PROJECT MANUAL VOL. 2

Issued for Tender

Mechanical and Electrical

YORK REGION

PARAMEDIC RESPONSE STATION #32

RFTC-604-22-10

53 Jacob Keffer Parkway,

City of Vaughan

PART 1 GENERAL

1.1 GENERAL

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

.2 This specification section forms part of the *Contract Documents* and is to be read, interpreted, and coordinated with all other sections.

.3 The general conditions and instructions to bidders as outlined in the general contract specification and all associated addenda shall govern this Division. This section covers items common to all sections of Division 20, 21, 22, 23, and 25 and is intended to supplement requirements of Divisions 00 and 01.

.4 Where requirements of this section contradict requirements of Divisions 00 or 01, the most stringent of the conditions shall take precedence.

1.2 DEFINITIONS

.1 Where not specifically defined in the general contract specifications, the following terms shall apply to Divisions 20, 21, 22, 23, and 25.

- .1 "*Provide*" means "supply and install" products and services as specified.
- .2 "*Work*" means the total construction required by the *Contract Documents* and includes all labour, products, and services.
- .3 "Products" means all material, equipment, machinery, and fixtures forming the completed work.
- .4 "Concealed" means normally hidden from sight in ceiling spaces, within walls, within furred spaces.
- .5 "Exposed" means normally visible, including work in equipment rooms and similar spaces.
- .6 "Install" means to secure in place, make all necessary connections, test, adjust, and verify.
- .7 "Authority Having Jurisdiction" and/or "Governing Authority" and/or "Regulatory Authority" means government agencies, standards, and regulations that govern work and to which work must adhere.

1.3 SCOPE OF *WORK*

.1 *Provide* all material and equipment as shown on the drawings and/or specifications, required to *Provide* complete, properly functioning and fully tested mechanical systems fit to the intended use. *Provide* fittings or materials not herein listed necessary for the proper operation of the systems. All materials shall be new, the best of their respective kinds, and installed to the highest industry standards.

.2 Where a product manufacturer is not specified, contractor shall *Provide* products of quality consistent these specifications. All products must have CSA certification or equivalent. *Contractor* shall obtain approval of the inspection authority having jurisdiction for every product lacking CSA certification. *Provide* products by the same manufacturer for like applications unless noted otherwise. All products shall comply with the National Energy Code for Buildings (NECB) / ASHRAE 90.1 standards.

.3 All low-voltage and communications wiring related to the functioning of mechanical equipment or devices shall be the responsibility of the mechanical contractor, unless otherwise noted on the drawings.

1.4 EXAMINATION OF *SITE* AND *CONTRACT DOCUMENTS*

.1 *Contractor* shall carefully examine *Documents* and visit the site of the building to determine and review existing site conditions that will or may affect work, and include for such conditions in *Bid* Price. This specification is to be read in conjunction with all other Sections and Divisions of the specification. In the event of conflict between documents, this specification shall govern.

.2 Upon finding discrepancies in, or omissions from *Documents*, or having any uncertainty as to their intent, the *Contractor* shall notify *Consultant* in writing prior to the close of tenders. Failure to notify the *Consultant* of any discrepancies will not relieve the *Contractor* of responsibility for completing the work as intended, nor will it be grounds for additional costs. The *Contractor* shall not proceed if uncertain as to the intent of any aspect of the *Documents*.

.3 Unless exceptions are specifically noted by the *Contractor* to the *Consultant* at the time of tender, the submission of a bid confirms that the *Contractor* has accepted all specifications, drawings, contract documents, and conditions without qualification.

.4 Read and be governed by the noise control instructions in Section 23 05 48.

1.5 INTERPRETATION OF DRAWINGS

.1 The *Specifications* are to be read in conjunction with the Drawings and neither shall be used alone. Any item shown, noted, specified, or implied in either the Drawings or the *Specifications* shall be provided by the *Contractor*, even if it does not appear in both the Drawings and the *Specifications*. Where there is conflict between Codes, *Specifications*, and Drawings, the maximum condition shall govern.

.2 Drawings are diagrammatic in nature, showing the layout, general design, proposed path, and extent of the completed systems. *Contractor* shall be responsible for laying out all equipment and services on site and making all necessary connections to leave equipment and systems in good working order. All piping and ductwork shall be concealed unless otherwise noted.

.3 Where the location of any system components and/or equipment is indicated by dimensions on the drawings, *Contractor* shall be checked and verified these dimensions in the field. Where any services and/or equipment cannot be installed in the location indicated on the drawings, the *Contractor* shall notify *Consultant* immediately and secure written approval for such revisions before proceeding with the work. Each Division shall make any necessary changes to equipment and/or service locations to accommodate structural elements without additional cost to the *Owner*.

.4 It is the responsibility of the *Contractor* to coordinate the location of fixtures, fittings, and equipment which may interfere with the work of other trades with said trades and with the *Project* Manager / General *Contractor*.

.5 *Contractor* shall not scale Mechanical Drawings. Refer to Architectural Drawings for all dimensions. Unless otherwise indicated on the drawings, dimensions shown on Mechanical Drawings are indicated in millimetres (mm).

1.6 PERMITS, CERTIFICATES, APPROVALS, AND FEES

.1 Obtain and pay for all permits and approvals required to complete the *Work* from local authorities having jurisdiction and utility providers. Submit applications requiring *Owner's* signature before commencing *Work*. Do *Work* in compliance with laws, rules, and regulations having jurisdiction.

.2 The following deposits and fees required for the completion of the *Work* shall be included in the tender price, unless otherwise indicated:

.3 fees required for the approval and inspection of any portion of the mechanical system by government agency, department, or authority;

.4 fees for the building gas and water services, complete with meters;

.5 fees required for the approval and inspection of the sprinkler system(s) shall be included in the tender price except that all fees required for the review of the system(s) by the insurance underwriters.

.6 *Contractor* shall be responsible for notifying authorities having jurisdiction when work is ready for inspection in a timeframe consistent with the authority's policy for inspection notice, and with sufficient time to correct deficiencies such that the schedule of completion of *Work* will not be impacted. Inspection certificates, as follows, shall be submitted before requesting final review:

 .1 Gas Inspection

 .2 Electrical Inspection

 .3 Plumbing Inspection

 .4 Fire Protection Inspection

 .5 HVAC Inspection

.7 Submit to *Consultant* all approval and inspection certificates issued by authorities having jurisdiction to confirm that *Work* as installed complies with all relevant rules and regulations. Include copies of these approval and inspection certificates in each copy of the operating and maintenance instruction manuals.

1.7 STANDARDS OF MATERIAL AND EQUIPMENT

.1 Material and equipment are described in this specification using the following terms.

 .1 "Acceptable products" means the bid may be based on any of the listed acceptable products, provided they meet all the specifications. Listing of a manufacturer or product as "acceptable" does not automatically grant acceptance of the product by the *Consultant* and/or the *Owner*, nor does it alleviate the *Contractor* of the responsibility to ensure that any product included in their bid and/or submitted for approval at the shop drawing stage meets or exceeds the requirements of the drawings and specifications.

.2 “Or approved equal” means the bid may be based on any product that meets all the specifications, including but not limited to space, power, energy consumption, sound levels, and all other specified requirements of base specified product. Products supplied by a manufacturer/supplier other than a manufacturer listed as acceptable or approved equal may be considered for acceptance by *Consultant* if requested in writing with full product documentation submitted a minimum of five working days prior to *Bid* closing date. *Contractor* shall certify in writing that product to be used meets or exceeds base specified product in every specified parameter. Acceptance of approved equal products is at sole discretion of *Consultant*. Do not order such products until approved in writing by *Consultant*. No increases in *Contract Price* will be allowed based on changes to associated equipment, mechanically, electrically, structurally or architecturally, required by acceptance of approved equal product, nor will any increase in *Contract* price be allowed due to *Consultant*’s rejection of proposed equivalent products.

.3 “Base specified” means the product and manufacturer listed in equipment schedules included in the Drawing set, or, if none is listed in the Drawing schedules, then the first name listed in a list of acceptable manufacturers in the *Specifications*. *Bid* price may be based on any of the listed “acceptable products”.

.4 "Base bid" means the *Contractor*’s bid shall be based on the specified equipment. Any equipment proposed by the bidding *Contractor* other than the “base bid” equipment shall be considered “alternative equipment” (see next point).

.5 "Alternative equipment" means any equipment proposed by the bidding *Contractor* other than the base bid equipment. The bidding *Contractor* shall list all alternative equipment on the Tender Form with the cost saving, and the *Owner* shall have sole discretion in accepting or rejecting the proposed alternative equipment. The cost saving identified by the contractor shall include all associated architectural, structural, or electrical changes required to accommodate the alternative equipment, as well as redesign time by architectural, structural or electrical consultants. Said changes shall be at the expense of this Division. *Contractor* shall be responsible for ensuring that alternative equipment meets all the specifications, including but not limited to space, power, energy consumption, sound levels, and all other specified requirements of base bid product. *Contractor* shall certify in writing that product to be used meets or exceeds “base bid” product in every specified parameter. *Contractor* shall prepare and submit for review detailed dimensioned drawings of all rooms affected by alternative equipment. These drawings shall identify architectural and structural elements and demonstrate that the alternative equipment and associated systems will not create interferences and will properly meet the design intent. *Owner* will not accept any increase in *Contract Price* for revisions associated with alternative equipment.

.2 *Contractor* shall bear the cost, if any, of any proposed changes to equipment and systems initiated by *Contractor* after award of *Contract*, if changes are approved by *Consultant*.

.3 Order equipment and materials and confirm all delivery dates with suppliers to meet project scheduling timelines. Failure to order said materials with sufficient production and delivery time shall not be considered grounds to request substitutions.

.4 *Provide* equipment and materials manufactured in Canada when the cost of said equipment and materials is cost competitive and of equivalent performance and quality.

.5 *Provide* only new products. Where a manufacturer is not specified *Provide* products of high commercial standard and quality consistent with the standards of these specifications. *Provide* products of same manufacture for like applications unless noted otherwise.

.6 All products must bear the approval of the CSA or have special approval of the inspection authority having jurisdiction for their respective functions and environments.

.7 When part of equipment does not bear the required UL label, the *Contractor* shall obtain UL approval on site, when that part of the equipment is an electric component, a special approval shall be obtained and the *Contractor* shall pay the applicable fees.

.8 Drawings and *Specifications* have been prepared based on product available at time of Bidding. If the specified manufacturer can no longer supply a product that meets base specifications after the contract is awarded, notify *Consultant* immediately. *Contractor* shall be responsible for obtaining other manufacturers' products that comply with base specified performance and meets project timelines. Proposed products shall be treated as "alternative equipment" and subject to the same review and credit process.

.9 Systems and equipment shall be the newest current production series/version of product available at time of the shop drawing review process. Non-current models will not be accepted.

.10 *Provide* a weatherproof on-site storage container for the protection of materials and equipment. Seal all openings in products with plastic sheeting or other mechanical means to prevent dust, dirt, and moisture from entering the equipment. Any materials or equipment damaged by water or deemed by the *Consultant* to be unfit for installation as a result of dirt accumulation shall be replaced at no additional cost

1.8 STANDARDS OF WORKMANSHIP

.1 Where regulations, codes, and standards conflict with drawings and specifications, the more stringent requirement shall apply unless otherwise directed by the consultant.

.2 Where any code, standard, regulation, bylaw and/or manual is referenced, it means the latest published edition that has been adopted by the local authorities having jurisdiction at the time of submission of bids, unless otherwise specifically noted.

.3 All mechanical *Work* shall be in accordance with the regulations of the following:

- .1 Ontario Building Code (OBC);
- .2 Canadian Gas Association (CGA);
- .3 Natural Gas and Propane Installation Code;
- .4 National Fire Protection Association (NFPA);
- .5 Canadian Standards Association (CSA);
- .6 Ontario Fire Code;
- .7 Mechanical Refrigeration Code;

.8 Ontario Electrical Safety Code (OESC);

.9 National Energy Code for Buildings (NECB) 2015;

.10 American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE);

.11 American Society of Mechanical Engineers (ASME);

.12 Sheet Metal and Air Conditioning Contractors' National Association (SMACNA);

.13 Technical Standards and Safety Authority (TSSA);

.14 All Municipal regulations and any authorities having jurisdiction;

.4 *Owner's* standards.

.5 Where any governing Code, Standard, or Regulation requires preparation and submission of drawings for review, they are the responsibility of the contractor to prepare and submit. The contractor shall pay all associated costs

1.9 *SITE* SUPERINTENDENCE

.1 *Provide* at all times qualified personnel and supervisory staff to undertake administration, meet schedules, ensure performance and coordination of all labour for satisfactory completion of the *Work*. Any individual deemed by the *Consultant* to be unsatisfactory at these duties shall be replaced.

1.10 PROGRESS PAYMENTS

.1 Submit a detailed breakdown of work cost prior to submitting first progress payment draw. Breakdown shall itemize one-time project milestones, including site mobilization, insurance and bonds, shop drawings, commissioning, testing, adjusting and balancing, and closeout submittals. Indicate site services costs, including equipment, material and labour. Progress payments will not be processed until *Consultant* has approved the breakdown in writing.

.2 Progress draws shall follow the same format as the breakdown approved by the *Consultant*

1.11 PLANNING AND LAYOUT OF *WORK*

.1 The *Consultant*'s drawings and instructions, properly coordinated with shop drawings that have been reviewed by the *Consultant*, shall govern the location of all items.

.2 Install all equipment and services in a neat and orderly manner, to the satisfaction of the *Consultant*.

.1 Equipment and services located in ceiling spaces shall be laid out in a compact manner that maximizes and headroom without compromising access to the equipment and services for future maintenance and replacement.

.2 Services shall follow building lines unless otherwise instructed by the *Consultant* in writing or indicated on the drawings.

.3 Located concealed pipes and ducts as close as possible to building structure to minimize the size of the furred chase.

.4 Conceal all work in finished areas unless otherwise indicated. All exposed ductwork and piping shall be neatly installed, following the lines of the building structure and centered in spaces such as hallways.

.3 Valves, fittings, cleanouts, balancing devices, air vents, and similar elements requiring access for service and adjustment shall be located in easily accessible spaces.

.4 *Provide* all supports, hangers, saddles, and fasteners required to support all equipment and services in a manner that prevents undue stresses on the structure and systems. Ensure that the load onto building structure does not exceed the allowable loading as shown on structural drawings or directed by the *Consultant*.

.5 Verify all measurements on site prior to fabricating ductwork, piping systems, and other such services. Do not use *Contract* Drawing measurements for this purpose.

.6 Confirm inverts on site and make allowances for work of other trades. Where site measured inverts or dimensions conflict with *Contract* Drawings, notify *Consultant* prior to proceeding with work.

.7 Prepare plan and interference drawings of the work at 1:50 drawing scale, including detailed section drawings cross referenced with plan drawings. Section drawings shall be prepared for congested areas, including corridor ceiling spaces, and shall indicate dimensions of mechanical work and structural elements. Submit drawings to *Consultant* for review.

.8 Install metering devices at a height that is easily read. Install meters and sensors in a location that allows accurate and reliable sampling.

.9 *Provide* appropriate physical protection or jacketing for all exposed equipment and services.

.10 Install all products and services in accordance with the manufacturer’s requirements and /or recommendations.

.11 Install all piping in a location or manner that will prevent freezing.

.12 *Provide* sleeves and inserts as required for piping and ductwork.

.13 Failure to comply with these requirements or to coordinate the location of services with structural elements or the work of other trades will render the *Contractor* responsible for the cost of all extra work required to remedy the deficiencies

1.12 CO-ORDINATION OF *WORK*

.1 Review the specifications and drawings of all Divisions to develop a thorough understanding of the building structure and systems.

.2 Co-ordinate the work with all other Divisions, including but not limited to equipment locations, connections, electrical data and wiring, supports, opening locations, sleeve locations, piping and duct locations, housekeeping pads, and sump pits. Re-work required due to improper coordination between trades shall be at the *Contractor*’s expense.

.3 Co-ordinate equipment delivery schedule with General *Contractor* to ensure equipment is on site and ready for installation in its final location prior to the close-in of building openings required for access.

.4 Ensure the work of this Division and all other Divisions does not impinge upon the clearances required for each piece of equipment. Similarly, ensure proper clearances are maintained for future removal of equipment. Co-ordinate work prior to and during installation.

.5 Exposed mechanical elements to be installed in including but not limited to wall and ceiling diffusers, grilles, sprinkler heads, and ceiling cassettes shall be located in exact accordance with dimensions provided by the Architect, masonry contractor, and installers of ceiling and wall finishes. *Contractor* shall adjust duct and piping branches as necessary to allow these mechanical elements to align exactly with ceiling and wall patterns.

1.13 *SHOP DRAWINGS*

.1 Submit shop drawings and data sheets for all equipment listed as requiring shop drawings prior to ordering and/or fabricating. Products and equipment requiring shop drawings are listed in their respective specification section under Submittals. *Consultant*'s final review is required prior to ordering and/or fabricating equipment.

.2 *Contractor* shall consult with Construction Manager and *Consultant* at time of start-up meeting to determine shop drawing submittal process.

.3 Do not bundle dissimilar equipment or large packages of equipment. Shop drawings may be bundled in small packages for like equipment (e.g. air handlers).

.4 Shop drawings must contain adequate technical information to verify all specified parameters. Non-specific data sheets, brochures, and advertising sheets shall not be considered acceptable.

.5 Every shop drawing shall contain the following information: project name, equipment tag matching drawings, equipment dimensions, dimensioned locations of field connections, make and model, performance curves including the specified operating points listed, capacity, HP, voltage, all accessories and options being provided, and all other specified parameters (e.g. sound data). Room schedules shall be provided for multiple units.

.6 All submittals shall be clearly legible. Submittals containing information that is illegible will be returned without review and will be required to be resubmitted.

.7 *Contractor* shall carefully review shop drawings for compliance with all specified parameters and shall stamp submitted shop drawings with *Contractor*'s identification review stamp including company name, submittal date, name of individual who completed the review and has certified that the submittal is complete and in compliance with all requirements, and a signature. *Contractor*'s stamp shall also state that the document to which it has been applied is certified to be in accordance with all requirements. Drawings that have not been stamped in this manner will not be reviewed by the *Consultant*.

.8 The *Contractor* shall pay the *Consultant* on an hourly basis for shop drawing reviews once shop drawing revisions have been submitted to the consultant more than two times due to poor shop drawing preparation and insufficient adherence to contract design requirements.

.9 For each shop drawing submittal, either original or revision, the *Contractor* shall allow 15-business days for review by the *Consultant*.

.10 Shop drawings will be returned stamped “Reviewed”, “Reviewed as Noted”, or “Revise and Resubmit”.

.1 Drawings stamped “Reviewed" shall be considered in general conformance with the drawings and specifications. The *Contractor* must still ensure that the Products supplied meet all requirements of the drawings and specifications.

.2 Drawings stamped “Reviewed as noted" shall be considered in general conformance with the design concept including corrections or comments as noted on drawings. The *Contractor* must still ensure that the Products supplied meet all requirements of the drawings and specifications.

.3 Drawings stamped "Revise & Resubmit" shall be considered as not conforming with the design concept and work shall not proceed on the manufacture or provision of the Products. These drawings shall be corrected and re-submitted for review and shall include all corrections, if any, as noted on drawings.

1.14 SCAFFOLDING, HOISTING, RIGGING, AND SHORING

.1 *Provide* scaffolding, hoisting, rigging, and shoring necessary to complete the work of this Division. This equipment shall be adequate to protect workers according to all Provincial and Local Regulations.

.2 Immediately remove from site scaffolding, rigging, hoisting, and shoring equipment when no longer required to complete the work.

.3 *Contractor* shall not place scaffolding and/or hoisting equipment loads on the building structure without written approval from the *Consultant*.

1.15 CHANGES OR REVISIONS

.1 Changes in work required by an Authority Having Jurisdiction shall be carried out without charge.

.2 When the *Consultant* proposes in writing a change or revision to the work required by the *Contract Documents* via a Proposed Change Notice (PCN) or Contemplated Change Notice (CCN), prepare and submit for *Consultant* review a quotation for the proposed cost of executing the change or revision.

.3 Quotation shall contain a detailed estimate of the product, labour, and equipment costs associated with the change or revision, for both additions and deletions. List the overhead and profit percentages, applicable taxes and duties, and present a summary of the total charges. State the source of the materials and labour rate estimates.

.4 Unless otherwise specified in Divisions 00 or 01, the following requirements apply to all quotations submitted:

.1 the cost of deleted work (less overhead and profit but including taxes and duties) shall be subtracted from the cost of additional work before overhead and profit are applied to the additional work;

.2 material costs shall not exceed those published in regional estimating guides;

.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 site superintendent's hours shall not exceed 10% of labour hours estimated for change or revision;

.6 the quotation shall not include a line item for estimation time, as this cost shall be considered part of the overhead percentage applied to the quotation;

.7 if overhead and profit percentages are allowable under *Contract* but not specified in Division 00 or 01, then allowable percentages for overhead and profit shall be 7% and 5% respectively;

.8 quotations shall include an estimate of any required change to *Contract* time.

.5 Submitted quotations not confirming to the requirements specified above will be rejected and returned for re-submittal. Failure to submit a proper quotation shall not be grounds for any additional change to *Contract* time.

.6 *Contractor*-initiated requests for changes or revisions shall be made to the *Consultant* in writing. If the *Consultant* approves, a *Change Order* will be issued.

.7 Do not commence work on any change or revision until written authorization for the change or revision has been issued by the *Consultant*.

1.16 EXCAVATION, TRENCHING, AND BACKFILLING

.1 Mechanical contractor shall be responsible for excavation, compacting, backfill, removal and disposal of materials necessary to accommodate all buried equipment in the mechanical scope of work including but not limited to sump pits, buried ductwork, cisterns, piping, and ground heat exchangers.

.2 Before commencing with excavation and trenching, investigate locations of all existing and proposed underground services. *Contractor* shall retain and pay for the services of a qualified firm to mark the location of all existing underground services prior to commencing excavation and trenching.

.3 Grade bottom of trenches as required to maintain design slopes on all piping.

.4 In firm, undisturbed soil, lay pipes directly on the soil and shape soil to fit the lower one-third (1/3) of pipes and pipe bells. Ensure continuous and uniform bearing along the entire pipe barrel.

.5 Unless otherwise noted, granular material shall be compacted to 98% Standard Proctor Density and all native material shall be compacted to 95% Standard Proctor Density.

.6 Backfill trenches within the building and under traffic or parking areas or similar with clean sharp sand or Granular 'A' (Type 33 Fill) in individual layers of maximum 150mm (6") thickness, compacted to 100% Standard Proctor Density. Hand compact the first layers up to a compacted level of minimum 500mm (20") above the top of pipe. Machine compact the balance up to grade.

.7 In all areas not within building and under traffic or parking areas or similar, backfill trenches up to 500mm (20") above the pipes using the method described above. Backfill the balance of the trench with approved excavated material replaced in 300mm (12") lifts and compacted to a minimum of 95% Standard Proctor Dry Density.

.8 In over-excavated areas and similar disturbed soil conditions, restore bedding base with Granular 'A' (Type 33 Fill) material compacted to 98% Standard Proctor Density and follow above requirements for backfilling.

.9 Trench walls shall be vertical to a minimum depth of 500mm (20") over pipe. Trench minimum width shall be pipe diameter plus 450mm (18").

.10 Support piping passing through building foundation walls or concrete supports and near footings as directed by the Structural *Consultant*.

.11 *Provide* timber sheeting, bracing, shoring, guard rails, etc. as required to protect all persons having access to the site from excavations. All excavation work shall comply with the latest edition of the Occupational Health and Safety Act. Keep all excavations free of water.

.12 Fill all depressions to correct grade level with approved material. After a sufficient period has passed to reveal any settlement, use maximum possible compaction and pay all costs required to make good all damages caused by settlement.

.13 Obtain approval before backfill.

.14 Remove all excavated materials not used as backfill from site.

1.17 CUTTING, PATCHING, AND CORING

.1 Layout all cutting, patching, and coring required to accommodate mechanical services. Coordinate work with other Divisions.

.2 All cutting and patching is the responsibility of the Division requiring the opening and shall be performed by trades specializing in the materials to be cut.

.3 This Division shall be responsible for installing all required framing and sleeves for mechanical services unless otherwise indicated.

.4 This Division shall be responsible for any costs incurred from remedial work required by other trades to cut openings and install frames and sleeves as a result of failure to install these measures at the appropriate stage of construction.

.5 All cutting, coring, grinding, and drilling shall be done in a neat and accurate manner and shall not be done on any portion of the building envelope or structural elements without the written permission of the *Consultant*.

.6 Consult with Structural Engineer prior to cutting any existing floors or ceilings. Where X-rays are required by the Structural Engineer, this Division shall be responsible for the cost of the X-rays.

1.18 SLEEVES

.1 *Provide* pipe and duct sleeves at points where pipes and ducts pass through concrete or masonry.

.2 Partition Walls: Sleeves shall be constructed of a minimum of 22-gauge (0.8mm) galvanized sheet steel with lock seam joints.

.3 Through foundation walls: Sleeves shall be cast iron or steel pipe with annular fin continuously welded at midpoint.

.4 Through poured concrete slabs: minimum 16 gauge flanged galvanized steel or, where permitted by governing authorities, factory fabricated plastic sleeves.

.5 *Provide* 6mm (1/4") clearance all around, between sleeve and pipes or between sleeve and insulation.

.6 Where piping passes below footings, *Provide* a minimum of 50mm (2") of clearance between sleeve and pipe. Backfill to underside of footing using same concrete strength as footing material.

.7 Terminate sleeves flush with masonry and concrete walls. Terminate sleeves 50mm (2") above and below floors. Terminate flush with top of concrete floors on grade.

.8 Cast iron sleeves with caulking recess and flashing clamp shall be used for pipes passing through roofs. Anchor sleeve in place to roof assembly, caulk between the sleeve recess and the pipe, fasten roof flashing to clamp, complete watertight and durable joint.

.9 Fill voids around pipes using the following methods:

  .1 Seal between sleeve and pipe in foundation walls, tank walls, and blow grade floors with permanent mechanical seal equal to Metraflex Metraseal or GPT Link-Seal.

  .2 Where sleeves pass through above-grade walls or floors, caulk space between insulation and sleeve or between pipe and sleeve with non-hardening, fire-retardant, waterproof mastic.

  .3 Take measures to ensure no contact is possible between copper pipe and ferrous sleeves.

  .4 Any sleeves which have been installed for future use shall be filled with a fire retardant and easily removable filler.

  .5 Coat exposed surfaces of ferrous sleeves with zinc rich paint.

.10 Where pipes pass through fire rated floor or walls, use approved firestop methods and devices to maintain the required fire rating of the wall or floor. Leave sufficient space for ducts penetrating fire separations to allow proper installation and maintenance of fire dampers.

1.19 FLASHING

.1 *Provide* flashings for the work of this Division. Where flashing details are not specified, *Provide* a description and/or sample for review prior to commencing work.

.2 Flash pipes and small ducts or stacks passing through the roof with an 18 gauge steel sleeve soldered watertight and fastened to the roof deck before the roofing is applied. Spun aluminum flashings as supplied by National Roofing Supply or equal are an acceptable alternate to soldered galvanized sheet steel.

.3 Flashings shall overlap with roof deck for a minimum of 200mm (8”), extend 200mm (8”) up the pipe or duct, and shall be sealed with a weather skirt.

.4 Vent stacks may be flashed with flashing cones.

.5 Profiled metal roof flashings shall be designed for that application.

1.20 CURBS AND SLEEPERS

.1 Prefabricated curbs for mechanical equipment shall be provided by this Division. Built-up curbs and sleepers, where specified, will be fabricated and installed by other divisions, except as specified herein and noted on the drawings.

.2 This Division shall be responsible for supplying detailed requirements for curbs, including their locations, sizes, required materials, and loads imposed on the curbs.

.3 Curbs are required for roof mounted equipment, surrounding holes in equipment room floors where groups of pipes and/or ducts pass through, and all other locations indicated on the Drawings.

.4 Sleepers shall be provided as noted on Drawings for equipment installed outdoor without a roof curb. Sleepers shall be constructed of pressure treated lumber and shall be covered by 18-gauge steel cladding, primed and painted unless otherwise noted on the drawings.

.5 Roof curbs shall be minimum 12" (300 mm) height above finished roof and higher where noted on drawings or in specifications.

.6 Curbs around holes in equipment room floors shall be concrete or steel, extending at least 150mm (6") above finished floor. Make watertight connection between curb and floor.

.7 Spaces between curbs and pipes and ducts shall be packed with glass fibre material. Caulk with fire-resistant waterproof sealant to make watertight connection. Where ducts penetrate equipment room floors, coordinate curb to enable proper installation and maintenance of fire dampers.

1.21 PAINTING

.1 All mechanical equipment, grilles and diffusers shall be shop prime-coated ready for finish painting by Architectural Trades. Where the prime coat has been marred, touch up the surface.

.2 Exposed ductwork and equipment shall be factory satin finished or degreased and etched on site by Mechanical *Contractor* and left in paint ready condition to the approval of Architectural Trades.

.3 Equipment exposed to the exterior shall be finished with factory-applied rust-resistant paint unless otherwise specified or noted.

.4 Painting for all exposed ductwork, piping and conduits shall be by Architectural Trades.

.5 *Contractor* shall leave all work in a clean, paintable condition.

1.22 ACCESS DOORS

.1 *Provide* access doors for concealed mechanical equipment, fixtures, and fittings requiring access for service and maintenance. Group these items together to share one access door whenever possible. Minimum door size shall be 200mm x 200 mm (8"x8"). Minimum door size shall be 600mm x 450 mm (24"x18") where head-and-shoulders access is required. Manufacturer's recommended service access size shall be used if it exceeds these recommendations.

.2 Doors shall be manufactured by Acudor Acorn or approved equal and shall be of the following types:

- .1 Drywall & Block: UF-5000, prime coated steel, flush style door with wall frame and screwdriver operated cam lock.
- .2 Ceramic Tile Areas: UF-5000-SS, #4 satin polish stainless steel door with wall frame and screwdriver operated cam lock.
- .3 Acoustical Tile (Non Removable): AT-5020, prime coated steel, recessed style door with wall frame and screwdriver operated camlock.
- .4 Plaster Finish: PS-5030, prime coated steel, flush style door with wall frame and screwdriver operated cam lock.
- .5 Fire Rated Partitions: FB-5060, prime coated steel fire rated door, ULC-2.0 hour 'B' label with self-closing key operated locking door.
- .6 Fire Rated Ceilings: FW-5050, prime coated steel fire rated door, ULC-1.5 hour 'B' label with self-closing key operated locking door.

.3 *Provide* ULC listed and labelled doors for all fire rated surfaces. Door rating shall match or exceed rating of surface. Non-rated surfaces do not require ULC listed, fire rated access doors.

.4 Installation of access doors shall be by this Division unless otherwise indicated within the scope of work of Architectural Trades.

1.23 ESCUTCHEONS AND PLATES

.1 *Provide* on pipes passing through finished walls, partitions, floors, and ceilings.

.2 Plates shall be stamped brass, solid type, chrome-plated or nickel-plated, with set screw for securing.

.3 Inside diameter shall fit around finished pipe. Outside diameter shall cover sleeve and opening.

.4 Secure plates to pipes or finished surface. Do not secure plates to pipe insulation.

.5 Where sleeve extends above finished floor or beyond wall, escutcheons or plates shall clear sleeve extension.

1.24 FIRESTOPPING

.1 All services penetrating fire rated separations shall be sealed by a fire stop system in compliance with ULC-S115-11. All voids around services penetrating rated or non-rated/0-rated fire separations shall be sealed using a fire-rated caulking compatible with the remaining fire stop systems in the building.

.2 Firestop materials and systems shall be by the same manufacturer as used by the General Trades. Where not specified, mechanical fire stopping systems shall be based on a single manufacturer: Tremco, 3M, Hilti, or equal.

.3 Fire stop systems shall meet the Flame (F) and Thermal (T) ratings of the fire separation in which they are installed. Systems shall be identified with appropriate SP numbers and complete with a 0.007psi (50 Pa) pressure differential where required by Code.

.4 Verify the construction of fire separations on Architectural drawings and *Provide* the type and number of firestop devices required. Systems shall be identified with appropriate SP numbers.

.5 Where services pass through walls and floors which do not form part of a fire separation, pack mineral wool around duct or pipe to reduce noise transmission.

.6 Upon project completion, the firestop manufacturer shall *Provide* a letter certifying that all mechanical fire stop systems throughout the project have been installed per their detailed installation instructions and Code requirements.

1.25 DISSIMILAR METALS

.1 *Provide* dielectric coupling wherever pipes of dissimilar metals are joined.

.2 For pipes size NPS 2 and smaller, use insulating unions. For pipes larger than size NPS 2, uses dielectric flanges.

.3 Brass fittings or brass valves are acceptable in making connections between copper and steel piping.

.4 Use electrolytic action tape or equivalent or use copper / plastic coated supports where supporting copper pipe.

.5 Direct contact between copper piping and concrete, masonry or precast construction shall be avoided.

1.26 AS-BUILT DRAWINGS

.1 Drawings for this project have been prepared in electronic format using AutoCAD software (release version may be confirmed with *Consultant*). Obtain electronic copies of the project drawings from *Consultant* for the purpose of producing record "as built" drawings. Obtaining the electronic drawings from the *Consultant* shall be at the *Contractor*'s expense. Rates shall be set at $50.00 CAD plus HST for the first drawing and $25 CAD plus HST per additional drawing. Drawings may also to be used for preparation of layouts and interference drawings.

.2 Maintain three (3) sets of bound white prints of *Contract* Drawings on site in *Contractor*'s office. Clearly mark in red ink in a neat and legible manner on these drawings on a daily basis. Mark-ups shall show all changes and deviations from routing of services and locations of equipment from that shown on *Contract* Drawings. Keep as-built mark-up set up-to-date at all times, and ensure set is always available for periodic review by the *Consultant*. The purpose of the as-built drawings is to *Provide* the *Owner* with a record of the exact location of all piping, ductwork and equipment upon completion of the job. As such, the as-built set shall also include the following:

.3 dimensioned location of inaccessible concealed work;

.4 locations and identification of control devices;

.5 location of piping system air vents;

.6 for underground piping and ducts, record dimensions, invert elevations, offsets, fittings, and locate dimensions from visible reference points, such as walls or columns;

.7 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;

.8 location of concealed services terminated for future extension.

.9 Submit a copy of the marked-up as-built white prints to the *Consultant* for review prior to applying for a Certificate of *Substantial Performance of the Work*. Make necessary revisions to drawings as per *Consultant*'s comments, to satisfaction of *Consultant*.

.10 Use *Consultant*-reviewed white prints to generate the CAD files of drawings, thereby creating the as-built set of *Contract* Drawings, identified as "*Project* Record Copy". *Provide* two (2) complete sets of electronic as-built drawings on separate USBs. Submit as-built sets of white prints and USBs to *Consultant*.

.11 Submitted drawings shall be of same quality as original *Contract* Drawings. Layers shall be used to differentiate services. CAD drawing files shall be compatible with AutoCAD software release version confirmed with *Consultant*.

.12 Unless otherwise noted, failure to maintain accurate record drawings will incur additional 5% holdback on progress claims until drawings are brought up to date to satisfaction of *Consultant*.

1.27 MAINTAINING EQUIPMENT PRIOR TO ACCEPTANCE

.1 Do not operate equipment during construction.

.2 Keep all opening in equipment sealed with plastic, cardboard, and/or tape, as required, to keep dust and dirt from entering the equipment until all pipe and duct connections are made.

.3 Maintain equipment per the manufacturer's printed instructions prior to start-up, testing and commissioning.

.4 Employ qualified tradespeople to check and align shafts, drives, and couplings on all base mounted split coupled motor driven equipment.

.5 Use copper or aluminum tubing to extend lubrications fittings that are not easily accessible.

.6 All filters shall be new upon *Substantial Performance of the Work*. *Provide* spare filters where specified.

1.28 USE OF SYSTEMS DURING CONSTRUCTION

.1 The Construction Manager shall *Provide* all temporary heat/dehumidification for the building during its construction.

.2 The permanent mechanical system shall not be used during construction. The *Owner* may accept the use of the permanent mechanical equipment/systems for temporary heating/dehumidification during construction to expedite completion of the building, provided all the following conditions are met:

.3 The *Consultant* has provided written permission to use the mechanical systems or a portion thereof for temporary heat/dehumidification.

