.13 Manufacturer's specifications, latest issue.

1.03 System Description

- .1 The Video Management System Software and any required servers shall be a highly scalable and complete end to end solution.
- .2 The Video Management System shall be designed to connect to the Video Surveillance System through a distributed processing architecture employing remote cameras and operator workstations connected to a redundant central server and storage solution.
- .3 As part of this project the contractor will provide a complete IP based video surveillance solution that is scalable from the existing scope of this project to thousands of cameras which can be added on a unit-by-unit basis. This future expansion capacity shall not require significant replacement or upgrading of equipment provided as part of the initial solution.
- .4 The system shall reside on the the Owner's network and video shall be viewable on the network on select client workstations.
- .5 The System shall be configured to a maximum of 75% of its device and recording capacity.
- .6 Provide general surveillance of exterior buildings and surrounding areas through the use of PTZ cameras. All other areas as noted on the drawings.
- .7 All video streams from cameras shall be digitally encoded using H.264 compression formats for simultaneous monitoring and recording in real time.
- .8 Each camera's bit rate, frame rate and resolution shall be set independently from other cameras in the system, and altering these settings shall not affect the recording and display settings of other cameras.
- .9 The system shall not require proprietary recording hardware, hardware multiplexers or time-division technology for video recording and monitoring.
- .10 The system client and server applications shall be based on a true open architecture that shall allow for use of non-proprietary PC storage hardware that shall not limit the storage capacity and shall allow for incremental upgrades of recording capacity.
- .11 The system client and server applications shall support a minimum of 12 simultaneous use CCTV keyboards where each keyboard can operate the entire set of cameras throughout the system, including cameras of various manufacturers' brands.
- .12 The system shall digitally sign recorded video by way of watermarking to prevent image tampering and to confirm image integrity.
- .13 The system server and client software applications shall be able to operate on separate networks.
- .14 The system shall have the capability of simultaneous live viewing and recording of individual cameras at different frame rates and resolutions.
- .15 The Video Surveillance System must incorporate Self-Monitoring Analysis and Reporting Technology incorporating diagnostics that monitor the internal operation of a drive (including external storage drives) and provide early warning notification to SOC operators for many types of potential problems. This shall allow for the drive to be repaired or replaced before any data is lost or damaged.
- .16 The Video Surveillance System shall utilize a redundant centralized storage topology. All Video System Storage shall be located in Data Centre room.

- .17 The Video Surveillance System shall allow authorized users to save video to a standard recordable DVD. The option to include the player software on the DVD shall be available so that no additional software needs to be purchased.
- .18 The Video Management System shall incorporate full programming and prioritized control between users and existing PTZ domes.
- .19 Provide online storage based on per camera recording rate of 24 hours a day, 7 days a week, 30ips, 1080p resolution, H.264 compression, with an online retention of minimum 30 days.
- .20 Monitoring Locations
 - .1 System monitoring shall be centrally monitored from the from the Main Reception and the Second Floor East Nurses Station.
 - .2 System monitoring shall also be provided at each Nurses Station with the ability to review all only relevant cameras within that floor.
 - .3 System monitoring shall also be provided via web browser accessible from any workstation on the converged network. Access shall require a valid user ID and password.
 - .4 Perimeter Cameras must be viewable via a web browser at a workstation designated by the Owner.
- .21 The system shall be capable of operating even in the event that the system management server is unavailable.
- .22 Following the restoration of power after a failure of main or Centralized UPS, the Video Surveillance System shall revert automatically, within 3.5 minutes, to normal service status without the need for operator intervention. The system shall restart in the same state as existed before the power interruption with no loss of functionality or transaction data.
- .23 Telecommunications Rooms
 - .1 All Video termination equipment with the possible exception of non-PoE camera power supplies shall be rack mounted in equipment cabinets.
 - .2 It shall be the responsibility of the contractor to keep all Video equipment clean and free of dust at all times during the installation.
 - .3 The system shall operate over a central communications backbone and reside on the Owner's network. The contractor shall coordinate with Owner's IT for all required network access.
- .24 Power
 - .1 All Source 120VAC power for security equipment shall be Centralized UPS.
 - .2 Provide protection against surges, spikes, noise, and other line problems for all system equipment and their components. In addition to generator support,
 - .3 All equipment and system components which are powered by more than 48 volts AC or DC shall be ULC listed for safety. This includes equipment or system components classified as non-power limited.
- .25 Network
 - .1 Ensure all IP addressing schemes used on the network are coordinated and reviewed by both the Facility and IT Service providers configuring the network.
- .26 Interface with Other Systems

.1 Network Time Protocol

.1 The Video Surveillance System shall be maintained with NTP time. The NTP master clock shall be provided by the contractor as specified.

1.04 Submittals

.1 Submit in accordance with Section 01 33 00, and Section 27 05 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for VMS software and equipment and include product characteristics, performance criteria, physical size, finish, and limitations.

.2 Submit WHMIS MSDS.

.3 Submit:

.1 Functional description of equipment.

.2 Technical data for all devices.

.3 Device location plans and cable lists.

.4 Devices mounting location detail drawings.

.5 Typical devices connection detail drawings.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Shop drawings to indicate project layout, including details.

.1 Shop drawings to indicate, mounting heights and locations, wiring diagrams.

.2 Submit zone layout drawing indicating number and location of zones and areas covered.

.3 Submit wiring diagrams.

.4 Submit complete equipment list.

.5 Manufacturer specification sheet for each new piece of equipment. Each sheet should clearly identify the particular model number of the hardware being provided.

.6 Software configuration parameters.

.4 Test and Evaluation Reports:

.1 Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

.5 Manufacturer's Instructions: submit manufacturer's installation instructions.

.6 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

.7 Integration Document for each interface to be implemented or configured.

- .8 Testing and commissioning plan
- .9 Sustainable Design Submittals:
 - .1 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.
- .10 Regional Materials: submit evidence that project incorporates required percentage 10% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.05 Closeout Submittals

- .1 Submit in accordance with Section 01 78 00, and Section 27 05 00.
- .2 Operation and Maintenance Data: submit operation and maintenance data for access controls and equipment for incorporation into manual.
 - .1 Include:
 - .1 System configuration and equipment physical layout.
 - .2 Functional description of equipment.
 - .3 Instructions of operation of equipment.
 - .4 Illustrations and diagrams to supplement procedures.
 - .5 Operation instructions provided by manufacturer.
 - .6 Cleaning instructions.

1.06 Delivery, Storage, and Handling

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect access controls and equipment from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .4 Extended warranty period must include warranty against meeting specified performance requirements, for specified time period.
- .5 Manufacturer's Warranty: submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official.

2 Products

2.01 Manufacturers

- .1 The surveillance systems integrators shall be:
 - .1 Cintel,
 - .2 Aatel or,
 - .3 Mircom.
- .2 Provide complete start-up verification report by manufacturer and include cost in tender price.

2.02 General Requirements

- .1 Contractor is fully responsible for the ultimate design and implementation of the system topology (physical and logical) best suited for the project, given identified and recognized physical infrastructure and constraints.

2.03 Display and Control Equipment

- .1 Central Management Servers
 - .1 The computer hardware described in this section will be used to run the Central Management System Server software used for administration, monitoring and configuration of the Video Surveillance System.
 - .2 Specifications for these servers shall be in compliance with the software developers recommended requirements for all software applications that are installed on the system.
 - .3 Operating System: Microsoft Windows Enterprise Server 2012 or approved equivalent.
 - .4 Database: SQL Server 2012 or approved equivalent
http://en.wikipedia.org/wiki/Microsoft_SQL_Server - SQL_Server_2012
 - .5 Hard Disk Drive: Hot swappable, 250 GB or more. It shall be possible to expand this capacity by upgrading the fixed disk or through additional disk drives.
 - .6 Redundancy: minimum of RAID 1.
 - .7 Accelerated Video Card
 - .8 Network Interface Card: 10/100/1000 Mbps Ethernet Fast Ethernet Controller, IEEE Compliance - 802.3, 802.3u, 802.3x, 802.3z, Compatible with Cat 6 cabling.
 - .9 Blu-Ray Recordable Drive
- .2 Operator Workstations
 - .1 Supply and install client workstations and application software where required for administrative and monitoring functions.
 - .1 Workstation shall be located at the 2nd floor East Nurse Station.
 - .2 The configuration should be capable of displaying at a minimum 16 simultaneous H.264 video streams at rate of 1080p/30fps.

- .3 Workstation requirements shall include as a minimum the following components. Specifications for these components shall be in compliance with the software developers recommended requirements for all software applications that are installed on the system:
 - .1 Main Memory
 - .2 Microprocessor
 - .3 Hard Disk Drive
 - .4 2 Accelerated Video Cards
 - .5 Network Interface Card
 - .6 Storage Media
 - .7 Mainboard
 - .8 Integrated 6-channel soundcard and speakers
 - .9 Integrated USB 3.0 controller with four (4) USB 3.0 ports.
 - .10 Key board: 101 key enhanced keyboard with USB 2.0 interface. Keyboard shall incorporate soft touch keys and a retractable cord of not less than 2 m in extended length.
 - .11 Mouse: Optical mouse with USB 2.0 interface.
 - .12 Operating System
- .4 Main Memory
 - .1 Architecture shall be based on DDR2 or FBDIMM technology.
- .5 Network Interface Card: 10/100/1000 Mbps Ethernet Fast Ethernet Controller, IEEE Compliance - 802.3, 802.3u, 802.3x, 802.3z, Compatible with Cat 6 cabling.
- .6 Provide an audible annunciator capability to signal alarm activation to the operator. It shall be possible for the operator to vary the level of the annunciator but not to turn it completely "off". The minimum allowable setting shall be 10 dB.
- .7 Provide the capability and program the system to annunciate different alarm signals for the various alarm types.
- .8 Invalid entries by the operator shall be annunciated and displayed on the computer monitors with another alternative entry.
- .9 Use appropriate common terms when displaying or printing text. The use of uncommon abbreviations is not acceptable.
- .10 All SOC and operator workstations shall be configured for dual 24" LCD monitors, Comm Centres shall be configured with a single 24" monitor
- .11 High Resolution Graphic:
 - .1 The system shall support a minimum of 100 user programmable color graphic map displays capable of showing the floor plan, location of alarm device, and alarm instructions. Floor plans shall be capable of being imported from other systems such as AutoCAD. All of the graphic maps are to be centralized in the system configuration and

shall be displayed on the operator's workstations. Systems requiring separate display monitors or PC are not acceptable.

.3 Keyboard Controller

- .1 The control unit joystick shall include integral camera zoom lens control, allowing one hand operation.
- .2 The controller shall provide, but not be limited to, selection of the following remote camera site functions:
 - .1 Joystick control of pan/tilt/zoom
 - .2 Focus, and iris lens control
 - .3 Auto pan, auto tour
 - .4 Selection of up to 99 pre-positioned scenes per camera.
- .3 Mechanical Specifications
 - .1 Controls:
 - .2 Momentary push buttons.
 - .3 Pan/tilt/zoom joystick.
 - .4 Control unit shall be supplied as a desktop model.
 - .5 Operating Temperature: 0°C - +40°C (+32°F - +104°F).
 - .6 Humidity: 10 to 80% relative, non-condensing.

.4 Video System Storage

- .1 As a part of the Video Surveillance System supply, install, and configure Network Storage Devices.
- .2 Recorders and associated storage shall be deployed to the Data Center room only.
- .3 Include all current software, firmware and licenses.
- .4 The Storage System Shall:
 - .1 Support storage of video images from cameras that terminate in remote communications room plus 25% spare capacity.
 - .2 Online storage based on per camera recording rate of 24 hours a day, 7 days a week, 30ips, 1080p resolution, H.264 compression, with an online retention of minimum 30 days.
 - .3 Support record and playback of H.264 video streams.
 - .4 be IP attached via Gigabit Ethernet using commonly available networking configurations and equipment.
 - .5 Conform to and be deployable in industry standard 19" rack configurations. Mounting of equipment on shelves is not acceptable.

- .6 Storage system shall support high availability with no single point of failure causing loss of data or interrupting access to data.
 - .1 Protect data for up to three simultaneous disk failures with no loss of data or loss of access to data.
 - .2 Protect against loss of a storage appliance or controller with no loss of data or loss of access to data.
 - .3 Protect against loss of a networking path between servers and storage, including network interface card, cables and switches, with the ability to dynamically reroute IO activity to an alternate network path.
- .7 Support dynamic replacement of hardware components without interrupting access to data.
 - .1 Support the ability to replace disk drives without the need to interrupt data access.
 - .2 Provide redundant power supplies to support the ability to replace power supplies without the need to interrupt data access.
 - .3 Support the ability to replace fan modules without the need to interrupt data access.
 - .4 Support the ability to replace entire appliances without the need to interrupt data access.
 - .5 Support the ability to replace network switches without the need to interrupt data access.
- .8 Support dynamic management features to insure continuous data access.
 - .1 Be expandable by the addition of disk capacity without the need to interrupt data access.
 - .2 Be expandable by the addition of processing capacity without the need to interrupt data access.
 - .3 Be expandable by the addition of network bandwidth without the need to interrupt data access.
- .9 Be scalable in capacity, supporting a single volume growth to a minimum of 100TB.
 - .1 Capacity scaling shall be non-disruptive allowing new capacity to be dynamically
 - .2 Physical capacity added to the system shall be configurable into new volumes or
- .10 Provide capacity and performance usage statistics.
- .11 Allow dynamic configuration of volumes.
- .12 Provide administrator security controls.
- .13 Detect controller and drive failures and shall export and annunciate / notify the SOC Operator via the Access Control System client application. The system shall also provide a local audible alarm.
- .14 Include SNMP management support

- .5 VMS Rack Mounting:
 - .1 All equipment to be located within termination equipment cabinets shall be rack mounted.
 - .2 Equipment to be security fastened in racks with manufacturer supplied or approved rails and mounting fasteners.
- .6 Information Backup/Retrieval:
 - .1 The System Server(s) shall be capable of transferring all programmed data and transactional history to an appropriate archive storage media. All programmed data shall be restorable from the back-up media in case of system hardware failure.
- .7 Communication Rates:
 - .1 The system shall be capable of supporting a minimum communication rate of 19,200 baud to all access control panels and 10 MB Ethernet communications rates to client workstations.
- .8 Communication Ports:
 - .1 Network Ports: The System Server shall support the use of Ethernet networks as the communications path between the server and end devices, and other systems for the purpose of integration. This communications path shall be the same network used for communications between the System Server and the operator workstations. The communications between the System Server and the field devices shall be encapsulated in a TCP/IP network/transport layer.
 - .2 Port Name: Each communications port shall be addressed with the system by a unique name.
 - .3 Port Description: The System Server shall provide the ability to add a communication port description to each port configuration. There shall be no limit to the amount of text that can be used to describe the communications port.
 - .4 On-line/Off-line: The System Server shall allow the operator to put a communications port on-line or off-line. If the communications port is placed off-line, the System Server shall not use the port to communicate to field device configured on that port. If the communications port is put on-line, the System Server shall use the port to communicate to field devices configured on that port.
 - .5 Communications failure:
 - .1 If the communications port is on a network device, such as a terminal server, the System Server shall indicate if there is a loss of communications to that network address. All field units connected to that network address should also be reported as being in communications failure.
 - .2 To allow for network delays, the System Server shall allow the system administrator to define a wait time before annunciation of a communications failure.
 - .3 The System Server shall provide the administrator the ability to set a reconnect retry period. This is the time period the system shall wait before attempting to re-establish communications with a network port which is in communications failure.
 - .4 Configuration of the remote communications port characteristics, i.e. baud rate, parity, error-checking etc. shall be done either on the network device or through network management tools. The configuration is not required to be executed by the Central Management System.
 - .5 IP address: For communications ports on a network device, the System Server shall allow the operator to define the IP address of the device, as well as the local port address, to which the remote field devices are connected.

- .9 Redundant Array of Independent Disks (RAID)
 - .1 The system shall support a redundant array of multiple independent hard disk drives (RAID) that provide high performance and fault tolerance. The RAID array shall appear to the System Server as a single storage unit or as multiple logical units.
 - .2 RAID 1: The System Server shall support the use of RAID level 1. RAID level 1 provides complete data redundancy.
- .10 Redundancy
 - .1 The System Server shall support a second System Server for redundant capability. During normal operation, data shall be written to either server and shall be mirrored to its counterpart in a bi-directional mirroring process.
 - .2 If a failure is detected, it shall be verified across both the network and the mirrored data links. When the failure has been verified, the surviving server shall assume the functions and identities of the failed server without having to sacrifice its own identities or functions. Applications originally running on the failed server are restarted on the surviving server.

2.04 Software

- .1 General
 - .1 Provide all required hardware and software licensing required to allow for complete system installation.
 - .2 Supply the most recent version of software that supports full integration and functionality as specified.
 - .3 The System shall be an IP based solution which will include the following functions:
 - .1 Live Viewing
 - .2 Recording and Playback
 - .3 Support of system integration
 - .4 Interactive Maps
 - .5 Centralized Administration
 - .1 Device discovery
 - .2 User groups
 - .3 Multiple administrator users
 - .4 System diagnostics
 - .4 Virtual Matrix
 - .1 Enable CCTV keyboard control similar to matrix switcher
 - .5 Analytics tools such as:
 - .1 Video Motion Detection
 - .2 Directional Video Motion Detection

- .3 Abandoned Object Detection
- .4 Virtual Tripwire
- .5 Shape-based detection
- .6 Theft detection
- .6 Remote video management
 - .1 The system shall work with a single remote software program that enables video management from a remote computer.
- .7 Password protection
 - .1 Logging on to the client application shall be done either through locally stored USP user accounts and passwords.
 - .2 Active Directory integration shall be supported. If Active Directory Integration is utilized, the operators Windows credentials may be used for authentication.
- .8 On-screen monitor display
 - .1 Each system output shall be configured to provide on-screen display of site number and title, video input number and title, time, date, camera and monitor status.
 - .2 The monitor display shall show the keyboard number or user number in situations where a higher priority keyboard or user has control of a camera or has locked a camera.
- .9 Time Synchronization
 - .1 Synchronize all video system devices to IP Ethernet Network Time Protocol (NTP) for integration with other network devices. This shall be synchronized to the [CAMH] clock
- .10 Communication ports
 - .1 The system shall be configured to provide external connection to computers, printers, alarm interface units, recorder interface units, and additional system control keyboards.
- .11 Macros
 - .1 Program and configure macro commands per keyboard as required.
- .12 Alarms
 - .1 The matrix switcher/controller shall be configured to provide e-mail messaging of specific alarms and diagnostic alarms when activated.
- .13 Activity logging
 - .1 The system shall have activity logging and reporting to an IP network PC used for setup and file storage.
- .14 Provide all programming and configuration of Tours, Salvo's and camera patterns as required.
- .15 Recorder control
 - .1 The system shall provide for remote management to directly control important video management system functions such as play, stop, pause, record, rewind, and fast-forward.

- .2 Server Applications
 - .1 Minimum Windows 2012 Server.
 - .2 All compatible necessary hardware/software drivers
 - .3 RAID management and diagnostics
 - .4 Blu-Ray management software for video and data back-up's.
 - .5 Lightweight antivirus software ideal for storage intensive servers
- .3 Video Management System (VMS)
 - .1 The Video Management System shall have the capability of viewing live and recorded video of all field cameras from all sites simultaneously.
 - .2 As a minimum the VMS shall be capable of quick analysis of thousands of recordings using Events triggering, Video Motion Detection, Time, Date and Camera search criteria, saving valuable incident search time and the ability to playback recordings from remote sites without interrupting current recordings.
 - .3 NVR recordings shall have the ability to be accessed simultaneously locally or remotely using the Video Management System Client Software by any number of users. It shall be possible to assign user rights and privileges to each user to restrict access to authorized users.
 - .4 NVR management and configuration shall be performed using a client application that forms part of the Digital Video Management System.
 - .5 NVR recorded video shall not have the ability to be altered, ensuring the audit trail is intact for evidential purposes. Recordings exported from the system shall be protected by a watermark and a digital signature.
 - .6 VMS shall work with other 3rd party IP components, e.g. cameras, monitors, keyboards and pan tilt zoom (PTZ) units. The system shall enable users to control PTZ cameras when viewing live video. In addition, administrators can have the capability of configuring custom commands and pre sets for each PTZ camera and also set user priorities and privileges by preventing other users from controlling it.
 - .7 PTZ cameras shall be controlled by using an external joystick, or directly in the video pane from the VMS using a mouse. The camera to be easily panned and tilted in different directions at variable speeds by simply moving the mouse, and zoomed by clicking.
 - .8 The VMS operator shall have the ability select any of the encoded camera video streams, live or recorded and manually link to a display monitor.
 - .9 The VMS shall support motion detect, binary and video loss alarms and to also trigger relays and send IP triggers when an alarm occurs.
 - .10 The ability to playback simultaneously recordings from a minimum of 8 cameras.
 - .11 The VMS Shall come equipped with an interactive facility and site mapping graphical user interface to allow for all site locations including camera and alarm positions accurately plotted.
 - .12 The Client Monitoring Application shall allow level access control per user to every camera.
 - .13 Several users shall have the ability to simultaneously view, manage and record across the network from any point on the network.

- .14 The video management system software shall provide the ability to cut video streams from remote client workstation at any time.
- .4 Video Management System Client Application
 - .1 The VMS Client Application shall consist but not be limited to the following tasks:
 - .1 Live camera viewing,
 - .2 Live PTZ control
 - .3 NVR Playback
 - .4 Alarm event processing,
 - .5 Device configuration,
 - .6 System administration,
 - .7 Video and event archiving,
 - .8 Mapping
 - .9 Event reporting.
 - .2 The Client Application shall perform all the necessary standard monitoring functions simultaneously without interfering with any of the System Server operations
 - .3 The Client Application shall support any form of IP network connectivity, including: LAN, WAN, VPN, Internet, and Wireless (WiFi) technologies.
 - .4 All Client Applications shall support IP Multicast and Unicast (UDP) video streaming.
 - .5 Client Application shall provide an authentication mechanism, which verifies the validity of the user.
 - .6 Each workstation shall be able to use a CCTV controller (keyboard) or PC keyboard/mouse that can control the entire set of cameras throughout the system, even if the system consists of motorized cameras produced by different manufacturers.
 - .7 The Client Applications shall allow for multiple instances to run simultaneously, by one or multiple users on separate workstations.
 - .8 The Client applications shall provide administrators with the ability to block video streams to lower level users.
 - .9 The Client Application graphical user interface shall include the following tasks and functions:
 - .10 Live Viewing:
 - .1 Display live video from any encoded camera on the workstation video panes.
 - .2 Display live video from any encoded camera on external monitors.
 - .3 Capability to view a set of cameras in succession.
 - .4 Perform camera to monitor call up, Pan Tilt Zoom (PTZ), focus, edit and enable pre sets and perform customized actions using internal or external controllers (keyboards).
 - .5 Record live video and take snapshots of images.

- .6 The Live Viewer shall allow live viewing of video streams.
- .7 Multiple users shall be able to view the same camera sequence simultaneously; users are able to pause the sequence without affecting other viewers.
- .8 Shall enable live monitoring of 1 to 16 video streams simultaneously on a single monitor and 1 to 32 video streams simultaneously on a dual monitor.
- .9 Shall display all cameras, monitors and camera sequences in the system.
- .10 Shall allow operators to control (Pause/Play, skip forwards, skip backwards) Camera Sequences.
- .11 Shall have the option to perform drag and drop functions to an external monitor (decoder) or workstation to view a camera.
- .12 The operator shall be able to control camera pan-tilt-zoom, iris, focus, call pre sets and configure integrated PTZ dome features by using an external or internal application controller (keyboard).
- .13 Each operator shall be assigned a PTZ priority to allow a prioritization between operators on who has control over a camera.
- .14 Users shall be able to take snapshots of live video feeds in the Live Viewer and be able to save or print the snapshots.
- .15 Users shall be able to control PTZ functions with a CCTV style joystick using the workstation.
- .16 Must have the ability to view minimum of 16 simultaneous live video streams from the DVMS Client Application in two windows using dual head monitors. Live and recorded video to be viewed at the same time.
- .17 The operator shall be able to start/stop recording on any camera in the system.
- .18 The video management system software shall provide the ability for SOC operators to stop video streams from displaying on a specific or group of remote client workstation at any time via an Operator initiated command. Should the selected client workstation(s) be viewing the video stream at the time a SOC Operator activates this feature, the remote client workstation(s) shall stop displaying the selected video stream, and automatically change the display to a black screen.
- .11 NVR Playback and Video Event Archiving
 - .1 Search through past recorded footage.
 - .2 Playback recordings.
 - .3 Save snapshots and recordings to file as evidence on workstation and export to USB drive and Blu-Ray recordable
 - .4 View thumbnails of a fixed number of images, distributed at equal intervals across the current range of the timeline.
 - .5 Export and protect recordings
 - .6 Find motion in sections of recorded footage.
 - .7 View a thumbnail image of each time that the motion profile in the current timeline range exceeds the threshold.

- .8 Shall allow for multiple recording schedules to be assigned to a single camera. Each schedule shall have the capability to vary parameters such as, Video quality, Recording mode and Time and date settings.
- .9 The NVR shall have the ability to dynamically change recording quality settings on alarm and events.
- .10 The NVR shall keep a log and compile statistics on disk space usage.
- .11 The NVR shall have the capacity to schedule backups of the video archives, with associated database events to an appropriate device.
- .12 The NVR shall keep log of the system events for maintenance purposes.
- .13 Shall support video playback of any time span.
- .14 Shall enable operators to choose from a number of possible camera display patterns ranging from 1 tile to 16 tiles patterns.
- .15 Shall allow the operator to select between synchronous playbacks of all selected video streams.
- .16 Shall allow the operator to simultaneously view the same camera in multiple tiles at different time intervals.
- .17 Shall be able to query archived video from one or multiple archived video servers using various search criteria, including but not limited to, time, date, camera, site and past alarms.
- .18 Shall allow operators to define an area of the video field in which to search for motion as well as define the amount of motion that will trigger search results.
- .19 Shall allow operators to validate if a digitally signed video sequence has been tampered with or not.
- .20 Shall provide still image export to JPEG and BMP format with Date and Time stamp on the image.
- .21 Shall provide tools to export video sequences in standard video formats, such as AVI and ASF.
- .22 Shall provide tools to export video sequences and any required video player on Blu Ray.
- .23 Shall support playback of archived video to NTSC system monitors.
- .12 Alarm Processing
 - .1 View and acknowledge all alarms that have occurred on sites.
 - .2 Respond to alarms as specified by an administrator
 - .3 Play back recordings associated with alarms.
 - .4 View live video of the scene where an alarm has occurred.
 - .5 View a thumbnail image for each alarm in the current timeline range.
 - .6 Display a map of the site where an alarm has occurred

- .7 The VMS shall receive all incoming events (motion detection, IP trigger) in the system and take appropriate actions based on user-defined event/action relationships.
- .8 The VMS shall receive and log all alarm events and system generated events.
- .9 The VMS shall have the capability to automatically execute any necessary actions in response to generated events.
- .10 The VMS shall use an event and timestamp database for advanced search of video archives.
- .11 The VMS shall provide the functionality of storing of video streams based on triggering events such as, Digital motion detection, Digital input activation or on a schedule.
- .12 Each entry in a sequence shall have the capacity to trigger camera pre sets, patterns or auxiliaries.
- .13 The Client Application shall have Advanced Alarm Management, which shall have the ability to assign alarms and procedures to specific users or user
- .13 Mapping:
 - .1 Client Application shall support Mapping functionality, where digital maps are used to represent the physical location of cameras, alarms, NVR's and other devices throughout the entire system
 - .2 Operators shall have the ability to double click on a camera map link to display live video to be displayed on the workstation on the first available monitor.
 - .3 Maps to automatically display alarm activity of a particular site.
 - .4 Administrators shall have the ability to create the following:
 - .1 Creating multiple maps of sites, and linking sub maps to sites.
 - .2 Adding and modifying Alarm sources to maps
 - .3 Adding and modifying cameras to maps, including editable field of view illustrations
 - .4 Dual workstation display capabilities
 - .5 System Administration
- .14 Provide as part of solution all associated cost for the supply, install, configuration, and coordination of a quantity of 10 Client Licenses and Workstations. System shall allow web browser viewing for all others with appropriate authorization.
- .15 Black Screen
 - .1 For monitoring of video at the Reception Area, the system shall be configured as a "Black Screen" system such that incoming alarms shall be displayed on a block (group) of monitors with which they are associated. The first incoming alarm is displayed on the first (lowest numbered) monitor of the block. The second alarm is displayed on the next lowest numbered monitor of the block, and so on. When all monitors in a given block are displaying alarm video signals, all subsequent alarms shall be placed in sequence and shall cycle continuously until each is cleared. Each alarm will be displayed for a pre-programmed dwell time before it is succeeded by the next received alarm. When the last

alarm on a given monitor within a group is cleared, a "Black Screen" shall automatically appear indicating there are no further alarms to be displayed.

- .2 During alarm response, the system must provide programming for automatic call-up of a camera pre set and provide on-screen text indicating the occurrence of an alarm.

3 Execution

3.01 General

- .1 Programming.
 - .1 Include as part of their solution all associated cost to program the system and ensure all configuration and naming conventions are reviewed by facilities.
 - .2 Attend pre-installation meetings as required with Owner's Facility Representative to identify the specifics of the system programming.
 - .3 Document all decided on software configuration parameters and submit for approval.
 - .4 Once approved, implement and test all system programming required.
 - .5 Include all approved software configuration parameters in final revisions shop drawings.
 - .6 Building door numbers are not yet final and will change prior to final system programming. Ensure final programming configuration and system documentation match this newest set to be provided by the Architect.

3.02 Examination

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

3.03 Installation

- .1 Shall install all required software on client supplied workstations to provide access to the VMS and all required operations.
- .2 All VMS hardware shall be installed in supplied Network Rack securely with a minimum of 4 screws and as per manufacturer instructions.