.4 The conditions for start-up have been met and the following conditions are complied with:

- .1 The building is fully enclosed;
- .2 Major dust generating activities are complete;
- .3 Freeze protection measures are in place for any systems subject to freezing;
- .4 All systems are properly maintained, operated, and lubricated by the *Contractor*;
- .5 Mechanical rooms are kept broom clean;
- .6 Air filters operated systems are installed in air handling units, inspected regularly and replaced as necessary by the *Contractor*;
- .7 Air filters are installed in all return air openings, inspected regularly and replaced as necessary by the contractor;
- .8 Guarantees on any equipment or systems are not affected.

.5 Before turning the systems over to the Owners comply with the following conditions:

- .1 Bring all mechanical systems to as-new condition in operation and appearance;
- .2 Replace all filters with new filters;
- .3 Obtain the services of an independent duct cleaning company to clean all ductwork

1.29 MANUFACTURER’S CERTIFICATION

.1 Arrange and pay for the equipment manufacturer’s authorized representative to visit the site to examine the equipment installation. This inspection shall occur when system installation is complete, but prior to start-up procedures. After any required corrective measures have been made, obtain written confirmation from manufacturer’s authorized representative certifying that the equipment installation is complete and in accordance with the manufacturer’s instructions.

1.30 MOTORS

.1 Motor efficiency shall comply with the following tables from Ontario Regulation SB-10 and 2010 ANSI/ASHRAE/IES 90.1 as applicable:

Minimum Nominal Efficiency for Motors (Premium Efficiency 60 Hz Motors)

Rated Power	Open Motors			Enclosed Motors		
	Number of Poles			Number of Poles		
Hp (kW)	2	4	6	2	4	6
	Minimum Energy Efficiency, %			Minimum Energy Efficiency, %		
1 (0.75)	77.0	85.5	82.5	77.0	85.5	82.5
1.5 (1.1)	84.0	86.5	86.5	84.0	86.5	87.5
2 (1.5)	85.5	86.5	87.5	85.5	86.5	88.5
3 (2.2)	85.5	89.5	88.5	86.5	89.5	89.5
5 (3.7)	86.5	89.5	89.5	88.5	89.5	89.5
7.5 (5.5)	88.5	91.0	91.0	89.5	91.7	91.0
10 (7.5)	89.5	91.7	91.7	90.2	91.7	91.0

Minimum Nominal Efficiency for Motors (Energy Efficient 60 Hz Motors)

Rated Power	Open Motors				Enclosed Motors			
	Number of Poles				Number of Poles			
Hp (kW)	2	4	6	8	2	4	6	8
	Minimum Energy Efficiency, %				Minimum Energy Efficiency, %			
1 (0.75)	75.5	82.5	80.0	74.0	75.5	82.5	80.0	74.0
1.5 (1.1)	82.5	84.0	84.0	75.5	82.5	84.0	85.5	77.0
2 (1.5)	84.0	84.0	85.5	85.5	84.0	84.0	86.5	82.5
3 (2.2)	84.0	86.5	86.5	86.5	85.5	87.5	87.5	84.0
4 (3)	84.0	86.5	86.5	86.5	85.5	87.5	87.5	84.0
5 (3.7)	85.5	87.5	87.5	87.5	87.5	87.5	87.5	85.5
5.5 (4)	85.5	87.5	87.5	87.5	87.5	87.5	87.5	85.5
7.5 (5.5)	87.5	88.5	88.5	88.5	88.5	87.5	89.5	85.5
10 (7.5)	88.5	89.5	90.2	89.5	89.5	89.5	89.5	88.5

Minimum Nominal Full-Load Efficiency for General Purpose Electric Motors (Subtype I), Except Fire-Pump Electric Motors

Rated Power	Open Motors			Enclosed Motors		
	Number of Poles			Number of Poles		
.2 Hp (kW)	2	4	6	2	4	6
	Synchronous Speed (rpm)			Synchronous Speed (rpm)		
	3600	1800	1200	3600	1800	1200
	Minimum Full-Load Efficiency, %			Minimum Full-Load Efficiency, %		
1 (0.75)	77.0	85.5	82.5	77.0	85.5	82.5
1.5 (1.1)	84.0	86.5	86.5	84.0	86.5	87.5
2 (1.5)	85.5	86.5	87.5	85.5	86.5	88.5
3 (2.2)	85.5	89.5	88.5	86.5	89.5	89.5
5 (3.7)	86.5	89.5	89.5	88.5	89.5	89.5
7.5 (5.5)	88.5	91.0	90.2	89.5	91.7	91.0
10 (7.5)	89.5	91.7	91.7	90.2	91.7	91.0

1.31 SYSTEM START-UP

.1 It is this responsibility of this Division to start-up equipment and operate for a minimum of five (5) days. During this period, *Contractor* shall make any necessary controls adjustments, clean strainers & fluid filters, replace any used air filters, replace faulty gauges and thermometers, fasten any loose equipment and eliminate any unnecessary noise sources.

.2 All the following conditions shall be met before starting mechanical systems:

  .1 Safety controls are installed and fully operational;

  .2 Qualified personnel employed by this Division will be on site to operate the equipment and systems;

  .3 Ducts, equipment, and plenums are clean, protective measures have been removed, duct access doors are in place, and new air filters have been installed;

  .4 Motor starters have been checked for correct size of thermal overload;

  .5 Control systems sequence of operations have been tested and verified;

  .6 Fans have been checked rotation direction, proper operation, and have been adjusted, fan drives are properly aligned;

  .7 Fluid systems have been flushed, cleaned and chemically treated;

  .8 Fire dampers are in the open position and their operation has been verified;

  .9 Pipe and duct insulation has been installed and sealed to prevent condensation;

  .10 Freeze protection measures have been installed for systems subject to freezing;

  .11 All bearings have been lubricated;

  .12 Adjust and set all direct drives and 'V' belt drives and drivers for proper alignment and tension;

  .13 Motors and speed switches have been tested and verified for correct wiring sequences.

.3 Follow start-up procedures as recommended by the manufacturer unless otherwise specified.

.4 For major equipment including boilers, energy/heat recovery units, air handling units, etc. this Division shall supply the services of a manufacturer's trained specialist to assist in the equipment start-up and *Provide* thorough instructions on the operation, service and maintenance of the equipment to the full satisfaction of the *Consultant* and *Owner*.

.5 Where requested by the *Consultant*, *Provide* acceptance tests to demonstrate that the equipment and systems meet the specified requirements. Make all changes, adjustments or replacements indicated in the preliminary tests as being required, prior to final tests

1.32 SYSTEM OPERATION & MAINTENANCE DEMONSTRATION AND TRAINING

.1 Refer to Division 01 equipment and system operational and maintenance training requirements.

.2 When all systems are complete, this Division shall instruct the *Owner's* representative in the operation and maintenance of all equipment. Demonstrations and training shall be performed by qualified technicians employed by equipment manufacturer and/or supplier. Supply hard copies of training materials to each attendee. *Provide* a minimum of 48 hours' notice to *Consultant* and *Owner's* representative when scheduling training session(s) and schedule session(s) at *Owner* convenience.

.3 Minimum demonstration and training requirements are for the manufacturer and/or supplier of each system and major equipment to *Provide* a minimum of two (2) separate sessions each consisting of minimum four (4) hours of on-site training of up to six (6) of the *Owner's* designated personnel, on operation and maintenance procedures of system, unless otherwise specified. At *Owner's* option, training may take place at manufacturer's factory.

.4 For each item of equipment and for each system for which training is specified, prepare training modules as specified below. Use O&M Manuals during training sessions to familiarize operations staff with this document. Training modules shall include but are not limited to:

.5 Operational Requirements and Criteria – equipment function including stopping and starting, safeties, operating characteristics, performance curves, and limitations;

.6 Documentation – equipment and system warranties, manufacturer and supplier parts and service contact information;

.7 Maintenance – inspection instructions, regular maintenance schedule including but not limited to filter changes, belt changes, cleaning methods and materials, preventive maintenance procedures, and use of any special tools;

.8 Troubleshooting and Repairs – diagnostic instructions, test and inspection procedures, disassembly, component removal and repair instructions, instructions for identifying parts and components, and review of any spare parts inventory.

.9 Submit to *Consultant* for review a preliminary copy of training manual and a proposed schedule of demonstration and training dates and times prior to commencing training. Incorporate *Consultant*'s comments in final training program.

.10 Submit training attendance logs to *Consultant* prior to application for a Certificate of *Substantial Performance of the Work*. Logs shall contain the following information at a minimum:

.11 date instructions were given to *Owner's* staff;

.12 duration of instruction;

.13 names of persons instructed and a signature from each attendee;

.14 other parties present (manufacturer's representative, consultants, etc.).

.15 *Contractor* shall be responsible for videotaping all training sessions and making digital files of the training videos available to the owner on USB flash drives or portable hard drives, at *Contractor*'s expense.

.16 Obtain signatures of *Owner's* staff to verify they properly understood system installation, operation and maintenance requirements, and have received O&M manuals and as-built record drawings.

.17 Submit to *Consultant*, copy of electronic version of training materials used to train *Owner's* designated personnel as well as digital files of the videotaped training. Include in O&M manuals submission.

1.33 OPERATION & MAINTENANCE MANUALS3

.1 *Provide* a minimum of three (3) complete sets of operation & maintenance (O&M) manuals in 3-ring binders, tabulated, and two (2) USB keys containing the following:

.1 cover info: project name, "Mechanical Systems Operating and Maintenance Manual", date of preparation;

.2 contact sheet listing *Consultant*, *Contractor*, and Subcontractors, complete with full contact details for each;

.3 Table of Contents and corresponding tab sheets in binder;

.2 Equipment information:

.1 description of each system, method of operation for each piece of equipment, and list of equipment with replacement parts, part number, suppliers, addresses etc.;

.2 reviewed shop drawing, manufacturer's literature, parts list, recommended maintenance instructions, and name and address of closest service organization and spare parts source, for each equipment item;

.3 voltage and amperage rating for each item, complete with manufacture's wiring diagrams and job specific contractor's wiring diagrams as herein specified;

.4 schematic drawings for electrical, ventilating, heating and plumbing systems (mount one set of schematic drawings in a glazed frame in the mechanical room).

.3 Operating data:

.1 description of operation of each system at various loads together with reset schedules and seasonal variances;

.2 description of actions to be taken in event of emergencies and/or equipment failure;

.3 controls complete with diagrams;

.4 description of the seasonal operation for each equipment item;

.5 valve tag schedule and flow diagrams indicating valve locations.

.4 Maintenance data:

.1 maintenance, lubrication and service point schedule;

.2 type of lubricant and filters to be used on each piece of equipment;

.3 complete numbered parts list.

.5 Performance data:

.1 TAB Reports.

.2 contractor warranty and equipment extended warranties.

.6 O&M manual shall be submitted and approved before training of the *Owner's* personnel

.7 Review O&M manual with *Owner's* operating personnel to ensure a thorough understanding of each item of equipment and its operation.

1.34 FINAL INSPECTION AND COMPLETION

.1 Submit written request for final inspection of systems to *Consultant*. Written request shall include certification that:

.1 deficiencies noted during job inspections have been completed;

.2 systems have been tested, adjusted, and balanced and are ready for operation;

.3 O&M manuals have been completed, submitted for review, and accepted by *Consultant*;

.4 tags and nameplates are in place and equipment identifications have been completed;

.5 final clean is complete;

.6 spare parts and replacement parts specified have been provided;

.7 as-built and record drawings have been completed, submitted for review, and accepted by *Consultant*;

.8 *Owner's* staff has been instructed in operation and maintenance of systems;

.9 commissioning procedures have been completed.

1.35 WARRANTY

.1 All equipment and systems shall be guaranteed against defects in workmanship and materials for a period of one (1) year from date of Substantial Performance, in accordance with the contract. Should the manufacturer's warranty not meet this requirement, *Provide* extended warranties as required to meet this duration.

.1 Warranty shall include parts and labour, as well as travel costs and living expenses incurred by manufacturer's authorized technician to *Provide* factory authorized on-site service.

.2 *Owner* deductible amounts shall not be included in warranties.

.3 Repair and/or replace any defects that appear in *Work* within warranty period without additional expense to *Owner*.

.4 This Division shall be responsible for all costs incurred in repairing defective work, including repairing or replacing building finishes and repairing damage to other equipment.

.2 Where equipment includes extended warranty period beyond a period of one (1) year, the first year of warranty period shall be governed by terms and conditions of warranty in *Contract Documents*. The remaining years of extended warranty shall be direct from equipment manufacturer and/or supplier to *Owner*.

.3 Warranties shall commence on the date of *Substantial Performance of the Work*. This Division shall be responsible for providing additional extended warranty as required from date of material purchase until Substantial Performance.

.4 Submit signed and dated copies of extended warranties to *Consultant*

1.36 CORRECTION AFTER COMPLETION

.1 *Contractor* shall attend immediately to all defects occurring during a period of one (1) year from the date of Substantial Performance of the completed work, or as further defined in Division 01. This shall be done at no cost to the *Owner*.

.2 Repair all defects in a manner that will prevent recurrence of the problem.

.3 *Contractor* shall instruct all manufacturers and suppliers that guarantee on products shall commence at the date for Substantial Performance and not from the date the products were put into operation.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

NOT USED.

END OF SECTION

PART 1 – GENERAL

1.1 General

.1 The purpose of this section is to specify Division 21 responsibilities in the commissioning process.

.2 The systems to be commissioned are listed in Section 01 91 00, Part 1.9.

.3 Commissioning requires the participation of Division 21 to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 01 91 00. Division 21 shall be familiar with all parts of Section 01 91 00 and the commissioning plan issued by the CA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

.4 CA = Commissioning Agent, TAB = Test and Balance Subcontractor.

1.2 Responsibilities

.1 <u>Fire Suppression Subcontractor:</u> The Contractor shall ensure that the fire suppression Subcontractor(s) complies with all requirements included in this Section and fulfills the following responsibilities during construction and acceptance phases (all references apply to commissioned equipment only):

   .1 Documentation of all procedures performed shall be provided and forwarded to the Professional Engineer of Record. Written documentation must contain recorded test values of all tests performed per the individual product specification.

   .2 The start-up service company shall be present during energization of the plumbing equipment. Site and equipment access must be provided by the fire suppression Subcontractor.

   .3 The Contractor shall supply a power source, specified by the start-up service company, for on-Site test equipment.

   .4 The fire suppression Subcontractor is to attend all factory witness testing required within the respective Specification Sections. All costs associated with the work of this Section shall be included in the Contract Price.

   .5 Perform tests using qualified personnel. Provide necessary instruments and equipment.

   .6 Include the cost of commissioning in the Contract Price, if not yet included.

   .7 In each purchase order or subcontract written, include requirements for submittal data, O&M data and training.

   .8 Attend a commissioning scoping meeting and other necessary meetings scheduled by the CA to facilitate the commissioning process.

   .9 The Contractor and its Subcontractors shall provide normal cut sheets and shop drawing submittals to the CA of commissioned equipment. Provide additional requested documentation, prior to normal O&M manual submittals, to the CA for development of pre-functional and functional testing procedures.

.1 Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any Region-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Region to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent.

.2 The Commissioning Agent may request further documentation necessary for the commissioning process. This data request may be made prior to normal submittals.

.10 Provide a copy of the O&M manuals submittals of commissioned equipment, through normal channels, to the CA for review.

.11 The Contractor and its Subcontractors shall assist (along with the design Professional Engineers) in clarifying the operation and control of commissioned equipment in areas where the Specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

.12 Provide assistance to the CA in preparation of the specific functional performance test procedures specified in Section 21. Subcontractors shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

.13 Develop a full start-up and checkout plan using manufacturer’s start-up procedures and the pre-functional test sheets from the CA. Submit manufacturer’s detailed start-up procedures and the full start-up plan and procedures and other requested equipment documentation to CA for review.

.14 During the startup and checkout process, execute and document the mechanical-related portions of the pre-functional test sheets provided by the CA for all commissioned equipment.

.15 Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CA.

.16 Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

.17 Perform functional performance testing under the direction of the CA for specified equipment in 01 91 00, Subsection 1.9. Assist the CA in interpreting the monitoring data, as necessary.

.18 Correct deficiencies (differences between specified and observed performance) as interpreted by the CA and Consultant and retest the equipment.

.19 Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

.20 During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for Contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing). Prepare red-line As-Built Drawings for all drawings and final as-builts for Contractor-generated coordination drawings.

.21 Provide training of the Region's operating personnel as specified in Section 3.5 below.

.22 Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

.23 Execute seasonal or deferred functional performance testing, witnessed by the CA, according to the Specifications.

.24 Correct deficiencies and make necessary adjustments to O&M manuals and As-Built Drawings for applicable issues identified in any seasonal testing.

.25 Assist and cooperate with the Mechanical and TAB Subcontractor and CA by:

.1 Putting all equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.

.2 List and clearly identify on the As-Built Drawings the locations of equipment.

.3 Prepare a preliminary schedule for Division 21 equipment start-up, as well as TAB start and completion for use by the CA. Update the schedule as appropriate.

.4 Notify the Consultant and CA when pipe testing, flushing, cleaning, startup of each piece of equipment and TAB will occur. Be responsible to notify the Consultant and CA, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that CA has the scheduling information needed to efficiently execute the commissioning process.

PART 2- PRODUCTS

.1 NOT USED

PART 3- EXECUTION

3.1 Submittals

.1 The Contractor shall ensure that Section 21 Subcontractors provide submittal documentation relative to commissioning to the CA as requested by the CA. Refer to Section 01 91 00 Part 3.3 for additional Section 21 requirements.

3.2 Start-up of Equipment

.1 The fire suppression Subcontractor(s) shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in 01 91 00. Division 21 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning agent or the Region.

.2 Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CA and Consultant. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all pre functional checklists as soon as possible.

.3 Prior to the start up of equipment the Division 21 Subcontractor shall arrange to have the manufacturer of all major equipment inspect the installation to ensure their equipment has been installed in accordance with their recommendations.

.4 The supplier shall submit a written report of their findings.

.5 Upon confirmation that the equipment has been installed in accordance with the manufacturer's recommendations the equipment may be started.

.6 All equipment shall be started by the manufacturer's representative.

3.3 Pre-Functional Test Sheets

.1 Pre-functional test sheets contain items for Section 21 Subcontractors to perform. On each checklist, a column is provided that is to be completed by the Contractor assigning responsibility for that line item to a Subcontractor. Those executing the test sheets are only responsible to perform items that apply to the specific application at hand. These test sheets do not take the place of the manufacturer's recommended checkout and start-up procedures or report. Some checklist procedures may be redundant in relation to checkout procedures that will be documented on typical factory field checkout sheets. Double documenting may be required in those cases.

.2 Refer to Section 01 91 00 for additional requirements regarding pre-functional test sheets, startup and initial checkout.

3.4 Operations and Maintenance Manuals

.1 The Contractor shall ensure that the Section 21 Subcontractors compile and prepare documentation for all equipment and systems covered in Section 21 and deliver it to the Contractor for inclusion in the O&M manuals.

.2 The CA shall receive a copy of the O&M manuals for review.

3.5 Training of Region Personnel

.1 The Contractor shall coordinate and schedule training and ultimately to ensure that training is completed. Refer to Section 01 91 00 for additional details.

.2 The CA will oversee and approve the content and adequacy of the training of the Region personnel for commissioned equipment. Refer to Section 01 91 00 for additional details.

.3 Fire Suppression Subcontractor. The Contractor shall ensure that the fire suppression Subcontractor fulfills the following training responsibilities:

  .1 Provide the CA with a training plan two weeks before the planned training according to the outline described in Section 01 91 00, Part 3.8.

  .2 Provide the designated the Region personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of commissioned fire suppression equipment

.3 Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.

.4 During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

.5 The appropriate Subcontractor or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing Subcontractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than one party may be required to execute the training.

.6 The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

.7 Training shall include:

.1 Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.

.2 A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.

.3 Discussion of relevant health and safety issues and concerns.

.4 Discussion of warranties and guarantees.

.5 Common troubleshooting problems and solutions.

.6 Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.

.7 Discussion of any peculiarities of equipment installation or operation.

.8 Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.

.9 The fire suppression Subcontractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.

.10 Training shall occur after functional testing is complete, unless approved otherwise by the the Region's PM.

3.6 Deferred Testing

.1 Refer to Section 01 91 00, Part 3.9 for requirements of deferred testing.

3.7 WRITTEN WORK PRODUCTS

.1 Written work products of Section 21 Subcontractors will consist of the startup and initial checkout plan as described in Section 01 91 00, as well as completed startup, initial checkout and pre-functional test sheets.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

.1 Pipe, fittings, valves, and connections for sprinkler systems.

.2 Related Sections

.1 Section 20 05 00 – Mechanical General Provisions.

.2 Section 21 13 00 – Fire Protection Sprinkler Systems.

.3 Section 23 05 53 - Mechanical Identification.

.4 Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

1.3 SUBMITTALS

.1 Submittals for Review:

.2 Section 01 33 00: Submission procedures.

.3 *Shop Drawings*/*Product* Data: Submit shop drawings/product data sheets to the regulatory authority for review and approval prior to submitting to the *Consultant*. Conform to the following requirements.

1. Indicate pipe materials used, jointing methods, supports, floor and wall penetration seals. Indicate installation, layout, weights, mounting and support details, and piping connections.
2. *Provide* manufacturers catalogue information. Indicate valve data and ratings.

.4 Closeout Submittals

1. *Project* Record *Documents*: Record actual locations of components and tag numbering.
2. Operation and Maintenance Data: Include installation instructions and spare parts lists.

1.4 REGULATORY REQUIREMENTS

.1 Codes and Standards

.1 Conform to OBC and OFC.

.2 Sprinkler Systems: Conform work to NFPA 13.

.3 Welding Materials and Procedures: Conform to ASME Code.

.4 Valves: Bear FM label or marking. *Provide* manufacturer's name and pressure rating marked on valve body.

.5 Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1.5 REFERENCE STANDARDS

.1 ASME Boiler and Pressure Vessel Code Section IX - Welding and Brazing Qualifications.

.2 ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

.3 ASME B16.3 - Malleable Iron Threaded Fittings.

.4 ASME B16.4 - Cast Iron Threaded Fittings.

.5 ASME B16.5 - Pipe Flanges and Flanged Fittings.

.6 ASME B16.9 - Factory-made Wrought Steel Buttwelding Fittings.

.7 ASME B16.11 - Forged Fittings Socket Welding and Threaded.

.8 ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.

.9 ASME B16.25 - Buttwelding Ends.

.10 ASME B36.10 - Welded and Seamless Wrought Steel Pipe.

.11 ASTM A135 - Electric-Resistance-Welded Steel Pipe.

.12 ASTM A47/A47M - Ferritic Malleable Iron Castings.

.13 ASTM A53/A53M - Pipe, Steel, Black and Hot-Dipped, Zinc-coated Welded and Seamless.

.14 ASTM A234/A234M - Piping Fittings of Wrought-Carbon Steel and Alloy Steel for Moderate and High Temperature Service.

.15 ASTM A795 - Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.

.16 AWS A5.8 - Filler Metal for Brazing and Braze Welding.

.17 AWS D10.10 - Recommended Practices for Local Heating of Welds in Piping and Tubing.

.18 AWWA C110 - Ductile-Iron and Gray-Iron Fittings 3" (76 mm) through 48" (1219 mm) for Welder.

.19 AWWA C151 - Ductile Iron Pipe, Centrifugally Cast, for Water.

.20 NFPA 13 - Installation of Sprinkler Systems.

.21 NFPA 14 - Installation of Standpipe, Private Hydrants, and Hose Systems.

.22 NFPA 24 - Installation of Private Fire Service Mains and Their Appurtenances

.23 ULC - Fire Resistance Directory.

.24 UL 262 - Gate Valves for Fire-Protection Service.

.25 UL 312 - Check Valves for Fire-Protection Service.

.26 UL 405 - Fire Department Connections.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Section 01 61 00: Transport, handle, store, and protect products.

.2 Deliver and store valves in shipping containers, with labelling in place.

.3 *Provide* temporary protective coating on cast iron and steel valves.

.4 *Provide* temporary end caps and closures on piping and fittings. Maintain in place until installation.

PART 2 PRODUCTS

2.1 BURIED PIPING

.1 Cast Iron Pipe: AWWA C151.

.1 Fittings: AWWA C110, standard thickness.

.2 Joints: AWWA C111, rubber gasket.

.3 Mechanical Couplings: Shaped composition sealing gasket, steel bolts, nuts, and washers.

2.2 ABOVE GROUND PIPING

.1 Steel Pipe: ASTM A53; Schedule 10.

.1 Joined by welding or by roll grooved pipe and fittings:

.1 Schedule 10 for sizes 5" (125mm) and smaller,

.2 0.134" (3.40mm) for 6" (150mm) diameter,

.3 0.188" (4.78mm) for 8" and 10" (200mm and 250mm) diameter.

.2 Joined with threaded fittings or cut groove pipe and fittings:

.1 Schedule 40 for sizes 6" (150mm) diameter and smaller,

.2 Schedule 30 for sizes 8" (200mm) diameter and larger.

.2 Pipe Hangers and Supports

.1 Conform to NFPA 13 and NFPA 14.

.2 Hangers for Pipe Sizes 1/2" to 1-1/2" (15 to 40 mm): Carbon steel, adjustable swivel, split ring.

.3 Hangers for Pipe Sizes 2" (50 mm) and Over: Carbon steel, adjustable, clevis.

.4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

.5 Wall Support for Pipe Sizes to 3-1/4" (80 mm): Cast iron hook.

.6 Wall Support for Pipe Sizes 4" (100 mm) and Over: Welded steel bracket and wrought steel clamp.

.7 Vertical Support: Steel riser clamp.

.8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.3 Valves – General

.1 cUL or ULC and FM approved, listed and labelled.

.2 All valves controlling connections to water supplies shall be listed indicating valves.

.3 Conform to requirements of ANSI, ASTM, ASME, and applicable MSS standards.

.4 *Provide* valves of the same manufacturer where possible.

.5 Manufacturer's name and pressure rating clearly marked on body to MSS-SP-25.

.6 All valves supplied for this project shall have a current and valid Canadian Registration Number for the Province of Ontario with TSSA. Suppliers shall *Provide* a copy of the Statutory Declaration for valves, stamped, signed and dated by TSSA as validation of the CRN registration. This shall be included with the shop drawing submittal package.

.7 Materials:

.1 Bronze: ASTM B62 or B61 as applicable

.2 Brass: ASTM B283 C3770

.3 Cast Iron: ASTM A126 Class B

.8 End Connections:

.1 Threaded ends: ANSI B1.20.1

.2 Flanged ends: ANSI B16.1 (Class 125), ANSI B16.5

.3 Face-to-face dimensions: ANSI B16.10

.9 Design and Testing:

.1 Bronze Gate & Check valves: MSS-SP-80

.2 Cast Iron Gate Valves: MSS-SP-70

.3 Cast Iron Globe Valves: MSS-SP-85

.4 Cast Iron Check: MSS-SP-71

.5 Butterfly Valves: MSS-SP-67

.10 Acceptable manufacturers:

.1 Kitz Corporation

.2 Crane & Jenkins Valve Group Incorporated

.3 Conbraco.Industries Canada

.4 Nibco Incorporated.

.4 Isolation Valves

.1 Electrically Supervised: ULC listed, FM approved, NO/NC SPDT dry contact switch suitable for electrical supervision on trouble circuit of facility fire alarm system. Valve monitoring switches shall be Potter Electric Signal and Manufacturing Limited or equivalent.

.2 Up to 2" (50 mm):

.1 Construction: ULC listed, FM approved, 300 psig non-shock WOG, ASTM B62 bronze body, solid wedge disc, rising stem, bronze trim, threaded ends, Kitz #25

.3 2-1/2" (65 mm) and Larger:

.1 Construction: ULC listed, FM approved, 175 psi 1210 kPa CWP, outside screw and yoke,cast iron body, stem with ACME double threads, tapered solid wedge disc, flanged ends, renewable bronze seat rings.

.5 Check Valves

.1 2-1/2 " (65 mm) and Larger:

.2 Construction: ULC listed, FM approved, 175psi (1210 kPa)CWP, iron body and bolted cap, bronze trim, bronze swing disc with replaceable bronze seat rings, flanged ends OR

.3 Construction: ULC listed, FM approved, 175 psi (1210 kPa), Cast Iron body, 316 stainless steel shaft, Double Door Bronze Disc to B-62, Buna seat, 316 stainless steel spring, wafer style.

.6 Drain Valves

.1 Construction: ULC listed and FM approved, brass ball valve with cap and chain, 3/4" (20 mm) hose thread.

PART 3 EXECUTION

3.1 PREPARATION

.1 Ream pipe and tube ends. Remove burrs.

.2 Remove scale and foreign material, from inside and outside, before assembly.

.3 Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

.1 Install piping to NFPA 13 for sprinkler systems.

.2 Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

.3 Install piping to conserve building space, to not interfere with use of space and other work.

.4 Group piping whenever practical at common elevations.

.5 Sleeve pipes passing through partitions, walls, and floors.

.6 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

.7 Inserts:

- .1 *Provide* inserts for placement in concrete formwork.
- .2 *Provide* inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- .3 *Provide* hooked rod to concrete reinforcement section for inserts carrying pipe over 100 mm.
- .4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- .5 Where inserts are omitted, drill through concrete slab from below and *Provide* through-bolt with recessed square steel plate and nut above slab.

.8 Pipe Hangers and Supports:

- .1 Install to NFPA 13.
- .2 Install hangers to *Provide* minimum 13 mm space between finished covering and adjacent work.
- .3 Place hangers within 300 mm of each horizontal elbow.
- .4 Use hangers with 38 mm minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
- .5 Support vertical piping at every other floor. Support riser piping independently of connected horizontal piping.
- .6 Where several pipes can be installed in parallel and at same elevation, *Provide* multiple or trapeze hangers.
- .7 *Provide* copper plated hangers and supports for copper piping.

.9 Slope piping and arrange systems to drain at low points. Use eccentric reducers to maintain top of pipe level.

.10 Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

.11 Do not penetrate building structural members unless indicated.

.12 *Provide* sleeves when penetrating floors, walls and footings. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.

.13 When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. *Provide* necessary joining fittings. Ensure flanges, union, and couplings for servicing are consistently provided.

.14 Die cut threaded joints with full cut standard taper pipe threads with red lead and linseed oil or other non-toxic joint compound applied to male threads only.

.15 Install valves with stems upright or horizontal, not inverted. Remove protective coatings prior to installation.

.16 *Provide* ball valves for shut-off or isolating service.

.17 *Provide* drain valves at main shut-off valves, low points of piping and apparatus.

.18 All control, drain and test connection valves shall be provided with permanently engraved and marked weatherproof metal or rigid plastic identification signs, secured with weather resistant chain or other approved method.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

- .1 Dry-pipe sprinkler assembly.
- .2 System design, installation, and certification.
- .3 Fire department connections.

.2 Related Sections

- .1 Section 31 23 18 - Trenching.
- .2 Section 20 05 00 - Mechanical General Provisions.
- .3 Section 23 05 53 - Mechanical Identification.
- .4 Section 23 05 48 - Vibration Isolation.
- .5 Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

1.3 SUBMITTALS

.1 Submittals for Review

- .1 Section 01 33 00: Submission procedures.
- .2 *Shop Drawings*/*Product* Data: Submit shop drawings/product data sheets to the regulatory authority for review and approval prior to submitting to the *Consultant*. Conform to the following requirements.
  - .1 Submit shop drawings/product data sheets for all products specified in this Section except pipe and fittings;
  - .2 Submit complete white print CAD layout drawings indicating the source of water supply with test flow and pressure, "head-end" equipment piping schematic, pipe routing and sizing, and zones, all signed and sealed by a qualified professional mechanical engineer as specified below;
  - .3 Submit copies of all calculations, including hydraulic calculations, stamped and signed by the same engineer who signs the layout drawings, and a listing of all design data used in preparing the calculations, system layout and sizing, including occupancy-hazard design requirements.
- .3 Test Certificate: Certify that system has been tested and meets or exceeds code requirements as specified in Part 3 of this Section.

1.4 REGULATORY REQUIREMENTS

.1 Codes and Standards

- .1 All system components must be UL and/or ULC listed and labelled.
- .2 Sprinkler Systems: Conform to NFPA 13, Standard for the Installation of Sprinkler Systems.

.3 Products Requiring Electrical Connection: Listed and classified by CSA testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

.2 *Subcontractor* and *Site* Personnel

.1 Fire protection sprinkler work is to be performed by a sprinkler company who is a member in good standing of the Canadian Automatic Sprinkler Association. All site personnel are to be sprinkler fitters licensed in the jurisdiction of the work and under the continuous supervision of a foreman who is an experienced fire protection system installer and a journeyman pipe fitter.

.3 Dimensions and Coordination: Check and verify all dimensions and conditions at the site and ensure that the work can be performed as indicated. Co-ordinate fire protection sprinkler work with all trades at the site and accept responsibility for and the cost of adjusting piping and/or spacing to avoid interference with other building components.

1.5 DESIGN REQUIREMENTS

.1 Design Criteria: Fire protection sprinkler work is to be designed in accordance with NFPA 13 and Provincial Standards and, where required, local building and fire department requirements and the standards of the *Owner's* Insurer. If water supply flow and pressure test data is not available, conduct Municipal main water flow and pressure tests at the nearest fire hydrant to obtain criteria to be used in sprinkler system design. Include hydrant location and flow and pressure test data with system design calculations.

.2 System Designer: Fire protection sprinkler work is to be designed by a fully qualified mechanical professional engineer registered and licensed in the jurisdiction of the work. Refer to Section 20 05 00 – Mechanical General Provisions for requirements governing employment of the engineer.

.3 *Consultant* Approval: The fire protection sprinkler system design, including all piping runs and sprinkler locations, are to be approved by the *Consultant* prior to the commencement of work on-site.

.4 Sprinkler / System Occupancy – Hazard Design Requirements: As per NFPA 13 occupancy-hazard density requirements, unless otherwise specified.

PART 2 PRODUCTS

2.1 PIPE, FITTINGS AND JOINTS

.1 Pipe, fittings and joints are to be as follows, with exceptions as specified in Part 3 of this Section:

.1 PVC – underground service pipe inside or outside building: Class 200, DR14, rigid, hub and spigot pattern PVC pipe and CSA certified fittings to CAN/CSA B137.2 and B137.3 and complete with gasketed joints.

.2 Schedule 40 Steel – Grooved Coupling Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B, complete with grooved ends and mechanical fittings and couplings equal to Victaulic "FireLock" fittings and Victaulic Style 005 rigid coupling joints. Strap type outlet fittings such as Victaulic "Snap-Let" are not acceptable. Use for pipe inside building and above ground from the service connection to the discharge side of "head end" equipment such as alarm valve, etc., and for all piping to the siamese connection

.3 Schedule 40 Steel – Screwed and Welded Joints: Schedule 40 mild black carbon steel, ASTM A53, Grade B. Screwed piping is to be complete with Class 125 cast iron screwed fittings to ANSI/ASME B16.4. Welded piping is to be complete with factory made seamless carbon steel butt welding fittings to ASTM A234, Grade WPB, long sweep pattern wherever possible. Use for pipe similar to .2 above.

.4 Schedule 10 Steel – Grooved Coupling Joints: Schedule 10 mild black carbon steel, ASTM A53, Grade B, complete with grooved ends and fittings and couplings equal to Victaulic "FireLock" fittings and Victaulic Style 005 rigid coupling joints.

.5 "Lightwall" Steel – Grooved Coupling Joints: Commercial quality. "Lightwall" rolled mild carbon steel pipe to ASTM A135, Grade A, complete with a galvanized exterior, grooved ends, and fittings and couplings equal to Victaulic "Fire Lock" grooved fittings and Victaulic Style 005 rigid coupling joints.

.6 Flexible Pipe: FlexHead Industries flexible stainless steel metallic hose sprinkler head connections or Victaulic “VicFlex” flexible stainless steel metallic hose sprinkler head connections, each complete with attachment bracket. For short sprinkler piping connections off a main to heads in exhaust ducts, in suspended ceilings, etc.

2.2 SERVICE MAIN DOUBLE CHECK VALVE ASSEMBLY

.1 Minimum 1205 kPa (175 psi) rated dual check valve backflow preventer assembly (less shut-off valves) to CAN/CSA B64, complete with test cocks. For service mains extended from domestic water main and where Municipality requires a double check valve assembly in lieu of a single check valve as required by Code.

2.3 SHUT-OFF VALVES

.1 Minimum 1205 kPa (175 psi) rated full port bronze body screwed ball valves and lug body or grooved end type butterfly valves.

2.4 CHECK VALVES

.1 Minimum 1205 kPa (175 psi) resilient seat check valves.

.2 Check valves associated with Fire Department connections and fire pump test connection are to be tapped for site installation of a 20 mm (¾") diameter ball drip.

2.5 BALL DRIPS

.1 Equal to National Fire Equipment Ltd. Model #A58, 20 mm (¾") diameter automatic ball drip.