3.04 Site Tests and Inspections

- .1 Perform verification inspections and test in presence of facility representatives.
 - .1 Provide all necessary tools, ladders and equipment.
 - .2 Ensure appropriate subcontractors manufacturer's representatives are present for verification.
- .2 Performance testing:

- .1 Test procedure: perform test on a "go-no-go" basis.
 - .1 Make only operator adjustments required to show proof of performance.
 - .2 Test to demonstrate and verify that installed system complies with installation and technical requirements of this specification under operating conditions.
 - .3 Test results to be evaluated by Consultant as either acceptable or unacceptable using following procedures.
- .2 Documentation review:
 - .1 This review will determine if information provided is sufficient to meet requirements of this specification.
 - .2 Provide for review all System manuals, as installed drawings, pretest forms, equipment cabinet pictorials, video equipment details.
- .3 Mechanical inspection:
 - .1 Consultant and Contractor to tour areas to ensure that Systems and Subsystems are installed in place for proof of performance testing.
 - .2 Take system inventory at this time. Verify following items before beginning proof of performance tests:
 - .1 Electrical power circuits designated for system equipment are properly labeled, wired, phased, protected and grounded.
 - .2 Conductor ends are protected by heat shrink wrap; audio spade lugs, barrier strips and punch blocks are used.
 - .3 Dust, debris, solder splatter, etc. are cleaned and removed from site.
 - .4 Equipment is properly labelled.
 - .5 Equipment identified in system's equipment lists are in-place and properly installed.
 - .6 Each System ground method are installed in accordance with manufacturer's instructions and this specification.
- .3 Subsystem functional test:
 - .1 Conduct operational testing after review of documentation and mechanical inspection completed. Proceed as follows.
 - .1 Perform operational test of each Subsystem to verify that all equipment is properly connected, interfaced and is functionally operational to meet requirements of this specification.
 - .2 Safety:
 - .1 Demonstrate with documentation that access control system meets safety requirements specified in UL 294.
- .4 Visual verification: objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:
 - .1 Sturdiness of equipment fastening.

- .2 Non-existence of installation related damages.
- .3 Compliance of device locations with reviewed shop drawings.
- .4 Compatibility of equipment installation with physical environment.
- .5 Inclusion of all accessories.
- .6 Device and cabling identification.
- .7 Application and location of ULC approval decals.
- .5 Technical verification: purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:
 - .1 Validate cameras, recording and interface with other systems.
 - .2 Connecting joints and equipment fastening.
 - .3 Compliance with manufacturer's specification, product literature and installation instructions.
- .6 Operational verification: purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:
 - .1 Operation of each device individually and within its environment.
 - .2 Operation of each device in relation with programmable schedule and or/specific functions.

3.05 Field Quality Control

- .1 Manufacturer Services:
 - .1 Manufacturer of products, supplied under this Section, to review Work involved in the handling, installation/application, protection and cleaning, of its products and submit written reports, in acceptable format, to verify compliance of Work with Contract.
- .2 Manufacturer's Field Services:
 - .1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.
 - .2 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
 - .3 Ensure manufacturer's representative is present before and during critical periods of installation and testing.
 - .4 Schedule site visits to review Work at stages listed:
 - .1 After delivery and storage of products, and when preparatory Work on which Work of this Section depends is complete, but before installation begins.
 - .2 Twice during progress of Work at 25% and 60% complete.
 - .3 Upon completion of Work, after cleaning is carried out.

3.06 Cleaning

- .1 Progress Cleaning: clean in accordance with Section 01 74 00.

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00.
 - .1 Remove protective coverings from accessories and components.
 - .2 Clean housings and system components, free from marks, packing tape, and finger prints, in accordance with manufacturer's written cleaning recommendations.
 - .3 Clean components free from dirt and fingerprints.
 - .4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.07 Protection

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by access controls and equipment installation.

End of Section

1 General

1.01 Section Includes

- .1 Modified two-stage addressable fire alarm system Sequence of Operation.

1.02 Related Requirements

- .1 Section 28 46 13 – Fire-Alarm Systems.

1.03 Closeout Submittals

- .1 Manuals
 - .1 Provide a clear and concise description of operation which gives, in detail, the information required to properly operate the equipment.

2 Products

2.01 General

- .1 The sequence listed below is representative sequence of operation, based on typical buildings.
- .2 The Contractor shall submit a project specific sequence of operation, as part of the submittal process.

2.02 Operation

- .1 Sequence of Operation by Signal Originating Location:
 - .1 When an alarm signal originates on any amenity or residential floor in the tower:
 - .1 Evacuation signal on alarm initiating floor, the floor above and the floor below.
 - .2 Alert signal on all other floors.
 - .3 Start five-minute timer sequence within the fire alarm control panel.
 - .4 Send signal to fire alarm monitoring station, building automation system, security system, etc.
 - .5 Initiate automatic elevator recall, and shut down associated air handling systems.
 - .6 Start smoke control fans where required.
 - .2 When an alarm signal originates in the ground floor sequence will operate as above, but in addition, evacuation signals will be operated on the, and all of the parking garage levels. All other floors will operate in alert.
 - .3 When an alarm signal originates in any parking garage level, then evacuation signals will operate on all levels of the building. All other ancillary functions will operate as identified above.
 - .4 Second stage evacuation signal will initiate on all floors upon manual activation of second stage key switch at manual station or CACF, or timed out (five minute timer) first stage notification without response, or second device activation.
 - .5 The Central Alarm and Control Facility (CACF) will be located on the ground floor and contain all code mandated annunciation and fire fighters control for EVC and Smoke Control/Smoke Venting.

- .2 Alert (First Stage)
 - .1 The activation of a manual station, automatic fire detector, automatic smoke detector, or sprinkler flow switch shall initiate the following sequence of operation:
 - .1 Sound an alert signal throughout building.
 - .2 Control panel and remote annunciators shall indicate exact location of alarm via a zoned RED LED.
 - .3 Fans shall be automatically turned off.
 - .4 Central station shall be automatically alerted via telephone lines connected for fire alarm system.
 - .5 If alert signal is not acknowledged within 5 minutes, the alarm signals will sound.
- .3 Alarm (Second Stage)
 - .1 Actuate CPU causes evacuation signal to sound and strobes to operate.
 - .2 The internal audible device shall sound at the control panel.
 - .3 Signal transmission to external systems:
 - .1 Transmit signal to monitoring station.
 - .2 Transmit signal to Building Automation System.
 - .3 Transmit signal to Access Control System.
 - .4 Door Releases:
 - .1 All stairwell/exit doors shall unlock throughout the building.
 - .2 All self-closing fire/smoke doors held open shall be released.
 - .5 Elevator:
 - .1 Provide elevator recall functions for primary and alternate floors and elevator power shunt trip activation for each elevator.
 - .2 Each elevator lobby smoke detector shall be complete with relay base. Provide five relays and interconnecting wiring to elevator controller for elevator recall. Coordinate requirements with elevator supplier.
 - .6 HVAC Shutdowns:
 - .1 Shut down air supply and return air fans.
 - .2 Activate smoke dampers.
- .4 Supervisory
 - .1 The activation of a sprinkler supervised valve or pressure switch shall initiate the following sequence of operation:
 - .1 The control panel and remote annunciator shall indicate exact location of activity via a zoned AMBER LED

- .2 Activate an audible tone on the control panel and remote annunciator
 - .3 The signals in the building shall not be sounded.
 - .5 Trouble
 - .1 A short, ground fault or open circuit to any fire alarm conductor, the tamper or removal of any field device or the loss of primary or standby power to any control equipment will result in the following trouble sequence of operation:
 - .1 The control panel and remote annunciator shall indicate exact location of activity via a zoned YELLOW LED.
 - .2 Activate an audible tone on the control panel and remote annunciator.
 - .3 The signals in the building shall not be sounded.

3 Execution – Not Used

End of Section

1 General

1.01 Summary

- .1 Section Includes
 - .1 Fire Alarm Control Panel.
 - .2 Fire alarm transponders, Data Gathering Panels.
 - .3 Fire alarm power supplies and batteries.

1.02 Related Requirements

- .1 Section 28 46 21.22 – Fire-Alarm Remote Annunciators.
- .2 Section 28 46 21.24 – Supervising Station Alarm Systems Communications Equipment.

1.03 References

- .1 Design, manufacture, install and test fire alarm system in accordance with good industry practice and in accordance with the following Codes and Standards:
 - .1 CAN/ULC-S524:2019, Standard for Installation of Fire Alarm Systems.
 - .2 CAN/ULC-S536-04 – Standard for the Inspection and Testing of Fire Alarm Systems.
 - .3 CAN/ULC-S537:2019 – Verification of Fire Alarm Systems.
 - .4 CAN/ULC-S527-11-AMD1 (2014), Control Units for Fire Alarm Systems.
- .2 If any of the requirements of the above Codes and Standards is in conflict with the Drawings or Specifications, the Code or Standard requirements shall govern, but in no instance shall the standards established by these Drawings and Specifications be reduced by any of the Codes and Standards listed above.

1.04 Action Submittals

- .1 Submit shop drawings in accordance with Section 01 33 00 and items noted below. Documentation to be project specific.
 - .1 Generic documentation and/or alternate or as-equal products are unacceptable.
 - .2 Product data for each type of system component including list of materials and Underwriters' Laboratories of Canada (ULC) listing. Product data to include technical documentation features, and/or functions, and parts list.
 - .3 Dimensioned drawings illustrating minimum clearances and any required access space.
 - .4 Point to point wiring diagrams of the entire installed system differentiating clearly between factory and field installed wiring. Identify all terminals and interconnections including conductor numbering.

1.05 Informational Submittals

- .1 Dimensional elevation of fire alarm control panel and mounting instructions.

1.06 Closeout Submittals

- .1 In accordance with Section 01 78 00.

- .1 Operation and Maintenance Manuals: Data on each product type including all features and operating sequences for both automatic and manual operations including trouble shooting and maintenance instructions, schematic and wiring diagrams, final reviewed shop drawings, manufacturer's warranty and verification test report.
 - .2 Final device address list and application program listing for the system as installed at the time of acceptance.
 - .3 A list of all input and output points in the system with a label indicating location or use of initiating device circuit, notification appliance circuit, relay, sensor, and auxiliary control circuits.
 - .4 System power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate per the prescribed backup time periods and under all voltage conditions per ULC standards.
 - .5 Operating instructions for control panel.
 - .6 Installation and programming manuals covering the installed system.
 - .7 All final and certified documentation.
 - .8 Drawings in PDF format.
- .2 Operations and Maintenance Manuals: Submit such manuals in accordance with Division 01, and prior to completion of project, in triplicate, containing following:
- .1 Actual system functional description, and sequence of operation of completed installation.
 - .2 Detailed maintenance instructions for control equipment and each device type, maintenance schedule in accordance with CAN/ULC-S536. Trouble shooting guide for control panels and devices.
 - .3 Pictorial drawing of control equipment layout, showing location of components, modules and parts, indicating catalogue numbers.
 - .4 Schematic diagrams of control equipment, except modules which can be exchanged as unit and internal interconnecting cables and wires.
 - .5 Copy of verification certificate, verification report and warranty certificates such as for fire alarm system, batteries, ancillary devices, including battery suppliers date coding for batteries.
 - .6 Name, address and telephone number of service representative of manufacturer to be contacted during warranty period.
 - .7 Name, address and telephone number of representative responsible for future software programming changes.

1.07 Maintenance Material Submittals

- .1 Keys.

1.08 Quality Assurance

- .1 Testing Personnel Qualifications: In addition to the requirements specified in [Division 01 Section "Quality Control"], provide persons currently certified by the Canadian Fire Alarm Association (CFAA) for fire alarm system testing and verification, to supervise on-site testing and verification as specified in Part 3.
- .2 Installer Qualifications: Engage an experienced factory-authorized installer to supervise work of this Section.

- .3 Single-Source Responsibility: Obtain fire alarm components from a single source who assumes responsibility for compatibility of system components.
- .4 Compliance with Local Requirements: Comply with the applicable building code, local ordinances, and regulations, and the requirements of the authorities having jurisdiction.
- .5 Listing and Labelling: Provide fire alarm systems and components specified in this Section that are listed and labelled by ULC.

1.09 Testing and Commissioning

- .1 Perform testing and commissioning services described herein, after fire alarm, visual and audible signalling system has been installed and pretested.

1.10 Warranty

- .1 Provide a warranty for materials and workmanship, including microprocessor components and software, to be free of defects for period from date of acceptance of system by Owner in accordance with the General Conditions.
- .2 Repair response times for problems defined as routine to be addressed and corrected within twenty-four (24) hours, excepting statutory holidays and weekends.
- .3 Repair response times for problems defined as major to be addressed and corrected within four (4) hours, excepting statutory holidays and weekends.
- .4 Contractor to provide a recommended list of spare components and devices.
- .5 Manufacturers of the major components to provide written confirmation of full warranty, extended warranty and service back-up in case of the failure to perform or insolvency of the successful supplier.
- .6 Maintain maintenance records for each system supplied, and must submit a monthly report containing a time and date record of all reported or detected problems, detail of corrective action taken and the cause of the problem.
- .7 At end of warranty period, perform tests described above, and in accordance to CAN/ULC-S536 annual inspection and produce a final inspection report.

2 Products

2.01 General

- .1 The Central Processing Unit (CPU) to use multiplex communication techniques to receive data from and transmit data to transponders remotely located throughout the facility to minimize wiring costs, simplify design, to allow economical expansion and easy retrofit.
- .2 Make provisions during detailed design for future expansion of the system.
- .3 The CPU is microprocessor-based to increase system reliability, speed response to alarm conditions, and reduce cost. CPU response time to alarm conditions to be no more than four seconds, regardless of system size.
- .4 Fire alarm system will be zoned as required plus 20 per cent spares.

2.02 Fire Alarm Control Panel

- .1 Fire Alarm Control Panel (FACP) complete with Central Processing Unit (CPU) shall be housed in a surface wall mounted cabinet with baked enamel finish, full viewing window, and hinged front door cover complete with lock and [two] keys.

- .1 Opening cabinet door shall provide access to all operating controls, but will not expose live electrical connections.
- .2 Cabinet provided with sufficient capacity to allow maximum system expansion and to house alphanumeric display.
- .2 Modules: concentrated in single central location in modular central control panel.

2.03 Power Supplies

- .1 The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24 hours with [2 hours] of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and recharging operations shall be automatic.
- .2 All circuits requiring system-operating power shall be 24 VDC and shall be individually fused at the control unit or transponder.
- .3 The incoming power to the system shall be supervised so that any power failure will be indicated at the control unit. A green "power on" LED shall be displayed continuously while incoming power is present.
- .4 The system batteries shall be supervised so that a low battery or depleted battery condition or disconnection of the battery shall be indicated at the control unit and displayed for the specific fault type.
- .5 The system shall support 100% of addressable devices in alarm, or operated at the same time, under both primary (AC) and secondary (battery) power conditions.
- .6 Loss of primary power shall annunciate a trouble signal at the FACP. FACP shall indicate when the system is operating on an alternate power supply.
- .7 120 V, 60 Hz as primary source of power for system.
 - .1 Provide [one][four] 120 V circuits to each [DGP or] FACP, or as directed by fire alarm system manufacturer.
- .8 Standby batteries: sealed, maintenance free, lead calcium sealed batteries.
 - .1 The batteries shall be sealed maintenance free type with expected life of ten years.
 - .2 Batteries shall be enclosed in a steel housing, or within the fire alarm control unit.
 - .3 A fully automatic battery charger shall be provided which shall be capable of restoring a dead battery's capacity per ULC standards.
- .9 Alarm signals arriving at the main FACP shall not be lost following a power failure (or outage) until the alarm signal is processed and recorded.

2.04 Passive Graphic Display

- .1 [].

3 Execution

3.01 Installation

- .1 Install to CAN/ULC-S524.
- .2 Control Panel mounting height: arranged such that visual displays and operating controls are not less than 600 mm and not more than 1800 mm above the finished floor level.

- .3 Power to be provided by 120 VAC [emergency] circuit.
- .4 Label batteries with the in-service date.
- .5 Install Fire Alarm System components as follows:
 - .1 Install fire alarm control panel [and DGPs] where shown on drawings.
 - .2 Provide DCLC loop with 1 hour fire rated conductors between FACP and DGPs. Maintain minimum spacing of the loop per CAN/ULC-S524:2019 figure 6.1.

3.02 Field Quality Control

- .1 Verification in accordance with Section 28 46 13.

End of Section

1 General

1.01 Section Includes

- .1 Fire alarm annunciator panels.
 - .1 Main annunciator panel and remote LCD annunciator panels.
- .2 Firefighter entrances.
- .3 Passive graphics.

1.02 Related Requirements

- .1 Section 21 12 00 – Fire-Suppression Standpipes.
- .2 Section 21 13 00 – Fire-Suppression Sprinkler Systems.
- .3 Section 26 05 00 – Common Work Results for Electrical.
- .4 Section 28 46 13 – Fire-Alarm Systems.

1.03 Reference Standards

- .1 The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only. Comply with the latest edition/amendment referenced code, standard, or publication.
 - .1 Ontario Regulations
 - .1 Ontario Building Code.
 - .2 Ontario Fire Code.
 - .2 Underwriters Laboratories of Canada
 - .1 CAN/ULC-S524:2019, Standard for Installation of Fire Alarm Systems.
 - .2 CAN/ULC-S525:2016, Audible Signal Appliances for Fire Alarm Systems.
 - .3 CAN/ULC-S526:2016, Visual Signal Appliances for Fire Alarm Systems.
 - .4 CAN/ULC-S527-11-AMD1 (2014), Control Units for Fire Alarm Systems.
 - .5 CAN/ULC-S528-14-AMD1 (2017), Manual Stations for Fire Alarm Systems.
 - .6 CAN/ULC-S529:2016, Smoke Detectors for Fire Alarm Systems.
 - .7 CAN/ULC-S530-M91 (R2018), Heat Detectors for Fire Alarm Systems.
 - .8 CAN/ULC-S533:2015 – Egress Door Securing and Releasing Devices.
 - .9 CAN/ULC-S536-04 – Inspection and Testing of Fire Alarm Systems.
 - .10 CAN/ULC-S537:2019 – Verification of Fire Alarm Systems.
 - .11 CAN/ULC-S541:2016-REV1 (2017), Speakers for Fire Alarm Systems, including accessories.
 - .12 CAN/ULC-S548:2015 – Devices and Accessories for Water Type Extinguishing Systems.

- .13 CAN/ULC-S553:2014 (R2019), Installation of Smoke Alarms.
- .14 CAN/ULC-S559-13 (R2018), Standard for Equipment for Fire Signal Receiving Centres and Systems.
- .15 CAN/ULC-S561:2013 (R2018) – Standard for Installation and Services for Fire Signal Receiving Centres and Systems.
- .16 CAN/ULC-S573:2014, Installation of Ancillary Devices Connected to the Fire Alarm System.
- .17 CAN/ULC-S576:2014, Standard for Mass Notification System Equipment and Accessories.
- .18 CAN/ULC-S588:2017, Standard for Gas and Vapour Detectors and Sensors, Including Accessories.
- .19 CAN/ULC-S1001:2011 (R2018) – Integrated Systems Testing of Fire Protection and Life Safety Systems.
- .20 ULC/ORD-C228-12, Door Closers and Holders.
- .3 All requirements of the Authority Having Jurisdiction (AHJ).
- .2 In the case of any discrepancy between these specifications, the project drawings, and any applicable local codes, comply with the most stringent requirement.

1.04 Coordination

- .1 Coordinate between all trades for inclusion of information to be included on passive graphic.

1.05 Action Submittals

- .1 In accordance with Section 01 33 00, and Section 28 46 13.
- .2 Shop Drawings:
 - .1 Annunciator:
 - .1 Provide annunciator layout and system wiring diagram showing each device and wiring connection required.
 - .2 Show annunciator layout and main control panel module layout, configurations, and terminations.
 - .2 Passive Graphic:
 - .1 Prepare a complete zoning schedule and artwork layout for each passive graphic to be included with submittal package.
 - .2 Submit colour PDF (electronic submittal) using the identical colours as will be used in a temporary graphic for use during occupancy review by municipal fire inspector.
 - .3 After occupancy review, incorporate comments from municipal fire inspector, and submit colour PDF (electronic submittal) using the identical colours as will be used in the final production graphic.

1.06 Delivery, Storage, and Handling

- .1 In accordance with Section 01 60 00.

1.07 Warranty

- .1 All work performed and all material and equipment furnished to be warranted as free from defects and for a period of at least one year from the date of acceptance.

2 Products

2.01 Manufacturers

- .1 In accordance with Section 28 46 13.

2.02 Fire Alarm Annunciator Panel (FAAP)

- .1 Annunciator panels will have an alphanumeric display for each detection device, and will identify the detection device initiating an alarm.
- .2 Annunciator panel located at the firefighter's entrance will have separate zone indication for each zone.
- .3 Install panel in a recessed enclosure with brushed aluminum finish [to suit the construction of the vestibule]. Coordinate exact location and dimensions with Architectural drawings.
- .4 Identify emergency exit door numbers/identifiers, and on the control panel/annunciator panel LED labels in order to identify the manual stations adjacent to said doors when being activated when cross referenced with the passive graphic.
 - .1 Coordinate with architectural plans indicating door IDs.

2.03 Passive Graphic Displays

- .1 Provide passive colour graphic display to be mounted adjacent to the fire alarm control panel and each annunciator panel as indicated on the drawings.
 - .1 Provides building and zone layout while defining zone boundaries.
 - .2 Visual reference of user's location within the building.
- .2 Multicoloured Passive Graphics:
 - .1 Plastic laminate type, on white background, framed and under plexiglass, 600 mm by 600 mm (24 inch by 24 inch) minimum size.
 - .2 Different brilliant colours used to distinguish the various fire alarm zones and building outline from one another, silk-screened with durable acrylic-based inks on a white matte 3 mm (1/8 inch) thick acrylic sheet. Use UV protected inks to protect against fading or colour changes for life.
 - .1 Provide a minimum of six different colours.
 - .3 Uppercase text, minimum height of 4 mm (0.15 in).
 - .4 Graphical display will indicate the following at minimum. Coordinate between all trades for inclusion of this information.
 - .1 "YOU ARE HERE" indicated in red (unique to each passive graphic location), and properly oriented to the viewer when standing in front of the graphic.
 - .2 North arrow.
 - .3 Floor plans of each floor level, use a common scale that adequately fits all floor plans on the sheet.

- .1 Where a floor outline is common to multiple storeys of a building, they can be combined and labelled as typical of those floors.
- .2 Use single lines for walls and partitions.
- .4 Zone colours to clearly indicate the extents of all fire alarm zones.
 - .1 Define all egress corridors in a distinctive (dot) black hatch pattern.
 - .2 All enclosed stairs and elevators to be coloured yellow.
- .5 Indicate the extents of zones served by air handling units with shut downs.
- .6 Indicate the location of the fire alarm control panel, all annunciators, and network panels/nodes.
- .7 Indicate the location of the ULC monitoring transmitter.
- .8 Indicate the location and designation of sprinkler and standpipe monitoring devices.
- .9 Indicate the location of Sprinkler Room(s), and all supervised fire protection devices. Coordinate with the fire protection trade(s) for exact locations of devices.
- .10 Emergency exit doors with door numbers shown. These will be needed to cross reference with the annunciator panel labels for manual stations that are activated next to these doors.
- .11 Label all Stair Letters. Designations to match Architectural drawings.
- .12 Main gas shut off location.
- .3 Frame
 - .1 [Stainless steel] [Extruded aluminum] frame with concealed mounting hardware and concealed screws
 - .2 Brushed silver finish.
 - .3 Concealed security mounting hardware.
 - .4 Frame to permit future replacement of graphic if the building or zone layouts change in future.
- .4 Allow for other requirements per the Authorities Having Jurisdiction, including the Municipal Building Inspector, and Municipal Fire Inspector.

2.04 Fire Alarm Remote LCD Annunciators (FARA)

- .1 Description: Remote Control and Annunciation provided using back-lit, alphanumeric display. Information is presented including:
 - .1 Point Status (alarm, trouble, etc.);
 - .2 Alarm Type (smoke detector, manual station, etc.);
 - .3 Number of System Alarms, Supervisory Conditions, and Trouble Conditions.
- .2 Features:
 - .1 Display:

- .1 LCD Display with two lines of 40 characters each.
- .2 LED status indicators.
- .2 Controls:
 - .1 Switches for system acknowledge, alarm silence, and system reset.
 - .2 Four programmable control switches.
 - .3 Lamp/LCD test
- .3 Finish: brushed stainless steel trim.

3 Execution

3.01 Installation

- .1 Installation in accordance with Section 28 46 13.
- .2 Install annunciators and passive graphics with the top no greater than 1800 mm (70 in) above finished floor.
- .3 Install main annunciators with temporary passive graphics in the following locations:
 - .1 Ground floor lobby (firefighter's entrance).
 - .2 [Main Electrical Room.]
 - .3 Other locations as noted on drawings.
- .4 Install temporary passive graphic at fire alarm control panel.
- .5 Install remote annunciators with temporary passive graphics in the following locations:
 - .1 Nurse's stations.

3.02 Site Tests and Inspections

- .1 Review passive graphics and annunciators with municipal fire inspector on site during occupancy review. Incorporate any comments and resubmit to the Consultant for review.
- .2 Include reprogramming of zone nomenclature by system manufacturer to suit municipal review comments.
- .3 After review by the Consultant, fabricate final passive graphics, and replace temporary graphics on site.

End of Section

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1 General

1.01 Section Includes

- .1 Two-way communication system consisting of remote telephones at exit stairwell(s), and as shown on drawings.
- .2 Emergency voice audio alarm notification.

1.02 Related Requirements

- .1 Section 28 46 13 – Fire-Alarm Systems.
- .2 Section 28 46 21.22 – Fire-Alarm Remote Annunciators.
- .3 Section 28 46 41 – Fire-Alarm Notification Appliances: Fire Alarm Speakers.

2 Products

2.01 Two-Way Emergency Voice Communication System Annunciator

- .1 The annunciator located in the CACF room shall incorporate the telephone handset for the two-way voice communication systems, including all required zone select and manual override control switches and the following LED indicators:
 - .1 3-Position Switch
 - .1 Provide 3-position switch for each evacuation signaling zone, with "Voice," "Auto" and "Evacuate" positions identified and two LED status indicators for each audio visual evacuation signaling "zone", one red and one yellow. These LED's shall illuminate to indicate respectively:
 - .1 Evacuation signals activated (red),
 - .2 Trouble in audio (speaker) or visual (strobe) circuit(s) (yellow).
 - .2 2-Position Switch
 - .1 Provide 2-position switch for each evacuation signaling zone, with "Voice" and "Auto" positions identified and two LED status indicators for each audio visual evacuation signaling "zone", one red and one yellow. These LED's shall illuminate to indicate respectively:
 - .1 Evacuation signals activated (red),
 - .2 Trouble in audio (speaker) or visual (strobe) circuit(s) (yellow).
 - .3 All Call Switch 2- Position
 - .1 Provide 2-position switch for "All-Call" to activate all the evacuation signaling zones, with "Voice" and "Auto" positions identified and two LED status indicators for each audio visual evacuation signaling "zone", one red and one yellow. These LED's shall illuminate to indicate respectively:
 - .1 Evacuation signals activated (red),
 - .2 Trouble in audio (speaker) or visual (strobe) circuit(s) (yellow).

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- .4 All Call Switch 3-Position
 - .1 Provide 3-position switch for "All-Call" to activate all the evacuation signaling zones, with "Voice", "Off" and "Auto" positions identified and two LED status indicators for each audio visual evacuation signaling "zone", one red and one yellow. These LED's shall illuminate to indicate respectively:
 - .1 Evacuation signals activated (red),
 - .2 Trouble in audio (speaker) or visual (strobe) circuit(s) (yellow).
- .2 Audio
 - .1 The system shall be capable of delivering up to eight audio messages simultaneously over a single copper pair and/or fiber media. All audio messages and live pages shall originate at the one-way audio control unit. The one-way audio control unit shall store pre-recorded audio messages digitally. These messages shall be automatically directed to various areas in a facility under program control. The system shall support remote cabinets with zoned amplifiers to receive, amplify and send messages through speakers over supervised circuits.
 - .1 The one-way emergency audio control shall provide control switches to direct paging messages as follows:
 - .2 "All Call" to direct the page messages to all areas in the facility, overriding all other messages and tones.
 - .3 "Page to Evacuation Area" to direct the message to the evacuation area(s), overriding all other messages and tones.
 - .4 "Page to Alert Area" to direct page messages to the area(s) receiving the alert message and tones, overriding all other messages and tones.
 - .5 "Page to Balance Building" to direct page messages to the areas) in the facility NOT receiving either the evacuation area or alert area messages.
 - .6 "Page by Phone" switch to select the firefighters telephone system as the source for paging.
 - .2 The two-way voice communications control unit shall provide two-way communications between remotely located phones and the command centre. The control unit shall provide the ability to individually select and display each two-way voice communication circuit support up to five (5) remote telephones in simultaneous two-way voice communications.
 - .3 Audio Amplifiers (Multi-Channel)
 - .1 Provide as minimum one twenty (20) watt audio amplifier per paging zone. The system software shall be capable of selecting the required audio source signal for amplification. To enhance system survivability, each audio amplifier shall automatically provide a local 3-3-3 1000 Hz temporal pattern output upon loss of the audio communications with the one-way audio control unit, during an alarm condition. Audio amplifiers shall be power limited and protected from short circuits conditions on the audio circuit wiring. Each amplifier output shall include a dedicated 70 Vrms output. Provide a standby audio amplifier that will automatically sense the failure of a primary amplifier, and replace the function of the failed amplifier.
- .3 Power Supply

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- .1 System power supply(s) shall provide multiple power limited 24 VDC output circuits as required by the panel. Upon failure of normal (AC) power, the affected portion(s) of the system shall automatically switch over to secondary power without losing any system functions. Each system power supply shall be individually supervised. Power supply trouble signals shall identify the specific supply and the nature of the trouble condition. All standby batteries shall be continuously monitored by the power supply. Low battery and disconnection of battery power supply conditions shall immediately be annunciated as battery trouble and identify the specific power supply affected.
- .2 All system power supplies shall be capable of recharging their associated batteries, from a fully discharged condition to a capacity sufficient to allow the system to perform consistent with the requirements of this section as per ULC. All AC power connections shall be to the building's designated emergency electrical power circuit and shall meet the requirements of CEC. The AC power circuit shall be installed in conduit raceway. The power circuit disconnect means shall be clearly labeled FIRE ALARM CIRCUIT CONTROL and shall have a red marking. The location of the circuit disconnect shall be labeled permanently inside each control panel the disconnect serves.
- .3 Standby power supply shall be an electrical battery with capacity to operate the system under maximum supervisory load for [24] [60] hours and capable of operating the system for fifteen (15) minutes of evacuation alarm on all devices, operating at maximum load. The system shall include a charging circuit to automatically maintain the electrical charge of the battery. The system shall automatically adjust the charging of the battery to compensate for temperature.