2.6 SHUT-OFF VALVE SUPERVISORY SWITCHES

.1 Tamper-proof supervisory switches, each arranged to activate a fire alarm system trouble alarm condition if the valve is closed or tampered with, each suitable in all respects for the application, and with each complete with all required mounting and connection hardware.

2.7 FIRE DEPARTMENT CONNECTION

.1 Wall mounting polished brass clapper type dual inlet Fire Department connection with two 65 mm (2½") diameter inlets threaded to Fire Department hose requirements and equipped with caps and chains, an outlet sized as shown, and a faceplate.

.2 The faceplate is to be complete with "AUTO SPKR STANDPIPE" cast-in raised lettering.

2.8 SPRINKLER MAIN "LOSS OF PRESSURE" ALARM SENSOR

.1 Piping mounted adjustable pressure sensor designed to actuate an alarm upon sensing a loss of pressure in the fire protection main. The switch is to be low voltage or line voltage as required.

2.9 WATER FLOW ALARM SWITCH

.1 Pipe mounting water flow alarm switch, minimum 1725 kPa (250 psi) rated, designed to actuate two 7 ampere rated (at 125/250 VAC) SPDT snap action switches when water flow exceeds 0.758 L/sec. (10 gpm), complete with a tamper-proof cover with conduit connection opening, a piping saddle and U-bolt, and an automatic reset pneumatic retard device with field adjustable (0 to 70 second) switch actuation delay to reduce false alarms caused by a single or series of transient water flow surges.

2.10 ALARM CHECK VALVE

.1 Enameled cast iron check type valve designed for either vertical or horizontal mounting with divided seat ring, rubber faced clapper to automatically actuate water motor alarm. The assembly is to be minimum 1205 kPa (175 psi) cold water rated with all moving parts constructed of brass, bronze, stainless steel or EPDM, and is to be complete with:

   .1 basic trim including piping materials and check valve for an external by-pass, potable water supply and system water supply pressure gauges with gauge test ports and shut-off valves, an angle type main drain valve, and fittings for mounting an alarm test by-pass;

   .2 alarm test by-pass piping with ball valve to permit alarm testing without operation of the alarm valve;

   .3 alarm trim with pipe and fittings for connection to a water motor alarm, and an adjustable pressure switch for electrical connection to an alarm system upon flow through the valve.

2.11 AIR COMPRESSOR

.1 Single unit, electric motor driven, motor, motor starter, safety valves, check valves, air maintenance device incorporating electric pressure switch and unloader valve.

   .1 0.25 kW – 0.38 kW

   .2 125 volts, single phase, 60 Hz

2.12 ZONE CONTROL RISER MODULES

.1 Equal to Victaulic Co. "FireLock" Series 747M factory assembled zone control riser modules, each complete with a painted cast ductile iron grooved end body, a ball type shut-off valve, a test and drain combination with properly sized orifice, a flow alarm switch, a pressure gauge with cock, and a pressure relief valve kit.

2.13 SPRINKLER HEADS

.1 Sprinkler heads, unless otherwise specified, are to be as scheduled in Part 3 of this Section.

.2 Recessed sprinkler heads in finished areas are to be chrome plated unless otherwise specified. Concealed sprinkler head ceiling plates are to match the ceiling colour.

.3 Where exposed pendent heads occurs in areas with suspended ceilings, they are to be complete with chrome plated escutcheon plates. Similarly, sidewall heads with concealed piping are to be complete with chrome plated escutcheon plates.

.4 Sprinkler heads which are exposed in areas where they may be subject to damage are to be complete with wire guards, chrome plated where in finished areas.

.5 Sprinkler heads located in areas or over equipment where high ambient temperature is present are to be, unless otherwise specified, 74°C (165°F) heads. All other heads, unless otherwise specified or required, are to be 57°C (135°F) rated.

.6 Acceptable sprinkler head manufactures are:

.1 Tyco Fire Suppression & Building Products;

.2 Victaulic Corporation.;

.3 The Viking Corporation;

.4 The Reliable Automatic Sprinkler Corporation.

2.14 SPARE SPRINKLER HEAD CABINET

.1 Surface wall mounting, red enameled steel, identified cabinet with hinged door, shelves with holes for mounting sprinkler heads, a wrench or wrenches suitable for each type of sprinkler head, and a full complement of spare sprinkler heads.

.2 The cabinet is to be sized to accommodate a minimum of four spare heads for each type of head used on the project, however, each cabinet is to be full of spare heads.

PART 3 EXECUTION

3.1 PIPING INSTALLATION REQUIREMENTS

.1 *Provide* all required sprinkler system piping.

.2 Do all piping work in accordance with requirements of NFPA 13, governing regulations, and "reviewed" shop drawings.

.3 Piping, unless otherwise specified, is to be as follows:

.1 for underground pipe inside or outside the building – Class 200, DR14 rigid PVC, braced and secured at bends and tees with concrete blocks in accordance with Municipal standards and details;

.2 for piping inside the building and above ground except as noted below – Schedule 40 grooved end black steel with Victaulic or equal fittings and coupling joints, or, for piping to and including 50 mm (2") diameter, screwed fittings and joints, or, for piping 65 mm (2½") diameter and larger, welding fittings and welded joints;

.3 for piping downstream of "head end" alarm valve(s) and equipment – Schedule 10 or "Lightwall" black steel pipe with Victaulic or equal fittings and coupling joints or screwed fittings and joints;

.4 for branch piping to heads in suspended ceilings, etc.: At your option, flexible piping installed in accordance with the manufacturer's instructions;

.4 Exceptions to above piping requirements are as follows:

.1 all ferrous pipe hangers, supports, and similar hardware used for galvanized steel piping are to be electro-galvanized.

.5 All pipe sizes, pipe routing, sprinkler head quantities and locations, and layout of work shown on the drawings are to assist you during the tendering period. Ensure adequate head coverage, head quantities and pipe sizing as specified in Part 1 of this Section. Do not reduce the size of the sprinkler main or re-route the main unless approved.

.6 All pipe, fittings, couplings, flanges and similar components are to be clean after erection is complete. Any ferrous pipe, fitting, coupling, flange, hanger, support and similar component which exhibits rust is to be wire brush cleaned and carefully coated with suitably coloured primer.

.7 When sprinkler work is complete, test system components and the overall system(s) and submit completed test certificate and other documentation in accordance with Chapter 8 of NFPA 13.

3.2 INSTALLATION OF DOUBLE CHECK VALVE ASSEMBLY

.1 *Provide* a double check valve assembly in the sprinkler main inside the building where shown.

.2 Support each end of the assembly from the floor by means of flanged pipe supports with saddles.

3.3 INSTALLATION OF SHUT-OFF VALVES AND CHECK VALVES

.1 *Provide* shut-off valves and check valves in piping where shown, and wherever else required.

.2 Locate all valves for easy operation and maintenance.

.3 Confirm exact locations prior to roughing-in.

3.4 INSTALLATION OF SHUT-OFF VALVE SUPERVISORY SWITCHES

.1 Unless otherwise specified, equip each shut-off valve with a supervisory switch.

.2 Identify each supervised valve with a 150 mm (6") square, engraved, laminated red-white plastic tag to correspond with supervised valve numbering specified and/or shown as part of the electrical work fire alarm system.

3.5 INSTALLATION OF FIRE DEPARTMENT CONNECTION

.1 *Provide* an exterior Fire Department connection where shown. Confirm exact location prior to roughing-in. Confirm finish prior to ordering.

.2 Equip the connection with a check valve. Equip the check valve with a ball drip to drain the piping between the Fire Department connection and the check valve, and extend drainage piping from the outlet of the ball drip to the nearest suitable floor drain.

3.6 INSTALLATION OF LOSS OF PRESSURE SENSOR

.1 Supply and mount a pressure sensor in the fire protection piping main to activate a "LOSS OF PRESSURE" trouble alarm should Municipal water service pressure fall below the acceptable level.

.2 Locate the sensor for easy access and maintenance, and set the alarm pressure to suit site conditions. Confirm setting on site.

.3 Identify the pressure sensor and its normal setting with a 150 mm (6") square red-white laminated plastic tag engraved to read "LOSS OF WATER PRESSURE SENSOR - NORMAL SETTING 210 kPa". Confirm wording prior to engraving.

3.7 INSTALLATION OF FLOW ALARM SWITCHES

.1 *Provide* water flow alarm switches in accessible locations in zone piping where shown.

.2 Adjust to suit site water pressure conditions. Check and test operation.

.3 Identify each switch with a 150 mm (6") square red-white laminated engraved plastic tag. Confirm wording prior to engraving.

3.8 INSTALLATION OF ALARM CHECK VALVES

.1 *Provide* alarm check valves, complete with trim, for dry pipe fire protection sprinkler piping where shown.

.2 Check and test operation of each valve and adjust as required to suit site water pressure conditions.

.3 Identify each valve with a 150 mm (6") square red-white laminated engraved plastic tag. Confirm wording prior to engraving.

3.9 INSTALLATION OF AIR COMPRESSOR

.1 Install air compressor on vibration isolators.

3.10 INSTALLATION OF ZONE CONTROL RISER MODULES

.1 *Provide* zone control riser modules with drain piping where required. Terminate drainage piping over a funnel floor drain unless otherwise shown or specified. Identify each assembly.

3.11 INSTALLATION OF SPRINKLER HEADS

.1 *Provide* all required sprinkler heads. Sprinkler head types are to be in accordance with the following schedule, unless otherwise specified. Sprinkler head manufacturers indicated on the schedule are for type indication purposes. Acceptable manufacturers are listed in Part 2 of this Section.

.2 Unless otherwise specified, sprinkler heads are to be in accordance with the following schedule:

APPLICATION	SPRINKLER HEAD TYPE
Rooms/areas with a suspended ceiling	Tyco Series RFII “Royal Flush II” concealed pendent Tyco Series TY-FRB recessed pendent Tyco Series TY-FRB pendent with escutcheon plates
Rooms/areas without a suspended ceiling	Tyco Series TY-RFB pendent
Elevator shafts	Tyco Series TY-FRB horizontal sidewall
Heated areas with overhead doors	Tyco Series TY-FRB horizontal sidewall
At non-rated windows in rated walls	Tyco Model WS horizontal and pendent vertical sidewall

.3 Sprinkler head locations must be carefully coordinated with all drawings, including architectural reflected ceiling plan drawings, and, where applicable, electrical drawings. Coordinate sprinkler head locations in areas with suspended ceilings with the location of lighting, grilles, diffusers, and similar items recessed in or surface mounted on the ceiling as per the reflected ceiling plans. In areas with lay-in tile, centre the sprinkler head both ways in the lay-in tile wherever possible. Confirm locations prior to roughing-in.

.4 Maintain maximum headroom in areas with no ceilings.

.5 *Provide* guards for heads where they are subject to damage.

.6 *Provide* high temperature heads in equipment rooms and similar areas over heat producing or generating equipment.

3.12 INSTALLATION OF SPARE SPRINKLER HEAD CABINET

.1 Supply a full complement (to fill cabinet) of spare sprinkler heads of the types used (minimum four of each type) and place in a wall mounting storage cabinet located adjacent to the sprinkler system "head end" equipment where later directed.

END OF SECTION

PART 1 – GENERAL

1.1 General

.1 The purpose of this section is to specify Division 22 responsibilities in the commissioning process.

.2 The systems to be commissioned are listed in Section 01 91 00, Part 1.9.

.3 Commissioning requires the participation of Division 22 to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 01 91 00. Division 22 shall be familiar with all parts of Section 01 91 00 and the commissioning plan issued by the CA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

.4 CA = Commissioning Agent, TAB = Test and Balance.

1.2 Responsibilities

.1 Plumbing Subcontractor: The Contractor shall ensure that the plumbing Subcontractor complies with all requirements included in this Section and fulfills the following responsibilities during construction and acceptance phases (all references apply to commissioned equipment only):

  .1 Documentation of all procedures performed shall be provided and forwarded to the Professional Engineer of Record. Written documentation must contain recorded test values of all tests performed per the individual product specification.

  .2 The start-up service company shall be present during energization of the plumbing equipment. Site and equipment access must be provided by the plumbing Subcontractor.

  .3 The Contractor shall supply a power source, specified by the start-up service company, for on-Site test equipment.

  .4 The plumbing Subcontractor is to attend all factory witness testing required within the respective specification sections. The Contractor shall cover all their costs and include them in their bid.

  .5 Perform tests using qualified personnel. Provide necessary instruments and equipment.

  .6 Include the cost of commissioning in the Contract Price, if not yet included.

  .7 In each purchase order or subcontract written, include requirements for submittal data, O&M data and training.

  .8 Attend a commissioning scoping meeting and other necessary meetings scheduled by the CA to facilitate the commissioning process.

  .9 The Contractor shall provide normal cut sheets and shop drawing submittals to the CA of commissioned equipment. Provide additional requested documentation, prior to normal O&M manual submittals, to the CA for development of pre-functional and functional testing procedures.

.1 Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any Region-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Region to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent.

.2 The Commissioning Agent may request further documentation necessary for the commissioning process. This data request may be made prior to normal submittals.

.10 Provide a copy of the O&M manuals submittals of commissioned equipment, through normal channels, to the CA for review.

.11 The Contractor shall assist (along with the design Professional Engineers) in clarifying the operation and control of commissioned equipment in areas where the Specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

.12 Provide assistance to the CA in preparation of the specific functional performance test procedures specified in Section 22. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

.13 Develop a full start-up and checkout plan using manufacturer's start-up procedures and the pre-functional test sheets from the CA. Submit manufacturer's detailed start-up procedures and the full start-up plan and procedures and other requested equipment documentation to CA for review.

.14 During the startup and checkout process, execute and document the mechanical-related portions of the pre-functional test sheets provided by the CA for all commissioned equipment.

.15 Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CA.

.16 Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

.17 Perform functional performance testing under the direction of the CA for specified equipment in 01 91 00, Section 1.9. Assist the CA in interpreting the monitoring data, as necessary.

.18 Correct deficiencies (differences between specified and observed performance) as interpreted by the CA and Consultant and retest the equipment.

.19 Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

.20 During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for Contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing). Prepare red-line As-Built Drawings for all drawings and final as-builts for Contractor-generated coordination drawings.

.21 Provide training of the Region's operating personnel as specified.

.22 Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

.23 Execute seasonal or deferred functional performance testing, witnessed by the CA, according to the Specifications.

.24 Correct deficiencies and make necessary adjustments to O&M manuals and As-Built Drawings for applicable issues identified in any seasonal testing.

.25 Assist and cooperate with the Mechanical and TAB Subcontractor and CA by:

.1 Putting all equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.

.2 Providing temperature and pressure taps according to the Contract Documents for TAB and commissioning testing.

.26 Install a P/T plug at each water sensor which is an input point to the control system.

.27 List and clearly identify on the As-Built Drawings the locations of applicable sensors and meters.

.28 Prepare a preliminary schedule, in conjunction with Division 25 Subcontractors for Division 22 pipe system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the CA. Update the schedule as appropriate.

.29 Notify the Consultant and CA when pipe system testing, flushing, cleaning, startup of each piece of equipment and TAB will occur. Be responsible to notify Consultant and CA, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the CA has the scheduling information needed to efficiently execute the commissioning process.

PART 2- PRODUCTS

.1 NOT USED

PART 3- EXECUTION

3.1 Submittals

.1 Section 22 Subcontractors shall provide submittal documentation relative to commissioning to the CA as requested by the CA. Refer to Section 01 91 00 Part 3.3 for additional Section 22 requirements.

3.2 Start-up of Equipment

.1 The plumbing Subcontractor(s) shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in 01 91 00. Division 22 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the Commissioning Agent or Region.

.2 Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CA and Consultant. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all pre functional checklists as soon as possible.

.3 Prior to the start up of equipment the Division 22 Subcontractor shall arrange to have the manufacturer of all major equipment inspect the installation to ensure their equipment has been installed in accordance with their recommendations.

.4 The supplier shall submit a written report of their findings.

.5 Upon confirmation that the equipment has been installed in accordance with the manufacturer's recommendations the equipment may be started.

.6 All equipment shall be started by the manufacturer's representative.

3.3 Pre-Functional Test Sheets

.1 Pre-functional test sheets contain items for Section 22 Subcontractors to perform. On each checklist, a column is provided that is to be completed by the Contractor assigning responsibility for that line item to a Subcontractor. Those executing the test sheets are only responsible to perform items that apply to the specific application at hand. These test sheets do not take the place of the manufacturer's recommended checkout and start-up procedures or report. Some checklist procedures may be redundant in relation to checkout procedures that will be documented on typical factory field checkout sheets. Double documenting may be required in those cases.

.2 Refer to Section 01 91 00 for additional requirements regarding pre-functional test sheets, startup and initial checkout. Items that do not apply should be noted along with the reasons on the form. If this form is not used for documenting, one of similar rigor and clarity shall be used pending approval from the CA. Contractor's assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their Subcontractors are completed and checked off. "Contr." column or abbreviations in brackets to the right of an item refer to the Subcontractor responsible to verify completion of this item.

3.4 Operations and Maintenance Manuals

.1 The Contractor shall ensure that the Section 22 Subcontractors compile and prepare documentation for all equipment and systems covered in Section 22 and deliver it to the Contractor for inclusion in the O&M manuals.

.2 The CA shall receive a copy of the O&M manuals for review.

3.5 Training of Region Personnel

.1 The Contractor shall coordinate and schedule training and ultimately to ensure that training is completed. Refer to Section 01 91 00 for additional details.

.2 The CA will oversee and approve the content and adequacy of the training of Region personnel for commissioned equipment. Refer to Section 01 91 00 for additional details.

.3 Mechanical Subcontractor. The Contractor shall ensure that the mechanical Subcontractor fulfills the following training responsibilities:

  .1 Provide the CA with a training plan two weeks before the planned training according to the outline described in Section 01 91 00, Part 3.8.

.2 Provide designated Region personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to, pumps, boilers, furnaces, chillers, heat rejection equipment, air conditioning units, air handling units, fans, terminal units, controls and water treatment systems, etc.

.3 Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.

.4 During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

.5 The appropriate Subcontractor or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing Subcontractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than one party may be required to execute the training.

.6 The controls Subcontractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

.7 The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

.8 Training shall include:

.1 Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.

.2 A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.

.3 Discussion of relevant health and safety issues and concerns.

.4 Discussion of warranties and guarantees.

.5 Common troubleshooting problems and solutions.

.6 Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.

.7 Discussion of any peculiarities of equipment installation or operation.

.9 The format and training agenda in The HVAC Commissioning Process, ASHRAE Guideline 1-1989R, 1996 is recommended.

.10 Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate.

.11 Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.

.12 The mechanical Subcontractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.

.13 Training shall occur after functional testing is complete, unless approved otherwise by the Consultant.

3.6 Deferred Testing

.1 Refer to Section 01 91 00, Part 3.9 for requirements of deferred testing.

3.7 WRITTEN WORK PRODUCTS

.1 Written work products of Section 22 Subcontractors will consist of the startup and initial checkout plan as described in Section 01 91 00, as well as completed startup, initial checkout and pre-functional test sheets.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 SUMMARY

.1 *Provide* all metering equipment required to monitor consumption by end use type.

1.3 RELATED SECTION

.1 Division 23 09 00 Instrumentation and Control Devices for HVAC

.2 Division 26 09 23 Metering and Switchboard Instruments

.3 Division 01 91 00 Commissioning

1.4 SUBMITTALS

.1 Submittals for review

- .1 Submit shop drawings in accordance with Section 20 05 00 – Mechanical General Provisions.

PART 2 PRODUCTS

2.1 END USES TO BE MONITORED

.1 *Provide* meters for all end uses, including but not limited to:

- .1 Facility incoming domestic cold water;
- .2 Facility data logger (may share with other meter inputs).

2.2 METERING EQUIPMENT

.1 Water Meters

- .1 Use of utility's meter is acceptable, and preferable, if allowable by utility, and meter meets requirements below.
- .2 Coordinate with local Water Utility for water meter installation. Water meter provided by Utility shall be capable of providing multiple tap points, with pulse outputs suitable for use with specified data logger, rather than providing separate water sub-meter for data logging purposes.
- .3 *Provide* water meters complete with bypass piping arrangement or other means to remove or isolate for service without interruption to water flow.
- .4 Materials shall be compatible with the systems in which they are installed at all potential operating temperatures and pressures.
- .5 Meters shall *Provide* a pulse output scaled to an appropriate volume. In general, *Provide* a scaled pulse output of 1 litre per pulse unless high consumption would result in pulses too frequent to be reliably captured by the pulse counting equipment.
- .6 Meters requiring power shall be hard-wired. Battery powered units are not acceptable.

.7 *Provide* meters with readout of totalized volume.

.8 Accuracy +/- 1.5% in expected operating flow range

.1 Acceptable Products

.1 Equal to Neptune Technology Group (Canada) Ltd. with Tricon hardware, or approved equal.

.2 Pulse Counting Data Logging Equipment

.1 Internet Protocol (IP) based data logger complete with:

.1 Built-in web server.

.2 Capable of operating with a dedicated IP address (to be provided by the *Region*).

.3 Communications Protocols

.1 HTTP capable of pushing data to 3rd party applications/databases.

.2 Modbus TCP

.4 Built-in real-time and historic graphics accessible with any HTML 5 internet browser (computer, tablet, phone) on the *Region*'s network.

.5 Real-time clock with battery backup and email alert for battery end of life.

.6 Ability to export all stored trend data to comma separated value (.csv) or Microsoft Excel format for importing into spreadsheets.

.7 Published application programming interface (API) allowing data to be retrieved from the pulse counter via non-proprietary means, such as JavaScript Object Notation (JSON).

.8 Multiple inputs (gas, water, electricity) per unit [MJL4]. *Provide* minimum 2 spare inputs for future additional meters. Location of spare inputs to be determined by the *Region*.

.9 Minimum two universal inputs for addition of 0-10V and 0-20mA/4-20mA sensors.

.10 Built-in trending and data storage:

.1 3 years of consumption data at 5-minute intervals for each input

.2 Stored in non- volatile memory.

.11 Battery/power backup (for pulse counting):

.1 Lasting a minimum of 72 hours.

.2 Rechargeable.

.3 Email alert for battery end of life.

.12 No special software required to set up pulse counting equipment or access data.

.13 Security:

.1 Unrestricted access to data and graphics over the *Region*'s network.

.2 Password protection for access to setup, changing settings/parameters and deleting data.

.14 Ability to measure and trend the following data:

.1 Totalized consumption for gas, water, electricity

.15 Acceptable Products

.1 z3 Controls Inc.NetMeter OMNI

.3 Data Cabling

.1 Cat 6a Unshielded Twisted Pair (UTP) OR

.2 Cabling base on ITS Network Cabling Standard.

.3 Colour: Green

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

.1 Install pulse counting equipment in a painted, hinged NEMA 1 enclosure.

.2 All communication and pulse cables to be continuous. No splicing is allowed.

.3 Affix York *Region* Property Services Branch Asset ID tag to data logging unit prior to installation.

.4 Connect data logging equipment to the *Region*'s IT network.

.1 Meter to be supplied and installed by mechanical contractor with bypass and isolation valves.

.2 A separate meter to be installed downstream of utility water meter for BAS with pulse contacts.

.5 Commission pulse counting equipment:

.1 Ensure data logger corresponds to physical meter reading

.2 Ensure latest available firmware version is installed in pulse counter.

.3 Obtain Network information from York *Region* project manager and program into pulse counter, including IP address, subnet mask, default gateway, primary and secondary DNS addresses.

.4 Set pulse counter clock to current local time.

.5 Set up email alerts as requested by the *Region*'s project manager.

.6 Set default homepage to display real-time graphs and consumption statistics.

.7 Verify pulse counter information is viewable through a web browser on a device on the *Region*'s network.

.8 Complete and submit Energy Meter Commissioning Form.

.9 *Provide* training on pulse counter software use to *Region* staff including 'Facilities Operations and Maintenance' and 'Climate Change and Energy Conservation'.

END OF SECTION

22 09 00.01 WATER METER INSTALLATION/STARTUP VERIFICATION FORM			
Project Name:		*Project* Number:	
Contractor/Installing *Subcontractor*:		Form Completed By (Name):	
Telephone No.:		Date (MM/DD/YY):	

Purpose: The following form is intended to ensure energy meters are correctly and completely set up prior to commissioning verification. Refer to *York Region Building and Facilities Design Standards and Guidelines Division 22 09 00 – Instrumentation and Control for Plumbing* for additional requirements.

1. General Information	
Manufacturer:	
Model:	
Serial Number:	

2. Physical Installation				
22 09 00 Reference	**Requirement**	**Confirm Compliance**		**Notes**
3.1.2	Is the data logger in a painted, hinged NEMA 1 (or better) enclosure complete with power supply?	☐ Yes	☐ No	
3.1.2	Is the front of the enclosure labelled with data logger name, IP address, meter name(s) and load(s) measured?	☐ Yes	☐ No	
3.1.3	Are communication and signal cables continuous (i.e. not spliced)?	☐ Yes	☐ No	
3.1.4	Has a York *Region* Property Services Branch Asset ID Tag been affixed to the data logger?	☐ Yes	☐ No	
3.1.6	Has the data logger been connected to the *Region*'s IT network?	☐ Yes	☐ No	

3. Network Configuration (Note 1 indicates the data is to be provided by the *Region*'s *Project* Manager)			
MAC Address:			
DHCP Disabled?	☐ Yes	☐ No	
IP Address:[1]			
Gateway: [1]			
Subnet Mask: [1]			
Primary DNS: [1]			
Secondary DNS: [1]			

22 09 00 Reference	**Requirement**	**Confirm Compliance**		**Notes**
3.1.5 and 3.1.7.2	Has the data logger's Network information been obtained from the *Region*'s *Project* Manager?	☐ Yes	☐ No	
3.1.7.9	Is the data logger viewable through a web browser on a device connected to the *Region*'s network?	☐ Yes	☐ No	

4. Access	
Administrator User Name:	
Administrator Password:	

5. Meter Configuration (Note 1 indicates the data is to be provided by the *Region*'s *Project* Manager)	
Data logger Name: [1]	
Meter Description/Load Served:	

22 09 00 Reference	**Requirement**	**Confirm Compliance**		**Notes**
3.1.7.1	Has the latest firmware been installed in the data logger?	☐ Yes	☐ No	
3.1.7.3	Has the data logger's internal clock been set to current local time?	☐ Yes	☐ No	
3.1.7.4	Have email alerts been set up as specified?	☐ Yes	☐ No	
3.1.7.5	Has trend logging been set up as specified?	☐ Yes	☐ No	
3.1.7.6	Has the data logger's web based home screen been set to display real-time demand graph and consumption statistics?	☐ Yes	☐ No	

6. Datalogger Data Verification

Complete the following Table with data logger readings and physical meter readings to verify correct setup:

	Input 1		Input 2		Input 3		Input 4		Input 5		Input 6		Input 7		Input 8	
Measured Load: (ex. DCW-MAIN)																
Parameter	Datalogger	Meter	Datalogger	Meter	Datalogger	Meter	Datalogger	Meter	Datalogger	Meter	Datalogger	Meter	Datalogger	Meter	Datalogger	Meter
$m^3_{time\ 1}$																
$m^3_{time\ 2}$																

22 09 00 Reference	Requirement	Confirm Compliance		Notes
3.1.7.7	Have data logger readings and physical meter been verified to correspond?	☐ Yes	☐ No	
3.1.7.8	Have any analog sensors been calibrated?	☐ Yes	☐ No	

7. Training

22 09 00 Reference	Requirement	Confirm Compliance		Notes
3.1.7.11	Has training been provided to *Region* staff?	☐ Yes	☐ No	
3.1.7.12	Have meter manufacturer's calibration certificate(s), installation, operations and maintenance manuals (for meter(s) and data logger) and recommended meter recalibration interval(s) been provided to the *Region*'s *Project* Manager?	☐ Yes	☐ No	

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

- .1 Pipe, pipe fittings, valves, and connections for piping systems.

1.3 SUBMITTALS

.1 *Shop Drawings* / *Product* Data

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

.2 Water Purity Data

- .1 Submit laboratory water purity test results indicating chlorine residual as required by local authority prior to applying for Substantial Performance.

.3 Plumbing Inspection Certificate

- .1 Submit a copy of the final plumbing inspection certificate prior to applying for Substantial Performance.

.4 Maintenance Material Submittals

- .1 Spare Parts: *Provide* two (2) repacking kits for each size valve.

1.4 ENVIRONMENTAL REQUIREMENTS

.1 Do not install underground piping when bedding is wet or frozen.

PART 2 PRODUCTS

2.1 SANITARY SEWER PIPING, BURIED, INSIDE BUILDING

.1 PVC Pipe: CAN/CSA-B1800, SDR 35 sewer pipe.

- .1 Application: Sanitary sewer piping buried inside building and to points 1.5m (5’) outside building lines, sizes 100mm (4”) and larger.
- .2 Fittings: Spigot and hub type with gasket joints assembled with pipe lubricant.
- .3 Joints: Spigot and hub type with gasket joints assembled with pipe lubricant.

.2 Copper Tube: Type ‘L’ hard copper tubing.

- .1 Application: Sanitary sewer piping buried inside building, sizes up to and including 40mm (1½”).
- .2 Fittings: ASME B16.23 cast bronze or ASME B16.29 wrought copper.
- .3 Joints: ASTM B32, silver solder.

.3 ABS Pipe: CAN/CSA-B1800, Type DWV.

.1 Application: Sanitary sewer piping buried inside building, sizes up to and including 150mm (6”).

.2 Fittings: ASTM D2468, ABS socket type.

.3 Joints: ASTM D2235, solvent cement and primer for fittings; ASTM D3138, solvent cement and primer for transition joints.

2.2 SANITARY SEWER PIPING, ABOVE GROUND

.1 Cast Iron Pipe: CAN/CSA-B70, Class 4000.

.1 Application: Above ground in sizes 80mm (3”) diameter and larger.

.2 Fittings: Hubless Cast Iron Pipe Fittings: FSWW-P-401.

.3 Joints: ASTM C564, rubber or compression gaskets.

.2 Copper Tube: ASTM B306, DWV.

.1 Application: Above ground in sizes to and including 65mm (2½”) diameter.

.2 Fittings: ASME B16.29 wrought copper.

.3 Joints: ASTM B32, 50% tin – 50% lead solder joints.

.3 PVC DWV Pipe flame spread/smoke rated for plenums: CSA B181.2.

.1 Application: Above ground, tested in accordance with CAN/ULC S102.2 clearly marked with certification logo indicating flame spread rating of 25, smoke developed classification of 50, permissible to be installed in air return plenums in accordance with local codes.

.2 Fittings: CSA B181.2.

.3 Joints: ASTM D2564 solvent cement and primer.

2.3 AIR-CONDITIONING CONDENSATE PIPING, CEILING PLENUM

.1 Copper Tube: ASTM B306, DWV.

.1 Application: Above ground, in ceiling plenum, in sizes to and including 65mm (2½”) diameter.

.2 Fittings: ASME B16.29 wrought copper.

.3 Joints: ASTM B32, 50% tin – 50% lead solder joints.

2.4 AIR-CONDITIONING CONDENSATE PIPING, ABOVE GROUND, NOT IN CEILING PLENUM

.1 PVC Pipe: CAN/CSA-B1800.

.1 Application: Above ground in lieu of type DWV copper and cast iron, at contractor’s option and where permitted by governing Codes and Regulations, including smoke and flame spread requirements for use in plenums.

.2 Fittings: CAN/CSA-B1800, socket type.

.3 Joints: ASTM D2564 solvent cement and primer.

2.5 DOMESTIC WATER PIPING, BELOW GROUND

.1 PVC Pipe: CAN/CSA B-137.3.

.1 Application: For underground water mains 100mm (4") and larger.

.2 Fittings: CAN/CSA B137.2, AWWA C900.

.3 Joints: Gasket joints, Ford "Uni-Flange" restraint collars, or equal.

.2 Semi-Rigid Polyethylene Tubing: 13mm (1/2") diameter, high density semi-rigid polyethylene tubing, 1380 kPa (200 psi) rated.

.1 Application: Floor drain trap seal primer piping underground or in concrete slab.

2.6 DOMESTIC WATER PIPING, ABOVE GROUND

.1 Copper Tubing: ASTM B88, Type L, hard drawn.

.1 Application: Domestic water piping above ground.

.2 Fittings: ASME B16.18 cast copper alloy, ASME B16.22 wrought copper and bronze, ASME B16.26 cast copper alloy, ASME B16.50 wrought copper.

.3 Joints: ASTM B32, soldered joints using The Canada Metal Co. Ltd. "SILVABRITE 100" or equivalent lead-free solder for cold water pipe, AWS A5.8 brazed.

.2 Stainless Steel Pipe: Type "L" ASTM A312, Schedule 10, 304L stainless steel.

.1 Application: Domestic water piping above ground, size 50mm and larger, at *Contractor*'s option.

.2 Fittings: ASTM A774, 304L stainless steel.

.3 Joints: ASTM B75, grooved end fittings, Victaulic or equal stainless steel roll grooved end fittings and, mechanical couplings with EPDM Grade E gasket, suitable for operating temperatures up to 110 degrees C (230 degrees F).

2.7 STORM WATER PIPING, BELOW GROUND

.1 PVC Pipe: CAN/CSA-B1800, SDR 35 pipe.

.1 Fittings: CAN/CSA-B1800.

.2 Joints: ASTM D2564 solvent cement.

2.8 STORM WATER PIPING, ABOVE GROUND

.1 Cast Iron Pipe: CAN/CSA-B70, Class 4000.

.1 Application: Above ground in sizes 80mm (3") diameter and larger.

.2 Fittings: Hubless Cast Iron Pipe Fittings: FSWW-P-401.

.3 Joints: ASTM C564, rubber or compression gaskets.

.2 Copper Tube: ASTM B306, DWV.

.1 Application: Above ground in sizes to and including 65mm (2½") diameter.

.2 Fittings: ASME B16.29 wrought copper.

.3 Joints: ASTM B32, 50% tin – 50% lead solder joints.

.3 PVC DWV Pipe flame spread/smoke rated for plenums: CSA B181.2.

.1 Application: Above ground, tested in accordance with CAN/ULC S102.2 clearly marked with certification logo indicating flame spread rating of 25, smoke developed classification of 50, permissible to be installed in air return plenums in accordance with local codes.

.2 Fittings: CSA B181.2.

.3 Joints: ASTM D2564 solvent cement and primer.

2.9 FLANGES, UNIONS, AND COUPLINGS

.1 Ferrous Pipe Size 80mm (3") and Under: Class 150 malleable iron threaded unions.

.2 Copper Tube and Pipe Size 80mm (3") and Under: Class 150 bronze unions with soldered joints.

.3 Ferrous Pipe Size Over 25mm (1"): Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.

.4 Copper Tube and Pipe Size Over 25mm (1"): Class 150 slip-on bronze flanges; preformed neoprene gaskets.

.5 Grooved and Shouldered Pipe End Couplings:

.1 Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.

.2 Sealing gasket: C-shape composition sealing gasket.

.6 Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

2.10 PIPE HANGERS AND SUPPORTS

.1 Plumbing Piping - Drain, Waste, and Vent:

.1 Conform to MSS SP-58.

.2 Hangers for Pipe Sizes 13mm to 40mm (1/2" to 1-1/2"): Carbon steel, adjustable swivel, split ring.

.3 Hangers for Pipe Sizes 50mm (2") and Over: Carbon steel, adjustable, clevis.

.4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

.5 Wall Support for Pipe Sizes to 80mm (3"): Cast iron hook.

.6 Wall Support for Pipe Sizes 100mm (4") and Over: Welded steel bracket and wrought steel clamp.

.7 Vertical Support: Steel riser clamp.

.8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

.10

.2 Plumbing Piping - Water:

.1 Conform to MSS SP-58.

.2 Hangers for Pipe Sizes 13mm to 40mm (1/2" to 1-1/2"): Carbon steel, adjustable swivel, split ring.

.3 Hangers for Cold Pipe Sizes 50mm (2”) and Over: Carbon steel, adjustable, clevis.

.4 Hangers for Hot Pipe Sizes 50mm to 100mm (2” to 4”): Carbon steel, adjustable, clevis.

.5 Hangers for Hot Pipe Sizes 150mm (6”) and Over: Adjustable steel yoke, cast iron pipe roll, double hanger.

.6 Multiple or Trapeze Hangers: Steel channels with welded supports or spacers and hanger rods.

.7 Multiple or Trapeze Hangers for Hot Pipe Sizes 150mm (6”) and Over: Steel channels with welded supports or spacers and hanger rods, cast iron roll.

.8 Wall Support for Pipe Sizes to 80mm (3”): Cast iron hook.

.9 Wall Support for Pipe Sizes 100mm (4”) and Over: Welded steel bracket and wrought steel clamp.