2.02 Emergency Telephones

- .1 Telephone handsets shall be installed in a lockable enclosure and provided with a means for gaining access to the telephone without the use of a key. In areas where telephone handsets are not subject to tampering and vandalism, the units need not be installed in lockable enclosures.
- .2 Telephone handset enclosures shall be installed in an accessible location between 1350 mm and 1500 mm above the finished floor level measured to the centreline of the enclosure.
- .3 Telephone handsets shall be compatible with the control unit or transponder.

2.03 Operation Sequences

- .1 Alarm Operation
 - .1 The following audio messages and actions shall occur simultaneously:
 - .1 An evacuation message shall be sounded on fire floors (zones) immediately above and below (adjacent to) the fire floor (zone) [general alarm evacuation]. It is the intent of this message to advise occupants hearing this message that they are near danger and should leave the building via the stairs (nearest exit) immediately.
 - .2 An alert message shall be sounded to the remainder of building. It is the intent of this message to advise occupants to prepare for evacuation if necessary.
 - .3 An instructional message shall be sounded in the stairwells instructing occupants to move carefully and quickly down the stairs to exit the building and to exit to a safe floor if you encounter smoke in the stairwell.
 - .4 An instructional message shall be sounded in the elevator cabs. It is the intent of this message to advise elevator occupants that an emergency exists, the elevator has been directed to the ground floor, and that occupants should quickly exit the building.

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- .5 An instructional message shall be sounded in the lobby. It is the intent of this message to advise lobby occupants to leave the lobby and clear the area for arriving firefighters.
- .6 An instructional message shall be sounded in the concourses connected to the building's lobby. It is the intent of this message to prevent new entries into the lobby by advising occupants not to attempt to enter the lobby of the affected building.
- .7 Provide selective paging to each individual floor (zone). In addition to the message/channels detailed above, a dedicated page channel shall be capable of simultaneously providing live voice instructions without interrupting any of the messages listed above shall be provided.

3 Execution

3.01 Installation

- .1 The entire system shall be installed in accordance with the latest edition of CAN/ULC-S524 and the approved manufacturer's manuals and wiring diagrams. The contractor shall furnish all labour, conduit, wiring, outlet boxes, junction boxes, cabinets and similar devices necessary for a complete, functional life safety fire alarm system. Provide all necessary power supply, interconnecting and remote signal wire in dedicated conduit throughout and installed in accordance with the manufacturer's wiring diagrams and the requirements of the Canadian Electrical Code and the Inspection Authority. All penetration of floor slabs and fire walls shall be fire stopped in accordance with all local fire codes. End-of-line resistors shall be furnished as required for mounting as directed by the manufacturer.

3.02 Site Tests and Inspections

- .1 The manufacturer's representative shall make an inspection of the fire alarm equipment, including those components necessary to the direct operation of the system such as manual stations, thermal and smoke actuated detectors and controls, whether or not manufactured by the manufacturer. The inspection shall comprise an examination and test of such equipment for the following:
 - .1 That the type of equipment installed is that designated by the specifications.
 - .2 That the wiring connections to all equipment components show that the installer undertook to have observed ULC requirements.
 - .3 That all products of combustion (smoke) detectors have been properly calibrated and adjustments set correctly.
 - .4 That the representative's equipment has been installed in accordance with the manufacturer's recommendations.
 - .5 That the supervisory wiring of all devices connected to a supervised circuit is operating and that the wiring, having been met to the satisfaction of the inspecting officials.
 - .6 Testing to be done in the presence of the local building inspector and the local fire Marshall.
 - .7 Fire alarm system shall be verified in accordance with CAN/ULC-S537.

3.03 Training

- .1 The System Supplier shall schedule and present a minimum of 8 hours of documented formalized instruction for the building owner, detailing the proper operation of the installed System. The instruction shall be presented in an organized and professional manner by a person factory trained in the operation and maintenance of the equipment and who is also thoroughly familiar with the installation. The

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instruction shall cover the schedule of maintenance required by ULC and any additional maintenance recommended by the system manufacturer. Instruction shall be made available to the Local Municipal Fire Department if requested by the Local Authority Having Jurisdiction.

End of Section

1 General

1.01 Section Includes

- .1 End-of-Line Devices.
- .2 Fault Isolators.
- .3 Wire Guards.

1.02 Related Requirements

- .1 Section 28 46 13 – Fire-Alarm Systems.
- .2 Section 28 46 31.31 – Fire-Alarm Manual Initiating Devices: manual station covers.

1.03 References

- .1 CAN/ULC-S524:2019, Standard for Installation of Fire Alarm Systems.
- .2 CAN/ULC-S528-14-AMD1 (2017), Manual Stations for Fire Alarm Systems.

1.04 Unit Prices

- .1 Refer to Document 00 43 00.26.
- .2 Unit price to supply and install wire guard for any fire alarm device.

1.05 Closeout Documents

- .1 As-Built Drawings: include location and zone of all End-of-Line devices.

1.06 Maintenance Material Submittals

- .1 Extra Stock Materials
 - .1 Provide (supply and install) an additional five of each of the following devices as directed during construction. Turn over unused surplus in addition to those devices listed above:
 - .1 Fault Isolators.
 - .2 End-of-Line devices.
 - .3 Wire guard.
- .2 Spare Parts
 - .1 Supply the following additional equipment as spare parts in a proper metal enclosure sized to accept the equipment as listed herein. Label the enclosure fire alarm spare parts. Enclosure shall be placed in the same room as the FACP.
 - .1 Supply three of each type of other installed initiating, notification, or controlling devices.
- .3 Tools
 - .1 Supply three of each type of any special tools required for system use and maintenance.

2 Products

2.01 End of Line Devices

- .1 One watt type resistors mounted within outlet boxes separate from those for other devices at the locations indicated. Provide on the cover plate for each such device on approved nameplate, engraved "END-OF-LINE RESISTOR" or with an approved symbol. Provide red lamacoid plate with white 6 mm letters identifying zone.
- .2 [Finish of end of line device cover plates to be priced based on stainless steel finish; confirm exact finish with the Consultant during submittal review process.]

2.02 Fault Isolators

- .1 Module shall detect and isolate a short-circuited segment of a fault-tolerant loop whilst allowing the rest of the addressing circuit to function normally.

2.03 Device Guards

- .1 Description: Welded wire mesh of size and shape for the initiation, signaling, or other device requiring protection.
 - .1 Factory fabricated and furnished by manufacturer of device.
 - .2 Finish: Paint of colour to match the protected device.
- .2 Manual station covers: as described in Section 28 46 31.31.

2.04 [Illuminated "Fire Do Not Enter" Signs]

- .1 Internally illuminated sign with red LED illuminating text.
- .2 Lettering within the sign not visible unless the sign is illuminated.
- .3 Display text:
 - .1 FIRE DO NOT ENTER
 - .2 Other custom text where specified on drawing.
- .4 Designed for 24 VAC/DC with integrated supervisory function.
- .5 Manufacturers:
 - .1 Geographics
 - .1 GEO-LIS series (indoor use).
 - .2 GEO-LIS-WP series (outdoor use).
 - .2 Fire alarm system manufacturer.

3 Execution

3.01 Installation

- .1 Installation to Section 28 46 13 and CAN/ULC-S524.
- .2 End-of-Line devices:

- .1 Provide End-of-Line devices as directed by the manufacturer on Class B circuits.
- .2 Install 1800 mm above finished floor in interior spaces and provide a label indicating the zone service.
- .3 Installation of End-of-Line devices within other field devices: not permitted.
- .4 Provide a permanent mark to identify the zone or circuit served by the End-of-Line device.
- .3 Fault Isolators:
 - .1 Provide fault isolators in accordance with CAN/ULC-S524.
- .4 Illuminated "Fire Do Not Enter" Signs
 - .1 Feed illuminated signs from the fire alarm system and provide electrically supervised output circuits.

3.02 Field Tests and Inspections

- .1 Testing and inspection to Section 28 46 13.
- .2 Verification to Section 28 46 13.

End of Section

1 General

1.01 Section Includes

- .1 Intelligent modules.
- .2 Sprinkler room temperature sensors.

1.02 Related Requirements

- .1 Section 21 05 33 – Heat Tracing for Fire-Suppression Piping.
- .2 Section 21 12 00 – Fire-Suppression Standpipes.
- .3 Section 21 13 00 – Fire-Suppression Sprinkler Systems.
- .4 Section 21 31 00 – Centrifugal Fire Pumps.
- .5 Section 23 38 13 – Commercial-Kitchen Hoods.
- .6 Section 26 05 00 – Common Work Results for Electrical.
- .7 Section 28 46 13 – Fire-Alarm Systems.
- .8 Section 32 17 43 – Pavement Snow Melting Systems.

1.03 Unit Prices

- .1 To Section 28 46 13.

1.04 References

- .1 CAN/ULC-S524:2019, Standard for Installation of Fire Alarm Systems.
- .2 CAN/ULC-S548:2015 (R2020), Standard for devices and accessories for water type extinguishing systems.
- .3 CAN/ULC-S573:2018, Standard for Installation of Ancillary Devices Connected to Fire Alarm Systems.
- .4 CAN/ULC-S1001-11, Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems.
- .5 NFPA 13-2019, Standard for the Installation of Sprinkler Systems.

1.05 Maintenance Material Submittals

- .1 Extra Stock Materials
 - .1 Provide (supply and install) an additional five of each of the following fire alarm devices as directed during construction. Turn over unused surplus in addition to those devices listed below:
 - .1 Zone Addressable Modules (ZAMs).
- .2 Spare Parts
 - .1 Supply the following additional equipment as spare parts in a proper metal enclosure sized to accept the equipment as listed herein. Label the enclosure fire alarm spare parts. Enclosure shall be placed in the same room as the FACP.
 - .1 Supply three of each type of other installed initiating, notification, or controlling devices.
- .3 Tools

- .1 Supply three of each type of any special tools required for system use and maintenance.

2 Products

2.01 Microprocessor Based Intelligent Modules

- .1 General
 - .1 Zone Addressable Modules (ZAM) shall be used for the monitoring of water flow, valve tamper, fire suppression control panels, non-addressable detectors, and for control of fans or dampers that require shutdown or manual control in an alarm condition.
 - .2 Monitor ZAM's shall monitor any N/O contact device and be capable of powering 2-wire smoke detectors. The ZAM will communicate the zone's status (normal, alarm, trouble) to the transponder. The ZAM's zone address shall be set at the time of installation via a dip switch package.
 - .3 Control ZAM's shall be able to provide supervised or non-supervised control of any control function. The ZAM will communicate the zone's status (normal, trouble) to the transponder. Each control ZAM shall provide a double pole double throw relay for switching loads of up to 120 VAC. Each common leg of the relay shall be equipped with a replaceable 2 Amp fuse. The ZAM's zone address shall be set at the time of installation via a dip switch package.
 - .4 Fire Alarm / Life Safety System shall incorporate microprocessor-based addressable modules for the monitoring and control of system Input and Output functions over a 2-wire electronic communications loop, using both broadcast and serial polling protocols. All modules shall display communications and alarm status via LED indicators. The function of each connected module shall be determined by the module type, and shall be defined in the system software through the application of a personality code. All addressing of the Microprocessor-based Addressable Modules shall be done electronically, and the electrical location of each module shall be automatically reported to the Fire Alarm Control Panel, where it may be downloaded into a PC, or printed out. The addressing of the modules will not be dependent on their electrical location on the circuit. All field wiring to the Microprocessor-based Addressable Modules shall be supervised for opens and ground faults and shall be location identified to the module of incidence. Diagnostic circuitry, and their associated indicators, with reviewable Trouble Codes, shall be integral to the Microprocessor-based Addressable Modules to assist in troubleshooting system faults. Each module shall be suitable for operation in the following environment:
 - .1 Temperature: 0°C to 49°C (32°F to 120°F).
 - .2 Humidity: 0-93% RH, non-condensing.
- .2 Single Input Module:
 - .1 Microprocessor-based Addressable Modules shall be used to provide one (1) supervised Class A input circuit capable of latching operation for use with contact devices, non-damped Waterflow Switches, non-latching supervisory sprinkler switches.
- .3 Dual Input Module:
 - .1 Microprocessor-based Addressable Modules shall be used to provide two (2) independent supervised Class A input circuits capable of operation with contact devices. Both of the input circuits shall be terminated to, and operated from, the same microprocessor-based addressable module.
 - .2 Modules configured for water flow operation shall have an automatic delay of 15 seconds before reporting the water flow alarm condition to the Fire Alarm Control Panel. The module shall

monitor sprinkler supervisory switches and shall automatically report the supervisory function to the Fire Alarm Control Panel each time the associated dry contact closes.

- .4 Monitor Module:
 - .1 The Microprocessor-based Addressable Monitor Module shall be factory set to support one (1) supervised Class A Normally-Open active non-latching monitor circuit. The module shall automatically report the monitor function to the Fire Alarm Control Panel each time the associated dry contact closes.
- .5 Control Relay Module:
 - .1 Microprocessor-based Addressable Control Relay Modules shall provide one form "C" dry relay contact rated at 2 amps @ 24 VDC or 0.5 amps at 120 VAC to, control external appliances or equipment processes. The control relay module shall be rated for pilot duty applications. The position of the relay contact shall be confirmed by the system firmware.

2.02 Temperature Switches

- .1 To sense a temperature approaching the freezing point in any dry pipe valve enclosure or water storage container used for firefighting purposes.
- .2 Basis of design: Potter RTS series.

3 Execution

3.01 Installation

- .1 Installation to Section 28 46 13.
- .2 Provide temperature sensor in any room containing a dry pipe valve and connect to fire alarm system to indicate a supervisory signal on the building fire alarm system annunciator for a temperature approaching the freezing point in any dry pipe valve enclosure or water storage container used for firefighting purposes.

3.02 Site Tests and Inspections

- .1 Testing, and inspection to Section 28 46 13.
- .2 Verification to Section 28 46 13.

End of Section

1 General

1.01 Section Includes

- .1 Fire alarm signalling speakers.
- .1 Speaker tap settings.
- .2 Boosters.

1.02 Related Requirements

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 28 46 13 – Fire-Alarm Systems.
- .3 Section 28 46 21.41 – In-Building Fire Emergency Voice/Alarm Communications System (EVACS) Equipment: Firefighter handsets (Emergency telephones).

1.03 Unit Prices

- .1 Refer to Document 00 43 00.26.
- .2 Submit with Tender unit prices to provide the following. Include installation and verification in the unit price:
 - .1 Speaker complete with wiring and conduit, based on 10 metre distance.
 - .2 Fire alarm strobe complete with wiring and conduit, based on 10 metre distance.
 - .3 Combination speaker/strobe complete with wiring and conduit, based on 10 metre distance.
 - .4 Unit cost of additional conduit and wire for the above items.

1.04 References

- .1 CAN/ULC-S524:2019, Standard for Installation of Fire Alarm Systems.
- .2 CAN/ULC-S526:2016, Visible signaling devices for fire alarm and signaling systems, including accessories.
- .3 CAN/ULC-S541:2016, Speakers for fire alarm and signaling systems, including accessories.

1.05 Submittals

- .1 Booster battery calculations, booster power supply voltage drop calculations.

1.06 Maintenance Material Submittals

- .1 Extra Stock Materials
 - .1 Supply the following additional equipment as spare parts in a proper metal enclosure sized to accept the equipment as listed herein. Label the enclosure fire alarm spare parts. Enclosure shall be placed in the same room as the FACP.
 - .1 Supply three of each type of signalling device used on the project.
- .2 Spare Parts

- .1 Provide (supply and install) an additional five of each of the following devices as directed during construction. Turn over unused surplus in addition to those devices listed above:
 - .1 Fire alarm speakers.
 - .2 Fire alarm strobes.
 - .3 Combination speaker/strobes.
- .3 Tools
 - .1 Supply three of each type of any special tools required for system use and maintenance.

1.07 Certifications

- .1 All appliances which are supplied for the requirements of this specification shall be ULC Listed.
- .2 All appliances shall be of the same manufacturer as the Fire Alarm Control Panel specified to ensure absolute compatibility between the appliances and the control panels, and to ensure that the application of the appliances are done in accordance with the single manufacturer's instructions.
- .3 Any appliances that do not meet the above requirements, and are submitted for use must show written proof of their compatibility for the purpose intended. Such proof shall be in the form of documentation from all manufacturers that clearly states that their equipment (as submitted) is 100% compatible with each other for the purpose intended.

2 Products

2.01 Audio

- .1 The system shall be capable of delivering up to eight audio messages simultaneously over a single copper pair and/or fiber media. All audio messages and live pages shall originate at the one-way audio control unit. The one-way audio control unit shall store pre-recorded audio messages digitally. These messages shall be automatically directed to various areas in a facility under program control. The system shall support remote cabinets with zoned amplifiers to receive, amplify and send messages through speakers over supervised circuits.
- .2 The one-way emergency audio control shall provide control switches to direct paging messages as follows:
 - .1 "All Call" to direct the page messages to all areas in the facility, overriding all other messages and tones.
 - .2 "Page to Evacuation Area" to direct the message to the evacuation area(s), overriding all other messages and tones.
 - .3 "Page to Alert Area" to direct page messages to the area(s) receiving the alert message and tones, overriding all other messages and tones.
 - .4 "Page to Balance Building" to direct page messages to the areas) in the facility NOT receiving either the evacuation area or alert area messages.
 - .5 "Page by Phone" switch to select the firefighters telephone system as the source for paging.
- .3 The two-way voice communications control unit shall provide two-way communications between remotely located phones and the CACF room. The control unit shall provide the ability to individually select and display each two-way voice communication circuit support up to five (5) remote telephones in simultaneous two-way voice communications.

.4 Audio Amplifiers (Multi-Channel)

- .1 Provide as minimum one twenty (20) watt audio amplifier per paging zone. The system software shall be capable of selecting the required audio source signal for amplification. To enhance system survivability, each audio amplifier shall automatically provide a local 3-3-3 1000 Hz temporal pattern output upon loss of the audio communications with the one-way audio control unit, during an alarm condition. Audio amplifiers shall be power limited and protected from short circuits conditions on the audio circuit wiring. Each amplifier output shall include a dedicated 70 Vrms output. Provide a standby audio amplifier that will automatically sense the failure of a primary amplifier, and replace the function of the failed amplifier.

2.02 Speakers

.1 Speaker-Ceiling Mount – 200 mm (8 inch)

- .1 Provide 200 mm (8 inch) ceiling mounted speakers at the locations shown on the drawings. In and out screw terminals shall be provided for wiring. Speaker baffles shall be round or square steel with white finish as required. Provide square surface mount boxes with matching finish where required. Speakers shall provide 1/2 W, 1 W, 2 W, and 4 W power taps for use with 70 V systems. At the 4 watt setting, the speaker shall provide a 94 dBA sound output a frequency of 1000 Hz. when measured in an anechoic chamber at 10 feet.

.2 Speaker-Cone – 100 mm (4 inch)

- .1 Provide 100 mm (4 inch) white speakers at the locations shown on the drawings. Speakers shall have a 100 mm (4 inch) mylar cone, paper cones are not acceptable. The rear of the speakers shall be completely sealed protecting the cone during and after installation. In and out screw terminals shall be provided for wiring. Speakers shall provide 1/4 W, 1/2 W, 1 W, and 2 W power taps for use with 70 V systems. At the 2 watt setting, the speaker shall provide a 88 dBA sound output over a frequency range of 400 Hz to 4000 Hz.

.3 Speaker-Reentrant Surface

- .1 Provide 100 mm (4 inch) surface re-entrant speakers at the locations shown on the drawings. Speakers shall provide 2 W, 4 W, 8 W, and 15 W power taps for use with 70 V systems. The re-entrant speakers shall utilize a high efficiency compression drivers. Cone type drivers are not acceptable. At the 15 watt setting, the speaker shall provide a 102 dBA sound output over a frequency range of 400 Hz to 4000 Hz. when measured in reverberation room per UL 1480. Weatherproof boxes shall be provided for outdoor mounting.

.4 Speaker-Strobes

- .1 Speaker strobes shall be supplied where shown on plans and drawings. Strobe output shall be determined as required by its specific location and application from a family of 15/75 cd, 30 cd, and 110 cd devices. Strobes shall provide a synchronized flash.
- .2 Size strobe power supplies based on all strobes set at 75 cd.

.5 Sirens

- .1 Provide surface mounted fire alarm combination horn/sirens of the heavy-duty electronic projector type at the locations shown on the drawings. The horn/siren shall be polarized for supervised operation. Select for horn or siren tone as required. Provide weatherproof wall boxes for outdoor mounting.

2.03 Strobes

- .1 Strobes shall be supplied where shown on plans and drawings. Strobe output shall be determined as required by its specific location and application from a family of 15/75 cd, 30 cd, and 110 cd devices. Strobes shall provide a synchronized flash.
- .2 Size strobe power supplies based on all strobes set at 75 cd with exact setting determined in the field to provide adequate visual signals in accordance with CAN/ULC-S524.

2.04 Remote Booster Power Supplies

- .1 Power supply booster designed to extend power available to notification appliance circuits.
- .2 Enclosure: Steel, with lockable front panel allowing access to all interior components, surface mounted.
- .3 Functions: Contains circuits to monitor and charge batteries, control and supervise 4 Class B appliance circuits, and monitor two controlling inputs from external sources.
 - .1 Configurable to operate at any one of three signaling rates, or to follow the main panel's notification appliance circuit.
 - .2 Trouble contact with 16-second delay.
- .4 Batteries: Two, sized for 24 hours of standby followed by 15 minutes of alarm.
- .5 Indicators: LEDs, one for each circuit, one for battery supervision, one for ground fault, and one for power.
- .6 Input: 120 volt circuit.

3 Execution

3.01 Installation

- .1 Installation to Section 28 46 13.
- .2 Initial speaker tap settings:
 - .1 Use 0.25 watt taps for speakers in residential suites.
 - .2 Use 0.5 watt taps for speakers in corridors.
 - .3 Use 0.5 watt taps for speakers in public areas.
- .3 Strobe light output (candela) in accordance with CAN/ULC-S524:

.1 Table 5 – Light Output for Wall-Mounted Strobe Lights for Various Room Sizes:

Maximum Area of Coverage (m)	Minimum Light Output, Candela (Effective Luminous Intensity)		
	One Light per Area	Two Lights per Area	Four Lights per Area
6.10 x 6.10	15	Not allowable	Not allowable
8.53 x 8.53	30	15	Not allowable
9.14 x 9.14	34	15	Not allowable
12.2 x 12.2	60	30	15
13.7 x 13.7	75	60	30
15.2 x 15.2	94	60	30
16.5 x 16.5	110	60	30
18.3 x 18.3	135	95	30
21.3 x 21.3	184	95	60
24.4 x 24.4	240	135	60
27.4 x 27.4	304	185	95
30.5 x 30.5	375	240	95
33.5 x 33.5	455	240	135
36.6 x 36.6	540	305	135
39.9 x 39.9	635	375	135

.2 Table 6 – Light Output for Ceiling-Mounted Strobe Lights for Various Room Sizes:

Maximum Area of Coverage (m)	Minimum Light Output, Candela (Effective Luminous Intensity)	
	Maximum Mounting Height (m)	One Light
6.10 x 6.10	3	15
9.14 x 9.14	3	30
12.2 x 12.2	3	60
15.2 x 15.2	3	95
6.10 x 6.10	6	30
9.14 x 9.14	6	45
12.2 x 12.2	6	80
15.2 x 15.2	6	115
6.10 x 6.10	9	55
9.14 x 9.14	9	75
12.2 x 12.2	9	115
15.2 x 15.2	9	150

- .3 Table 7 – Corridor Spacing Allocation for Ceiling or Wall-Mounted Strobe Lights:

Corridor Length (m)	Minimum Number of 15 cd Strobe Lights
0 – 9	1
10 – 40	2
41 – 70	3
71 – 100	4
101 – 130	5
131 - 160	6

3.02 Site Tests and Inspections

- .1 Testing, and inspection to Section 28 46 13.
- .2 Perform audibility test. Adjust tap settings to ensure required audibility is provided.
- .1 Minimum 65 dBA and at least 10 dBA over ambient.
- .2 Minimum 75 dBA in sleeping rooms.
- .3 Submit audibility report. Ensure tap settings for each speaker and strobe are documented.
- .4 Perform verification to Section 28 46 13.

End of Section

1 General

1.01 Section Includes

- .1 Fire alarm interfaces to other systems.

1.02 Related Requirements

- .1 Section 26 32 13.13 – Diesel-Engine-Driven Generator Sets.
- .2 Section 26 32 13.16 – Gas-Engine-Driven Generator Sets.
- .3 Section 26 09 23 – Lighting Control Devices.
- .4 Section 27 41 00 – Audio-Video Systems.
- .5 Section 27 51 16 – Public Address Systems.
- .6 Section 27 51 19 – Sound Masking Systems.

1.03 References

- .1 Ontario Building Code.
- .2 CSA C282:19, Emergency Power Supply for Buildings.
- .3 CAN/ULC-S524:2019, Standard for Installation of Fire Alarm Systems.
- .4 CAN/ULC-S573:2018, Standard for Installation of Ancillary Devices Connected to Fire Alarm Systems.
- .5 CAN/ULC-S1001-11, Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.04 Submittals

- .1 Submit under provisions of Section 01 33 00.
- .2 Product Data: Manufacturer's data sheets on each product to be used, including:
 - .1 Preparation instructions and recommendations.
 - .2 Storage and handling requirements and recommendations.
 - .3 Installation methods.
- .3 Operating and Maintenance Data: Include operating, troubleshooting, maintenance, and repair instructions for each item, with lists of spare parts, if any, and name, address, and phone number of local stocking distributors.

1.05 Maintenance Material Submittals

- .1 Extra Stock Materials:
 - .1 Provide (supply and install) an additional five of each door hold open device as directed during construction.
 - .2 Turn over unused surplus in addition as spare parts.
- .2 Tools:
 - .1 Supply three of each type of any special tools required for system use and maintenance.

1.06 Quality Assurance

- .1 Installer Qualifications: experienced door hardware installer.

1.07 Delivery, Storage, and Handling

- .1 Store products in manufacturer's unopened packaging until ready for installation.

1.08 Warranty

- .1 Provide manufacturer's standard warranties:
 - .1 Magnets: Lifetime warranty.

2 Products

2.01 System Interfaces

- .1 Emergency Power Systems:
 - .1 Provide a Supervisory input for Motorised Smoke Damper supervisory contacts as follows:
 - .1 Motorised Smoke Damper Open
 - .2 Provide a supervisory monitoring input for Emergency Power supply contacts as follows that provides status indication but does not cause an audible alert, and automatically resets:
 - .1 Motorised Smoke Damper Closing.

3 Execution

3.01 Examination

- .1 Do not begin installation until substrates have been properly prepared.
- .2 If substrate preparation is the responsibility of another installer, notify Consultant of unsatisfactory preparation before proceeding.

3.02 Preparation

- .1 Clean surfaces thoroughly prior to installation.
- .2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 Installation

- .1 Install in accordance with manufacturer's instructions.
- .2 Test for proper operation with building power energized; coordinate with start-up procedures of other installers.

3.04 Site Tests and Inspections

- .1 Perform functional test in accordance with CAN/ULC-S1001 and Section 28 08 46 to confirm that systems operate as described. Perform test in the presence of the Contractor, sub-trades, Consultant, and applicable vendors.

3.05 Protection

- .1 Protect installed products until completion of project.
- .2 Repair or replace damaged products before Substantial Performance.
- .3 Three bound copies which summarize the training instruction shall be submitted to the Owner for future reference.

End of Section

1 General

1.01 Section Includes

- .1 Shutdown relays.
- .2 Smoke Control.

1.02 Related Requirements

- .1 Section 23 30 00 – HVAC Air Distribution.
- .2 Section 23 34 00 – HVAC Fans.
- .3 Section 23 70 00 – Centralized HVAC Equipment.
- .4 Section 23 75 00 – Custom Air Handling Units.
- .5 Section 28 46 13 – Fire-Alarm Systems.
- .6 Section 28 46 31 – Fire-Alarm Initiating Devices: duct mounted smoke detectors.

1.03 References

- .1 2024 Ontario Building Code.
- .2 CAN/ULC-S524:2019, Standard for Installation of Fire Alarm Systems.
- .3 CAN/ULC-S573:2018, Standard for Installation of Ancillary Devices Connected to Fire Alarm Systems.
- .4 CAN/ULC-S1001-11, Standard for Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.04 Submittals

- .1 Submit under provisions of Section 01 33 00.
- .2 Product Data: Manufacturer's data sheets on each product to be used, including:
 - .1 Preparation instructions and recommendations.
 - .2 Storage and handling requirements and recommendations.
 - .3 Installation methods.
- .3 Shop Drawings: Door Schedule showing each item of hardware to be installed on each door.
 - .1 Use door numbers on door schedule.
 - .2 Schedule may be combined with submittals required in other door hardware sections.
- .4 Operating and Maintenance Data: Include operating, troubleshooting, maintenance, and repair instructions for each item, with lists of spare parts, if any, and name, address, and phone number of local stocking distributors.

1.05 Quality Assurance

- .1 Installer Qualifications: experienced door hardware installer.

1.06 Delivery, Storage, and Handling

- .1 Store products in manufacturer's unopened packaging until ready for installation.

1.07 Warranty

- .1 Provide manufacturer's standard warranties:
 - .1 Magnets: Lifetime warranty.