.10 Wall Support for Hot Pipe Sizes 150mm (6”) and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron pipe roll.

.11 Vertical Support: Steel riser clamp.

.12 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.13 Floor Support for Hot Pipe Sizes to 100mm (4”): Cast iron adjustable pipe saddle, locknut, nipple, floor flange, and concrete pier or steel support.

.14 Floor Support for Hot Pipe Sizes 150mm (6”) and Over: Adjustable cast iron pipe roll and stand, steel screws, and concrete pier or steel support.

.15 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.11 BALL VALVES

.1 Ball Valves 80 mm (3”) and Smaller in copper pipe, solder joints: Class 600, 4140 kPa (600 psi), WOG rated full port, forged brass body, forged brass cap, sold forged brass chrome plated ball, Teflon or PTFE seats, blow-out proof stem, removable lever handle, solder ends. *Provide* stem extensions for valves installed in insulated piping.

.1 Toyo Valve Co. Fig. 5049A

.2 Milwaukee Valve Co.

.3 Kitz Corporation Code 59

.4 Apollo Valves

.5 Watts Industries (Canada) Inc.

2.12 BUTTERFLY VALVES

.1 Butterfly Valves 100mm (4”) and Larger: Non-corrosive, 1200 kPa (175 psi) CWP, cast or ductile iron body, stainless steel shaft, bronze disc, EPDM seat, worm gear operators, and chain-wheel operators for valves mounted over 2.4m (8’) above floor.

.1 DeZurik APCO Hilton

.2 Kitz Corporation Code

.3 Toyo Valve Corporation.

.4 Bray Valve and Controls Canada Series 34

.5 Apollo Valves

.6 Watts Industries (Canada) Inc.

2.13 SWING CHECK VALVES

.1 Horizontal Swing Check Valves: Class 125, 1380 kPa (200 psi) WOG rated horizontal swing type check valve with soldered ends, bronze body and cap, bronze swing disc with rubber seat.

.1 Toyo Valve Co. Fig 237

.2 Milwaukee Valve Co.

.3 Kitz Corporation Code 23

.4 Apollo Valves #61-600

.2 Vertical Lift Check Valves: 1725 kPa (250 psi) WOG rated vertical lift bronze check valve with soldered ends.

.1 Kitz Corporation Code 26

2.14 DRAIN VALVES

.1 Drain Valves: 2070 kPa (300 psi) water rated, 20mm (3/4”) diameter, full port bronze ball valves, complete with threaded male outlet suitable for connecting a 20mm (3/4”) diameter garden hose, cap and chain.

.1 Toyo Valve Co. Fig 5046

.2 Dahl Brothers Canada Ltd. 50430

.3 Kitz Corporation Code 58CC

.4 Apollo Valves # 78-104-01

.5 Watts Industries (Canada) Inc. #B6000-CC

2.15 WATER PRESSURE REDUCING VALVES

.1 Water Pressure Reducing Valves: CSA 356, bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verify existing conditions before starting work.

.2 Verify that excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

.1 Ream pipe and tube ends. Remove burrs.

.2 Remove scale and dirt, on inside and outside, before assembly.

.3 Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 *Provide* non-conducting dielectric connections wherever jointing dissimilar metals.

.3 Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

.4 Install piping to maintain headroom, conserve space, and not interfere with use of space.

.5 Group piping whenever practical at common elevations.

.6 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.

.7 *Provide* clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19.

.8 *Provide* access where valves and fittings are not exposed.

.9 Establish elevations of buried piping outside the building to ensure not less than 1.5m (4') of cover. Install frost protection measures where ground cover is inadequate.

.10 Install vent piping penetrating roofed areas to maintain integrity of roof assembly.

.11 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

.12 *Provide* support for utility meters to requirements of utility companies.

.13 Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to relevant specification section for finish painting.

.14 Excavate to relevant specification sections regarding excavation for work of this Section.

.15 Backfill to relevant specification sections regarding backfilling for work of this Section.

.16 Install bell and spigot pipe with bell end upstream.

.17 Install valves with stems upright or horizontal, not inverted.

.18 Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

.19 Install water piping to ASME B31.9.

.20 Sleeve pipes passing through partitions, walls and floors.

.21 Inserts:

- .1 *Provide* inserts for placement in concrete formwork.
- .2 *Provide* inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- .3 *Provide* hooked rod to concrete reinforcement section for inserts carrying pipe over 100mm (4").
- .4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- .5 Where inserts are omitted, drill through concrete slab from below and *Provide* through-bolt with recessed square steel plate and nut flush with top of slab.

.22 Pipe Hangers and Supports:

- .1 Install to OBC, ASME B31.9.
- .2 Support horizontal piping as scheduled.

.3 Install hangers to *Provide* minimum 13mm (1/2") space between finished covering and adjacent work.

.4 Place hangers within 300mm (12") of each horizontal elbow.

.5 Use hangers with 40mm (1-1/2") minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

.6 Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

.7 Where several pipes can be installed in parallel and at same elevation, *Provide* multiple or trapeze hangers.

.8 *Provide* copper plated hangers and supports for copper piping, or *Provide* electrolytic action tape or equivalent if copper pipe attachment is not provided.

.9 Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

.10 *Provide* hangers adjacent to motor driven equipment with vibration isolation; refer to Section 23 05 29.

.11 Support cast iron drainage piping at every joint.

3.4 APPLICATION

.1 Use grooved mechanical couplings and fasteners only in accessible locations.

.2 Install unions downstream of valves and at equipment or apparatus connections.

.3 Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.

.4 Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

.5 *Provide* lug end butterfly valves adjacent to equipment when provided to isolate equipment.

.6 *Provide* spring loaded check valves on discharge of water pumps.

.7 *Provide* plug valves in natural gas systems for shut-off service.

.8 *Provide* flow controls in water recirculating systems where indicated.

3.5 DISINFECTION OF DOMESTIC WATER PIPING SYSTEM

.1 Prior to starting work, verify the system is complete and clean.

.2 Flush and disinfect all new and/or reworked domestic water piping after leakage is complete.

.3 *Provide* connections and pumps as required. Flush piping until all foreign materials have been removed and the flushed water is clear. Open and close valves, faucets, hose outlets, and service connections to ensure thorough flushing.

.4 Ensure Ph of water to be treated is between 7.4 and 7.6 by adding alkali (caustic soda or soda ash) or acid (hydrochloric).

.5 When flushing is complete, disinfect the piping with a solution of chlorine in accordance with AWWA C601. Inject disinfectant, free chlorine in liquid, powder, tablet or gas form, throughout system to obtain 50 to 80 mg/L residual.

.6 Bleed water from outlets to ensure distribution and test for disinfectant residual at minimum 15% of outlets.

.7 Maintain disinfectant in system for twenty-four (24) hours.

.8 If final disinfectant residual tests less than 25 mg/L, repeat treatment.

.9 Flush disinfectant from system until residual equal to that of incoming water or 1.0 mg/L.

.10 When disinfecting is complete, submit water samples to a certified laboratory for purity testing. Take samples no sooner than twenty-four (24) hours after flushing, from 5% of outlets and from water entry, and analyze to AWWA C651.

.11 When testing indicates pure water in accordance with governing standards, submit a copy of the test results and fill the system.

3.6 SCHEDULES

.1 Pipe Hanger Schedule:

.1 Metal Piping:

Pipe size: 13mm to 32mm (1/2” to 1-1/4”):

.1 Maximum hanger spacing: 2m (6.5’).

.2 Hanger rod diameter: 9mm (3/8”).

Pipe size: 40mm to 50mm (1-1/2” to 2”):

.3 Maximum hanger spacing: 3m (10’).

.4 Hanger rod diameter: 10mm (3/8”).

Pipe size: 65mm to 75mm (2-1/2” to 3”):

.5 Maximum hanger spacing: 3m (10’).

.6 Hanger rod diameter: 13mm (1/2”).

Pipe size: 100mm to 150mm (4” to 6”):

.7 Maximum hanger spacing: 3m (10’).

.8 Hanger rod diameter: 15mm (5/8”).

Pipe size: 200mm to 300 mm (8” to 12”):

.9 Maximum hanger spacing: 4.25m (14’).

.10 Hanger rod diameter: 22mm (7/8”).

Pipe size: 350mm and Over (14” and Over):

.11 Maximum hanger spacing: 6m (20’).

.12 Hanger rod diameter: 25mm (1”).

.2 Plastic Piping:

All Sizes:

.1 Conform to pipe manufacturer’s recommended support spacing.

.2 Hanger rod diameter: 9mm (3/8”).

3.7 SERVICE CONNECTIONS

.1 *Provide* new sanitary sewer services. Before commencing work check invert elevations required for sewer connections, confirm inverts and ensure that these can be properly connected with slope for drainage and cover to avoid freezing.

.2 *Provide* new water service complete with approved reduced pressure backflow preventer and water meter with by-pass valves pressure reducing valve.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

- .1 Roof and floor drains.
- .2 Floor drain trap seal primers.
- .3 Cleanouts.
- .4 Hose bibs.
- .5 Hydrants.
- .6 Backwater valves.
- .7 Water hammer arrestors.
- .8 Oil Interceptor.
- .9 Thermostatic mixing valves.
- .10 Backflow preventers.

PART 2 PRODUCTS

2.1 ROOF DRAINS

.1 Aluminum or galvanized cast iron drain with sump, removable cast aluminum, coated cast iron or cast bronze domed strainer with vandal proof screws and including the following accessories.

- .1 Membrane flange and membrane clamp with integral gravel stop.
- .2 Adjustable under deck clamp.
- .3 Roof sump receiver.
- .4 Waterproofing flange.
- .5 Levelling frame.
- .6 Adjustable extension sleeve for roof insulation.
- .7 Perforated or slotted ballast guard extension for inverted roof.
- .8 Perforated stainless steel ballast guard extension.
- .9 Control flow weir, in locations shown on drawings denoted as ‘CFRD’, for number of weirs shown on drawing.
- .10 Plastic components are not acceptable.
- .11 *Provide* drains by single manufacturer throughout.
- .12 Acceptable Manufacturers:
  - .1 Zurn.
  - .2 Lexcor.

.3 Jay R. Smith.

.4 Mifab.

.5 Watts.

2.2 FLOOR DRAINS AND SHOWER DRAINS

.1 Unless otherwise specified or scheduled, floor drains are to be vandal-proof drains, each complete with a cast iron body and a trap seal primer connection. All cast iron components are to be factory finished with latex based paint coating.

.2 MIFAB or equal J.R. Smith, Watts or Zurn, of the following types (*Contractor* to choose applicable type. Refer also to drawings.) Selection of bronze or stainless finishes by Architect. (Refer also to drawings.)

.1 *Provide* on floor areas except as noted below, MIFAB F1100-1-5-7, 125mm dia. round nickel bronze, or F1100-3-5-7, 125mm dia. round stainless steel strainer.

.2 *Provide* on ceramic tile, quarry tile or terrazzo floor areas, MIFAB F1100-S-1-5-7, 150 x 150 mm square nickel bronze, or F1100-S-3-5-7, 150 x 150 mm square stainless-steel strainer.

.3 *Provide* on ceramic tile for a shower drain, MIFAB FD212TC-S5-49 132 x 132 mm square heavy duty polished chrome strainer.

.4 Hub drains shall be provided where indicated on the drawing(s), MIFAB F1100-DD-1-5-7, 125mm dia. round nickel bronze, or F1100-DD-3-5-7, 125mm dia. round stainless steel hub.

.5 Funnel floor drains shall be provided where indicated on the drawing(s). *Provide* next to equipment where only one (1) pipe has to relieve to drain, MIFAB F1100-EF-1-5-7, 125mm dia. round nickel bronze, or F1100-EF-3-5-7, 125mm dia. round stainless steel strainer and 100mm funnel.

.6 Funnel floor drains receiving more than one (1) pipe relief to drain, shall be revised to MIFAB F-1100-EG type, supplied with a 4” x 9” (100 x 230mm) funnel in lieu of the 100mm funnel above.

.7 All floor and funnel drains shall be complete with adjustable top assemblies, cast iron frames, sediment buckets and trap seal primmer tapings.

.8 Floor and funnel drains installed in water-proofed areas shall be revised to MIFAB F1100C type supplied with clamp collar and weep holes.

.3 Lacquered finish is standard. Use clamping collar on floors above grade. The following is a standard floor drain.

2.3 FLOOR DRAIN TRAP SEAL PRIMERS

.1 Electronic type

.1 CSA certified electronic automatic trap priming manifold, sized and located to suit the quantity of traps, complete with:

.1 16 ga. galvanized steel cabinet with door, flush recessed mounting for exposed areas and surface mounted in services areas (e.g. mechanical rooms, custodial rooms);

.2 20 mm (3/4”) dia. NPT copper pipe inlet with shut-off valve, solenoid valve, atmostpheric vacuum breaker, calibrated discharge manifold for equal water distribution, compression fitting connections to suit quantity of traps to be primed;

.3 UL certified electronic assembly including manual override / test switch, 24-hour adjustable timer, circuit breaker.

.2 Acceptable manufacturers:

.1 Precision Plumbing Products PT series;

.2 Mifab, Inc.;

.3 or approved equal.

2.4 CLEANOUTS - GENERAL

.1 Horizontal Piping: TY pipe fitting with an extra heavy brass plug screwed into the fitting.

.2 Vertical Piping: 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): 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. Acceptable products are:

.1 Zurn #ZSS-1666-1;

.2 Jay R. Smith #SQ4-1819;

.3 Mifab #C1440-RD;

.4 Watts Industries (Canada) Ltd. #CO-440.

2.5 CLEANOUTS – VEHICLE BAY

.1 Epoxy-coated cast iron floor cleanout with adjustable gasketed extra heavy duty stainless steep top, and removable gas tight gasketed brass cleanout plug. Suitable for live loads up to 10,000 pounds.

.1 Acceptable products:

.1 Watts CO-1200-RX;

.2 Or approved equal.

2.6 FLOOR CLEANOUT TERMINATIONS

.1 Factory finished cast iron terminations, each adjustable and complete with a cast iron body with neoprene sleeve, solid, gasketed, polished nickel-bronze scoriated top access cover to suit the floor finish, a seal plug, and captive, vandal-proof, stainless steel securing hardware.

.2 MIFAB or equal J.R. Smith, Watts or Zurn, of the following types (*Contractor* to choose applicable type. Selection of bronze or stainless finishes by Architect. Refer also to drawings.)

.1 *Provide* on floor areas except as noted below, MIFAB C1100-R-1-34, round nickel bronze, or C1100-R-3-34, round stainless steel access cover.

.2 *Provide* on vinyl tile floor areas, MIFAB C1100-TS-1-34, square nickel bronze, or C1100-TS-3-34,square stainless steel access cover.

.3 *Provide* on ceramic tile, quarry tile or terrazzo floor areas, MIFAB C1100-US-1-34, square nickel bronze, or C1100-US-3-34, square stainless steel recessed access cover.

.4 All floor cleanouts shall be complete with adjustable top assemblies, cast iron frames, primary gasket seals and secondary plugs.

.5 Floor cleanouts installed in water-proofed areas shall be revised to MIFAB C1100C type supplied with clamp collar and weep holes.

.6 *Provide* at the base of each vertical stacks MIFAB C1450 or C1460.

.7 *Provide* on exposed walls, accessible pipe chases and outside grade, MIFAB C1450.

.8 *Provide* on plaster walls, MIFAB C1450-RD-6.

.9 *Provide* at urinals, MIFAB C1440-RD-6 with round stainless steel access cover and neoprene plug.

.10 In plastic piping (where not terminating through building finishes), *Provide* plastic cleanouts.

.11 Access doors shall be provided as specified elsewhere in the specification.

.3 Acceptable products are:

.1 Zurn # ZN-1602-SP Series;

.2 Jay R. Smith #4020-F-C Series;

.3 Mifab # as noted above

.4 Watts Industries (Canada) Ltd. # CO-200-R-1.

2.7 INTERIOR HOSE BIBBS

.1 Flush-Concealed: Recessed, 92 mm (3 5/8") deep, recessed, encased wall hydrant with lockable bronze or stainless-steel box with hinged cover identified "WATER", bronze interior parts, a screwdriver operated stop in the supply, key operated control valve, 20 mm (¾") dia. hose connection, and a vacuum breaker. Acceptable products are:

.1 Jay R. Smith #5509QT-CL-SAP;

.2 Zurn #Z1350;

.3 Mifab #MHY-55.

.2 Semi-Recessed - Finished Areas: Anti-siphon type, 100 mm (4") deep hose bib with stainless steel face with operating key, bronze interior parts, 20 mm (¾") dia. solder inlet, 20 mm (¾") dia. hose connection, and integral vacuum breaker. Acceptable products are:

.1 Jay R. Smith #5619-SAP-98;

.2 Zurn #Z1333 "ECOLOTROL";

.3 Mifab #MHY-30. HOSE BIBS

.3 Surface - Exposed – Cold Water -Unfinished Areas: Brass or bronze hose bibb with hose end vacuum breaker. Acceptable products are:

.1 Watts Industries (Canada) Inc. #SC8-1;

.2 Zurn/Wilkins # Z1341 with hose end vacuum breaker;

.3 Chicago Faucets #293-E27CP;

.4 Jay R. Smith #5609QT-SAP.

.4 Exposed – Unfinished Areas – Hot and Cold Water: Mixing faucet for surface mounting. Acceptable products are:

.1 Delta Commercial #28T8083;

.2 Zurn #Z841L1-RC;

.3 Jay R. Smith #5560QT-LB-SAP.

2.8 EXTERIOR NON-FREEZE WALL HYDRANTS

.1 Flush-Concealed: Recessed, encased, self-draining hydrants, each complete with a copper casing, operating rod assembly to suit the wall thickness, polished nickel bronze box with hinged locking cover, 20 mm (¾") dia. threaded hose connection outlet, vacuum breaker, and a loose tee handle operating key. Acceptable products are:

- .1 Jay R. Smith #5519-98;
- .2 Zurn #Z1320;
- .3 Mifab #MHY-26.

2.9 BACKWATER VALVES

.1 Heat bonded powder epoxy coated cast iron in-line type, each complete with a bolted and gasketed cover, bronze flapper, stainless steel extension, and stainless-steel hardware. Acceptable products are:

- .1 Zurn #Z-1095-15-MJ;
- .2 Jay R. Smith #7022.

2.10 WATER HAMMER ARRESTORS.

.1 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 the diameter of the pipe in which the arrestor is required. Acceptable products are:

- .1 Zurn #Z1705;
- .2 Precision Plumbing Products Inc. #SC;
- .3 Watts Industries (Canada) Inc.;
- .4 Mifab MWH Series.

2.11 OIL INTERCEPTOR

.1 Oil interceptor with extra heavy duty cover and extension as required. Acceptable products are:

- .1 Watts Drainage OI-525-X

2.12 THERMOSTATIC MIXING VALVES.

.1 Chrome plated cast brass body, stainless steel or copper alloy bellows, integral temperature adjustment, check valve on inlets, volume control shut-off valve on outlet, stem thermometer on outlet and strainer stop checks on inlets.

- .1 Watts or equal manufacturer.

2.13 BACKFLOW PREVENTER

.1 Reduced pressure zone dual check valve design backflow preventers in accordance with CAN/CSA B64 (including supplements), each of bronze or epoxy coated cast iron bronze fitted construction depending on size, and complete with inlet strainer, inlet and outlet shut-off valves, an intermediate relief valve, ball valve type test cocks, and a proper air gap fitting. Acceptable products are:

.1 Watts Industries #009QT-S for 12 mm (½") size, #909QT-S for 20 mm to 50 mm (¾" to 2") size, and #909-NRS-S for 65 mm (2½") and larger size;

.2 Zurn/Wilkins 975XL and 375 Series;

.3 Conbraco Industries Inc. Series 40-200;

.4 Danfoss Flomatic Corp. Series RPZ. SUMPS

PART 3 EXECUTION

3.1 INSTALLATION

.1 Roof Drains

.1 Supply roof drains and place roof drain bodies in position for flashing into roof construction as part of the roofing work. Connect with piping and *Provide* accessories.

.2 Protect roof drains from damage and entrance of debris until roofing work is complete and refinish any areas where the cast iron factory finish has been damaged or removed, including rusted areas.

.2 Floor Drains

.1 *Provide* floor drains where shown on the drawings. Confirm the exact location of drains prior to roughing in.

.2 Equip each drain with a trap.

.3 In equipment rooms and similar areas, exactly locate floor drains to suit the location of mechanical equipment and equipment indirect drainage piping. In washrooms, exactly locate floor drains to avoid interference with toilet partitions.

.4 Temporarily plug and cover floor drains during construction procedures. Remove plugs and covers during final cleanup work and when requested, demonstrate free and clear operation of each drain. Replace any damaged grates and refinish any areas of the drain where the cast iron finish has been damaged or removed, including rusted areas.

.3 Cleanouts

.1 *Provide* cleanouts in drainage piping in locations as follows:

.1 in the building drain or drains as close as possible to the inner face of the outside wall, and, if a building trap is installed, locate the cleanout on the downstream side of the building trap;

.2 at or as close as practicable to the foot of each drainage stack;

.3 at maximum 15 m (50') intervals in horizontal pipe 100 mm (4") dia. and smaller;

.4 at maximum 30 m (100') intervals in horizontal pipe larger than 100 mm (4") dia.;

.5 in the wall at each new urinal or bank of urinals in a washroom;

.6 wherever else shown on the drawings.

.2 Cleanouts are to be the same diameter as the pipe in piping to 100 mm (4") dia., and not less than 100 mm (4") dia. in piping larger than 100 mm (4") dia.

.3 Where cleanouts in vertical piping are concealed behind walls or partitions, install the cleanouts near the floor and so that the cover is within 25 mm (1") of the finished face of the wall or partition.

.4 Floor Cleanout Terminations

.1 Where cleanouts occur in horizontal inaccessible underground piping, extend the cleanout TY fitting up to the floor, and *Provide* a cleanout termination set flush with the finished floor.

.2 In waterproof floors, ensure that each cleanout termination is equipped with a flashing clamp device. Cleanout terminations are to suit the floor finish.

.3 Where cleanout terminations occur in finished areas, confirm locations prior to rough-in and arrange piping to suit.

.4 Ensure that cleanout termination covers in tiled floor are square in lieu of round.

.5 Hose Bibbs

.1 *Provide* hose bibbs where shown and/or specified on the drawings.

.2 Unless otherwise shown, specified, or required, mount hose bibbs approximately 1 m (3') above the floor. Confirm exact locations prior to roughing-in.

.6 Exterior Non-Freeze Wall Hydrants

.1 *Provide* non-freeze wall hydrants where shown.

.2 Install hydrants level and plumb such that hose outlets are approximately 600 mm (2') above grade level. Confirm exact locations prior to roughing-in.

.3 *Provide* a shut-off valve inside the building to each exterior non-freeze wall hydrant.

.4 *Provide* sign “Non potable water – do not drink”

.7 Backwater Valves

.1 *Provide* backwater valves in drainage piping where shown on the drawings and connect with piping as indicated.

.8 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 the 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 the manufacturer’s published instructions and details.

.9 Thermostatic Mixing Valves

.1 *Provide* a domestic hot water thermostatic mixing valves at DHW tanks and as required by local code.

.2 Adjust each valve to design requirements and check and test operation. Set maximum temperature limit stops.

.10 Backflow Preventers

.1 *Provide* a backflow preventer on incoming DCW incoming service and in each direct domestic cold water connection to equipment other than plumbing fixtures and fittings. Backflow preventers are not required at fixtures connected to non-potable water.

.2 Locate each backflow preventer on floor or wall between 765 mm and maximum 1.5 m (30" and 60") above the floor such that it is easily accessible for maintenance and testing. Equip each backflow preventer with an air gap fitting and pipe the reduced pressure zone water outlet to drain.

.3 Test operation of each backflow preventer in accordance with requirements of CAN/CSA B64 by personnel certified for such testing by governing authorities, and submit signed test results and a properly and clearly identified and marked inspection and test record card for each backflow preventer.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

.1 Water closets.

.2 Lavatories.

.3 Sinks.

.4 Service sinks.

.5 Showers.

.6 Eye wash fountains.

1.3 SUBMITTALS

.1 *Shop Drawings* / *Product* Data

.1 Submit shop drawings / product data for all plumbing fixtures and fittings that confirm the proposed products meet all requirements of this Section. *Provide* catalogue illustrations of fixtures, sizes, rough-in dimensions.

.2 Maintenance Material Submittals

.1 Maintenance and extra material requirements.

.2 Spare Parts: Supply two (2) sets of faucet washers, flush valve service kits.

PART 2 PRODUCTS

2.1 GENERAL: PLUMBING FIXTURES AND FITTINGS

.1 Plumbing fixtures and fittings shall be in accordance with the requirements of CAN/CSA B45 Series, General Requirements for Plumbing Fixtures, including all supplements.

.2 Supply and install all barrier-free fixtures and fittings in accordance with governing code requirements.

.3 All vitreous china, porcelain enameled, and acrylic fixtures shall be white unless otherwise specified.

.4 All fittings and exposed piping shall be chrome plated and polished unless otherwise specified.

.5 All fitting shall be vandal-proof unless located in a private washroom.

.6 Fixture carriers shall be suitable for the fixture they support and the wall construction in which they are installed.

.7 Floor flanges for floor mounted water closets shall be cast iron or brass construction and shall be secured to the floor to prevent movement. Furnish with wax seal and brass or stainless steel nuts, bolts, and washers. Plastic floor flanges are not acceptable.

.8 Exposed traps for fixtures not equipped with integral traps shall be fitted with adjustable chrome plated cast brass ‘P’ traps complete with cleanouts. *Provide* minimum 17 gauge, chrome plated tubular extension compete with chrome escutcheon.

.9 Concealed traps for fixtures not equipped with traps shall be cast brass complete with cleanout plugs.

.10 Exposed fixture supplies for fixtures not equipped with integral stops shall be solid chrome plated brass angle valves with loose key stops for public areas and wheel stops for private areas, flexible stainless steel risers and stainless steel or chrome plated steel escutcheons.

.11 Concealed fixture supplies for fixtures not equipped with integral stops shall be as specified with the water piping.

2.2 PLUMBING FIXTURES AND FITTINGS

.1 *Provide* plumbing fixtures and fittings as listed on Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verify existing conditions before starting work.

.2 Verify that walls and floor finishes are prepared and ready for installation of fixtures.

.3 Verify that electric power is available and of the correct characteristics.

.4 Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.2 PREPARATION

.1 Rough-in fixture piping connections to minimum sizes indicated Drawings for the respective fixture. Confirm exact location of all plumbing fixtures and trim prior to roughing in. Refer to architectural plans and elevations for mounting heights.

3.3 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Install each fixture with trap, easily removable for servicing and cleaning.

.3 Install components level and plumb.

.4 Install and secure fixtures in place with wall carriers and bolt, washer, nut fasteners.

.5 Install barrier free fixtures in compliance with governing codes.

.6 Supply templates for all counter-mounted fixtures and trim to the trades responsible for cutting the counters. Verify openings are properly located.

.7 Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 92 00, colour to match fixture.

.8 Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

.9 Located control panels for electronic faucets under lavatories and recessed into the wall. Coordinate location and installation with electrical trades who will *Provide* power to the panels. Install cord from faucet in flexible conduit from the faucet to the control box. Make complete hot, cold, and tempered water connections and set mixing valve temperature limit stops to 43°C (110°F). Verify each controller is functioning properly and water shuts off after 3 seconds from deactivation.

.10 Locate electronic flush valve transformers in the ceiling space above the flush valves being served. Coordinate location and installation with electrical trades who will *Provide* power to the panels. *Provide* low voltage wiring from the controller to each electronic flush valve. All line and low voltage wiring shall be concealed. Maintain access to transformer for servicing.

.11 Protect bathtubs and shower bases from damage during construction until final clean. Pack concealed voids under bathtubs with mineral wool insulation.

.12 Confirm exact showerhead and mixing valve locations with architect prior to roughing in.

.13 *Provide* roughed-in water and drain connections for *Owner*-supplied dishwasher consisting of a 13mm (1/2”) domestic hot water connections with valve as specified with the water piping, complete with a water hammer arrestor, a 40mm (1-1/2”) diameter DWV copper drain connection with ‘P’ trap and cleanout plug.

.14 *Provide* roughed-in water and drain connections for *Owner*-supplied clothes washer consisting of a recessed supply box with supply valves and waste drain equal to Oatey Metal 20 gauge steel laundry box complete with 13mm (1/2”) piping connections for both hot and cold water terminated at a 1/4 turn brass hammer ball valve, a 50mm (2”) drain opening to receive clothes washer discharge pipe.

3.4 INTERFACE WITH OTHER PRODUCTS

.1 Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.5 ADJUSTING

.1 Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

.1 Clean installed work.

.2 Clean plumbing fixtures and equipment.

3.7 PROTECTION OF FINISHED WORK

.1 Protect installed work.

.2 Do not permit use of fixtures.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

  .1 Water heaters.

  .2 Pumps.

.2 Related Sections

  .1 Section 20 05 00 – Mechanical General Provisions.

  .2 Section 22 10 00 – Plumbing Piping.

  .3 Section 22 41 01 – Plumbing Specialties.

  .4 Section 22 42 02 – Plumbing Fixtures.

1.3 SUBMITTALS

.1 *Shop Drawings* / *Product* Data

  .1 Submit shop drawings/product data sheets for all products specified in this Section.

.2 Maintenance Material Submittals

  .1 Spare Parts: *Provide* two (2) pump seals for each pump installed.

PART 2 PRODUCTS

2.1 COMMERCIAL HEAT PUMP WATER HEATERS

.1 CSA-certified electric hot water heater with model number and performance as specified on the drawings, and complete with:

  .1 a 1035 kPa (150 psi) rated (working pressure) steel tank, glass lined, insulated (except for control panel area) with injected minimum 50 mm non-CFC foam insulation, covered with an enamelled steel jacket, and equipped with 20 mm (3/4”) dia. inlet and outlet water connections, a drain valve, and sacrificial anode rod;

  .2 removable multiple immersion heating elements;

  .3 temperature and pressure relief valve;

  .4 factory prewired power and control panel.

.2 Acceptable Manufacturers:

  .1 Rheem Manufacturing Company;

  .2 A.O. Smith Corporation;

  .3 Or approved equal.

2.2 HOT WATER RECIRCULATING PUMPS

.1 Corrosion resistant casing with integral flow check, composite impeller, composite cartridge, ceramic shaft, EPDM O-ring, 20 mm (3/4") dia. NPT shut-off flange, under-cabinet mounting with hard wire push button operation.

.2 Acceptable Manufacturers:

.1 Taco

.2 Wilo

.3 Or approved equal

PART 3 EXE\CUTION

3.1 INSTALLATION

.1 Commercial Heat Pump Water Heater

.1 *Provide* water heater where shown.

.2 Secure the heater in place, level and plumb, complete with vibration/seismic isolation as recommended by vibration/seismic designer, on a concrete housekeeping pad, and:

.1 pipe the temperature/pressure relief valve outlet to nearby drain with air gap;

.2 pipe the condensate to nearby drain with air gap;

.3 pipe the drain valve outlet to nearby drain with air gap;

.4 coordinate installation with the electrical trade who will connect the heater with power wiring.

.3 *Provide* and set a thermostatic mixing valve to produce 48.8°C (120°F) hot water.

.4 *Provide* flexible piping connectors at the heat pump water heater to reduce vibration transmission to system piping.

.5 *Provide* heat traps in the water piping feed to the domestic hot water system. The trap shall consist of an arrangement of pipe fittings, such as elbows, connected so that the piping makes vertically upward runs just before turning downward to connect to the domestic hot water system.

.6 Connect ductwork as shown on drawings to water heater with duct connection kits provided by manufacturer, complete with flexible duct connectors at the heat pump to reduce vibration transmission to the ductwork system.

.2 Hot Water Recirculating Pumps

.1 *Provide* electric hot water recirculating pumps where shown.

.2 Secure the pump in place horizontally inside the finish millwork and below the height of the fixture served by the pump.

.3 Connect the shut-off flanges to the recirculating pump and the supply tees to the shut-off flanges with flexible supply lines.

.4 Coordinate installation with the electrical trade who will connect the heater with power wiring.

.5 Install the manual start button in a location approved by the *Consultant*.

.3 Equipment and System Manufacturer's Certification:

.1 Refer to the article entitled Equipment and System Manufacturer’s Certification in the mechanical work Section entitled Mechanical *Work* General Instructions.

.4 Start-Up:

.1 Refer to the article entitled Equipment and System Start-up in the mechanical work Section entitled Mechanical *Work* General Instructions.

.5 Demonstration and Training:

.1 Refer to the article entitled Equipment and System O&M Demonstration & Training in the mechanical work Section entitled Mechanical *Work* General Instructions. Include for a one-half day on-site operation demonstration and training session. The 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

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

- .1 Flexible pipe connectors.
- .2 Expansion joints and compensators.
- .3 Pipe loops, offsets, and swing joints.

.2 Related Sections

- .1 Section 21 11 00 - Fire Protection Piping.
- .2 Section 22 10 00 - Plumbing Piping.
- .3 Section 23 23 00 - Refrigerant Piping And Specialties.

1.3 PERFORMANCE REQUIREMENTS

.1 *Provide* structural work and equipment required to control expansion and contraction of piping. Verify that anchors, guides, and expansion joints provided, adequately protect system.

- .1 Expansion Calculations:
  - .1 Installation Temperature: <10 degrees C (50 degrees F).
  - .2 Hot Water Heating: 99 degrees C (210 degrees F).
  - .3 Domestic Hot Water: 60 degrees C (140 degrees F).
  - .4 Safety Factory: 30%.

1.4 SUBMITTALS FOR REVIEW

.1 Flexible Pipe Connectors: Indicate maximum temperature and pressure rating, face-to-face length, live length, hose wall thickness.

.2 Expansion Joints: Indicate maximum temperature and pressure rating, and maximum expansion compensation.

1.5 SUBMITTALS FOR INFORMATION

.1 Design Data: Indicate selection calculations.

.2 Installation Data: Indicate special procedures, and external controls.

1.6 CLOSEOUT SUBMITTALS

.1 Record Documentation: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides Installation Data: Indicate special procedures, and external controls.

.2 Maintenance Data: Include adjustment instructions.

1.7 QUALITY ASSURANCE

.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum [three (3)] years [documented] experience.

.2 Design expansion compensating system under direct supervision of a Professional Structural Engineer experienced in design of this *Work* and licensed at the place where the *Project* is located.

PART 2 PRODUCTS

2.1 FLEXIBLE PIPE CONNECTORS

.1 High Temperature:

- .1 Double braided, heat resistant, up to 200°C bronze braid, up to 230°C stainless steel braid.
- .2 Chemically inert and resistant to steam and moisture.
- .3 Capacity to absorb 150 mm with length across flexible portion not less than six diameters.
- .4 Manufacturers:
  - .1 Anaconda, Flexonics

2.2 EXPANSION JOINTS

.1 Stainless Steel Bellows Type:

- .1 For axial, lateral or angular movements. Bellows type, corrugated, packless.
- .2 Designed for maximum operating pressure and temperature of 2068 kPa and 200°C.
- .3 Internal stainless steel guide sleeves. External machined cast-iron control rings, full circumference. With external guide rods and flanged ends.
- .4 Manufacturers
  - .1 Adsco, Anaconda, Flexonics, Hydro-Flex, Tube Turns, United Flexible, Vibra-Flo.

2.3 EXPANSION COMPENSATORS

.1 Copper Pipe Expansion Compensator - Low Pressure

- .1 Bronze or stainless-steel convoluted bellows.
  - .1 suitable for 415 kPa working pressures.
  - .2 19 mm to 32 mm diameter, suitable for 12 mm compression and 6.0 mm extension.
- .2 Steel Pipe Expansion Compensator.
  - .1 Factory assembled unit, with stainless steel or phosphor bronze in carbon steel casing. Antitorque groove in casing, internal pipe guide at both ends, full length internal liner. Suitable for 1,034 kPa operating pressure. Suitable for 38 mm compression and 6.0 mm extension.
  - .2 Acceptable Products:
    - .1 Adsco Manufacturing Corporation
    - .2 Senior Flexonics Canada
    - .3 Flextech Industries Incorporated
    - .4 Hydroflex Hose Limited

.5 Metraflex Piping System Solutions

2.4 ACCESSORIES

.1 Anchors:

.1 Anchors shall be fabricated from mild steel plate and structural steel angle and channel

.2 sections, in accordance with ANSI B.31

.3 Anchors shall securely attach piping to structural members. Size anchors to accommodate forces due to pipe expansion and weight.

.4 Where bolts secure anchor to structure, weld bolts to plate. Arrange anchors so that bolts are in shear not in tension.

.5 *Provide* anchors on both sides of expansion devices, as indicated on drawings, and as required to control flexing of the piping system

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Ensure that piping is properly aligned through expansion joint, over full travel.