2 Products

2.01 Materials

- .1 General Requirements: Provide devices suitable for door type, lock type, frame type, dimensions, and overall operation.
 - .1 Coordinate with doors, frames, and hardware specified in other sections.
 - .2 Provide all brackets, spacers, shims, lip extensions, strike boxes, and other accessory parts necessary to complete the installation.
 - .3 Power Supplies or Transformers: Provide all necessary components to supply power to devices from building power distribution system.

2.02 Commercial Kitchen Hood Fire-Suppression

- .1 Connect kitchen hood control panel to fire alarm system via auxiliary contacts. Provide a dedicated fire alarm zone on the fire alarm system to annunciate the kitchen hood per NFPA 96 and 2024 OBC 3.2.4.8.(2)(e).

2.03 Air Handling Unit Shutdown Relays

- .1 Provide duct smoke detectors in the supply air duct of air handling units feeding more than one storey, or more than one suite in a storey.
- .2 Provide a relay to shut down the air handling system upon detection of smoke at the aforementioned smoke detector.
- .3 For HVAC equipment noted in the fire alarm zone schedule, provide a shutdown relay to deactivate noted HVAC equipment upon an alarm signal.

2.04 HVLS Fans

- .1 In buildings equipped with sprinklers, all HVLS (High Volume, Low Speed) fans shall be interlocked to shut down immediately upon receiving a sprinkler waterflow signal via the fire alarm system.

2.05 Smoke Dampers

- .1 Smoke dampers and combination smoke and fire dampers shall be configured so as to close automatically upon a signal from an adjacent smoke detector located as described in CAN/ULC-S524, "Installation of Fire Alarm Systems", within 1.5 m horizontally of the duct or air-transfer opening in the fire separation,
 - .1 on both sides of the air-transfer opening, or
 - .2 in the duct downstream of the smoke damper or combination smoke and fire damper.
- .2 Provide smoke detectors in accordance with code requirements for control of smoke dampers.

2.06 Smoke Control and Venting Annunciation and Control

- .1 On/Auto/Off switches and status indicators (LEDS) shall be provided for monitoring and manual control of each fan, damper, HVAC control unit, stairwell pressurization fan, and smoke exhaust fan. To ensure compliance the units supplied shall meet the following UL categories: UUKL, PAZX, UDTZ, QVAX as well as the requirements of NFPA 90A, HVAC, and NFPA 92A & 92B, Smoke Control. The control System shall be field programmable for either 90A operation or 92A/B operation to allow for future use and system expansion.
- .2 The OFF LED shall be Yellow, the ON LED shall be green, the Trouble/Fault LED shall be Amber/Orange for each switch. The Trouble/Fault indicator shall indicate a trouble in the control and/or monitor points associated with that switch. In addition, each group of eight switches shall have two LEDS and one momentary switch which allow the following functions: An Amber LED to indicate an OFF-NORMAL switch position, in the ON or OFF position; A Green LED to indicate ALL AUTO switch position; A Local Acknowledge/Lamp Test momentary switch.
- .3 Each switch shall have the capability to monitor and control two addressable inputs and two addressable outputs. In all modes, the ON and OFF indicators shall continuously follow the device status not the switch position. Positive feedback shall be employed to verify correct operation of the device being controlled. Systems that indicate on/off/auto by physical switch position only are not acceptable.
- .4 All HVAC switches (i.e., limit switches, vane switches, etc.) shall be provided and installed by the HVAC contractor.
- .5 Annunciation graphic shall include custom graphic display.

3 Execution

3.01 Examination

- .1 Do not begin installation until substrates have been properly prepared.
- .2 If substrate preparation is the responsibility of another installer, notify the Consultant of unsatisfactory preparation before proceeding.

3.02 Preparation

- .1 Clean surfaces thoroughly prior to installation.
- .2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 Installation

- .1 Install in accordance with manufacturer's instructions.
- .2 Coordinate with installers of other door hardware.
- .3 Adjust installed items to operate properly without interfering with operation of door and other hardware.
- .4 Test for proper operation with building power energized; coordinate with start-up procedures of other installers.
- .5 Smoke Control and Smoke Venting:
 - .1 All control wiring related to smoke venting and smoke control shall be installed in conduit embedded in slab, or use MI cable or similar to ensure fire continuity.

- .2 Install in accordance with UUKL requirements.

3.04 Site Tests and Inspections

- .1 Perform functional test to confirm that held doors release upon smoke detection.
- .2 Smoke control and smoke venting: test in accordance with UUKL and local authority's requirements.

3.05 Protection

- .1 Protect installed products until completion of project.
- .2 Repair or replace damaged products before Substantial Performance.
- .3 Three bound copies which summarize the training instruction shall be submitted to the Owner for future reference.

End of Section

1 General

1.01 Summary

- .1 All equipment, material and installation to be in accordance with the latest edition of codes and standards (CEC, OBC, OESC, TIA/EIA-568-B/569-B/606-A, CSA T527 and BICSI TDMM).
- .2 Comply with following Owner's documents for design and construction references; confirm with the Owner for any addenda versions. Wherever there is discrepancy between this specification and the following standards, the one with the stricter requirement applies.
 - .1 Security System.
 - .2 CCTV System
- .3 Provided dedicated Security and CCTV drawings set for detail design, construction and As-Built/Record.

1.02 Section Includes

- .1 Furnish and install a complete and operable Electronic Personal Safety Duress Alarm System as shown on the drawings and herein after described. The system shall be capable of high quality, reliable, and satisfactory operation as herein described.
- .2 The system shall have the ability to integrate with a Pocket Paging and or Computer Report Management System.
- .3 Furnish and install all required Data Network Interfaces, Personal Computers, Software, and Associated Accessories required for a complete and operable system as herein described.
- .4 One complete and operable system shall be provided and defined as all conduit, raceways, cables, back boxes, contacts, software, etc. to achieve a complete and functional system. Also included are all power supplies, hardware, and interfaces to equipment supplied by others. Documents do not show or list every item to be provided. When an item not shown or listed is clearly necessary for proper installation and operation of the equipment and systems, provide, install, and test/certify, the item at no increase in contract price.

1.03 Related Requirements

- .1 Drawings and General Provisions of Contract including General and Supplemental Conditions and Division 01 Specification Section, apply to the work of this Section.
- .2 Section 27 05 00 – Common Work Results for Communications.

1.04 System Description

- .1 The system shall provide concealed Duress Alarm Push Button located under the desk or counter as shown on the drawings to active an alarm condition.
- .2 Each button shall have a Call Assurance Light to let the person under Duress know that an alarm call has been placed.
- .3 Multiple pressing of the alarm button will not in any way change or cancel the alarm.
- .4 The Alarm shall light a light and activate a repeating tone in the security office. By pressing the button associated with the flashing light the security officer shall simultaneously silence the tone and change the alarm light to steady at both the annunciator and the button of origination Call Assurance light.
- .5 To clear the call and reset the system the button of origination shall be pressed while the light is in the on Steady condition.

1.05 References

- .1 Published Codes, Standards, Tests, or Recommended Standards of the Trade, Industry, or Government Organizations apply to these sections include but are not limited to:
 - .1 NFPA - National Fire Protection Association
 - .2 NEC- National Electrical Code - NFPA 70
 - .3 UL - Underwriter's Laboratories, Inc.
 - .4 ADA – Americans with Disabilities Act
 - .5 EIA – Electronic Industry Association
 - .6 NEMA – National Electrical Manufacturers Association
 - .7 NSCA – Nation Systems Contractors Association – Best Practices
 - .8 ASCII – American Standard Code for Information Interchange
 - .9 ASTM - American Society for Testing and Materials

1.06 Quality Assurance

- .1 Qualifications:
 - .1 The systems shall be the product of a manufacturer or an agency experienced in such work. The authorized representative of the manufacturer or aforementioned agency shall make the installation and connections of all equipment and test of the operation of the system.
 - .2 All items of a given type shall be the product of the same manufacturer.
 - .3 All items shall be of the latest technology, no discontinued models or products are acceptable.
 - .4 Installers shall have a minimum of 5 years experience in the installation of similar systems on at least 10 projects of similar scope.
 - .5 The Manufacturer or the Authorized Representative shall provide proof that within 60 miles of the project they maintain:
 - .6 A full compliment of parts to support the installation.
 - .7 Offer service by fully trained and qualified technicians during normal working hours.
 - .8 Will supply parts and service without delay and at a reasonable cost.
- .2 Substitutions:
 - .1 All materials and equipment shall conform to these specifications. No substitute materials may be used unless previously accepted in writing by the Architect.
- .3 Regulatory Requirements:
 - .1 Comply with NEC as applicable to construction and installation of system components and wiring.
 - .2 Conform to NFPA 70
 - .3 Conform to HIPAA regulations relating to paging and public address systems.

- .4 Systems must be inspected and receive accreditation from all agencies such as OSHPOD and JCAHO if mandated by the owner. Suppliers of all systems must include all documentation and staff to support the owner during these inspections and certifications.

.4 Submittals

- .1 Refer to Section General Conditions and Related Sections for full details of submittal requirements.
- .2 Provide full service contact information including company name, address, contact name, and phone number of authorized representative. Provide written proof from the Manufacturer of major system components affirming that the representative is duly authorized and trained to supply, support, and service the equipment.
- .3 Provide a complete list of all equipment to be furnished.
- .4 Provide Product Data: For each equipment component shown on the riser and or wiring diagram.
- .5 Provide complete written sequence of operation for all factions of all systems.
- .6 Provide dimensioned detail drawings of all special assemblies including custom panels, mounting assemblies, and location.
- .7 Provide System Riser Diagram including:
 - .1 Annunciator / Master Stations
 - .2 Corridor Lights
 - .3 Zone Lights
 - .4 Patient Stations
 - .5 Pull Stations
 - .6 Data Collection Modules
 - .7 Data Interface Modules
 - .8 Personal Computers
 - .9 Power Supplies
- .8 Provide Wiring Details of all connections between all systems components.
- .9 Manufacturer Instructions: Provide manufacturer's written installation instructions.
- .10 Proposed training program, including name and qualification of trainer(s), schedule of training, curricula, and written training materials.
- .11 Closeout Submittals
 - .1 Refer to Section General Conditions and Related Sections for full details of closeout requirements
 - .2 As-Built Drawings indicating actual location and connection of components.
 - .3 Operation and maintenance manuals for each system and equipment component.
 - .4 Executed warranty documentation.

- .5 Submit Low-Emitting Material Declaration Form, together with applicable supporting documentation listing VOC content for all paints, coatings, adhesives, and sealants applied on Site. Factory applied finishes do not need to be submitted.

1.07 Closeout Submittals

- .1 The Contractor shall provide the following regarding warranties and guarantees.
- .2 Extend the manufactures warranty to the owner. The owner understands that manufactures warranties will vary from manufacturer to manufacturer.
- .3 Provide one year of free maintenance on the system from date of substantial completion and the owner's first beneficial use of the system.

1.08 Delivery, Storage, and Handling

- .1 Refer to Section General Conditions and Related Sections for full details.
- .2 Deliver materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact.
- .3 Store materials as recommended by manufacturer.
- .4 During construction all products must be protected from dust, dirt, and construction foreign matter including dents, bumps, and scratches.

1.09 Warranty

- .1 Refer to Section General Conditions and Related Sections for full details.
- .2 The installing manufacturer's representative shall guarantee all labor, parts, and installation for a period of 1 year from substantial completion or first beneficial use of the system.
- .3 Provide manufacturer 2-year warranty for the intercommunication and program system.
- .4 Upon written notification of unacceptable work or warrantee request the installing manufacturer's representative shall provide qualified technicians and parts within 24 hours of notification.

2 Products

2.01 Manufacturers

- .1 The following manufacturers are known to provide products that meet or exceed these specifications.
 - .1 []

2.02 Electronic Personal Safety Duress Alarm System

- .1 System Description:
 - .1 The Light Signaling System shall be a distributed processing intelligent network consisting of a combination of Intelligent Substations having four push buttons inputs and four light outputs, Intelligent Corridor Lights having four lights, and Master Stations capable of displaying up to eight Substations. The buttons/lights shall be provided with custom printed colour labeling per the Architect's instruction and clear adhesive Lexan faceplates to easily identify functions or staff. Annunciator panels with surface mounted or exposed labeling will be totally unacceptable under these specifications. The system shall be expandable up to 512 Substations on a single system.

- .2 The system shall use RS485 digital communication between intelligent devices. All Substations shall have two sets of dipswitches that allow addressing of each unit. One set of dipswitches will assign a Substation to a Master and the second set selects the column of lights on the Master to represent the Substation. Any Substation status change shall be reflected in the Master lights and annunciated by a tone. Any Masters, Substations, or Corridor Lights with the same address setting shall be totally interactive. This interaction shall allow multi-point control for tailoring a system to meet special needs.
- .3 All user interfaces shall employ moisture and electrostatic resistance to provide reliable yet friendly operation.
- .4 Wiring for the Light Signaling System shall consist of two twisted pair network wiring from one device to the next. Size and type of wire shall be as recommended by the manufacturer of the system. Systems, which require a home run to a central equipment location will be totally unacceptable under this specification.
- .5 The Electronic Personal Safety Duress Alarm System shall be Tech Works LIGHT-CALL.

2.03 Equipment

- .1 The Light Signaling System Intelligent Control Interface Module shall be a standard four gang electrical box mounting device constructed of ABS plastic with a water resistant lexan face plate. A minimum of four columns of four buttons and four lights shall be provided to allow both input and output. An electronic tone shall sound at the Master each time a light changes status. The tone must have an installer removable jumper to permanently disable the electronic tone if so desired. Two four position dip switches set by the installer shall determine the Module address. The Module shall be an intelligent electronic device requiring no more than 264 mA at 12 Volts DC for full operation. The Intelligent Module shall employ EIA standard RS485 digital communication. The system shall operate on two twisted pair parallel wiring. Systems requiring more than two twisted pairs from one station to the next for full operation shall not be considered under this specification.
The Light Signaling System Interface Module shall be Tech Works Model 5260-DC.
- .2 The Light Signaling System Intelligent Interface Module shall be a surface-mounting device constructed of cold rolled steel with a removable cover plate. The Module shall not have any lights or buttons and shall include screw terminals on the rear for support of passive push buttons and lights. Each push button screw terminal shall have an associated "LED" screw terminal to support a remote signaling light. Two four-position dipswitches set by the installer shall determine the group and Master address. Any two Intelligent Modules having the same address must be totally interactive. Any system not capable of installer programmable interaction of Modules shall not be considered under this specification. The Interface Module shall be an intelligent electronic device requiring no more than 60 mA at 12 Volts DC for full operation. The system shall operate on two twisted pair parallel wiring. Systems requiring more than two twisted pairs from one Module to the next for full operation shall not be considered under this specification. The 5250-DCS push button screw terminals shall operate as a multi-function momentary switch with the first push of each button changing the status from off to flashing, and after the master has acknowledged the call changing the light to steady the second push changing the output to off. Two software configurations are included with each unit. When the software select switch is in the down position, all inputs are set to normally open momentary contact monitoring. When the "S" switch is in the up position all inputs are set to normally closed contact monitoring.
The Light Signaling System Intelligent Interface Modules shall be Tech Works Model 5250-DCS.
- .3 The recessed Duress Alarm Push Button shall be a surface mounting device with integral acknowledge light. To prevent accidental false alarms, the button shall be recessed inside a durable plastic housing measuring no more than 1" high, 2" wide, and 2.3125" deep. The call acknowledge light shall be a wide angle super bright LED for long life reliable operation.
The Light Signaling System Duress Alarm Push Button shall be Tech Works Model 5131.
- .4 The Light Signaling System Wall Mount Help Button Station shall be a standard one gang electrical box mounting device constructed of ABS plastic with a water resistant Lexan faceplate. A large 1.25 inch

square red push button clearly labeled "HELP" shall be included with a call confirmation light to indicate that a call has been placed. The push button Station shall be a passive electronic device requiring no more than 2 mA at 12 Volts DC for full operation.