.3 Be aware of temperature when expansion compensator is installed to properly establish the length

.4 Locate expansion joint centrally between anchors and position guides to Manufacturer’s specific

.5 requirement. *Provide* structure as required to properly mount guides

.6 Construct spool pieces to exact size of flexible connection for future insertion.

.7 Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. *Provide* line size flexible connectors.

.8 Install flexible connectors at right angles to displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.

.9 Rigidly anchor pipe to building structure where necessary. *Provide* pipe guides so movement is directed along axis of pipe only. Erect piping such that strain and weight is not on cast connections or apparatus.

.10 *Provide* support and equipment required to control expansion and contraction of piping. *Provide* loops, pipe offsets, and swing joints, or expansion joints where [required] [indicated].

.11 *Provide* victaulic piping with minimum one joint per 25 mm (1 inch) pipe diameter instead of flexible connector supported by vibration isolation. Victaulic piping need not be anchored.

.12 *Provide* expansion loops as indicated on drawings.

3.2 MANUFACTURER'S FIELD SERVICES

.1 *Provide* inspection services by flexible pipe manufacturer's representative for final installing and certify installation is to manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

- .1 Pressure gauges and Pressure gauge taps.
- .2 Thermometers and thermometer wells.
- .3 Test plugs and kits.
- .4 Static pressure gauges.

1.3 REFERENCES

.1 Reference Standards

- .1 ASME B40.100-2013 - Pressure Gauges and Gauge Attachments.
- .2 ASTM E1-13 - Standard Specification for ASTM Liquid-in-Glass Thermometers.
- .3 ASTM E77-07 - Standard Test Method for Inspection and Verification of Thermometers.

1.4 SUBMITTALS

.1 Submittals for review

- .1 Submit shop drawings in accordance with Section 20 05 00 – Mechanical General Provisions.
- .2 *Product* Data: Submit manufacturer's instructions, printed product literature and data sheets for thermometers and pressure gauges and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Close-Out Submittals

- .1 Operation and Maintenance Data: Submit maintenance data including monitoring requirements for incorporation into manuals

1.5 ENVIRONMENTAL REQUIREMENTS

.1 Do not install instrumentation when areas are under construction, except for required rough-in, taps, supports and test plugs.

1.6 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.2 Storage and Handling Requirements:

- .1 Store thermometers and pressure gauges off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect thermometers and pressure gauges from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

PART 2 PRODUCTS

2.1 PRESSURE GAUGES

.1 Manufacturers:

.1 H. O. Trerice Co.

.2 Weiss Instruments

.3 Ashcroft

.2 Gauges:

.1 Adjustable, glycerine filled, 100 mm or 115 mm (4" or 4½") diameter, complete with a type 304 stainless steel case with relief valve and polished stainless steel bayonet, stainless steel rotary movement with stainless steel bushings and socket, a clear acrylic window, a dual scale white dial with a scale range such that the working pressure of the system is at the approximate mid-point of the scale, and black pointer.

.2 Accuracy to be +/- 1% of full scale.

.3 On all pumps liquid filled gauges shall be utilized.

.4 A bronze ball type shut-off valve is to be provided in the piping to each pressure gauge.

.5 Each pressure gauge for piping and equipment with normal everyday flow is to be equipped with a brass pressure snubber.

.6 Materials regardless of specification shall be compatible with system requirements and media.

.7 Gauges shall have combined kPa and psi scales.

.8 All pressure gauges shall comply with the requirements outlined in ASME B40.1. Manufactures shall *Provide* valid CRN registration numbers for the appropriate governing province.

.9 Pressure gauges in fire protection piping must be ULC listed and labelled.

2.2 THERMOMETERS

.1 Manufacturers:

.1 H. O. Trerice Co.

.2 Weiss Instruments

.3 Ashcroft

.2 Direct Reading Thermometers

.1 Round, 125 mm (5") diameter, adjustable (90°) angle bimetal dial type thermometers, complete with a hermetically sealed stainless steel case with stainless steel ring, dampened bimetal coil, calibration adjustment screw, white aluminum dual scale dial with black and blue markings and a range such that the working temperature of the system is the approximate mid-point of the scale, black aluminum pointer, double strength glass window, 12 mm (½") NPT connection with 6.4 mm (¼") diameter stainless steel stem, and a suitable thermowell.

.2 Accuracy to be +/- 1% of full scale.

.3 Scale shall be suitable for 2 times the temperature range of service. Scale shall be combined Celsius and Fahrenheit.

.4 Thermometer shall be fully adjustable to *Provide* full 360 degree positioning on the vertical axis and 180 degree rotation on the horizontal axis. The thermometer shall be able to be locked into any position along this arc.

.5 All thermometers and thermowells shall comply with all aspects of ASME B40.8 including internal thermowell dimensions.

.3 Remote Reading Thermometers

.1 Dial size shall be 4 ½" (112mm) with black and red markings.

.2 Casing shall be aluminum with polycarbonate lens.

.3 Pointer to be anodized black pointer.

.4 Internals shall be phosphor bronze tube, brass movement.

.5 Connection shall be brass 7/16" OD x 2" insertion depth brass bulb. Operating range shall be 75% of full scale range.

.6 Capillary length will be a minimum of 5 feet in length, with brass braiding to *Provide* mechanical protection of the capillary.

.7 *Provide* with 5 feet of double braided bronze armor over copper capillary. Care shall be taken to ensure that the capillary tube is not located in areas of extreme temperatures.

.8 *Provide* with ½" NPT removable brass union connection. Thermometer shall be designed as a sealed system for easy replacement of the thermometer without the need for shut down or drain the system. A proper brass thermowell is required.

.9 Thermometer shall be gas filled accuracy to be 0.5% of full scale.

.10 All thermometers and thermowells shall comply with the requirements outlined in ASME B40.4.

2.3 THERMOWELLS

.1 Copper pipe: copper or bronze.

.2 Steel pipe: brass.

2.4 THERMOMETER TEST WELLS

.1 ¾" NPT female connection brass test well.

.2 Test well to be provided with cap and chain.

.3 Test well to be provided for future installation of thermometer specified above.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Pressure Gauges:

.1 *Provide* in the following locations:

.1 In valved tubing across the suction, suction strainer (if applicable), and discharge piping of each circulating pump;

.2 In the supply and return piping connections to main mechanical plant equipment such as boilers, chillers, heat exchangers, main coils, etc.;

.3 In separate domestic hot water storage tank(s);

.4 In piping at each side of a pressure reducing valve;

.5 In potable water service piping downstream of the meter;

.6 Wherever else shown and/or specified on the drawings or in the Specification.

.2 Install to manufacturer's written instructions.

.3 For pressure gauges in piping at equipment locations, install the pressure gauge between the equipment and the first pipe fitting.

.4 Locate, mount and adjust all instruments so they are easily readable from floor or platform.

.5 Where gauges are located at high level or in an area where they cannot be easily seen, *Provide* remote reading instruments.

.6 Install gauge cocks for balancing purposes, elsewhere as indicated.

.7 Use extensions where pressure gauges are installed through insulation.

.2 Thermometers:

.1 *Provide* in the following locations:

.1 In supply and return piping connections to main mechanical plant equipment such as boilers, chillers, cooling towers, heat exchangers, main coils, etc., unless temperature indication is supplied with the equipment;

.2 Wherever else shown and/or specified on the drawings or in the Specification.

.2 Install to manufacturer's written instructions.

.3 Locate, mount and adjust all instruments so they are easily readable from floor or platform.

.4 Where gauges are located at high level or in an area where they cannot be easily seen, *Provide* remote reading instruments.

.5 Install in wells on piping.

.6 Thermometer shall be designed as a sealed system to allow for easy replacement of the thermometer without the need to shut down or drain the system.

.7 *Provide* thermal grease in the well to ensure good heat transfer between the

.8 thermometer probe and the well. Include heat conductive material inside well.

.9 Install wells as indicated only for balancing purposes.

.10 Use extensions where thermometers are installed through insulation.

.3 Protection:

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by thermometer and gauge installation.

3.2 IDENTIFICATION

.1 Locate engraved lamacoid nameplate as specified in Section Identification, identifying medium adjacent to thermometers and gauges.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

.2 Where requirements of this section contradict requirements of section 23 05 48 Sound and Vibration Controls for HVAC Piping and Equipment, section 23 05 48 shall govern.

1.2 SUMMARY

.1 Section Includes

- .1 Pipe and equipment hangers and supports.
- .2 Equipment bases and supports.
- .3 Sleeves and seals.
- .4 Flashing and sealing equipment and pipe stacks.

1.3 SUBMITTALS

.1 Submittals for Review

- .1 *Product* Data: *Provide* manufacturers catalogue data including load capacity.
- .2 *Shop Drawings*: Indicate system layout with location and detail of trapeze hangers.

1.4 REGULATORY REQUIREMENTS

.1 Conform to applicable code for support of plumbing and hydronic piping.

.2 Supports for Sprinkler Piping: To NFPA 13.

.3 Supports for Standpipes: To NFPA 14.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

.1 Acceptable Manufacturers:

- .1 E. Myatt & Co. Inc.;
- .2 Anvil International Inc.;
- .3 Empire Tool & Mfg. Co. Inc.;
- .4 Hunt Manufacturing Ltd. ;
- .5 Unistrut Canada Ltd.
- .6 Nibco Inc. “Tolco”;
- .7 Taylor Pipe Supports.

.2 Fire Protection Piping:

- .1 Conform to NFPA 13 and NFPA 14.
- .2 Hangers for Pipe Sizes 13 to 38 mm: carbon steel, adjustable swivel, split ring.

.3 Hangers for Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.

.4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

.5 Wall Support for Pipe Sizes to 80 mm: Cast iron hook.

.6 Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.

.7 Vertical Support: Steel riser clamp.

.8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

.3 Plumbing Piping - DWV:

.1 Conform to ASME B31.9.

.2 Hangers for Pipe Sizes 13 to 38 mm: Carbon steel, adjustable swivel, split ring.

.3 Hangers for Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.

.4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

.5 Wall Support for Pipe Sizes to 80 mm: Cast iron hook.

.6 Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.

.7 Vertical Support: Steel riser clamp.

.8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

.4 Plumbing Piping - Water:

.1 Conform to ASME B31.9.

.2 Hangers for Pipe Sizes 13 to 38 mm: Carbon steel, adjustable swivel, split ring.

.3 Hangers for Cold Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.

.4 Hangers for Hot Pipe Sizes 50 to 100 mm: Carbon steel, adjustable, clevis.

.5 Hangers for Hot Pipe Sizes 150 mm and Over: Adjustable steel yoke, cast iron roll, double hanger.

.6 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

.7 Multiple or Trapeze Hangers for Hot Pipe Sizes 150 mm and Over: Steel channels with welded spacers and hanger rods, cast iron roll.

.8 Wall Support for Pipe Sizes to 80 mm: Cast iron hook.

.9 Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.

.10 Wall Support for Hot Pipe Sizes 150 mm and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

.11 Vertical Support: Steel riser clamp.

.12 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.13 Floor Support for Hot Pipe Sizes to 100 mm: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.14 Floor Support for Hot Pipe Sizes 150 mm and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

.15 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

.5 Hydronic Piping:

.1 Conform to ASME B31.9.

.2 Hangers for Pipe Sizes 13 to 38 mm: Carbon steel, adjustable swivel, split ring.

.3 Hangers for Cold Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.

.4 Hangers for Hot Pipe Sizes 50 to 100 mm: Carbon steel, adjustable, clevis.

.5 Hangers for Hot Pipe Sizes 150 mm and Over: Adjustable steel yoke, cast iron roll, double hanger.

.6 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

.7 Multiple or Trapeze Hangers for Hot Pipe Sizes 150 mm and Over: Steel channels with welded spacers and hanger rods, cast iron roll.

.8 Wall Support for Pipe Sizes to 80 mm: Cast iron hook.

.9 Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.

.10 Wall Support for Hot Pipe Sizes 150 mm and Over: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.

.11 Vertical Support: Steel riser clamp.

.12 Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.13 Floor Support for Hot Pipe Sizes to 100 mm: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.14 Floor Support for Hot Pipe Sizes 150 mm and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.

.15 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

.6 Refrigerant Piping:

.1 Conform to ASME B31.5.

.2 Hangers for Pipe Sizes 13 to 38 mm: Carbon steel adjustable swivel, split ring.

.3 Hangers for Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.

.4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

.5 Wall Support for Pipe Sizes to 80 mm: Cast iron hook.

.6 Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.

.7 Vertical Support: Steel riser clamp.

.8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

.7 Natural Gas Piping:

.1 Conform to ASME B31.9.

.2 Hangers for Pipe Sizes 13 to 38 mm: Carbon steel, adjustable swivel, split ring.

.3 Hangers for Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.

.4 Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

.5 Wall Support for Pipe Sizes to 80 mm: Cast iron hook.

.6 Wall Support for Pipe Sizes 100 mm and Over: Welded steel bracket and wrought steel clamp.

.7 Vertical Support: Steel riser clamp.

.8 Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

.9 Copper Pipe Support: Carbon steel ring, adjustable, copper plated.

2.2 ACCESSORIES

.1 Hanger Rods: Mild steel threaded both ends, threaded one end, or continuous threaded.

2.3 INSERTS

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

2.4 FLASHING

.1 Metal Flashing: 0.50 mm (26 ga) galvanized steel.

.2 Metal Counterflashing: 0.80 mm (22 ga) galvanized steel.

.3 Lead Flashing:

.1 Waterproofing: 24.5 kg/sq m (5 lb/sq ft) sheet lead.

.2 Soundproofing: 5 kg/sq (1 lb/sq ft) sheet lead.

.4 Flexible Flashing: 1.2 mm (47 mil) thick sheet compatible with roofing.

.5 Caps: Steel, 0.8 mm (22 ga) minimum; 1.5 mm (16 ga) at fire resistant elements.

2.5 EQUIPMENT CURBS

.1 Fabrication: Welded 1.2 mm (18 gauge) galvanized steel shell and base, mitred 80 mm (3 inch) cant, variable step to match root insulation 38 mm thick insulation, factory installed wood nailer.

2.6 SLEEVES

.1 Sleeves for Pipes Through Non-fire Rated Floors: 1.2 mm thick (18 gauge) galvanized steel.

.2 Sleeves for Pipes Through Non-fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 1.2 mm thick (18 gauge) galvanized steel.

.3 Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals.

.4 Sleeves for Round Ductwork: Galvanized steel.

.5 Sleeves for Rectangular Ductwork: Galvanized steel or wood.

.6 Firestopping Insulation: Glass fibre type, non-combustible.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install components to manufacturer's written instructions.

3.2 INSERTS

.1 *Provide* inserts for placement in concrete formwork.

.2 *Provide* inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

.3 *Provide* hooked rod to concrete reinforcement section for inserts carrying pipe over 100 mm.

.4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

.5 Where inserts are omitted, drill through concrete slab from below and *Provide* through-bolt with recessed square steel plate recessed into slab.

3.3 PIPE HANGERS AND SUPPORTS

.1 Size hangers to account for insulation and jacketing system. Ensure all insulation and jacketing is within the hanger. Hangers supporting piping between or under insulation and jacketing is not acceptable.

.2 Support horizontal piping as scheduled.

.3 Install hangers to *Provide* minimum 13 mm space between finished covering and adjacent work.

.4 Place hangers within 300 mm of each horizontal elbow.

.5 Use hangers with 38 mm minimum vertical adjustment.

.6 Support horizontal cast iron pipe adjacent to each hub, with 1.5 m maximum spacing between hangers.

.7 Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

.8 Where several pipes can be installed in parallel and at same elevation, *Provide* multiple or trapeze hangers.

.9 Support riser piping independently of connected horizontal piping.

.10 *Provide* copper plated hangers and supports for copper piping.

.11 Design hangers for pipe movement without disengagement of supported pipe.

.12 Prime coat exposed steel hangers and supports [as specified in Section 09 91 10]. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

3.4 EQUIPMENT BASES AND SUPPORTS

.1 *Provide* housekeeping pads of concrete, minimum 100 mm thick and extending 150 mm beyond supported equipment. Refer to Section 03 30 00.

.2 *Provide* templates, anchor bolts, and accessories for mounting and anchoring equipment.

.3 Construct supports of steel members. Brace and fasten with flanges bolted to structure.

.4 *Provide* rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING

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

.2 Flash vent and soil pipes projecting 80 mm minimum above finished roof surface with lead worked 25 mm minimum into hub, 200 mm minimum clear on sides with 600 x 600 mm sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counterflash, and seal.

.3 Flash floor drains in floors with topping over finished areas with lead, 250 mm clear on sides with minimum 910 x 910 mm sheet size. Fasten flashing to drain clamp device.

.4 Seal floor drains and mop sink drains watertight to adjacent materials.

.5 *Provide* acoustical lead flashing around ducts and pipes penetrating equipment rooms, installed to manufacturer's written instructions for sound control.

.6 *Provide* curbs for mechanical roof installations350 mm minimum high above roofing surface. Flash and counterflash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.

.7 Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 SLEEVES

.1 Set sleeves in position in formwork. *Provide* reinforcing around sleeves.

.2 Size sleeves large enough to allow for movement due to expansion and contraction. *Provide* for continuous insulation wrapping.

.3 Extend sleeves through floors 25 mm above finished floor level. Caulk sleeves.

.4 Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk air tight. *Provide* close fitting metal collar or escutcheon covers at both sides of penetration.

.5 Install chrome plated steel escutcheons at finished surfaces.

3.7 SCHEDULES

PIPE SIZE	MAX. HANGER SPACING	DIAMETER
12 - 32 mm	2 m	9 mm
38 - 50 mm	3 m	9 mm
62 - 75 mm	3 m	13 mm
100 - 150 mm	3 m	15 mm
200 - 300 mm	4.25 m	22 mm
350 and over mm	6 m	25 mm
PVC (All Sizes)	1.8 m	9 mm
C.I. Bell and Spigot (or No-Hub) and at Joints	1.5 m	

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SCOPE OF WORK

.1 All mechanical equipment ductwork and piping as noted on the equipment schedule or in the specification shall be mounted on or suspended from vibration isolators to reduce the transmission of vibration and mechanically transmitted sound to the building structure. Vibration isolators shall be selected in accordance with the weight distribution so as to produce reasonably uniform deflections. The work in this section includes, but is not limited to the following:

Vibration isolation for piping, ductwork and equipment

Equipment isolation bases

Flexible piping connections

Resilient Pipe Anchors and Guides

1.3 DEFINITIONS

.1 In this contract acoustic walls are indicated on the drawings with the alphabetic prefix “AC”, e.g. AC-1, AC-2, etc. Any wall so defined shall incorporate the noise control measures described in this Section.

.2 Products described as “approved equivalent” shall be approved by the acoustical consultant.

.3 “Active” piping is defined as piping that contains flow that typically generates noise or is connected to rotating equipment. This includes but is not limited to the following piping: Sanitary, Chilled Water, Domestic Hot and Cold Water piping.

.4 “Passive” piping is defined as piping that does not contain noise generating flow including but not limited to: fire, storm water piping.

.5 “Isolated building structure” is defined as those parts of the building described as “Noise Critical 1” in Section **Error! Reference source not found.**.

.6 References in this specification to penetrations of noise critical space or of isolation adjacent to noise critical space are, by definition, references to both the horizontal and vertical directions.

.7 Sound pressure levels are defined in octave bands as follows:

	31	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**
PNC-20	59	46	39	32	26	20	15	13	13
PNC-25	60	49	43	37	31	25	20	18	18
PNC-30	62	55	50	45	40	35	30	28	28

1.4 SUBSTITUTION AND VARIANCE

.1 Substitution of materials or details shall meet or exceed the quality of the products that are listed in these *Specifications*. Submit samples and test reports by an independent laboratory to establish suitability for the job. The acoustical consultant shall be the sole judge of any alternate materials, details or procedures proposed by the contractor.

.2 Any variance or non-compliance with these specification requirements shall be corrected by the contractor to meet with the approval of the consultant.

1.5 SUBMISSIONS

.1 *Provide* schedules of flexibly mounted equipment, referencing drawings by number.

.2 *Provide* catalogue cuts or data sheets of vibration isolators. Catalogue cuts and the accompanying schedule shall use the nomenclature defined in Part 2 of this specification. Submission to include the size of the isolator, the diameter, the height when uncompressed, the static deflection under load, the maximum allowable static deflection and the stiffness coefficient or curve. Submit diagrams or drawings indicating support point locations, the load to be carried at each support point and the type of isolator to be used at the support point.

.3 Submit shop drawings and details of equipment bases including dimensions, structural member sizes and support point locations. Submit information on the isolators supporting the base as outlined in Section .2.

  .1 Clearly indicate any equipment that is internally isolated. Information on isolators supplied with equipment shall comply with this specification.

.4 Submittals for isolation hangers shall include a drawing showing the ability of the hanger rod to swing through a 30 degree arc from side to side without contacting the cup bushing.

.5 Penetrations for fluid filled piping shall be inspected after the load of the fluid is applied. Inform the consultant when the piping will be filled, one month prior to the event.

.6 *Provide* a sample of each type isolator to be used on the project, when requested. Samples shall be provided at the same time as the shop drawings. Sample submission not required for products listed in this specification.

.7 Submit at the time of the main mechanical tender the names and qualifications of the vibration control manufacturer(s).

1.6 CONTRACTOR'S RESPONSIBILITY

.1 The *Contractor* is directly responsible for the supply, installation adjustment of vibration control equipment and work for the Mechanical Systems.

1.7 COORDINATION WITH SEALING OF PENETRATIONS

.1 Penetrations of pipes and ducts through walls or slabs bordering noise-critical spaces shall be sleeved, packed and sealed airtight as specified herein. Isolator installation and adjustment shall be coordinated with sealing of penetrations so that pipes and ductwork are properly loaded and located in the openings prior to sealing and do not later impose any load on the wall. See Part 3.6 of this Section.

.2 Refer to detail sheets in this specification for penetration details.\\

PART 2 PRODUCTS

2.1 GENERAL

.1 All spring mounts shall be equipped with levelling devices.

.2 All springs shall be colour coded stable springs.

.3 All springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.

.4 All neoprene mounts and hangers shall be colour coded.

.5 Any isolator installed outdoors or exposed to outdoor weather conditions shall be hot dipped galvanized and shall be furnished with rubber mounting sleeves for hold-down bolts to prevent any metal to metal contact.

.6 Elastomeric isolators exposed to UV light or temperatures below 0 degrees C shall be natural rubber.

2.2 PENETRATION SEALANTS

.1 Sealant material shall be in accordance with CAN/CGSB-19.21-M87. Sealant shall be non-hardening and remain resilient for the life of the building. Cured hardness shall not exceed Durometer 40. The minimum density shall be 900 kg/m3. If fire sealant is required, it shall conform with all local fire codes. Use Acoustic Sealant by Tremco, CGC Acoustic Sealant, TREMstop Acrylic Firestopping Sealant or approved equivalent.

.2 Foam backer rod shall be closed cell polyethylene and shall conform to all local fire codes.

.3 Glass or mineral fibre insulation shall have a density between 25 and 50 kg/m^3.

2.3 ACCEPTABLE ISOLATOR MANUFACTURERS

.1 All vibration control apparatus shall be furnished by a single manufacturer who has supplied isolation equipment for at least five years. The manufacturer for vibration isolation equipment shall be one of the following:

Kinetics Noise Control

Mason Industries

Vibro-Acoustics

.2 Manufacturers' model numbers are provided for reference purposes only.

2.4 SUBSTITUTION AND VARIATION

.1 Vendors not listed in Section 2.3 may be considered if they satisfy the requirements of Section 01 and meet with the approval of the acoustical consultant.

  .1 Substitution of materials or details shall meet or exceed the quality of the products that are listed in these *Specifications*. Submit samples and test reports by an independent laboratory to establish suitability for the job. The acoustical consultant shall be the sole judge of any alternate materials, details or procedures proposed by the contractor.

.2 Any variance or non-compliance with these specification requirements shall be corrected by the contractor to meet with the approval of the acoustical consultant.

2.5 NEOPRENE SLEEVES

.1 Type NS (Neoprene Sleeve) Minimum 3 mm (1/8") thick neoprene washer bushing. Neoprene shall be bridge bearing quality. Inside diameter of the hole in the bushing shall be 10% greater than the outside diameter of the bolt passing through it. Unless specified otherwise hardness shall match the Durometer of other isolators in the assembly and shall not exceed 50. Use Mason Type HG or approved equivalent.

2.6 ELASTOMERIC PADS

.1 Type WP (Waffle Pad) Waffle pads shall be minimum 8 mm thick neoprene pads ribbed or waffled on both sides. Neoprene shall be bridge-bearing quality. The pad to have a maximum Durometer of 50. Use Mason Type W or approved equivalent.

.2 Type MWP (Metal Waffle Pad sandwich) Metal Waffle Pads shall consist of two 8 mm thick ribbed or waffle neoprene pads sandwiching a 1.71 mm (16 ga) stainless steel plate. Holes in the pad assembly are shall be sleeved with neoprene isolation washers. Neoprene shall be bridge-bearing quality. The pad to have a maximum Durometer of 50. Use Mason Type MSW or approved equivalent.

2.7 ELASTOMERIC MOUNTS

.1 Type NM (Neoprene Mount). Neoprene mountings shall have a minimum static deflection of 9 mm (0.35"). All metal surfaces shall be neoprene covered and have friction pads both top and bottom. Bolt holes shall be provided on the bottom and a tapped hole and cap screw on top. Steel rails shall be used as required under equipment to ensure an even distribution of load to the mounts. Use Mason Industries Type ND Mountings or approved equivalent.

.2 Type NM-C (Neoprene Mount – Captive). Captive neoprene mountings shall consist of a steel housing with a captive steel insert embedded in neoprene to prevent contact between the housing and the central threaded insert. Bonded assemblies without mechanical interlocks are not acceptable. All mountings shall have minimum 1.0 horizontal G ratings. Where seismic qualification require, anchorage shall have pre-approval "R" numbers from the Office of Statewide Health Planning and Development (OSHPD) in the state of California, attesting to the maximum horizontal and vertical load ratings. All mountings shall have bolts for rigid attachment to the equipment and adequate base bolting provision. Mountings have a minimum static deflection of 4 mm (0.15"). In seismic zones, submittals shall include calculations showing that the intersection of the horizontal and vertical seismic loads fall below the OSHPD approved curves. Anchorages shall be designed to meet the applicable building codes. All calculations shall be signed by a professional engineer. Durometer of pad to shall not exceed 50. Use Mason Type RBA, RCA and RDA or approved equivalent.

2.8 SPRING MOUNTS

.1 Type SM (Spring Mount). Spring isolators shall be free standing and laterally stable without any housing and complete with a moulded neoprene cup or 6 mm (1/4") neoprene acoustical friction pad between the baseplate and the support. Installed and operating heights shall be equal. The ratio of the spring diameter divided by the compressed spring height shall be no less than 0.8. Use Mason Industries Type SLF or approved equivalent.

.2 Type CSM (Constrained Spring Mount) Spring mount shall be as Type SM, described in Section .1, but shall include a rigid sided metal housing that contains vertical limit stops to prevent spring extension when weight is removed and temporary steel spacers between the upper and lower housings. A 6mm (1/4) thick non-skid neoprene acoustical pad shall be provided underneath the metal housing. All restraining bolts shall have large rubber grommets to *Provide* cushioning in the vertical and horizontal directions. The hole through the bushing shall be a minimum of 20 mm (0.75") larger in diameter than the restraining bolt. Horizontal clearance on the sides between the spring assembly and the housing shall be a minimum of 12 mm (0.5") to avoid bumping and interfering with the spring action. Vertical limit stops shall be out of contact during normal operation. Housings and springs shall be powder coated and hardware electro-galvanized. Use Mason Industries Type SLR or approved equivalent.

2.9 SPRING AND ELASTOMERIC HANGERS

.1 Type NH (Neoprene Hanger) Hangers shall consist of a moulded neoprene element in a steel hanger box. A neoprene sleeve shall be located where the lower hanger rod passes through the steel box supporting the isolator, such that the hanger rod cannot contact the steel hanger body. The diameter of the clear hole in the mounting box shall be at least 19 mm larger than the diameter of the hanger rod and permit the hanger rod to swing through a 30 degree arc. Unless otherwise specified, the static deflection shall be 8mm. Neoprene shall be bridge-bearing quality with a maximum Durometer of 50. Use Mason Industries Type HD hangers or approved equivalent.

.2 Type SH (Spring Hanger). Hangers shall consist of rigid steel frames containing a steel spring in a steel washer reinforced neoprene cup locate at the bottom of the frame. The neoprene cup shall have neoprene bushings projecting through the steel box. In order to maintain stability the box shall not be articulated as a clevis hanger. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc from side to side before contacting the cup bushing and short circuiting the spring. Use Mason Industries Type 30 hangers or approved equivalent.

.3 Type SNH (Spring & Neoprene Hanger). Hangers shall be as Type SH, described Section .2, but shall include minimum 32 mm (1-1/4") thick neoprene elements at the top of the steel spring. The neoprene element have neoprene bushings projecting through the steel box. In order to maintain stability the neoprene element shall not be stacked on top of the spring. Use Mason Industries Type 30N hangers or approved equivalent.

.4 Type SH-PC (Spring Hanger – Pre-compressed). Hangers shall be as Type SH, described in Section .2, but they shall be pre-compressed and locked at the rated deflection by means of a resilient up-stop to keep the piping or equipment at a fixed elevation during installation. The hangers shall be designed with a release mechanism to free the spring after the installation is complete and the hanger is subjected to its full load. Deflection shall be clearly indicated by means of a scale. Use Mason Industries Type PC30 hangers or approved equivalent.

.5 Type SNH-PC (Spring and Neoprene Hanger – Pre-compressed). Hangers shall be as Type SNH described in Section .3, but they shall be pre-compressed as described in Section .4. Use Mason Industries Type PC30N hangers or approved equivalent.

  .1 Type SH-EB (Spring Hanger with Eye Bolts) For ducts that are suspended by flat strap metal and require vibration isolation, the Type SN hanger assembly described in Section .3 shall be modified with an eye on top of the box and on the bottom of the spring hanger rod to allow for bolting to the hanger straps. Submittals on either of the above hangers shall include a scale drawing of the hanger showing the 30° capability. Use Mason Industries Type W30N hangers or approved equivalent.

.6 Type SNH-EB (Spring and Neoprene Hanger with Eye Bolts) Same as Type SNH, as described in Section .3 but modified with eye-bolts as described in .5.1 Use Mason Industries Type W30N hangers or approved equivalent.

2.10 ALTERNATIVE ISOLATORS

.1 Type GF (Glass or Mineral Fibre) – Thermal insulation on pipes or ducts may be used as an isolator under the following conditions: (i) only in the locations specifically stipulated in this specification; (ii) the insulation is made from glass or mineral fibre; (iii) it is at least 25 mm thick; (iv) the load imparted on the insulation does not compress the insulation more than half its unloaded thickness.

.2 Type PS (Pipe Sleeve) – Minimum 6 mm thick neoprene pad placed between pipe and clamp or between pipe and support, hardness not to exceed Durometer 40.

2.11 BASES

.1 Type SB Base. (Steel Base) Integral structural steel bases. All perimeter members shall be steel beams with a minimum depth equal to 1/10 of the longest dimension of the base. Base depth need not exceed 350 mm (14") provided that the deflection and misalignment is kept within acceptable limits as determined by the manufacturer. Height saving brackets shall be employed in all mounting locations to *Provide* a base clearance of 25 mm (1"). Rectangular bases shall be used for all equipment with the exception of centrifugal refrigeration machines and pumps in which case the bases may be T or L shaped. Pump bases for split case pumps shall be large enough to support suction and discharge elbows. Use Mason Industries Type WF base or approved equivalent.

2.12 ROOF CURBS

.1 Type RTC Curb (Roof Top Curb). Where indicated, curb mounted rooftop equipment shall be mounted on spring isolation curbs. The lower member shall consist of a sheet metal Z section containing adjustable and removable steel springs that support the upper floating section. The upper frame shall *Provide* continuous support for the equipment and shall be captive so as to resiliently resist wind forces. All directional neoprene snubber bushings shall be a minimum of 1/4"(6mm) thick. Steel springs shall be laterally stable and rest on 1/4"(6mm) thick neoprene acoustical pads. Hardware shall be plated and the springs provided with a rust resistant finish. The curbs waterproofing shall consist of a continuous galvanized flexible counter flashing nailed over the lower curbs waterproofing and joined at the corners by EPDM bellows. All spring locations shall have access ports with removable waterproof covers. Lower curbs shall have provision for 2"(50mm) of insulation. Use Mason Industries Type RSC or approved equivalent.

2.13 RISER GUIDES

.1 Riser guides for isolated pipes shall be fabricated as follows: bolt Type NM isolators to the vertical edge of a 90 degree steel angle.

2.14 FLEXIBLE PIPE CONNECTORS

.1 Use either single or double sphere flexible neoprene pipe connectors where indicated. Do not use flexible connectors with rigid control rods. Use Mason Industries Type MFNEC, Type MFTNC or approved equivalent.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

.1 All isolators shall be loaded to operate in the linear portion of their deflection curves. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.

.2 Verification of the isolators will be carried out after the springs have been loaded and adjusted to ensure that they are in their proper operating range. To facilitate this inspection, all isolators shall have either known undeflected heights or some form of marking on the isolator housing to indicate the undeflected heights.

.3 Vibration isolator sizes and layout shall be determined by the vibration isolator supplier.

.4 Any isolator requiring hold down bolts shall be supplied with neoprene mounting sleeves to prevent direct metal to metal contact or direct contact with the building.

.5 Any mechanical equipment containing rotating or vibrating machinery that is not specifically referred to in the schedules or this specification shall be mounted on Type WP pads.

.6 All pads, neoprene mounts and neoprene hangers shall be selected for 15% strain.

.7 Static deflection of pads, hangers, neoprene mounts and springs shall be as indicated on the equipment schedule. In the event of a conflict, the isolator schedule shall take precedence.

.8 The ratio of lateral to vertical stiffness shall not be less than 1.0 or greater than 2.0.

.9 *Provide* a minimum 50 mm (2") clearance between isolated equipment and any part of the building (i.e. walls, floors, columns, etc). Likewise, *Provide* a minimum 50 mm (2") clearance between isolated and unisolated equipment.

.10 The necessities of thermal expansion do not supersede the necessity for vibration isolation. In areas where thermal expansion restraint is required, isolation should match that which would otherwise be required in that location.

.11 Type SH-PC pre-compressed isolators may be used to facilitate pipe alignment with wall sleeves or equipment. After the compression clips have been removed, piping shall float free and clear of the opening in the wall or slab. No load shall be transferred to wall or slab.

.12 Piping, ductwork, conduit and cable connected to vibration isolated equipment shall not compromise the flexibility of the isolation system.

.13 Piping and ductwork penetrations into Noise Critical 1 space or through acoustic walls shall not transmit vibration.

3.2 INSTALLATION

.1 Vibration isolation equipment shall be installed according to the manufacturer's instructions. Isolator mountings shall be adjusted to ensure that equipment is level and that there is no rigid connection between isolated equipment and the building.

.2 Isolators for piping, ductwork or other mechanical equipment shall supported or hung directly from building structure. Do not support or hang from other isolated equipment or conduit.

.3 *Work* shall be coordinated with other trades to avoid rigid connections to the building. Conflicts with other trades that might result in a rigid connection, either because of inadequate space or other unforeseen conditions shall be brought to the attention of the *Consultant* prior to installation.

.4 Unless indicated otherwise, isolators located indoors do not need to be bolted to the floor. If isolators are bolted to the floor, use neoprene grommets or Type NS washers to prevent short circuiting.

.5 Wiring connections to vibration isolated mechanical equipment shall be made in a 360 degree loop. The length of the cable or flexible conduit shall be at least 10 times its diameter (e.g. a 100 mm diameter cable requires a loop 1,000 mm in circumference). Ties used to install the loop shall be cut prior to isolator adjustment.

.6 The contractor shall inform the consultant of any discrepancies between specifications and site conditions that might affect specific equipment selection or re-location. Notification shall be given prior to installation equipment. Should equipment be improperly installed without prior notice to the consultant and without their review, all corrective work shall be at the contractor's expense.

.7 Installations that are deemed defective, either in materials or workmanship, shall be corrected at no additional cost to the owner.

.8 Isolators for rooftop equipment shall be bolted to equipment and structure and shall be designed to resist wind forces of 160 kph (100 mph).

.9 Piping and ductwork passing through walls and floors shall not transmit vibration. See Part 3.6 of this Section.

.10 Isolators for piping may be installed before or after the piping is filled with fluid. If the isolators are installed before the fluid, ensure that piping will be properly centred in wall openings after the load of the fluid has been applied.

.11 Fan bases and isolators shall be sized to prevent need for thrust restraints to against turning moment caused by static pressure.

.12 Plena for air handlers shall be supported on a continuous Type WP neoprene isolator around the entire perimeter of the base.

.13 Coils and filters in built-up air handling units shall be supported on Type WP2 neoprene pads. Gaps beneath the coil or filter frame shall be sealed airtight with non-hardening acoustic sealant.

.14 Where equipment is not easily supported by isolators, *Provide* a rigid frame capable of holding the equipment and allowing the support by the isolators.

.15 Leave a minimum clearance of 50 mm (2") between steel bases and their sub-bases. Clearances shall be checked by the contractor and the area cleared of any materials that might short circuit the isolators.

.16 The deflection of isolators will vary for equipment connected to piping depending on whether or not the piping is filled with fluid. After the initial installation of equipment and, typically, before the pipes are filled with fluid, the equipment shall be blocked up with temporary shims to the appropriate height. After the fluid has been added to the system, the blocks or shims shall be removed and the isolators adjusted to the appropriate height.

3.3 MACHINERY AND EQUIPMENT

.1 Base mounted pumps shall be isolated as follows:

  .1 Pumps less than 3 kW, located on grade: Pumps shall be mounted on Type NM isolators.

  .2 Pumps less than 3 kW located on floors above grade: Pumps shall be installed on Type CB concrete inertia bases with Type NM isolators.

  .3 Pumps 3 kW and larger located on grade or above: Pumps shall be rigidly mounted to concrete inertia bases (CIB). CIBs shall weigh 1.5 times the combined weight of the fluid filled pump(s) and motor(s) or more. Rigid pipe elbows at the intake and discharge connections shall be supported from the inertia base. The inertia base shall be supported on Type SM isolators.

.2 Inline pumps shall be isolated as follows:

  .1 Inline pumps 1 kW and greater shall be supported by the piping which is isolated on SH isolators. If support is required below the pump, the pump shall be supported on Type SM spring isolators.

.2 Inline pumps less than 1 kW and adjacent piping shall be supported on neoprene isolating hangers Type NH, unless other provisions of this specification or the schedule call for greater deflection.

.3 Floor mounted fans and fans inside packaged air handling units shall be mounted on a steel base. The base shall be mounted on Type SM spring isolators and dedicated housekeeping pad.

.4 Drain pipes for packaged air handling units (AHU) shall be supported from a properly isolated AHU frame, avoid direct connections to the floor. If the pipe must be supported from the floor, use a Type NM isolator. The condensate shall drip into a funnel and the gap between the funnel and the AHU condensate pipe shall be at least 25 mm.

.5 Air Handling Units, fans and other equipment suspended from above shall be hung on Type SH spring isolators. The static deflection of the isolators shall be 50mm, unless otherwise specified in the Schedule. Where required, a Type SB base may also be used. If thrust restraint is required it shall be done by means of pre-compressed isolators. Rigid connections to structure for thrust restraint are not permitted.

.6 Roof top fans shall be mounted on a Type RTC base. Ensure that the fan floats freely on the isolators.

.7 Cooling Units: The indoor and outdoor components of Split Cooling Units located in or adjacent to Category 1 Noise Critical space shall be either floor mounted on Type NM isolators or wall mounted on Type NM-C isolators.

.8 Exhaust flues for gas boilers, both vertical and horizontal shall be supported by NH or NM isolators. Vertical risers shall have a neoprene isolated riser guide to limit lateral movement and to prevent direct contact to the building structure. There shall be a minimum clearance of 25 mm between the flue and the building structure.

.9 Air compressors shall be isolated with Type NH or NM neoprene isolators.

.10 Variable refrigerant flow (VRF) compressors shall be isolated with Type SM spring isolators.

.11 Expansion Tanks, De-aerators, Heat Exchangers and Water Heaters without pumps or motors shall be supported on either Type WP2 neoprene sandwich pads or suspended with Type NH hangers. If piping connected to this equipment is on isolators the connection shall be made with a flexible neoprene connector.

.12 Circulation chemical feed pumps for Expansion Tanks, Deaerators, Heat Exchangers or Water Heaters shall be isolated as follows:

.1 Pumps 0.5 kW or smaller – Type NM-C captive neoprene mount. The pump may be mounted directly on the equipment.

.2 Pumps larger than 0.5 kW – Type NM or NH neoprene isolators. The pumps shall be mounted or hung from building structure.

.3 Pumps larger than 1.5 kW – Type CB concrete inertia bases supported on Type SM isolators.

.4 Connections between equipment and pumps mounted on building structure shall be made with flexible connectors.

3.4 PIPE ISOLATION

.1 Unless indicated otherwise, piping connected to isolated equipment shall be supported from the same type of isolator and with the same static deflection as the equipment it is connected to. For Type SH or SM isolators the minimum static deflection shall be 25 mm (1”). For Type NH or NM isolators the minimum static deflection shall be 3 mm (0.1”). In the absence of other instructions, *Provide* isolation as follows:

.1 Inside mechanical rooms: All pipes shall be isolated inside mechanical rooms. Use Type NH or NM for pipe diameters less than 50 mm; Type SH or SM for pipe diameters greater than 50 mm.

.2 Outside Mechanical Rooms: The isolator type and the number of isolation points are listed in the following table.

Pipe Diameter	Isolator Type	# of Isolators
0 – 49 mm	PS or GF	First 3 points of support
50 – 99 mm	NH or NM	First 4 points of support

.2 If so desired pipes may be isolated in groups. For example, build a metal trapeze and support it at either end with isolators. The isolators shall be selected as follows: the type and static deflection of the isolator shall match that required on the largest pipe in the gang; the isolators shall be selected to carry the combined load of the gang of pipes. Use neoprene isolator guides if lateral restraint is required. Inactive piping (e.g. sprinklers, storm piping, etc.) does not normally require isolation. If inactive piping is included on the trapeze, *Provide* flexible connects at the point of entry and exit.

.3 Where vertical pipe risers are supported with Type SH, SM, NH or NM isolators and if they require lateral bracing, *Provide* a neoprene isolated riser guide to limit lateral movement and to prevent direct contact to the building structure.

.4 Where a pipe run connects to multiple pieces of equipment, pipe isolators for the entire run shall be selected to match the piece of equipment requiring the greatest static deflection.

.5 If an isolated pipe needs to connect with a piece of equipment that has isolators with smaller static deflections than required on the pipe, the connection shall be made with a flexible connector.

.6 Pipe Isolation Inside Mechanical Rooms

.1 The following instructions apply to mechanical or machine rooms inside the building and to roof top equipment areas above the building.

.2 All pipes inside the mechanical room that are connected to equipment installed on spring vibration isolators shall be supported on vibration isolators. This includes domestic cold water, domestic hot water, domestic hot water re-circulating, secondary hot water, steam, heat recovery, condensate and chilled water/glycol pipes. Sprinkler piping, storm drains, roof drains and floor drains do not need to be isolated.

.3 Piping connected to equipment that is installed on spring isolators shall be isolated with Type SM spring mounts or Type SH spring hangers. The first three points of support shall be pre-compressed and shall have the same static deflection of the isolators used on the equipment up to a maximum of 50 mm (2"). The remaining pipe isolators shall have a static deflection of 25 mm (1”)

.4 Piping connected to equipment that is installed on neoprene isolators (and without any spring isolators) shall be isolated with Type NM neoprene mounts or Type NH neoprene hangers.

.7 Pipe Isolation Outside Mechanical Rooms

.1 Pipes outside the mechanical rooms shall be isolated according to the following schedule.

Vibration Isolation Schedule

Pipe	OD < =50mm	OD > 50mm
Chilled water/glycol	NH/NM	NH/NM
Condensate	PS or GF	NH/NM
Heating	PS or GF	PS or GF
Domestic water	PS or GF	PS or GF

.2 All drain pipes and vent pipes on isolated building structure shall be supported on NM or NH isolators.

.3 All piping connected to washroom fixtures underneath the stage shall be isolated with Type NH neoprene hangers or Type NM neoprene mounts.

3.5 DUCT ISOLATION

.1 All ducts inside the mechanical rooms shall be isolated on Type NM neoprene mounts or Type NH neoprene hangers. Ducts connected to all fans, fan casings or fan plena inside the mechanical room shall be provided with flexible connectors.

.2 Ducts connected to fans outside the mechanical room shall have Type NM or NH isolators for the first three points of support. Ducts connected to fans outside the mechanical room that service Noise Critical 1 or 2 space shall be provided with flexible connectors. Other fans outside the mechanical room shall not have flexible connections unless specifically noted on the drawings.

.3 Ducts connected to kitchen exhaust fans shall be mounted on the same type of isolator as the fan.

3.6 ACOUSTIC PENETRATION

.1 Where penetration through a wall or floor requires both fire and acoustic seals, both requirements shall be satisfied. A fire seal does not negate the need for an acoustic seal. Alterations to acoustic details dictated by fire code interpretations shall be reviewed by the Acoustical *Consultant* prior to installation.

.2 All penetrations of acoustical walls, the walls and slabs of Noise Critical 1 rooms and the walls and slabs of mechanical rooms shall be sealed as described here and in the drawings. This also includes penetrations of masonry shafts, shaft wall enclosures and gypsum board enclosures of piping.

.3 Where piping penetrates an acoustical wall floor or ceiling, the opening shall be oversized by no less than 25 mm (1”) on all sides and no more than 50 mm (2”). Install the pipe in such a way that it does not contact the wall at any point. Pack the full depth of the 25 mm opening with glass fibre batt or mineral wool. Seal the opening on both sides with polyethylene backer rod covered with non-hardening caulk or non-hardening, permanently resilient fire stop.

.4 Piping sleeves may be used in acoustical floors or walls as follows. Cast or grout a steel sleeve into the wall or floor. Pack the full depth of the void between the pipe and the sleeve with glass fibre batt or mineral wool. Seal the opening on both sides with polyethylene backer rod covered with non-hardening caulk or non-hardening, permanently resilient fire stop. Pipes passing through a sleeve must not touch the sleeve. For pipes that are 25 mm in diameter or smaller, the internal diameter of the sleeve must be no less than 12 mm greater than the external diameter of the pipe passing through it and no more than 25 mm diameter, i.e.

Pipe External Diameter + 12 mm < Sleeve Internal Diameter < Pipe External Diameter + 25 mm

For pipes that are 50 mm in diameter or larger, the internal diameter of the sleeve shall be at least 25 mm greater than the external diameter of the conduit or conduit bundle and no more than 50 mm diameter, i.e.

Pipe External Diameter + 25 mm < Sleeve Internal Diameter < Pipe External Diameter + 50 mm

.5 In lieu of glass fibre, the void between the pipe and the sleeve may be filled full depth with non-hardening acoustic caulk or non-hardening, non-shrinking fire sealant.

.6 The following procedures shall be employed wherever a group of pipes penetrate together,

  .1 Concrete Walls – A rectangular void shall be left for the group of pipe sleeves. It shall be no more than 25 mm larger than the space required for the sleeves. The pipes shall then be installed with the sleeve and shall be suspended in the appropriate location with temporary hangers. Cast the sleeves in place filling the entire void with grout. The temporary hangers shall then be removed when the grout is dry. Coordinate with Section 13 48 23.

  .2 Masonry Walls – For a group of pipes that penetrate together, the sleeves shall be cast into a block, then lift the block into place and install the pipes. The sleeve shall then be stuffed around the pipe with mineral fibre and sealed with non-hardening acoustical sealant or non-hardening firestop as required. Coordinate with Section 13 48 23.

  .3 The two sides of a double acoustical wall shall be structurally independent of each other. No rigid connections are permitted from one side of the partition to the other. This includes but is not limited to ductwork, piping and conduit.

3.7 PASSAGE INTO CATEGORY 1 NOISE CRITICAL SPACE

.1 This section applies to all pipes and ducts entering the rooms defined as Category 1 Noise Critical in Section **Error! Reference source not found.**.

.2 Ducts entering Category 1 Noise Critical rooms require isolation. Use neoprene isolators on ducts with cross-sectional areas smaller than 0.5 m2, spring isolators on ducts with cross-sectional areas larger than 0.5 m2. *Provide* isolators on either side of the boundary up to a minimum distance equal to 5 times the longer dimension of the face of the duct.

.3 All ductwork passing through the rooms defined as Category 1 Noise Critical shall be provided with a flexible connection on the noise critical (i.e. quiet) side of the barrier.

.4 Where sprinkler, drain, vent or compressed air piping enters Category 1 Noise Critical rooms, the first support on each side of the boundary shall be a Type NM neoprene mount or Type NH neoprene hanger. There shall be no rigid connection between the pipe and building within 5 m of either side barrier between these rooms and other space.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 GENERAL INSTRUCTIONS

.1 OBC. This section covers design, supply, installation and inspection of complete SFRS (Seismic Force Resisting System) for all mechanical systems.

.2 SFRS to be fully integrated into, compatible with noise and vibration controls in accordance with Section 23 05 48 – Sound and Vibration Control.

.3 *Provide* restraint devices as required for isolated and non-isolated systems and equipment. *Provide* calculations to determine restraint loadings for all restrained systems and equipment resulting from seismic forces. Certification documents shall be signed and sealed by a Professional Engineer with at least 5 years experience in the design of seismic restraints.

.4 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 with at least 5 years experience in the design of seismic restraints.

.5 Seismic restraints are to be provided for all mechanical & non-structural components of building services in accordance with the current OBC and best practice guidelines:

  .1 CSA Group (Canadian Standard Association) S832-14, Seismic risk reduction of operation and functional components (OFCs) of building

  .2 SMACNA (Sheet Metal and Air-conditioning Contractors’ National Association’s) Seismic Restraint Manual Guidelines for Mechanical Systems (3rd ed.).

  .3 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 171-2008: Methods of Test for Seismic restraints.

  .4 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.

.6 Contractors on a project shall use a single manufacturer/ designer to *Provide* and certify seismically rated isolators and restraints.

.7 At the completion of the project, there shall be a review of the installations on site and a sealed written report, certifying that the installations have been completed in accordance with the specified design(s).

1.3 ENGINEERING PERFORMANCE REQUIREMENTS

.1 Specified design criteria for seismic and vibration for elements and components are to be designed to accommodate these specific calculation components factors:

  .1 Spectral Acceleration values:

  5% spectral response acceleration Sa(0.2) = 0.167
  Acceleration based coefficient Fa = 1.12

.2 Design (*Site* Class) Soil Type: D

.3 **Importance Category: Post-disaster; Importance Factor, IE = 1.5**

.2 Wind loads shall be based on the requirements of OBC.

.3 All mechanical piping systems and equipment of the building is designated as essential and shall structurally resist the design forces of a seismic event. Mechanical systems are required to be operational after the seismic event.

.4 It shall be understood that the requirements of this seismic restraint section are in addition to other requirements as specified elsewhere for the support and attachment of equipment and mechanical services, and for the vibration isolation of same equipment. Nothing on the project drawings or specifications shall be interpreted as justification to waive the requirements of this seismic restraint section or the other requirements.

.1 Seismic restraint systems shall be designed to offer seismic restraint in all directions, unless otherwise noted.

.2 Anchor types and sizes are to be per the design data as provided by the seismic restraint designer.

.3 Seismic restraint capacities, seismic cable restraint system, rod stiffener clamps to be verified by an independent test laboratory or certified by a registered design professional to ensure that the design intent of this specification is realized. Verification shall be by one of the following methods:

.1 a. An NRTL (National Recognized Testing Laboratory), or laboratory recommended by VISCMA.

.2 b. By a nationally recognized agency, such as VISCMA, that has reviewed and approved the restraint.

.4 It’s the contractor’s responsibility to ensure the seismic engineers’ requirements have been met.

1.4 SEISMIC SYSTEM DESIGN

.1 The seismic restraint designer shall be responsible for the selection of the attachment hardware as required to attach snubbers/restraints to both the equipment and supporting structure on vibration isolated equipment, or to directly attach equipment to the building structure for non-isolated equipment.

.2 The contractor shall *Provide* to the seismic restraint designer, a complete set of approved shop drawings of all equipment that is to be restrained, from which the selection and design of seismic restraint devices and/or attachment hardware will be completed. The shop drawings shall include, at a minimum, basic equipment layout, length and width dimensions, and installed operating weights of the equipment to be restrained.

.3 All piping and ductwork is to be restrained to meet code requirements. At a minimum, the seismic restraint designer shall *Provide* documentation on maximum restraint spacing for various restraint sizes and anchors, as well as “worst case” reaction loads for each restraint and/or anchor size.

.4 The contractor shall ensure that all housekeeping pads used are adequately reinforced and are properly dowelled to the building structure, so as to withstand calculated seismic forces. In addition, the size & thickness of the housekeeping pad is to be coordinated with the seismic restraint designer to ensure that adequate edge distances & embedment depths exist in order to obtain the desired equipment anchor capacities.

1.5 COORDINATION

.1 Coordinate size, shape, reinforcement and attachment of all housekeeping pads supporting vibration/seismically rated equipment. Concrete shall have a minimum compressive strength of 20 MPa minimum unless it is noted otherwise as requiring more.

.2 Coordinate with vibration control 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).

.3 Coordinate with other trades for locations and compatibility.

1.6 SUBMITTALS

.1 All seismic / wind / vibration restraint systems shall be by a single Designer.

.2 *Product* Data: Include Seismic Rating Data for each seismically rated isolator or restraint component.

.3 Submit shop drawings for all devices specified herein. Submittals shall include device dimensions, placement, attachment(s) and anchorage requirements. *Shop Drawings* shall include the following:

- .1 Design Calculations: Calculate the load requirements for all seismically rated vibration isolators and seismic restraints. Certification documents to be signed and sealed by a registered Professional Engineer with at least 5 years experience in the design of seismic restraint systems.
- .2 Vibration Isolation Bases: Dimensional drawings including anchorage and attachment to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads.
- .3 Seismic-Restraint Details: *Provide* detailed submittal drawings of seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors. Include load rating where appropriate.
- .4 Equipment Manufacturer Seismic Qualification Certification: The Equipment Manufacturer must submit certification that each piece of provided equipment will withstand seismic forces identified in "Engineering Performance Requirements"; Include the following:
  - .1 Basis for Certification: Indicate whether the “withstand” certification is based on actual test of assembled components or on calculations.
  - .2 Indicate the equipment is certified to be durable enough to:
    - .1 structurally resist the design forces (non-essential equipment) and/or
    - .2 will remain functional after the seismic event (essential equipment).

.4 Working drawings, schedules, materials lists, schematics and full specifications for all components of each SFRS to be provided. Design calculations are to include restraint loads resulting from seismic forces in accordance with OBC, detailed work sheets and tables as appropriate. Separate shop drawings for each SFRS and devices for each system or equipment are to be provided. Coordinate with building architect and structural engineer to *Provide* project-specific fastening details. These drawings shall be designed and bear the signed stamp of a Professional Engineer.

.5 Materials and systems specified herein and detailed or scheduled on the drawings are based upon materials manufactured by Kinetics Noise Control, Inc. Materials and systems provided by other manufacturers are acceptable, provided that they meet the requirements as listed in this specification.

.6 Closeout submittals:

.1 Maintenance data including monitoring requirements for incorporation into O&M manuals.

PART 2 PRODUCTS

2.1 GENERAL

.1 Seismic Restraint System or Seismic Force Resisting System (SRS or SFRS) to *Provide* gentle and steady cushioning action and avoid high impact loads.

.2 SRS to restrain seismic forces in every direction.

.3 Fasteners and attachment points to resist same load as seismic restraints.

.4 SRS of Piping systems compatible with:

.1 Expansion, anchoring and guiding requirements.

.2 Equipment vibration isolation and equipment SRS.

.5 SRS utilizing cast iron, threaded pipe, other brittle materials not permitted.

.6 Attachments to reinforced concrete structure:

.1 Use high strength mechanical expansion anchors. Coordinate with structural engineer prior to work.

.2 Drilled or power driven anchors not permitted.

.7 Wet pipe sprinkler systems

.8 Dry pipe sprinkler systems

.9 Seismic control measures not to interfere with integrity of fire stopping.

2.2 SRS FOR STATIC EQUIPMENT, SYSTEMS

.1 Floor-mounted equipment, systems:

.1 Anchor equipment to equipment supports.

.2 Anchor equipment supports to structure.

.3 Use size of bolts scheduled in approved shop drawings.

.2 Suspended equipment, systems:

.1 Use one or combination of following methods:

.1 Install tight to structure.

.2 Cross-brace in every direction.

.3 Brace back to structure.

.4 Slack cable restraint system.

.2 SCS to prevent sway in horizontal plane, "rocking" in vertical plane, sliding and buckling in axial direction.

.3 Hanger rods to withstand compressive loading and buckling.

2.3 SRS FOR VIBRATION ISOLATED EQUIPMENT

.1 Floor mounted equipment, systems:

.1 Use one or combination of following methods:

.1 Vibration/seismic spring floor mounts

.2 Vibration/seismic Restrained Spring Isolators

.3 Vibration/seismic modular restrained spring isolators

.4 All direction neoprene isolator

.5 Vibration isolators with built-in snubbers.

.6 Vibration isolators and separate snubbers.

.7 Other devices as required, reviewed and approved by Seismic Control Engineer

.2 SRS to resist complete isolator unloading.

.3 SRS not to jeopardize noise and vibration isolation systems. *Provide* 4-8 mm clearance between seismic restraint snubbers and equipment during normal operation of equipment and systems.

.4 Cushioning action: gentle and steady by utilizing elastomeric material or other means in order to avoid high impact loads.

.2 Suspended equipment, systems:

.1 Use one or combination of following methods:

.1 Slack cable restraint system.

.2 Brace back to structure via vibration isolators and snubbers.

2.4 SEISMIC RESTRAINTS

.1 Use one or combination of following methods as required:

.1 Seismic cable restraints

.2 Hanger rod stiffeners

.3 Seismic beam clamps

.4 Seismic restraint brackets

.5 Seismic snubbers

.6 Concrete anchor bolts

2.5 MANUFACTURERS

.1 Acceptable Manufacturers:

.1 Kinetics Noise Control, Inc. or approved equal.

PART 3 EXECUTION

3.1 GENERAL

.1 Comply with manufacturer’s written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

.2 Coordinate size, shape, reinforcement and attachment of all housekeeping pads supporting vibration/seismically rated equipment. Concrete shall have a minimum compressive strength of 20 MPa (3,000 psi) or as specified by the project engineer. 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. Housekeeping Pads must be adequately reinforced and adequately sized for proper installation of equipment anchors. Refer to seismic restraint manufacturer's written instructions.

.3 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.

.4 Isolated and restrained equipment, duct and piping located on roofs must be attached to the structure. Supports (e.g., sleepers) that are not attached to the structure will not be acceptable.

.5 Attach piping 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.

.6 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.

.7 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.

3.2 SEISMIC RESTRAINTS APPLICATION

.1 All equipment, piping and ductwork shall be restrained to resist seismic forces per the applicable building code(s) as a minimum.

.2 Install seismic restraint devices per the designer's submittals. Any deviation from the manufacturer's instructions shall be reviewed and approved by the manufacturer.

.3 Attachment to structure for suspended equipment, pipe and duct: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members with a seismic wedge anchor rated for the concrete tension zone.

.4 *Provide* hanger rod stiffeners where indicated or as required to prevent buckling of rods due to seismic forces.

.5 Ensure housekeeping pads have adequate space to mount equipment and seismic restraint devices and shall also be large enough and thick enough to ensure adequate edge distance and embedment depth for restraint anchor bolts to avoid housekeeping pad breakout failure.

3.3 CONCRETE ANCHOR BOLTS

.1 Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid pre-or post-tensioned tendons, electrical and telecommunications conduit, and gas lines.

.2 Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

.3 Mechanical Anchors: Protect threads from damage during anchor installation.

.4 Adhesive Anchors: Clean holes to remove loose material and drilling dust per manufactures instructions prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

.5 Set anchors to manufacturer's recommended torque, using a torque wrench.

3.4 EQUIPMENT RESTRAINTS:

.1 Seismically restrain equipment as indicated on the schedule by the Seismic Control Engineer. Install fasteners, straps and brackets as required to secure the equipment.

.2 As indicated on the schedule, install seismic snubbers on HVAC equipment supported by floor-mounted, non-seismic vibration isolators. Position snubbers as necessary and attach to equipment base and supporting structure as required.

.3 Install neoprene grommet washers or fill the gap with epoxy on equipment anchor bolts where clearance between anchor and equipment support hole exceeds 3.2 mm (0.125 inch).

.4 Suspended Equipment: All suspended equipment that meets any of the following conditions requires seismic restraints as specified by the supplier:

- .1 Rigidly attached to pipe or duct that is 75 lbs. and greater,
- .2 Items hung independently or with flexible connections greater than 20 lbs.
- .3 Wall mounted equipment weighing more than 20 lbs.
- .4 The 12” rule does not apply to suspended equipment.

.5 Base Mounted Equipment: All base mounted equipment that meets any of the following conditions requires attachments and seismic restraints as specified the supplier:

- .1 Connections to or containing hazardous material,
- .2 With an overturning moment,
- .3 Weight greater than 400 lbs.,
- .4 Mounted on a stand 4 ft. or more from the floor.

.6 Rigid Mounted Equipment:

- .1 Anchor floor and wall mounted equipment to the structure as per the stamped seismic certifications / drawings.
- .2 Suspended equipment shall be restrained using seismic cable restraints, or struts, and hanger rods as per the stamped seismic certifications / drawings.

.7 Vibration Isolated Equipment:

- .1 Seismic control shall not compromise the performance of noise control, vibration isolation or fire stopping systems.
- .2 Equipment supported by vibration-isolation hangers shall be detailed and installed with approximately a 1/8” gap between the isolation hangers and the structure. Isolators at restraint locations must be fitted with uplift limit stops.

3.5 PIPING; DUCT; ELECTRICAL SYSTEMS:

.1 All piping, duct electrical systems are to be restrained to meet code requirements.

.1 Seismically restrain / brace all pipes 76 mm (3”) in nominal diameter and larger.

.2 Seismically restrain / brace all exposed piping (not hidden behind suspended ceilings) 32 mm (1 ¼”) in nominal diameter and larger.

.3 Seismically restrain / brace all Gas (ie: natural gas, medical gas, vacuum, petroleum based liquid, compressed air, etc.) piping 25 mm (1”) in nominal diameter and larger.

.4 Branch lines may not be used to brace main lines.

.2 Restraint Spacing For Piping:

.1 For ductile piping: Transverse supports a maximum of 12 m (40’) o.c.

.2 For ductile piping: Longitudinal supports a maximum of 24 m (80’) o.c.

.3 For non-ductile piping (e.g., cast iron, PVC) space Transverse supports a maximum of 6 m (20’) o.c., and Longitudinal supports a maximum of 12 m (40’) o.c. Differential spacing can be designed depending upon pipe size and length(s) of run (design will be indicated on drawings of approved method).

.4 For piping with hazardous material inside (e.g., natural gas, medical gas) space Transverse supports a maximum of 6 m (20’) o.c., and Longitudinal supports a maximum of 12 m (40’) o.c.

.5 For pipe risers, restrain the piping at floor penetrations using the same spacing requirements as above.

.3 Seismically restrain per specific code requirements, all ductwork listed below (unless otherwise indicated on the drawings), using seismic cable restraints (Ductwork not meeting listed below criteria is to be “Exempt”):

.1 All ducts with cross sectional area equal to or greater than 0.55 m2 (6 ft2).

.2 All round ducts with diameters equal to or greater than 710 mm (28”).

.3 All ductwork weighing more than 25 kg/m (17 lb/ft).

.4 Restraint Spacing For Ductwork:

.1 Transverse supports a maximum of 9 m (30’) o.c.

.2 Longitudinal supports a maximum of 18 m (60’) o.c.

.5 Seismically restrain per specific code requirements all Electrical (including controls and data) components listed below (unless otherwise indicated on the drawings), using seismic cable restraints:

.1 Seismically restrain all conduit 76 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 10 lb/ft (146 N/m). This total weight includes not only the conduit, bus duct, or cable trays, but also includes the trapeze bars as well.

.6 The electrical contractor / engineer are to *Provide* the weight per unit length for cable trays and bus duct.

.7 Single supported conduit and trapeze supported conduit, bus duct, and cable trays to be seismically restrained in a manner similar to pipe and duct.

.1 Conduit: Follow piping spacing requirements and required criteria as listed in Section 3.3.5..2

.2 Bus Ducts and Cable Trays: Follow duct spacing requirements and required criteria as listed in section 3.3.5..4

.8 The seismic restraint components may be intended to be used with suspended single supported conduit and trapeze supported conduit, cable trays, and bus ducts depending on the manufacturer. 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.

.9 To ensure that the seismic forces are transferred properly to the restraint points, the 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).

.10 Brace a change of direction longer than 3.7 m (12').

.11 This specification does not allow the use of the "12-inch rule" where the piping, duct 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.

.12 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.

.13 Longitudinal restraints for single pipe supports shall be attached rigidly to the pipe, not to the pipe hanger.

.14 For supports with multiple pipes (trapezes), secure pipes to trapeze member with clamps approved for application.

.15 Install flexible metal hose loops in piping which crosses building seismic joints, sized for the anticipated amount of movement. Coordinate any new wetted component of the piping system with Mechanical Engineer prior to order with a clear shop drawing submittal indicating it is for seismic restraint purposes.

.16 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. Coordinate any new wetted component of the piping system with Mechanical Engineer prior to order with a clear shop drawing submittal indicating it is for seismic restraint purposes.

.17 Where pipe sizes reduce below required dimensions noted above in Sentence .3.E.1, the final restraint shall be installed at the transition location.

.18 Where duct sizes reduce below required dimensions noted above in Section 3.E.3, the final restraint shall be installed at the transition location.

.19 Longitudinal restraints for single conduit supports shall be attached rigidly to the pipe, not to the pipe/conduit hanger.

.20 For supports with multiple conduits (trapezes), secure conduit to trapeze member with clamps approved for application.

.21 Where conduit, bus ducts, cable trays sizes reduce below required dimensions noted above in Section 3.E.5, the final restraint shall be installed at the transition location.

.22 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.

.23 Seismically Rated Beam Clamps are required where welding to or penetrations to steel beams are not approved.

.24 Adjust restraint cables so that they are not visibly slack. Cable not to support weight during normal operation.

.25 Seismic systems are to be compatible with requirements for anchoring and guiding of systems.

.26 Drilled or power driven anchors or fasteners shall not be permitted for use with seismic control measures.

.27 Friction due to gravity does not constitute a seismic attachment.

.28 Seismic restraint connections are not to be connected to the bottom chord of steel joists or the bottom flange of steel beams.

.29 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.

.30 Brace remaining piping, ductwork, electrical components to code requirements OBC and in conformance with SMACNA (Sheet Metal and Air Conditioning Contractors National Association, Inc.) “Seismic Restraint Manual Guidelines for Mechanical Systems”, 3rd ed.

3.6 INSPECTION AND CERTIFICATION

.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 The contractor shall notify the local representative of the seismic restraint materials manufacturer 30% through the listed project for inspection of any vibration and seismic restraint devices already installed. A typed written 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 by the representative and distributed to General contractor and *Consultant* team. The report shall include clear sketches as required. 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. The contractor shall *Provide* written response to each issue/item identified in the report, noting how the corrections have been made, and distribute the response.

.3 The contractor shall notify the local representative of the seismic restraint materials manufacturer after completing installation of all vibration and seismic restraint devices already installed. The manufacturer representative shall *Provide* an inspection report certifying compliance with Seismic Control Engineer’s design and manufacturer installation requirements.

.4 The installing contractor shall submit a report to the building architect and/or engineer, 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

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

- .1 Materials and requirements for the identification of piping systems, duct work, valves and controllers, including the installation and location of identification systems.

1.3 REFERENCES

.1 Reference Standards

- .1 Canadian Gas Association (CGA)
- .2 CSA/CGA B149.1-10, Natural Gas and Propane Installation Code.
- .3 Canadian General Standards Board (CGSB)
- .4 CAN/CGSB-24.3-[92], Identification of Piping Systems.
- .5 National Fire Protection Association (NFPA)
- .6 NFPA 13-2010, Standard for the Installation of Sprinkler Systems.
- .7 NFPA 14-2010, Standard for the Installation of Standpipe and Hose Systems
- .8 ASME A13.1-2007 - Scheme for the Identification of Piping Systems.

1.4 SUBMITTALS

.1 Submittals for review

- .1 Submit shop drawings in accordance with Section 20 05 00 – Mechanical General Provisions.
- .2 *Product* Data: *Provide* paint colour chips and manufacturers catalogue literature for each product required.
- .3 Identification Information:
  - .1 Submit list of wording, symbols, letter size, and colour coding for mechanical identification.
  - .2 Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

PART 2 PRODUCTS

2.1 EQUIPMENT IDENTIFICATION

.1 Manufacturer’s Nameplates

- .1 *Provide* metal nameplate on each piece of equipment, mechanically fastened with raised or recessed letters.
- .2 Include Underwriters’ Laboratories Canada (ULC) or Canadian Standards Association (CSA) registration logos and those of other agencies, as required by respective agencies.

.3 Manufacturer's nameplates shall indicate Manufacturer's name, equipment model, size, serial number and electrical characteristics and pertinent information for any other service connections.

.4 Locate nameplates so that they are easily read. Do not insulate or paint over plates.

.2 System Nameplates:

.1 Each piece of equipment shall be identified with its equipment schedule identification, e.g. supply fan SF-1, cooling coil CC-1, pump P-1.

.2 Wording is generally to be as per the drawings, i.e. Fan EF-1, and is to include equipment service and building area/zone served.

.3 Submit list of nameplates for review prior to engraving.

.4 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 2½") for equipment, and minimum 50 mm x 100 mm (2" x 4") for control panels and similar items.

.5 Unless otherwise specified or required, each nameplate is to be white, complete with bevelled edges and black engraved wording to completely identify the equipment and its use with no abbreviations.

.6 All plates shall be secured using stainless steel screws or pop rivets.

.7 As an alternate, it is acceptable to tag smaller equipment with machine-printed self-adhesive labels.

2.2 PIPING IDENTIFICATION

.1 Each piping system shall be colour coded for identification and labelled with system identification code letters, including temperature and pressure, if applicable, and directional flow arrow in accordance with Pipe Identification Colour Schedule and with CGSB 24-GP-3a.

.2 Standard pipe identification is to be equal to Smillie McAdams Summerlin Ltd. or Brady vinyl plastic with indoor/outdoor type vinyl ink lettering and directional arrows with a UV vinyl inhibitor, as follows:

.1 For pipe to and including 150 mm (6") diameter, coiled type snap-on markers of a length to wrap completely around the 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.

.3 Identification labels must use an adhesive that is compatible with surface temperature.

.3 Identification wording and colours for pipe identification materials are to be as follows:

Pipe Service	Identification Colour	Legend
Domestic cold water	Green	DOM. COLD WTR
Domestic hot water supply	Green	DOM. HW SUPPLY
Domestic hot water recirculation	Green	DOM. HW RECIRC.
Tempered domestic water	Green	TEMP. DOM. WTR
Non-potable water	Purple	NON POT. WTR.
Storm drainage	Green	STORM

Pipe Service	**Identification Colour**	**Legend**
Sanitary drainage	Green	SAN
Plumbing vent	Green	SAN. VENT
Fire protection sprinklers	Red	F.P. SPRINKLER
Pumped condensate	Yellow	COND
Refrigerant suction	Yellow	REFRIG. SUCTION
Refrigerant liquid	Yellow	REFRIG. LIQUID

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

Identification Colour	Legend & Arrow Colour
Yellow	Black
Green	White
Red	White
Purple	White

.5 Letter heights shall be as follows:

O.D. Range	Letter Height
3/8” to 5/8”	1/4”
3/4” to 1 1/4”	1/2”
1 1/8” to 2 3/8”	3/4”
2 ½” to 6”	1 1/4”
6” to 10”	1 3/4"
10” to 18”	2 1/2"
Over 18”	3 1/2"

2.3 BURIED PIPING IDENTIFICATION/MARKERS

.1 Metallic Pipe: *Provide* continuously printed 100 mm wide, 4 Mil thick blaze orange plastic tape with printing indicating type of service of buried pipe. Place tape at ±300 mm above buried pipe in backfill lifts.

.2 Non-Metallic Piping: *Provide* detectable multi-ply tape consisting of aluminum foil core between two layers of 100 mm wide x 4 Mil blaze orange plastic tape with printing indicating type of service of buried pipe. Place tape at ±300 mm above buried pipe in backfill lifts.

.3 Where multiple small pipes are buried in a common trench and does not exceed an overall width of 450 mm, install a single tape line marker.