The Light Signaling Room Status Help Button Station shall be Tech Works Model 5221-H.

- .5 The Light Signaling System shall be supplied with a 12-Volt Direct Current power supply capable of powering all devices, as shown on plans, simultaneously with a minimum of 25% reserve power. The power supply shall be UL/CSA Listed for use with alarm and signaling systems. A surface mounting case shall be included to house the power supply. This unit shall operate from an input of 100 to 240 Volts AC and supply a minimum of 7.0 Amps at 12-Volts DC. The Light Signaling System Power Supply shall be Tech Works Model PSD1270A.

2.04 Accessories

- .1 Wire and Cable
 - .1 System Network Wire shall be 18 AWG stranded twisted two pair cable with overall jacket. Wire twist shall be industry standard audio twist per foot or greater. Jacket material shall be compliant with NFPA and NEC codes for the type of location in which the cable is installed.
 - .2 All patch Cords shall be CAT6 type standard network patch cords.
 - .3 All Adapters, Plugs, and connectors shall be included as required.
- .2 Cable Management
 - .1 Cable management shall be as shown on the plans.
 - .2 Where not shown on the plans wire shall be open run through concealed spaces and dressed using tie-wraps and screw mount tie-wrap holders on all exposed open runs.
 - .3 In all cases wire routing and cable management shall be compliant with NEC and all Codes, Standards, and Best Practices applicable.

3 Execution

3.01 Installation

- .1 Provide duress alarms in the following locations:
 - .1 Duress alarms in reception area
 - .2 Duress alarms in all barrier free washrooms
 - .3 Duress alarms in fare-box audit room
 - .4 Duress alarms tie into intrusion detection system.
 - .5 Strobes and audible annunciators outside protected area/rooms
- .2 The Contractor shall furnish and install all interconnected cable, equipment, miscellaneous parts and accessories to make a complete and fully operational system as described herein and as shown on the drawings.
- .3 All cables shall be sized in accordance with manufactures recommended cabling requirements. All cable and wire shall be air plenum rated even if installed in conduit.

- .4 Equipment shall be installed and wired in accordance with accepted engineering and installation practices. Only the highest degree of workmanship will be accepted. Install in accordance with Electronic Systems Technician (EST) practices.
- .5 All cables shall be run continuously and no splicing may be made in any cable run.
- .6 Cable and wiring routed through inaccessible spaces or spaces where there is risk of damage to conductors shall be installed in conduit or raceways supplied by other sections of this specification.
- .7 All cable and wiring shall be run concealed in ceiling spaces or surface raceways, except for in wiring closets such as the Main Distribution Frame (MDF).
- .8 All cable and wiring shall be securely fastened to the permanent building structure. Cable and wire not installed in raceway shall be supported at regular intervals appropriate to the cable and wire size. Cable and wiring shall not lay loose on ceiling tiles or grids and shall not be suspended from or attached to existing conduit.
- .9 Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer have published torque tightening values for equipment connectors. Where manufacturer's torque requirements are not indicated, tighten connectors and terminals to comply with tightening torque per NEC specification.
- .10 The following circuit types shall be installed in their own conduits:
 - .1 Microphone and control lines
 - .2 Control lines
 - .3 AC power lines
- .11 Provide a #6 AWG insulated copper ground wire from the main equipment to the building main ground bus.
- .12 Install in accordance with NFPA 70 and manufacturer recommended installation procedures.

3.02 Field Quality Control

- .1 Cleaning
 - .1 Clean all devices, cabinets, and housings as recommended by electronic industry manufacturer.
- .2 Labeling
 - .1 All wiring and connections must be clearly labeled using industry standard permanent marking devices. Contractor shall identify and tag all cables with permanent type markers to denote locations served.
 - .2 All user interfaces must be clearly and permanently labeled for their intended use. All front panel controls used in the normal operation of the system shall be clearly labeled using plastic laminate engraved labels or approved equal. Labels shall be firmly affixed to the panel or device. Dymo or Kroy tape adhesive backed lettering is not acceptable. Each major system component shall be labeled as to function and area served.
- .3 Site Tests/Inspection
 - .1 Post Occupancy testing: Test inputs and outputs of all devices to verify compliance with functionality of designed system.
 - .2 Verify installed cable is free of opens grounds and shorts.

- .3 Verify ventilation for equipment is adequate for installed units.

3.03 Demonstration

- .1 Provide instruction to the Owner or their appointed representative related to operation, maintenance and programming of all systems Training sessions shall be on-site, limited to 15 people maximum in any one session. Sessions shall last approximately one (1) hours each. In addition, Contractor shall provide a minimum of four (4) hours training for system administrator.
- .2 Follow-up training must be provided on all systems, one (1) week after cutover.
- .3 Provide demonstration and training by a staff member/trainer who is certified by the system manufacturer to provide training.

3.04 Final Checkout and Acceptance

- .1 The Contractor shall verify that the system is complete and fully operational before requesting final approval and before scheduling system demonstration.
- .2 This Contractor shall be available to demonstrate the operation and use of the system to the Architect/Engineer and to the Owner's representatives.
- .3 At the time of the demonstration, this Contractor shall furnish to the Owner one (1) complete record manuals.
- .4 Substantial Completion of the system will start the warranty period for both material and labor.

End of Section

1 General

1.01 Section Includes

- .1 Automatic door controls for restrooms.
- .2 Emergency call systems for universal and barrier-free restrooms.
- .3 Automatic door relay controls.
- .4 Automatic door activation.
- .5 Automatic door wireless activation.

1.02 Related Requirements

- .1 Section 08 71 00 – Hardware: requirements for door operators and electric strikes interconnected with this equipment.
- .2 Section 26 05 00 – Common Work Results for Electrical.

1.03 References

- .1 ANSI A117.1 – Accessible and Usable Buildings and Facilities.
- .2 ANSI A156.19 – Standard for Power Assist and Low Energy Power Operated Doors.
- .3 [2024 Ontario Building Code, section 3.8.3.12.(2) – Universal Washrooms.]

1.04 Submittals

- .1 Submit under provisions of Section 01 33 00 – Submittal Procedures.
- .2 Product Data: Manufacturer's data sheets on each product to be used, including:
- .3 Preparation instructions and recommendations.
- .4 Storage and handling requirements and recommendations.
- .5 Installation methods.
- .6 Shop Drawings: Electrical schematic, device mounting requirements and rough-in for recessed devices.
- .7 Verification Samples: For each finish product specified, two samples, minimum size 150 mm (6 in) square representing actual product, color, and patterns.

1.05 Closeout Submittals

- .1 Functional test report.
- .2 Training attendance records.

1.06 Quality Assurance

- .1 Manufacturer Qualifications: Minimum 5 year experience manufacturing similar products.
- .2 Installer Qualifications: Minimum 2 year experience installing similar products.
- .3 Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

- .1 Finish areas designated by Architect.
- .2 Do not proceed with remaining work until workmanship is approved by the Consultant.
- .3 Rework mock-up area as required to produce acceptable work.

1.07 Pre-Installation Meetings

- .1 Convene minimum two weeks prior to starting work of this section.

1.08 Delivery, Storage, and Handling

- .1 Deliver and store products in manufacturer's unopened packaging bearing the brand name and manufacturer's identification until ready for installation.
- .2 Handling: Handle materials to avoid damage.

1.09 Project Conditions

- .1 Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by the manufacturer for optimum results. Do not install products under environmental conditions outside the manufacturer's recommended limits.

1.10 Sequencing

- .1 Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.11 Warranty

- .1 Manufacturer's Warranty: Provide manufacturer's warranty for defective parts for a three-year period from the date of Substantial Completion.

2 Products

2.01 Manufacturers

- .1 Camden Door Controls (basis of design).
- .2 Substitutions: Thomas Door & Security Hardware, TA-3230C-KIT.

2.02 Emergency Call Systems for Universal Restrooms

- .1 Performance:
 - .1 Emergency Call System shall comply with the latest requirements of the Ontario Building Code (OBC).
 - .2 Emergency Call System shall be designed to provide a washroom occupant with the ability to request emergency assistance, to receive visual and audible confirmation that their request has been made, and visual and audible notification to building staff and occupants outside the restroom of an emergency condition.
- .2 Product: Emergency Call Systems For Universal and Barrier Free Restrooms – CX-WEC10K2 System as manufactured by Camden Door Controls.
 - .1 Operation: the 'Press For Emergency Assistance' mushroom push button is activated by the occupant. This energizes the LED annunciator and sounder within the washroom and the dome

light with sounder outside the washroom. Both annunciators will be energized until the latching mushroom push button switch is pulled out.

.2 Components:

.1 The following items are part of the CX-WEC10K2 equipment package:

- .1 CM-AF540SO Double gang, push/pull mushroom push button, red, 'Assistance Required', w/ LED annunciator and adjustable sounder, 'Assistance Requested'.
 - .1 'Press for Emergency Assistance' switch, 'Push/Pull' operation 41.27 mm (1-5/8") vandal resistant red button, N/O and N/C contacts, rated 10 Amp @ 30 VDC and permanently laser etched graphics (black).
 - .2 Single gang LED annunciator with adjustable sounder rated 85 dB at 102 mm (4 in), weather and vandal-resistant construction, brushed stainless steel faceplate, with 'ASSISTANCE REQUESTED'. 'White Out' text shall not be legible unless the annunciator is energized.
 - .3 Heavy gauge stainless steel double gang faceplate.
- .2 CM-AF141SO: Single gang LED dome light with adjustable piezo sounder, rated 93 dB at 1 m (3 feet), weather (indoor/outdoor) and vandal resistant construction, white. 180 degree visibility with 'ASSISTANCE REQUIRED' text printed on two sides of the lens.
- .3 CM-SE21A: sign, to be located above the activation switch, 1.6 mm (1/16 in), 152 mm high by 270 mm wide (6 in by 10-5/8 in), fire-rated expanded PVC white with 25 mm (1 in) red lettering. The text shall be "IN THE EVENT OF AN EMERGENCY PUSH EMERGENCY BUTTON AND AUDIBLE AND VISUAL SIGNAL WILL ACTIVATE".

.2 The following items are required, but not included in the CX-WC11 equipment package:

- .1 CX-PS13 24V linear power supply and CX-TRX-4024 UL listed 40 VA transformer.
- .2 Electric Strike: CX-ED2079 ('Universal' Grade 2 Electric Strike).
- .3 Contact for Pushbutton (normally closed CM-4000/61N).
- .4 Door contact.

2.03 Automatic Door Controls for Restrooms

.1 Performance:

- .1 Automatic door controls shall comply with Americans with Disability Act.
 - .1 Regulatory compliance with Accessibility Guidelines (ADAAG) and the Uniform Federal Accessibility Standard (UFAS) as required by Authority Having Jurisdiction (AHJ).
- .2 Automatic door controls shall comply with National Building Code of Canada.
- .3 Automatic door controls shall comply with NFPA National Fire Code or International Fire Code for restroom doors acting as egress doors as required by Authority Having Jurisdiction (AHJ).
- .4 Emergency Power: System shall be provided with an emergency power connection.

- .2 Product: Push Button and Annunciator Restroom Control System - CX-WC11 as manufactured by Camden Door Controls.
 - .1 Operation:
 - .1 The door is normally closed and either locked or unlocked. Pressing the exterior push plate unlocks and opens the door. Once inside and the door is closed, pressing the 'Push to Lock' mushroom pushbutton locks the door, disables the exterior 'Push to Open' push plate switch and illuminates the exterior annunciator to show 'Occupied when Lit'. Pressing the interior push plate switch unlocks the door, deactivates the illuminated annunciator, and resets the system. If the door is opened manually to exit the restroom, the overhead magnetic contact switch resets the system.
 - .2 Status: Normally locked. Fail secure electric strike.
 - .3 Status: Normally unlocked. Fail safe electric strike.
 - .2 Components:
 - .1 The following items are part of the CX-WC11 equipment package:
 - .1 CX-33PS includes Advanced Logic Control Relay and 2 Amp Power Supply in pre-wired metal cabinet.
 - .2 CM-45/4 114 mm (4.5 in) square activation (wall) switch (2 required), stainless steel construction, N/O contacts rated 15 Amps @ 30 VDC and paint filled debossed 'wheelchair symbol and 'Push To Open' graphics (blue). Mounted on in-wall single gang electrical box.
 - .3 CM 400/8 'Push to Lock' Mushroom Push Button with heavy duty brushed stainless steel faceplate, 40 mm (1-5/8") vandal resistant red button and N/O contacts rated 10 Amps @ 30 VDC.
 - .4 CM-AF500 Single Gang LED Annunciator, with heavy duty 18 gauge, vandal resistant stainless steel faceplate, 'Occupied When Lit' 'white out' text, super-bright LEDs, 10 VDC to 36 VDC voltage, max. 40 mA current draw.
 - .5 CX-MDA surface mount SPST N/C Magnetic Door Contact.
 - .6 CX-ED2079 Electric Strike, grade 2 'universal' strike for cylindrical locksets c/w 3 faceplates, 12/24V AC/DC, selectable fail safe/fail secure. The strike shall have horizontal faceplate adjustment.
 - .2 The following items are required, but not included in the CX-WC11 equipment package:
 - .1 CX-PS13 12/24V linear power supply and CX-TRX-4024 UL listed 40 VA transformer.

3 Execution

3.01 Examination

- .1 Do not begin installation until substrates have been properly prepared.
- .2 If substrate preparation is the responsibility of another installer, notify the Consultant of unsatisfactory preparation before proceeding.

3.02 Preparation

- .1 Clean surfaces thoroughly prior to installation.

- .2 Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 Installation

- .1 Install in accordance with manufacturer's instructions.
 - .1 Install push button and the red "assistance requested" annunciator ganged together adjacent to the toilet.
 - .2 Install the emergency push button adjacent to the toilet, and post the sign above the emergency button.
 - .3 Install the dome light at exterior of the universal washroom, above the door of the washroom.
 - .4 Install conduit between system components, and install wiring as directed by manufacturer.
- .2 Provide all low voltage control wiring between system components.
- .3 [Connect emergency push button to remote duress system where noted on plans.]

3.04 Field Quality Control

- .1 Perform test of system in the presence of the Owner. Submit report documenting the test was completed.

3.05 Demonstration and Training

- .1 Manufacturer's representative shall provide on-site training of staff and maintenance of operation, maintenance and "trouble/error" detection/correction.

3.06 Protection

- .1 Protect installed products until completion of project.
- .2 Touch-up, repair or replace damaged products before Substantial Completion.

End of Section