2.4 DUCT IDENTIFICATION

.1 Vinyl plastic similar to piping identification, or custom made with Mylar stencils with 50 mm (2") high lettering to accurately describe the duct service, i.e. "AHU-1 SUPPLY", complete with a directional arrow 150 mm long x 50 mm, and coloured ink with ink pads and roller applicators. Ink colour is generally to be black but must contrast with the lettering background.

2.5 VALVE AND CONTROLLER TAGS

.1 *Provide* valve identification tags and secure them using non-ferrous chain, braided band or plastic band (suitable for temperature). Tags may be of brass, aluminum, metalphoto, lamicoid or fibreglass, stamped or engraved, of 25 mm minimum diameter.

.2 Valves to be tagged include:

.1 Valves on main piping circuits.

.2 Valves on major branch lines.

.3 Valves on minor branch lines in horizontal service spaces, vertical service spaces and mechanical equipment rooms.

.4 DO NOT TAG valves on control valve stations, steam trap stations, fixture stops, or system drain valves.

.5 Drain valves and hose bibbs on systems containing glycol.

.6 Control valves

.3 Schedule valve numbers using sequential numbering system indicating location, service and the normal position (open or closed). Numbers shall be prefixed by letter “P” or letter “H” indicating valve is on plumbing or heating service.

.4 *Provide Consultant* with six (6) identification flow diagrams of approved size for each system. Include tag schedule, designating number, service, function, and location of each tagged item and normal operating position of valves.

.5 Install where directed one (1) copy of flow diagram and valve schedule mounted in glazed frame. *Provide* one (1) copy in each operating and maintenance instruction manual.

2.6 CEILING ACCESS IDENTIFICATION

.1 Secure 6.0 mm self-adhesive coloured dots (Brady Quik Dots or Avery Data Dots) to ceiling to identify location of access to equipment concealed above ceiling, according to the following schedule:

	Colour
Concealed equipment and cleaning access	Yellow
Control Equipment, including control valves, dampers and sensors	Black
Fire and smoke dampers	Red
Fire protection, including sprinkler equipment and drains	Red
Heating/Chilled water, DCW, DHW isolation valves	Green
Pipe mounted equipment, other than fire, smoke and sprinkler equipment	Green

.2 When T-bar ceilings are installed, adhere coloured dots to T-bar framing, adjacent to panel to be removed.

PART 3 EXECUTION

3.1 PREPARATION

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

.2 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

3.2 TIMING

.1 *Provide* identification only after painting specified (Section 09 90 00 – Painting) has been completed.

3.3 INSTALLATION

.1 Perform work in accordance with CAN/CGSB-24.3 except as specified otherwise.

.2 Nameplates:

.1 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 Fasten nameplates securely in conspicuous place, on cool surfaces. Where nameplates cannot be mounted on cool surface, *Provide* standoffs.

.3 Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

.4 Do not paint, insulate or cover.

.3 Piping Identification:

.1 Locate markers and classifying colors on piping systems so they can be seen from floor or platform.

.2 Locations:

.1 Identify piping runs at least once in each room.

.2 Maximum 50 ft (15 m) between identifications in open areas.

.3 Both sides where piping passes through walls, partitions and floors.

.4 At point of entry and leaving, where piping is concealed in pipe chase or other confined space, and at each access opening.

.5 At start and end points of runs and at each piece of equipment.

.6 At major manual and automatic valves immediately upstream of valves.

.7 Identify branch, equipment or area served after valve.

.4 Duct Identification:

.1 Locations:

.1 Maintain maximum 50 ft (15 m) distance between markings.

.2 Identify ducts each side of dividing walls or partitions and beside each access door.

.3 Stencil on plenum doors, downstream from air filter bank, “Do not open when fan operating.”

.4 Identify ductwork in mechanical equipment rooms to denote system and/or zone served and air flow direction arrow.

.5 Identify automatic control dampers concealed in ductwork. Identify “open” and “closed” position of operator arm on outside of duct or duct insulation.

.2 Stencil over final finish only.

.5 Valve and Controller Tags

.1 Install tags with corrosion resistant chain or closed “S” hooks.

3.4 CLEANING

.1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SUMMARY

.1 Application

.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.

.2 Section Includes

.1 Testing, adjustment, and balancing of air systems.

.2 Testing, adjustment, and balancing of hydronic systems.

.3 Measurement of final operating condition of HVAC systems.

.4 Sound measurement of equipment operating conditions.

.5 Vibration measurement of equipment operating conditions.

.3 Purpose

.1 Test to verify proper and safe operation, determine actual point of performance, evaluate qualitative and quantitative performance of equipment, systems and controls at design, average and low loads using actual or simulated loads

.2 Adjust and regulate equipment and systems to meet specified performance requirements and to achieve specified interaction with other related systems under normal and emergency loads and operating conditions.

.3 Balance systems and equipment to regulate flow rates to match load requirements over full operating ranges.

1.3 REFERENCES

.1 Definitions

.1 TAB: Means testing, adjusting and balancing to determine and confirm quantitative performance of equipment and systems and to regulate the specified fluid flow rate and air patterns at the terminal equipment, e.g., reduce fan speed, throttling, etc.

.2 Air systems: Includes all outside air, supply air, return air, exhaust air, and relief air systems

.3 Hydronic systems: Includes heating water, chilled water, glycol-water solution, condenser water, and any similar system.

.4 Flow rate tolerance: Means the allowable percentage variation, minus to plus, of actual flow rate values in the *Contract Documents*.

.5 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 the permanent record to be used as the basis for required future testing, adjusting and balancing.

.6 Terminal: Means the point where the 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.

.7 Main: Means the duct or pipe containing the system's major or entire fluid flow.

.8 Submain: Means the duct or pipe containing part of the systems' capacity and serving two or more branch mains.

.9 Branch main: Means duct or pipe servicing two or more terminals.

.10 Branch: Means duct or pipe serving a single terminal.

1.4 SUBMITTALS

.1 Submittals for Information

.1 Submit name of adjusting and balancing agency for approval within thirty (30) days after award of *Contract*.

.2 Submit sample test forms, if other than those standard forms prepared by the Associated Air Balance Council (AABC) or National Environmental Balancing Bureau (NEBB) are proposed for use.

.2 Construction Submittals

.1 Drawing Evaluation: Submit a report by the Agency to indicate the Agency's evaluation of the mechanical drawings with respect to service routing and location, or lack of balancing devices. The set of drawings and mark-ups used by the Agency to prepare the report shall be included.

.2 Field Reports: Submit a report after each site visit made by the Agency during the construction phase of the project.

.3 Close-Out Submittals

.1 Draft Report: Submit a draft report, as specified in Part 3 of this Section.

.2 Final Report: Submit a final report, as specified in Part 3 of this Section.

.3 Warranty: Submit a testing and balancing warranty, as specified in Part 3 of this Section.

.4 Post-Construction *Site* Visit Reports: Submit reports listing observations and results of post-construction site visits, as specified in Part 3 of this Section.

1.5 QUALITY ASSURANCE

.1 Qualifications of Tab Personnel

.1 The independent testing, adjusting, and balancing agency shall meet the qualifications specified below, and be the single source of responsibility to test, adjust, and balance the building mechanical systems to produce the design objectives. The testing, adjusting and balancing agency is to have successfully completed testing, adjusting and balancing of mechanical systems for a minimum of five projects similar to this *Project* within the past three years, and is to be certified as an independent agency in all required categories by one of the following:

.1 AABC - Associated Air Balance Council;

.2 NEBB - National Environmental Balancing Bureau;

.2 Standards

.1 Testing, adjusting and balancing of the complete mechanical systems is to be performed over the entire operating range of each system in accordance with one of the following publications:

.1 National Standards For A Total System Balance published by the Associated Air Balance Council;

.2 Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems published by the National Environmental Balancing Bureau;

.3 Chapter 37, Testing, Adjusting, and Balancing of ASHRAE Handbook HVAC Applications.

PART 2 PRODUCTS

2.1 INSTRUMENTS

.1 Instruments for TAB of air and hydronic systems shall have been calibrated within six months and verified for accuracy before start of work.

.2 Submit list of equipment to be used for balancing and calibration certificates for each instrument listed.

PART 3 EXECUTION

3.1 SCOPE OF WORK

.1 Perform total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications and comfort conditions and recording and reporting the results.

.2 Mechanical systems to be tested, adjusted and balanced include:

.3 Heating Systems: TAB of heating systems is to include all piping and equipment fluid temperatures, flows and control, and if TAB is not done during the heating season, a follow-up site visit during the heating season will be required to confirm proper flows and temperatures, and any required system "fine tuning".

.4 Cooling Systems: TAB of cooling systems is also to include all piping and equipment fluid temperatures, flows and control, and if TAB is not done during the cooling season, a follow-up site visit during the cooling season will be required to confirm proper flows and temperatures, and any required system "fine tuning".

.5 Air Handling Systems: TAB of air handling systems is to include all equipment and ductwork air temperatures, capacities and flows.

3.2 GENERAL REQUIREMENTS

.1 As soon as possible after award of *Contract*, the Agency is to carefully examine a white print set of mechanical drawings with respect to routing of services and location of balancing devices, and is to issue a report listing the results of the evaluation.

.2 The set of drawings examined by the Agency is to be returned with the 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 the mechanical work drawings and specification, the Agency is to visit the site at frequent, regular intervals during construction of the 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, the Agency is to report results of the site visit indicating the date and time of the 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 All 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 all applicable mechanical plant equipment and terminals, and temperature control diagrams and sequences;

.8 The Agency is to walk each system from the system "head end" equipment to terminal units to determine variations of installation from design, and the system installation trades shall accompany the Agency;

.9 The Agency is to check all valves and dampers for correct and locked position, and temperature control systems for completeness of installation before starting equipment;

.10 Wherever possible, the Agency is to lock all balancing devices in place at the proper setting, and permanently mark settings on all devices;

.11 For belt-driven equipment, the Agency is to report to the Commissioning Agent who in turn is to inform the *Contractor* and *Consultant* of any situation where sheaves have to be replaced to suit testing and balancing, and replacements are to be done by the *Contractor* at no cost;

.12 The Agency is to balance all 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 the design conditions, the Agency is to immediately report the problem and submit data, including sound readings, to permit an accurate assessment of the noise problem to be made;

.13 The Agency is to check all supply air handling system mixing plenums for stratification, and where the variation of mixed air temperature across coils is found to be in excess of plus or minus 5 percent of design requirements, the Agency is to report the problem and issue a detail sketch of plenum baffle(s) required to eliminate the stratification;

.14 Filters for all air handling systems equipped with air filters, test and balance the systems with simulated 50% loaded (dirty) filters by providing a false pressure drop;

.15 Test, adjust and balance air conditioning systems during the 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.

.16 Mechanical *Contractor* to *Provide* all required parts, belts and adjustments for all systems as deemed necessary to complete the required balancing.

.17 Mechanical *Contractor* shall *Provide* the required assistance to the TAB *Contractor* as deemed necessary by the *Consultant*.

3.3 EXAMINATION

.1 Verify that systems are complete and operable before commencing work. Ensure the following conditions:

- .1 Systems are started and operating in a safe and normal condition.
- .2 Temperature control systems are installed complete and operable.
- .3 Proper thermal overload protection is in place for electrical equipment.
- .4 Final filters are clean and in place. If required, install temporary media in addition to final filters.
- .5 Duct systems are clean of debris.
- .6 Fans are rotating correctly.
- .7 Fire and volume dampers are in place and open.
- .8 Air coil fins are cleaned and combed.
- .9 Access doors are closed and duct end caps are in place.
- .10 Air outlets are installed and connected.
- .11 Duct system leakage is minimized.
- .12 Hydronic systems are flushed, filled, and vented.
- .13 Pumps are rotating correctly.
- .14 Proper strainer baskets are clean and in place.
- .15 Service and balance valves are open.

.2 Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

.3 Beginning of work means acceptance of existing conditions.

3.4 PREPARATION

.1 *Provide* instruments required for testing, adjusting, and balancing operations. Make instruments available to *Consultant* to facilitate spot checks during testing.

.2 *Provide* additional balancing devices as required.

3.5 TOLERANCES

.1 Application Tolerances:

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

.2 Accuracy Tolerances:

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

3.6 TESTS

.1 Give written 24 hour written notice of date for tests.

.2 Do not externally insulate or conceal work until tested and approved. Follow construction schedule and arrange for tests.

.3 Conduct tests in presence of *Consultant*. Arrange for *Owner's* Representative to be present.

.4 Bear costs including retesting and making good.

.5 Refer to Piping Sections for specific test requirements.

.6 Prior to tests, isolate equipment or other parts which are not designed to withstand test pressures.

3.7 ADJUSTING

.1 Ensure recorded data represents actual measured or observed conditions.

.2 Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

.3 After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

.4 Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

3.8 AIR SYSTEM PROCEDURE

.1 Execute air systems balancing for each air system in accordance with AABC and NEBB specifications and as described herein.

.2 Make tests with supply, return and exhaust systems operating and doors and windows closed or in normal operation condition.

.3 Test and adjust blower r/min to design requirements.

.4 Test and record motor full load amps.

.5 Make air quantity measurements in supply and return ducts at each major air handling or rooftop system by pilot tube traverse of entire cross-sectional area. Take minimum of 16 readings on each air handler.

.6 Test and record required and measured system static pressures, filter differential, coil differential and fan total static pressure.

.7 Test and adjust systems for design recirculated airflows rates.

.8 Test and adjust systems for design outdoor air quantities.

.9 Test and record entering air temperatures (DB heating), (DB/WB cooling).

.10 Test and record leaving air temperatures (DB heating), (DB/WB cooling).

.11 Adjust main supply and return ducts to design flow rates.

.12 Adjust zones to design, supply and return flow rates.

.13 Test and adjust each diffuser, grille and register to within 5% of design requirements.

.14 Identify each diffuser, grille and register as to location and area.

.15 Identify and list size, type and Manufacturer of diffusers, grilles, registers and testing equipment. Use Manufacturer's rating on equipment to make required calculations.

.16 Control and/or equipment Manufacturer shall set adjustments of automatically operated dampers to operate as indicated in cooperation with balancing firm.

.17 Adjust diffusers, grilles and registers to minimize drafts.

.18 *Provide* fire damper drop tests, in association with the Sheet Metal *Contractor* in accordance with Section 23 33 00.

.19 Use volume control devices to regulate air quantities only to extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

.20 Vary total system airflow rates by adjustments of fan speeds. Vary branch air quantities by damper regulation.

.21 *Provide* system schematic with required and actual air flow rates at each outlet or inlet. Schematic shall include all fire dampers shown on drawings.

.22 Record installed fan drive assemblies, fan sheaves, motor sheaves and belts.

.23 Record each installed motor Manufacturer.

.24 Final balanced condition of each area shall include testing and adjusting of pressure conditions. Test and record building pressurization levels in variable volume systems throughout full range of fan delivery rates under both heating and cooling conditions. Test pressure conditions at ground, intermediate and upper levels. Check front doors, exits and elevator shafts for airflow so that exterior conditions do not cause excessive or abnormal pressure conditions. Document abnormal building leakage conditions noted.

.25 Complete TAB to achieve positive building pressure unless otherwise instructed. Positive pressure relative to outside pressure of 10 Pa minimum and 18 Pa maximum shall be achieved, measured with negligible outside wind velocity.

3.9 HYDRONIC SYSTEM PROCEDURE

.1 Preparation of System - Phase I: Hydronic system shall be prepared for TAB by Mechanical *Contractor* in the following manner:

- .1 Open valves, close bypass valves.
- .2 Determine water in system has been treated and is clean.
- .3 Check pump rotation.
- .4 Confirm expansion tanks are not air bound and system is full of water.
- .5 Confirm air vents at high points are installed properly and are operating freely and air is removed from circulation system.
- .6 Set temperature controls for full flow.
- .7 Check operation of automatic bypass valves.
- .8 Check and set operating temperature of equipment to design requirements.

.2 TAB Procedure – Phase II:

- .1 Set pumps to proper flow rate.
- .2 Proportionally balance flow of water through equipment.
- .3 Record leaving water temperatures and return water temperatures and pressure drops through equipment. Reset to design temperatures.
- .4 Record water temperature at inlet side of terminals. Note rise or drop of temperatures from source.
- .5 Proportionally balance each terminal or in the absence of flow measuring commissioning valves balance each terminal based on temperature differential.

.6 Upon completion of flow readings and adjustments, mark settings and record data.

.7 Coordinate shaving of pump impeller to pump operating condition on pumps larger than 1.5 KW

.3 TAB Procedure – Phase III:

.1 After adjustments to terminals, recheck settings at pumps. Readjust if required.

.2 Read pressure drop through each terminal and set flow rate on call for full flow. Set pressure drop across bypass valve to match terminal full flow pressure drop.

3.10 TAB DATA

.1 Measure and record the data required by referenced organization standards, including but not limited to, following:

.2 Air Systems:

.1 Measurements:

.1 Air velocity

.2 Static pressure

.3 Velocity pressure

.4 Temperature

.1 Wet bulb

.2 Dry bulb

.5 Cross sectional area

.6 RPM

.7 Electric power:

.1 Voltage

.2 Amperage

.3 Phase

.8 Noise and vibration

.2 Location of equipment requirements:

.1 Inlet and outlet of:

.1 Fan

.2 Coil

.3 Filter

.4 Damper

.5 Other auxiliary equipment

.3 Location of system measurements at:

.1 Main ducts

.2 Main branch ducts

.3 Sub-branch ducts

.4 Each supply, exhaust and return air inlet and outlet

.5 Other auxiliary equipment

.6 All areas served by system

.4 In addition to the above, the TAB contractor shall set balancing dampers on return air sections to ensure return air volume and heat reclaim air volumes match the coil manufacturers suggested air flow requirements.

.3 Hydronic Systems:

.1 Measurements:

.1 Flow

.2 Pressure

.3 Temperature

.4 Specific gravity

.5 RPM

.6 Electric power:

.1 Voltage

.2 Amperage

.3 Phase

.7 Noise and vibration

.2 Location of equipment measurements:

.1 Inlet and outlet of each:

.1 Coil

.2 Pump

.3 PRV

.4 Control valve

.5 Make-up (water)

.6 Other auxiliary equipment

.2 Location of system measurements at:

.1 Supply and return of each primary and secondary loop of the following hydronic equipment:

.2 Glycol

.3 Consider glycol systems as hydronic for purpose of this section.

3.11 OTHER MECHANICAL SYSTEM

.1 Plumbing:

.1 Flush valves: adjust for proper operation to suit actual site pressure conditions

.2 Mixing Valves: Adjust for specified discharge temperature

.2 Building pressure conditions:

.1 Adjust HVAC systems, equipment, controls to ensure specified pressure conditions at all times coordinate with consultant.

3.12 PREPARATION OF REPORTS

.1 Draft Reports:

.1 Upon completion of testing, adjusting, and balancing procedures, prepare draft reports on AABC or NEBB forms.

.2 Draft reports may be hand written, but must be complete, factual, accurate, and legible.

.3 Organize and format draft reports in the same manner specified for the final reports.

.4 Submit two complete sets of draft reports. Only one complete set of draft reports will be returned.

.2 Final Report:

.1 Upon verification and approval of draft reports, prepare final reports, type written, and organized and formatted as specified below.

.2 Submit 2 complete sets of final reports. Use units of measurement (SI or Imperial) as used on the *Project Documents*.

.3 Report Format:

.1 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.

.2 Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. *Provide* binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the divisions listed below, separated by divider tabs:

.1 General Information and Summary;

.2 Hydronic Systems;

.3 Air Systems;

.4 Temperature Control Systems;

.5 Special Systems.

.4 Report Contents:

.1 The Agency is to *Provide* the following minimum information, forms and data:

.1 Inside cover sheet to identify the Agency, the *Contractor*, and *Project*, including addresses, and contact names and telephone numbers and a listing of the instrumentation used for the procedures along with the proof of calibration;

.2 The remainder of the report is to contain the appropriate forms containing as a minimum, the information indicated on the standard AABC or NEBB report forms prepared for each respective item and system;

.3 The 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 all equipment, terminals, and accessories;

.4 The Agency is to include report sheets indicating building comfort test readings for all rooms.

.5 Verification of Reports:

.1 After the final testing and balancing report has been submitted, the Agency is to visit the site with the *Contractor* and *Consultant* to spot check results indicated on the balancing report.

.2 The Agency is to supply all labour, ladders, and instruments to complete spot checks.

.3 Note that if results of spot checks do not, on a consistent basis, agree with the final report, the spot check procedures will stop and the Agency is to then rebalance the systems involved, resubmit the final report, and again perform spot checks with the *Contractor* and *Consultant*.

.6 Certification and Warranty:

.1 The TAB Agency shall submit a written warranty from the Agency covering one full heating season and one full cooling season, during which time any balancing problems which occur, with the exception of minor revision work done during scheduled site visits, will, at no cost, be investigated by the Agency and reported on to the *Owner*, and if it is determined that the problems are a result of improper testing, adjusting and balancing, they are to be immediately corrected without additional cost to the *Owner*.

3.13 ACCEPTANCE

.1 Mechanical systems shall not be considered ready for final field review until TAB results are acceptable to *Consultant*.

.2 If found that specified flows cannot be achieved on portions of system, actual conditions shall be reported to *Consultant* for consideration of correctible action before continuing TAB procedure.

.3 If measured flow at final field review shows deviation of 10% at terminal devices, 5% at equipment or more or mean sound level deviation of 10 db or more from certified report listing, by more than 10% of selected areas, report shall be rejected.

.4 If report is rejected, systems shall be re-balanced and certified report submitted at no extra cost.

3.14 POST BALANCING SITE VISITS

.1 After acceptance of the final report, the Agency is to perform post testing and balancing site visits in accordance with the following requirements:

.1 Post testing and balancing site visits are to be made:

.1 Once during the third month of building operation;

.2 Once between the fourth and tenth months in a season opposite to the first and third month visit.

.2 During each return visit and accompanied by the *Owner's* representative, the Agency is to spot rebalance terminal units as required to suit building occupants and eliminate complaints;

.3 The Agency is to schedule each visit with the *Contractor* and the *Owner*, and inform the *Consultant*;

.4 After each follow-up site visit, the Agency is to issue to the *Contractor* and *Consultant* a report indicating any corrective work performed during the visit, all abnormal conditions and complaints encountered, and recommended corrective action.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

.1 Duct work insulation.

.2 Duct Liner.

.3 Insulation jackets.

1.3 SCOPE OF WORK

.1 Supply and install insulation for duct systems in all areas, including:

.1 Intake and exhaust ducts and plenums between equipment and wall, soffit or roof penetrations.

.2 Heating/cooling supply air ductwork.

.3 Return air ductwork in unconditioned spaces.

.4 Insulate all duct penetrations through exterior wall to fan or ERV.

.5 Miscellaneous ducts and vents indicated on the drawing(s).

1.4 SUBMITTALS

.1 *Product* Data: *Provide* product description, thermal characteristics, list of materials and thickness for equipment scheduled.

PART 2 PRODUCTS

2.1 PRE-MOULDED MINERAL FIBRE

.1 Manufacturers:

.1 Johns Manville;

.2 Knauf;

.3 Manson Insulation;

.4 Owens Corning.

.2 Rigid, sectional, sleeve type insulation to ASTM Standard C 547-00, with a factory applied vapour barrier jacket.

.1 Use for round heating/cooling supply air ductwork and round exhaust/intake ductwork inside the building and above ground, except as noted.

2.2 ELASTOMERIC PIPE INSULATION

.1 Manufacturers:

.1 Armacell;

.2 Approved equal

.2 Closed cell foam, preformed for round pipes/ducts with all longitudinal and circumferential joints sealed with manufacturer recommended adhesive or manufacturer's black lapseal tape, 25/50 flame/smoke rating to ASTM E84.

.1 Alternative insulation type for use for round exhaust/intake ductwork inside the building and above ground, except as noted.

2.3 RIGID FIBREGLASS BOARD

.1 Manufacturers:

.1 Johns Manville;

.2 Knauf;

.3 Approved equal

.2 Rigid board insulation, 25/50 flame/smoke rating to ASTM E84 with a factory applied vapour barrier facing. Minimum 36 kg/m^3 density.

.1 For all rectangular heating/cooling ductwork up to 12" x 6" (300 mm x 150 mm) inside building.

2.4 RIGID MINERAL FIBRE BOARD

.1 Manufacturers:

.1 Knauf;

.2 Manson Insulation;

.3 Johns Manville;

.4 Owens Corning;

.5 Specialty Products & Insulation Co.

.2 Preformed board type insulation to ASTM C612-00a, 48 kg/m^3 (3.0 lb/ft^3) density, with a factory applied reinforced aluminum foil and kraft paper facing.

.1 For all rectangular heating/cooling ductwork inside building.

2.5 FLEXIBLE FOAM ELASTOMERIC SHEET

.1 Manufacturers:

.1 Armacell;

.2 K-Flex.

.2 Sheet form, CFC free, closed cell, self-adhering elastomeric nitrile rubber insulation with a water vapour permeability rating of 0.08 in accordance with ASTM E96 Procedure A.

.1 Alternative insulation type for use for exhaust/intake ductwork inside the building and above ground, except as noted.

2.6 BLANKET MINERAL FIBRE

.1 Manufacturers:

.1 Johns Manville;

.2 Knauf;

.3 Manson Insulation;

.4 CertainTeed.

.2 Blanket type roll form insulation to ASTM Standard C553-00, 24 kg/m³ (1½ lb/ft³) density, 40 mm thick, with a factory applied vapour barrier facing.

.1 Alternative for concealed rectangular heating/cooling ductwork up to 12" x 6" (300 mm x 150 mm) and alternative for concealed round ducts up to 12" (300 mm) inside building.

2.7 FIRE RATED DUCT WRAP

.1 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".

.5 Multi-Glass Insulation Ltd. Pyroscat FP Type 6#F2E

.2 Flexible, non-combustible, blanket type mineral fibre duct wrap completely encapsulated in reinforced foil, 40 mm thick, suitable for installation with zero clearance to combustibles, and ULC tested and listed (ULC Designs FRD-3 & 5 for ventilation ducts, ULC Design FRD-4 for kitchen exhaust duct) to facilitate a 1 or 2 hour fire resistance rating to kitchen grease exhaust duct in accordance with requirements of NFPA-96, and/or a 1 or 2 hour fire resistance rating to ventilation or pressurization ductwork in accordance with requirements of ISO 6944.

.1 For ducts such as kitchen exhaust, stairwell pressurization, etc., which require a fire rating and are not protected by rated construction

2.8 INSULATION FASTENINGS

.1 Duct Insulation Fasteners: Weld-on 2 mm (3/32") diameter zinc coated steel spindles of suitable length, complete with minimum 40 mm square plastic or zinc plated steel self-locking washers.

.1 For securing mineral fibre duct and casing insulation in place.

.2 Tape Sealant: Equal to MACtac Canada Ltd. self-adhesive insulation tapes, types PAF, FSK, ASJ, or SWV as required to match the surface being sealed.

.1 For sealing and securing joints in mineral fibre duct insulation

.3 Adhesive - Mineral Fibre Insulation: Clear, pressure sensitive, brush consistency adhesive, suitable for a temperature range of -20°C to 82°C (-4°F to 180°F), compatible with the type of material to be secured, and WHMIS classified as non-hazardous.

.1 For adhering board or blanket mineral fibre insulation to ducts and equipment

.4 Adhesive – Flexible Elastomeric Insulation: Armacell "Armaflex" #520 air-drying contact adhesive.

.5 Adhesive – Closed Cell Foamed Glass Insulation: Pittsburgh Corning PC88 multi-purpose two-component adhesive.

.1 For securing and finishing canvas jacket on exposed mineral fibre insulation

.6 Aluminium Banding:

.1 Equal to ITW Insulation Systems Canada "FABSTRAPS" minimum 12 mm wide, 0.6 mm (1/16") thick aluminium strapping.

.2 For securing fiberglass insulation for tanks, shell and tube heat exchangers, etc., and for securing metal jacket on weather-proofed pipe insulation.

.7 Stainless Steel Banding:

.1 Equal to ITW Insulation Systems Canada "FABSTAPS" minimum 12 mm wide, 0.6 mm (1/16") thick type 304 stainless steel strapping.

.2 For securing stainless steel insulation jacket in place.

2.9 INSULATION JACKETS AND FINISHES

.1 White PVC:

.1 Manufacturers:

.1 Proto Corp. "LoSMOKE";

.2 The Sure-Fit System "SMOKE-LESS 25/50";

.3 Johns Manville Inc. "Zeston" 300.

.2 Roll form sheet and fitting covers, minimum 15 mil thick white PVC, 25/50 rated, complete with manufacturer recommended installation and sealing accessories.

.1 For finishing exposed pipe insulation inside building

.2 For providing continuous vapour barrier around fittings.

.2 Rigid Aluminium:

.1 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, and "Fabstraps" and butt straps with weatherproof the end to end joints. Fittings are to be two-piece epoxy coated pressed aluminum with weather locking edges.

.2 For jacket on insulation outside building to protect from damage and *Provide* additional weather-proofing. May also be used inside building alternate to PVC.

.3 Adhesive Backed Flexible Aluminium:

.1 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.

.2 For use as an alternative to rigid aluminum jacket material for exposed exterior pipe and duct insulation and for underground pipe insulation, where approved by Engineer. Note that ambient temp. must be 65°F or better for installation

.4 Protective Coating - Flexible Foam Elastomeric Insulation:

.1 Equal to Armacell "WB Armaflex" weatherproof, water-based latex enamel finish.

.2 for Armacell "Armaflex" type flexible elastomeric insulation exposed to weather, underneath and in addition to protective jacketing such as aluminum jacketing or for small areas where the jacketing cannot be used.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verify that duct work has been tested before applying insulation materials.

.2 Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

.1 Rigid insulation:

- .1 Apply according to the Fibreglass installation procedure using welded pins or perforated base metal fasteners adhered with Bakelite #230-35 and speed washers. These shall be located on maximum 12" (300 mm) centres with a minimum of two (2) rows per duct side. When the insulation has been placed on the metal spike, the speed washers shall be attached, and the excess spike cut off flush with the washer.
- .2 Corners of insulation shall be provided with a pre-formed protective edge applied to insulation before canvassing.

.2 Flexible insulation:

- .1 Wrap tightly on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 2" (50 mm). Adhere insulation with 4" (100 mm) strips of insulation bonding adhesive at 8" (200 mm) O.C.
- .2 Where faced flexible insulation is used on concealed rectangular ducts, secure insulation to the bottom of ductwork with suitable mechanical fasteners on maximum 18" (450 mm) O.C.
- .3 On circumferential joints the 2" (50 mm) flange on the facing shall be stapled with staples on 6" (150 mm) centres and taped with minimum 3" (80 mm) wide RFFRK tape.
- .4 On longitudinal joints, the overlap shall be stapled with flare-door staples on 6" (150 mm) centres and taped with minimum 3" (80 mm) wide RFFRK tape. All pin penetrations or punctures in facing shall also be taped.

.3 At duct connection flanges insulate the flanges with neatly cut strips of the rigid insulation material secured with adhesive to side surfaces of the flange with a top strip to cover the exposed edges of the side strips, then butt the flat surface duct insulation up tight to the flange insulation, or, alternatively, increase the insulation thickness to the depth of the flange and cover the top of the flanges with tape sealant.

.4 For round duct fittings such as elbows use flexible insulation blanket, covered with PVC fitting jacket sealing all edges (including circumferential and longitudinal) of the PVC cover with PVC jacket manufacturer recommended solvent welding system adhesive (eg. Johns Manville Perma-Weld). For concealed spaces, PVC jacket tape (equal to Johns Manville Z-Tape) is acceptable for sealing all jacket edges and seams. Alternative for elastomeric insulated ductwork: Neatly custom-fashion insulation around fittings from closed-cell elastomeric sheets (refer to manufacturer instructions).

.5 The installation of fastener pins and washers is to be concurrent with the duct insulation application;

.6 Cut insulation fastener pins almost flush to the washer and cover with neatly cut pieces of tape sealant;

.7 Accurately and neatly cut and fit insulation at duct accessories such as damper operators (with standoff mounting) and pitot tube access covers.

.8 Prior to concealment of insulation by either construction finishes or canvas jacket material, patch all vapour barrier damage by means of tape sealant.

.9 Insulate all exposed exterior ductwork (except fresh air intake ductwork) and associated plenums and/or casings outside the building with minimum 40 mm thick flexible elastomeric sheet insulation as required, applied in two minimum 20 mm thick layers with staggered tightly butted joints.

.1 Install with adhesive in strict accordance with the manufacturer's published instructions to produce a weather-proof installation. Ensure that sheet metal work joints are sealed watertight prior to applying insulation.

.10 Insulated duct work conveying air below ambient temperature:

.1 *Provide* insulation with vapour barrier jackets.

.2 Finish with tape and vapour barrier jacket.

.3 Continue insulation through walls, sleeves, hangers, and other duct penetrations.

.4 Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

.11 Insulated duct work conveying air above ambient temperature:

.1 *Provide* with or without standard vapour barrier jacket.

.2 Insulate fittings and joints. Where service access is required, bevel and seal ends of insulation.

.12 Duct *Work* Exposed in Mechanical Equipment Rooms or Finished Spaces below 3 m (10 ft) above finished floor: Finish canvas jacket sized for finish painting.

.13 Exterior Applications: *Provide* insulation with vapour barrier jacket. Cover with caulked aluminum jacket with seams located on bottom side of horizontal duct section.

.14 External Duct Insulation Application:

.1 Secure insulation with vapour barrier with wires and seal jacket joints with vapour barrier adhesive or tape to match jacket.

.2 Secure insulation without vapour barrier with staples, tape, or wires.

.3 Install without sag on underside of duct work. Use adhesive or mechanical fasteners where necessary to prevent sagging. Lift duct work off trapeze hangers and insert spacers.

.4 Seal vapour barrier penetrations by mechanical fasteners with vapour barrier adhesive.

.5 Stop and point insulation around access doors and damper operators to allow operation without disturbing wrapping.

.15 Plenum Liner, Duct Liner Application:

.1 Adhere insulation with adhesive for 100% coverage.

.2 Secure insulation with mechanical liner fasteners. Refer to SMACNA 1966 Standards for spacing.

.3 Seal and smooth joints. Seal and coat transverse joints.

.4 Seal liner surface penetrations with adhesive.

.5 Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.

3.3 SCHEDULES

.1 Insulate the following ductwork systems inside the building and above ground with insulation of the thickness indicated. Insulation for casings, plenums, and exposed rectangular ductwork shall be rigid board type and exposed round ductwork shall be rigid pre-formed type. Insulation for concealed round ductwork and concealed rectangular ductwork shall be pre-formed, rigid board or blanket type. Thickness of alternate products shall *Provide* equivalent R-value to that of specified mineral fibre.

Duct Type	Temp. Difference (ºC) between air inside and outside duct	Thickness (mm)
all outside air intake ductwork, casings and plenums from fresh air intakes to and including air handler	22 or greater	50 rigid or elastomeric
mixed supply air or preheated supply air casings, plenums and sections to and including the fan section where not factory insulated	5 - 22	25 rigid or elastomeric or 38 flexible blanket
supply air ductwork outward from fans, except for supply ductwork exposed in the area it serves	5 – 22	25 rigid or elastomeric or 38 flexible blanket
all exhaust discharge ductwork and plenums between heat recovery ventilation equipment and exhaust openings to atmosphere	5 – 22	25 rigid or elastomeric or 38 flexible blanket
other exhaust discharge ductwork and plenums within 4 m of exhaust openings to atmosphere	5 – 22	25 rigid or elastomeric or 38 flexible blanket
any other ductwork, casings, plenums or sections specified or detailed on the drawings to be insulated	5 – 22	as specified

3.4 INSULATION FINISH REQUIREMENTS

.1 White PVC: Jacket exposed pipe insulation work inside the 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 all joints to produce a neat water-tight installation. *Provide* slip-type expansion joints where required by manufacturer’s instructions.

.2 Rigid Aluminum: Install 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 the following insulation:

.1 exposed refrigerant piping;

.2 exterior insulated ductwork.

.3 Protective Coating – Flexible Elastomeric Insulation: Apply 2 coats (with 24 hr. between coats) of the specified coating to all insulation outside the building which cannot be covered with rigid aluminum jacket.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

  .1 Equipment insulation.

  .2 Covering.

  .3 Breeching insulation.

1.3 SUBMITTALS

.1 *Product* Data: *Provide* product description, thermal characteristics, list of materials and thickness for equipment scheduled.

PART 2 PRODUCTS

2.1 BLANKET MINERAL FIBRE

.1 Manufacturers:

  .1 Johns Manville;

  .2 Knauf;

  .3 Manson Insulation;

  .4 CertainTeed.

.2 Blanket type roll form insulation to ASTM Standard C553-00, 24 kg/m^3 (1½ lb/ft^3) density, with factory applied vapour barrier facing.

  .1 For “cold” equipment such as roof drain bodies, water meters, and “cold” pump casings”.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Section 01 70 00: Verify existing conditions before starting work.

.2 Verify that equipment has been tested before applying insulation materials.

.3 Verify that surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

.1 Install components to manufacturer's written instructions.

.2 Factory Insulated Equipment: Do not insulate.

.3 Exposed Equipment: Locate insulation and cover seams in least visible locations.

.4 Apply insulation close to equipment by grooving, scoring, and bevelling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

.5 Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapour barrier cement.

.6 Insulated equipment containing fluids below ambient temperature: Insulate entire system.

.7 Fibre glass insulated equipment containing fluids below ambient temperature: *Provide* vapour barrier jackets, factory-applied or field-applied. Finish with glass cloth and vapour barrier adhesive.

.8 For hot equipment containing fluids 60 degrees C or less, do not insulate flanges and unions, but bevel and seal ends of insulation.

.9 For hot equipment containing fluids over 60 degrees C, insulate flanges and unions with removable sections and jackets.

.10 Fibre glass insulated equipment containing fluids above ambient temperature: *Provide* standard jackets, with or without vapour barrier, factory-applied or field-applied. Finish with glass cloth and adhesive.

.11 Inserts and Shields:

- .1 Application: Equipment 50 mm diameter or larger.
- .2 Shields: Galvanized steel between hangers and inserts.
- .3 Insert location: Between support shield and equipment and under the finish jacket.
- .4 Insert configuration: Minimum 150 mm long, of same thickness and contour as adjoining insulation; may be factory fabricated.
- .5 Insert material: Hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

.12 Finish insulation at supports, protrusions, and interruptions.

.13 Equipment in Mechanical Equipment Rooms or Finished Spaces: Finish with PVC jacket and fitting covers.

.14 Exterior Applications: *Provide* vapour barrier jacket or finish with glass mesh reinforced vapour barrier cement. Cover with stainless steel jacket with seams located on bottom side of horizontal equipment.

.15 Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

.16 Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.

3.3 SCHEDULES

.1 Blanket Type Mineral Fibre:

- .1 Insulate the following equipment with mineral fibre blanket type insulation of the thickness indicated:
  - .1 roof drain sumps where inside the building – 25 mm thick;
  - .2 water meter(s) – 40 mm thick.
- .2 Unless otherwise noted, wrap the equipment to a thickness and insulating value equal to an equivalent thickness of rigid sectional pipe insulation. Laminate the insulation in place with a full coverage of adhesive and secure with wire. Apply a jacket of the 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 the fibreglass blanket on radiant ceiling panels after testing is complete.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

.1 Piping insulation.

.2 Jackets and accessories.

1.3 SCOPE OF WORK

.1 Supply and install insulation for piping systems in all areas, including:

.1 Domestic cold water, domestic hot water, hot water re-circulating, and tempered water piping and fittings.

.2 Condensate drain piping and fittings serving refrigeration and cooling equipment.

.3 Refrigerant piping/tubing inside and outside the building.

.4 Roof drain sumps and storm piping inside the building.

.5 Miscellaneous piping indicated on the drawing(s).

1.4 SUBMITTALS

.1 *Product* Data: *Provide* product description, list of materials and thickness for each service, and locations.

PART 2 PRODUCTS

2.1 PERFORMANCE

.1 Fire Hazard Ratings: Unless otherwise specified, all insulation system materials inside the 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 Thermal Performance: Unless otherwise specified, thermal performance of insulation is to meet or exceed the values given in the National Energy Code of Canada for Buildings 2011 or Tables 6.8.2.A, 6.8.2.B, 6.8.3.A, and 6.8.3.B of ASHRAE/IES Standard 90.1-2007.

.1 In the event of a contradiction between two specified requirements, the higher thermal performance requirement shall govern.

2.2 FLEXIBLE FOAM ELASTOMERIC

.1 Manufacturers:

.1 Armacell;

.2 K-Flex.

.2 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 E96-90, Procedure B, and all required installation accessories.

.1 Use for refrigerant gas and liquid tubing/piping.

2.3 FIRE-RATED PREMOULDED MINERAL WOOL

.1 Manufacturers:

.1 Roxul;

.2 Johns Manville;

.3 Paroc Group.

.2 Non-combustible, fire-rated, rigid, sectional, longitudinally split mineral wool or basalt pipe insulation with a reinforced vapour barrier jacket and compatible with CAN4-S115 and CAN/ULC-S01 firestopping.

.1 Use only where insulated piping penetrates fire-rated construction.

.2 Apply where the pipe penetrates the fire barrier and is required to form a component of the ULC firestop system at the penetration.

.3 Coordinate with firestopping work.

2.4 PRE-MOULDED MINERAL FIBRE

.1 Manufacturers:

.1 Johns Manville;

.2 Knauf;

.3 Manson Insulation;

.4 Owens Corning.

.2 Rigid, sectional, sleeve type insulation to ASTM Standard C 547-00, with a factory applied vapour barrier jacket.

.1 Use for all piping inside the building and above ground, except as noted.

.2 Not acceptable for refrigerant piping.

2.5 BLANKET MINERAL FIBRE

.1 Manufacturers:

.1 Johns Manville;

.2 Knauf;

.3 Manson Insulation;

.4 CertainTeed.

.2 Blanket type roll insulation to CGSB 51-GP-11M, 24 kg/m^3 (1½ lb/ft^3) density, with a factory applied vapour barrier facing.

.1 Use in conjunction with premoulded mineral fibre for insulating valves and similar odd shaped items.

2.6 INSULATION FASTENINGS

.1 Aluminium Banding: Equal to ITW Insulation Systems Canada "FABSTRAPS" minimum 12 mm wide, 0.6 mm (1/16") thick aluminium strapping.

  .1 for securing fiberglass insulation for tanks, shell and tube heat exchangers, etc., and for securing metal jacket on weather-proofed pipe insulation

.2 Stainless Steel Banding: Equal to ITW Insulation Systems Canada "FABSTAPS" 0.6 mm (1/16") thick, minimum 12 mm wide type 304 stainless steel strapping.

  .1 for securing stainless steel insulation jacket in place

.3 Duct Insulation Fasteners: Weld-on 2 mm (3/32") diameter zinc coated steel spindles of suitable length, complete with minimum 40 mm square plastic or zinc plated steel self-locking washers.

  .1 for securing mineral fibre duct and casing insulation in place

.4 Tape Sealant: Equal to MACtac Canada Ltd. self-adhesive insulation tapes, types PAF, FSK, ASJ, or SWV as required to match the surface being sealed.

  .1 for sealing and securing joints in mineral fibre pipe and duct insulation

.5 Adhesive - Mineral Fibre Insulation: Clear, pressure sensitive, brush consistency adhesive, suitable for a temperature range of -20°C to 82°C (-4°F to 180°F), compatible with the type of material to be secured, and WHMIS classified as non-hazardous.

  .1 for adhering board or blanket mineral fibre insulation to pipe, ducts and equipment

.6 Adhesive – Flexible Elastomeric Insulation: Armacell "Armaflex" #520 air-drying contact adhesive.

.7 Adhesive – Closed Cell Foamed Glass Insulation: Pittsburgh Corning PC88 multi-purpose two-component adhesive.

.8 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.

  .1 for securing and finishing canvas jacket on exposed mineral fibre insulation

.9 Sheet Metal Screws: No. 10 stainless steel sheet metal screws.

2.7 INSULATION JACKETS AND FINISHES

.1 White PVC:

  .1 Manufacturers:

    .1 Proto Corp. "LoSMOKE";

    .2 The Sure-Fit System "SMOKE-LESS 25/50";

    .3 Johns Manville Inc. "Zeston" 300.

  .2 Roll form sheet and fitting covers, minimum 15 mil thick white PVC, 25/50 rated, complete with installation and sealing accessories.

    .1 for finishing exposed pipe insulation inside building

.2 Rigid Aluminium:

.1 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, and "Fabstraps" and butt straps with weatherproof the end to end joints. Fittings are to be two-piece epoxy coated pressed aluminum with weather locking edges.

.2 For jacket on insulation outside building to protect from damage and *Provide* additional weather-proofing. May also be used inside building as alternate to PVC.

.3 Stainless Steel:

.1 Equal to ITW Insulation Systems Canada "Lock-on" 0.254 mm (0.010") thick type 304 embossed stainless steel to ASTM A240, factory cut to size and complete with moisture barrier and continuous modified Pittsburgh Z-Lock, and butt straps with "Fabstraps" to cover end to end joints. Fittings are to be two piece pressed stainless steel with weather locking edges.

.2 For use as a protective jacket as for rigid aluminum specified above but where a more corrosion-resistant material is required. May also be used inside building.

.4 Adhesive Backed Flexible Aluminium:

.1 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.

.2 For use as an alternative to rigid aluminum jacket material for exposed exterior pipe and duct insulation and for underground pipe insulation, where approved by Engineer. Note that ambient temp. must be 65°F or better for installation

.5 Insulation Cement:

.1 Heat resistant, trowel consistency thermal insulating and finishing cement to CAN/CGSB 51.12, and suitable in all respects for the application.

.6 Protective Coating - Foamed Glass Insulation:

.1 Pittsburgh Corning "PITTCOTE 404" flexible acrylic latex weather barrier coating, white unless otherwise specified.

.2 For "FOAMGLAS" insulation when used above ground and does not require a metal jacket or other jacket

.7 Protective Coating - Flexible Foam Elastomeric Insulation:

.1 Equal to Armacell "WB Armaflex" weatherproof, water-based latex enamel finish.

.2 for Armacell "Armaflex" type flexible elastomeric insulation exposed to weather.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verify that piping has been tested before applying insulation materials.

.2 Verify that surfaces are clean, foreign material removed, and dry.

3.2 INSTALLATION

.1 Install materials to manufacturer's written instructions.

.2 On exposed piping, locate insulation and cover seams in least visible locations.

.3 Insulated dual temperature pipes or cold pipes conveying fluids below ambient temperature:

.1 *Provide* vapour barrier jackets, factory applied or field applied.

.2 Insulate fittings, joints, and valves with moulded insulation of like material and thickness as adjacent pipe.

.3 Finish with glass cloth and vapour barrier adhesive.

.4 PVC fitting covers may be used.

.5 Continue insulation through walls, sleeves, pipe hangers, and other pipe penetrations.

.6 Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, [pump bodies] and expansion joints.

.4 For insulated pipes conveying fluids above ambient temperature:

.1 *Provide* standard jackets, with or without vapour barrier, factory applied or field applied.

.2 Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe.

.3 Finish with glass cloth and adhesive.

.4 PVC fitting covers may be used.

.5 For hot piping conveying fluids 60 degrees C (140 degrees F) or less, do not insulate flanges and unions at equipment, but bevel and seal ends of insulation.

.6 For hot piping conveying fluids over 60 degrees C (140 degrees F), insulate flanges and unions at equipment.

.5 Inserts and Shields:

.1 Application: Piping 40 mm (1-1/2 inch) diameter or larger.

.2 Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.

.3 Insert Location: Between support shield and piping and under the finish jacket.

.4 Insert Configuration: Minimum 150 mm >(6 inches) long, of same thickness and contour as adjoining insulation; may be factory fabricated.

.5 Insert Material: hydrous calcium silicate insulation or other heavy density insulating material suitable for the planned temperature range.

.6 Finish insulation at supports, protrusions, and interruptions.

.7 For pipe exposed in mechanical equipment rooms or in finished spaces finish with PVC jacket and fitting covers.

.8 For exterior applications, *Provide* vapour barrier jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapour barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

.9 For buried piping, *Provide* factory fabricated assembly with inner all-purpose service jacket with self-sealing lap, and asphalt impregnated open mesh glass fabric, with 0.025 mm (1.0 mil) thick aluminum foil sandwiched between three layers of bituminous compound; outer surface faced with a polyester film.

.10 For heat traced piping, insulate fittings, joints, and valves with insulation of like material, thickness, and finish as adjoining pipe. Size large enough to enclose pipe and heat tracer. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.3 TOLERANCE

.1 Substituted insulation materials: Thermal resistance within 10% at normal conditions, as materials indicated.

3.4 SCHEDULES

.1 Insulate piping as per the following table, using insulation K factor of 0.034 W/m·°C at 24°C (0.24 BTU·in/hr·ft² at 75°F). Thickness of alternate products shall *Provide* equivalent R-value.

	MINIMUM INSULATION THICKNESS	
PIPING SYSTEM / Piping Diameter	32 mm diameter & smaller	38 mm diameter & larger
Domestic Hot Water Supply, Recirculation, and Tempered	25 mm	38 mm
Domestic Cold Water	25 mm	25 mm
Roof Drainage and Piping within building	25 mm	25 mm
Plumbing Vents	38 mm	38 mm
Heating Water and Glycol Supply & Return	25 mm	38 mm
Chilled Water Supply & Return	25 mm	25 mm
Refrigerant Lines within building	25 mm	38 mm
Refrigerant Lines outside building	38 mm	38 mm
Miscellaneous Piping and Fittings	25 mm	25 mm
Steam Lines from Humidifier	38 mm	50 mm
Condensate Line from Humidifier	25 mm	38 mm

END OF SECTION

PART 1 – GENERAL

1.1 General

.1 The purpose of this section is to specify Division 23 responsibilities in the commissioning process.

.2 The systems to be commissioned are listed in Section 01 91 00, Part 1.9.

.3 Commissioning requires the participation of Division 23 to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 01 91 00. Division 23 shall be familiar with all parts of Section 01 91 00 and the commissioning plan issued by the CA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

.4 CA = Commissioning Agent, TAB = Test and Balance.

1.2 Responsibilities

.1 Mechanical Subcontractor. The Contractor shall ensure that the HVAC Subcontractor (“mechanical Subcontractor”) complies with all requirements included in this Section and fulfills the following responsibilities during construction and acceptance phases (all references apply to commissioned equipment only):

  .1 Documentation of all procedures performed shall be provided and forwarded to the Consultant. Written documentation must contain recorded test values of all mechanical tests performed per the individual product specification.

  .2 The start-up service company shall be present during energization of the mechanical equipment. Site and equipment access must be provided by the mechanical Subcontractor.

  .3 The Contractor shall supply a power source, specified by the start-up service company, for on-Site test equipment.

  .4 The Contractor is to attend all factory witness testing required within the respective Specification Sections. The Contractor shall cover all their costs and include them in the Contract Price.

  .5 Perform tests using qualified personnel. Provide necessary instruments and equipment.

  .6 Include the cost of commissioning in the Contract Price, if not yet included.

  .7 In each purchase order or subcontract written, include requirements for submittal data, O&M data and training.

  .8 Attend a commissioning scoping meeting and other necessary meetings scheduled by the CA to facilitate the commissioning process.

  .9 The Contractor and its Subcontractors shall provide normal cut sheets and shop drawing submittals to the CA of commissioned equipment. Provide additional requested documentation, prior to normal O&M manual submittals, to the CA for development of pre-functional and functional testing procedures.

.1 Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any Region-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Region to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent.

.2 The Commissioning Agent may request further documentation necessary for the commissioning process. This data request may be made prior to normal submittals.

.10 Provide a copy of the O&M manuals submittals of commissioned equipment, through normal channels, to the CA for review.

.11 The Contractor and its Subcontractors shall assist (along with the design Professional Engineers) in clarifying the operation and control of commissioned equipment in areas where the Specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

.12 Provide assistance to the CA in preparation of the specific functional performance test procedures specified in Section 23. The Contractor shall ensure that its Subcontractors review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

.13 Develop a full start-up and checkout plan using manufacturer's start-up procedures and the pre-functional test sheets from the CA. Submit manufacturer's detailed start-up procedures and the full start-up plan and procedures and other requested equipment documentation to CA for review.

.14 During the startup and checkout process, execute and document the mechanical-related portions of the pre-functional test sheets provided by the CA for all commissioned equipment.

.15 Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CA.

.16 Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

.17 Perform functional performance testing under the direction of the CA for specified equipment in 01 91 00, Section 1.9. Assist the CA in interpreting the monitoring data, as necessary.

.18 Correct deficiencies (differences between specified and observed performance) as interpreted by the CA and Consultant and retest the equipment.

.19 Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

.20 During construction, maintain as-built red-line drawings for all drawings and final CAD as-builts for Contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing). Prepare red-line As-Built Drawings for all drawings and final as-builts for Contractor-generated coordination drawings.

.21 Provide training of the Region's operating personnel as specified.

.22 Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

.23 Execute seasonal or deferred functional performance testing, witnessed by the CA, according to the Specifications.

.24 Correct deficiencies and make necessary adjustments to O&M manuals and As-Built Drawings for applicable issues identified in any seasonal testing.

.25 Assist and cooperate with the TAB Subcontractor and CA by:

.1 Putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.

.2 Including cost of sheaves and belts that may be required by TAB.

.3 Providing test holes in ducts and plenums where directed by TAB Subcontractor to allow air measurements and air balancing. Providing an approved plug.

.4 Providing temperature and pressure taps according to the Contract Documents for TAB and commissioning testing.

.26 Install a P/T plug at each water sensor which is an input point to the control system.

.27 List and clearly identify on the As-Built Drawings the locations of all air-flow stations.

.28 Prepare a preliminary schedule for Division 23 pipe and duct system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the CA. Update the schedule as appropriate.

.29 Notify the Region's PM, Consultant and CA when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and TAB will occur. Be responsible to notify the Region's PM, Consultant and CA, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and that the CA has the scheduling information needed to efficiently execute the commissioning process.

.2 <u>TAB Subcontractor</u>: The Contractor shall ensure that the TAB Subcontractor complies with the following duties, in addition to those listed in 1.2.1:

.1 Six weeks prior to starting TAB, submit to the Contractor the qualifications of the Site technician for the project, including the name of the Subcontractors and facility managers of recent projects the technician on which was lead. The Region will approve the Site technician's qualifications for this project.

.2 Submit the outline of the TAB plan and approach for each system and component to the Region's PM, CA, Consultant and the controls Subcontractor six weeks prior to starting the TAB. This plan will be developed after the TAB Subcontractor has some familiarity with the control system. The submitted plan will include:

.1 Certification that the TAB Subcontractor has reviewed the construction documents and the systems with the design Professional Engineers and Contractor to sufficiently understand the design intent for each system.

.2 An explanation of the intended use of the building control system. The controls Subcontractor will comment on feasibility of the plan.

.3 All field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.

.4 Discussion of what notations and markings will be made on the duct and piping drawings during the process.

.5 Final test report forms to be used.

.6 Detailed step-by-step procedures for TAB work for each system and issue: terminal flow calibration (for each terminal type), diffuser proportioning, branch / submain proportioning, total flow calculations, rechecking, diversity issues, expected problems and solutions, etc. Criteria for using air flow strengtheners or relocating flow stations and sensors will be discussed. Provide the analogous explanations for the water side.

.7 List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.

.8 Details of how total flow will be determined (Air: sum of terminal flows via BAS calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pilot traverse, SA or RA flow stations. Water: pump curves, circuit setter, flow station, ultrasonic, etc.).

.9 The identification and types of measurement instruments to be used and their most recent calibration date.

.10 Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and provide methods to verify this.

.11 Confirmation that TAB understands the outside air ventilation criteria under all conditions.

.12 Details of whether and how minimum outside air cfm will be verified and set and for what level (total building, zone, etc.).

.13 Details of how building static and exhaust fan / relief damper capacity will be checked.

.14 Proposed selection points for sound measurements and sound measurement methods.

.15 Details of methods for making any specified coil or other system plant capacity measurements.

.16 Details of any TAB work to be done in phases (by floor, etc.), or of areas to be built out later.

.17 Details regarding specified deferred or seasonal TAB work.

.18 Details of any specified false loading of systems to complete TAB work.

.19 Details of all exhaust fan balancing and capacity verifications, including any required room pressure differentials.

.20 Details of any required interstitial cavity differential pressure measurements and calculations.

.21 Plan for hand-written field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).

.22 Plan for formal progress reports (scope and frequency).

.23 Plan for formal deficiency reports (scope, frequency and distribution).

.3 A running log of events and issues shall be kept by the TAB field technicians. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests to the Region's PM, CA and Consultant at least twice a week.

.4 Communicate in writing to the controls Subcontractor all setpoint and parameter changes made or problems and discrepancies identified during TAB which affect the control system setup and operation.

.5 Provide a draft TAB report within two weeks of completion. A copy shall be provided to the CA. The report will contain a full explanation of the methodology, assumptions and the results in a clear format with designations of all uncommon abbreviations and column headings. The report should follow the latest and most rigorous reporting recommendations by AABC, NEBB.

.6 Provide the CA with any requested data, gathered, but not shown on the draft reports.

.7 Provide a final TAB report for the CA with details, as in the draft.

.8 Conduct functional performance tests and checks on the original TAB as specified for TAB in this Section.

PART 2- PRODUCTS

.1 NOT USED

PART 3- EXECUTION

3.1 Submittals

.1 The Contractor shall ensure that Section 23 Subcontractors provide submittal documentation relative to commissioning to the CA as requested by the CA. Refer to Section 01 91 00 Part 3.3 for additional Section 23 requirements.

3.2 Start-up of Equipment

.1 The HVAC Subcontractor(s) shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in 01 91 00. Division 23 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the Commissioning Agent or the Region.

.2 Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CA and Consultant. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all pre functional checklists as soon as possible.

.3 Prior to the start up of equipment the Division 23 Subcontractor shall arrange to have the manufacturer of all major equipment inspect the installation to ensure their equipment has been installed in accordance with their recommendations.

.4 The supplier shall submit a written report of their findings.

.5 Upon confirmation that the equipment has been installed in accordance with the manufacturer's recommendations the equipment may be started.

.6 All equipment shall be started by the manufacturer's representative.

3.3 Pre-Functional Test Sheets

.1 Pre-functional test sheets contain items for Section 23 Subcontractors to perform. On each checklist, a column is provided that is to be completed by the Contractor assigning responsibility for that line item to a Subcontractor. Those executing the test sheets are only responsible to perform items that apply to the specific application at hand. These test sheets do not take the place of the manufacturer's recommended checkout and start-up procedures or report. Some checklist procedures may be redundant in relation to checkout procedures that will be documented on typical factory field checkout sheets. Double documenting may be required in those cases.

.2 Refer to Section 01 91 00 for additional requirements regarding pre-functional test sheets, startup and initial checkout. Items that do not apply should be noted along with the reasons on the form. If this form is not used for documenting, one of similar rigor and clarity shall be used pending approval from the CA. The Contractor's assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their Subcontractors are completed and checked off. "Contr." column or abbreviations in brackets to the right of an item refer to the Subcontractor responsible to verify completion of this item.

3.4 Operations and Maintenance Manuals

.1 The Contractor shall ensure that Section 23 Subcontractors compile and prepare documentation for all equipment and systems covered in Section 23 and deliver it to the Contractor for inclusion in the O&M manuals

.2 The CA shall receive a copy of the O&M manuals for review.

3.5 Training of Region Personnel

.1 The Contractor shall coordinate and schedule training and ultimately to ensure that training is completed. Refer to Section 01 91 00 for additional details.

.2 The CA will oversee and approve the content and adequacy of the training of the Region personnel for commissioned equipment. Refer to Section 01 91 00 for additional details.

.3 <u>Mechanical Subcontractor.</u> The Contractor shall ensure that the mechanical Subcontractor fulfills the following training responsibilities:

- .1 Provide the CA with a training plan two weeks before the planned training according to the outline described in Section 01 91 00, Part 3.8.

- .2 Provide the designated Region personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to, pumps, boilers, furnaces, chillers, heat rejection equipment, air conditioning units, air handling units, fans, terminal units, controls and water treatment systems, etc.

.3 Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.

.4 During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

.5 The appropriate Subcontractor or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing Subcontractor or manufacturer’s representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than one party may be required to execute the training.

.6 The controls Subcontractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

.7 The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

.8 Training shall include:

.1 Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.

.2 A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.

.3 Discussion of relevant health and safety issues and concerns.

.4 Discussion of warranties and guarantees.

.5 Common troubleshooting problems and solutions.

.6 Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.

.7 Discussion of any peculiarities of equipment installation or operation.

.9 The format and training agenda in The HVAC Commissioning Process, ASHRAE Guideline 1-1989R, 1996 is recommended.

.10 Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate.

.11 Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and preventative maintenance for all pieces of equipment.

.12 The mechanical Subcontractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.

.13 Training shall occur after functional testing is complete, unless approved otherwise by the -Region’s PM

3.6 Deferred Testing

.1 Refer to Section 01 91 00, Part 3.9 for requirements of deferred testing.

3.7 WRITTEN WORK PRODUCTS

.1 Written work products of Section 23 Subcontractors will consist of the startup and initial checkout plan as described in Section 01 91 00, as well as completed startup, initial checkout and pre-functional test sheets.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SUMMARY

.1 *Provide* all metering equipment required to monitor consumption by end use type.

1.3 RELATED SECTION

.1 Division 22 09 00 Instrumentation and Control Devices for Plumbing

.2 Division 26 09 23 Metering and Switchboard Instruments

.3 Division 01 91 00 Commissioning

1.4 SUBMITTALS

.1 Submittals for review

.1 Submit shop drawings in accordance with Section 20 05 00 – Mechanical General Provisions.

.2 *Product* Data: Prior to ordering any products, the *Contractor* shall submit the product data sheets, installation manuals, operation manuals, and shop drawings for all equipment specified herein for review and comment. This includes:

.1 Natural Gas Meter (GM-1)

.3 Operation & Maintenance Manual

.1 At the completion of the project, *Provide* copies of all documentation related to components of the metering system. This includes: shop drawings with model and serial numbers for each meter clearly indicated; product brochures; installation and operation guides; as-built wiring-diagrams, contact information for the contractor or supplier (e.g. address, telephone number, and email address) of the EMS system. The documentation listed above shall be provided in a dedicated section within the Operation and Maintenance Manual labeled with a separate marked tab titled “Natural Gas Metering System”.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.2 All equipment must be in new condition, and packaging free of dust, moisture, and physical damage. Any equipment not satisfying these requirements will be rejected at the Engineer’s discretion.

.3 All equipment once onsite must be stored in secure, rigid, dry, weather tight locations free from damage by dust, moisture or physical abrasion. Equipment stored onsite during construction is the responsibility of the *Contractor*.

.4 Where practicable, all packaging materials shall be reused and recycled at the end of their useful life.

1.6 WARRANTY

.1 The energy meters shall include a full five (5) year manufacturer warranty which repairs the devices at no cost to the owner or replaces them with a model of equal or better quality. In the event that the devices cannot be repaired or replaced, and refund of equal (or greater) than the depreciated purchase price of the product shall be paid to the *Owner*. All shipping costs with repair or replacement shall be paid for by the manufacturer.

.2 The *Contractor* shall prepare and submit all warranty information and registration documentation required by product manufacturers on behalf of the *Owner*. Copies of all Manufacturer Warranty Documentation shall be included (as specified) in the Operation & Maintenance Manual.

PART 2 PRODUCTS

2.1 END USES TO BE MONITORED

.1 *Provide* gas meters for all end uses, including but not limited to:

- .1 Facility incoming natural gas line.
- .2 Facility data logger (may share with other meter inputs).

2.2 METERING EQUIPMENT

.1 Meters

- .1 *Provide* gas meters for:
  - .1 Facility incoming gas
- .2 Metering Equipment
  - .1 Coordinate with local Gas Utility for gas meter installation. Gas meter provided by Utility shall be capable of providing pulse outputs suitable for use with specified data logger, rather than providing separate gas sub-meter for data logging purposes.
  - .2 All meters shall have 2 Zener Barrier (R.Sthal Cards) installed in a Hoffman Model S604NF-5 NEMA 4, Rated CSA/UL listed enclosure (6" H x 4" W x 4" D), 2 – R.Stahl I.S. positive barriers. This barrier configuration is also required to be properly grounded, to meet Enbridge Engineering intrinsically safe requirements. This zener barrier configuration is required between the Enbridge Gas meter and the customer’s monitoring equipment. Available from Alpha Controls (905-477-2133).
  - .3 *Contractor* shall *Provide* SPA Board if required by meter type/model installed, available from C.R. Wall (877-427-9255). *Contractor* shall *Provide* wiring harness if required for the meter type/model installed, available from Tevelec Ltd (905-624-5241).
  - .4 *Provide* gas meters complete with bypass piping arrangement or other means to remove or isolate for service without interruption to gas flow.
  - .5 Materials shall be compatible with the systems in which they are installed at all potential operating temperatures and pressures.
  - .6 Meters shall *Provide* a pulse output scaled to an appropriate volume. In general, *Provide* a scaled pulse output of 0.01 m3 per pulse unless high consumption would result in pulses too frequent to be reliably captured by the pulse counting equipment.

.7 Meters requiring power shall be hard-wired to an emergency power circuit. Battery powered units are not acceptable.

.8 *Provide* meters with readout of totalized volume.

.9 Accuracy +/- 1.5% in expected operating flow range.

.2 Pulse Counting Data Logging Equipment

.1 Internet Protocol (IP) based data logger complete with:

.1 Built-in web server.

.2 Capable of operating with a dedicated IP address (to be provided by the *Region*).

.3 Communications Protocols:

.1 HTTP/Post capable of pushing data to 3rd party applications/databases.

.2 Modbus TCP

.3 Built-in real-time and historic graphics accessible with any HTML 5 internet browser (computer, tablet, phone) on the *Region*'s network. Data to be displayed in local time, adjusted for daylight savings time.

.2 Real-time clock with battery backup and email alert for battery end of life.

.3 Time-Stamp:

.1 Represent date and time

.2 In UTC time or offset from a specified UTC time

.3 Resolution: Minimum 1 second

.4 Ability to export all stored trend data to comma separated value (.csv) or Microsoft Excel format for importing into spreadsheets. Time-stamps to be exported as a single field with a numeric (non-text) value in local time.

.5 Published application programming interface (API) allowing data to be retrieved from the pulse counter via non-proprietary means, such as JavaScript Object Notation (JSON).

.6 *Provide* minimum 2 spare inputs for future additional meters. Location of spare inputs to be determined by the *Region*.

.7 Minimum two universal inputs for addition of 0-10V and 0-20mA/4-20mA sensors.

.8 Built-in trending and data storage:

.1 3 years of consumption data (m3) at 5 minute intervals for each input with time-stamp.

.2 Stored in non-volatile memory.

.9 Battery/power backup (for pulse counting):

.1 Lasting a minimum of 72 hours.

.2 Rechargeable.

.3 Email alert for battery end of life.

.10 No special software required to set up data logger or access data.

.11 Security:

.1 Unrestricted access to data and graphics over the *Region*'s network.

.2 Password protection for access to setup, changing settings/parameters and deleting data.

.12 Ability to measure, store and trend the following data complete with timestamp:

.1 Totalized consumption (m3)

.2 Acceptable product: z3 Controls Inc. NetMeter OMNI.

.3 Data Cabling

.1 Cat 6a Unshielded Twisted Pair (UTP) OR

.2 Cabling base on ITS Network Cabling Standard.

.3 Colour: Green

PART 3 EXECUTION

3.1 INSTALLATION REQUIREMENTS

.1 Meters to be supplied and installed by the mechanical contractor. Meters to be supplied with complete pulse output. Sub Meters by American Meter, Itron or Norgas are acceptable. Pulse output should be complete with wiring harness. BAS contactor to supply intrinsically safe barrier as required. Manufacturer's technician to be on site for the startup, to be included with the meter supply.

.2 Install data logger in a painted, hinged NEMA 1 (or better depending on location) enclosure complete with power supply. Label front of enclosure with data logger name, IP address, meter name(s) and load(s) measured.

.3 *Provide* optical isolation/safety devices as required by the local gas utility or other authorities having jurisdiction.

.4 For gas meter, installation of pulse output equipment shall be performed by an authorized Enbridge *Contractor*. The *Contractor* is responsible for all costs associated with the use of the authorized contractor:

.1 Authorized Enbridge *Contractor*:

.1 (UMS) Utilities Management Solutions Ltd.

Jeremy Laprairie, 416-771-5084, Jeremy.Laprairie@umsl.ca

.5 All communication and signal cables to be continuous. No splicing is allowed.

.6 Affix York *Region* Property Services Branch Asset ID tag (to be provided by the *Region*) to data logging unit prior to installation.

.7 Data logger and network configuration to be done in consultation with the *Region*'s Property Services Branch.

.8 Connect data logging equipment to the *Region*'s IT network.

.9 Commission data logger:

.1 Ensure latest available firmware version is installed in data logger.

.2 Obtain Network information from York *Region* project manager and program into data logger, including IP address, subnet mask, default gateway, primary and secondary DNS addresses.

.3 Set data logger clock to current local time.

.4 Set up email alerts as specified and/or requested by the *Region*'s project manager.

.5 Set up trend logging as specified and/or requested by the *Region*'s project manager. At minimum, set up trend logging per 2.1.2.2.1.10 and 2.1.2.2.1.14 above.

.6 Set default homepage to display real-time demand graphs and consumption statistics.

.7 Confirm data logger readings correspond to physical meter reading.

.8 Calibrate any analog sensors connected to the data logger.

.9 Verify data logger information is viewable through a web browser on a device on the *Region*'s network.

.10 Complete and submit Gas Meter Installation/Startup Verification Form (23 09 13.01 Included at end of this section).

.11 *Provide* training on data logger software use to *Region* staff including 'Facilities Operations and Maintenance' and 'Climate Change and Energy Conservation'.

.12 *Provide* meter manufacturer's calibration certificate(s), installation, operations and maintenance manuals (for meter(s) and data logger) and recommended meter recalibration interval(s).

3.2 IDENTIFICATION AND LABELING

.1 The natural gas meter shall be clearly identified and labeled with the Meter # (GM-1) to facilitate future troubleshooting, maintenance and/or expansion. Labels shall be of the lamacoid or laser etched (or stamped) enameled metallic type and be permanently affixed to the meter in accordance with manufacturer recommendations.

END OF SECTION

23 09 13.01 GAS METER INSTALLATION/STARTUP VERIFICATION FORM			
Project Name:		*Project* Number:	
Contractor/Installing *Subcontractor*:		Form Completed By (Name):	
Telephone No.:		Date (MM/DD/YY):	

Purpose: The following form is intended to ensure energy meters are correctly and completely set up prior to commissioning verification. Refer to *York Region Building and Facilities Design Standards and Guidelines Division 23 09 13 – Instrumentation and Control Devices for HVAC* for additional requirements.

1. General Information

Manufacturer:	
Model:	
Serial Number:	

2. Physical Installation

23 09 13 Reference	Requirement	Confirm Compliance		Notes
3.1.2	Is the data logger in a painted, hinged NEMA 1 (or better) enclosure complete with power supply?	☐ Yes	☐ No	
3.1.2	Is the front of the enclosure labelled with data logger name, IP address, meter name(s) and load(s) measured?	☐ Yes	☐ No	
3.1.3	Are communication and signal cables continuous (i.e. not spliced)?	☐ Yes	☐ No	
3.1.4	Has optical isolation/safety devices as required by the local gas utility or other authorities having jurisdiction been provided.	☐ Yes	☐ No	
3.1.5	Has a York *Region* Property Services Branch Asset ID Tag been affixed to the data logger?	☐ Yes	☐ No	
3.1.7	Has the data logger been connected to the *Region*'s IT network?	☐ Yes	☐ No	

3. Network Configuration (Note 1 indicates the data is to be provided by the *Region*'s *Project* Manager)		
MAC Address:		
DHCP Disabled?	☐ Yes	☐ No
IP Address:[1]		
Gateway: [1]		
Subnet Mask: [1]		
Primary DNS: [1]		
Secondary DNS: [1]		

23 09 13 Reference	**Requirement**	**Confirm Compliance**		**Notes**
3.1.6 and 3.1.8.2	Has the data logger's Network information been obtained from the *Region*'s *Project* Manager?	☐ Yes	☐ No	
3.1.8.9	Is the data logger viewable through a web browser on a device connected to the *Region*'s network?	☐ Yes	☐ No	

4. Access	
Administrator User Name:	
Administrator Password:	

5. Meter Configuration (Note 1 indicates the data is to be provided by the *Region*'s *Project* Manager)	
Data logger Name: [1]	
Meter Description/Load Served:	

23 09 13 Reference	**Requirement**	**Confirm Compliance**		**Notes**
3.1.8.1	Has the latest firmware been installed in the data logger?	☐ Yes	☐ No	
3.1.8.3	Has the data logger's internal clock been set to current local time?	☐ Yes	☐ No	
3.1.8.4	Have email alerts been set up as specified?	☐ Yes	☐ No	
3.1.8.5	Has trend logging been set up as specified?	☐ Yes	☐ No	
3.1.8.6	Has the data logger's web based home screen been set to display real-time demand graph and consumption statistics?	☐ Yes	☐ No	

6. Datalogger Data Verification																
Complete the following Table with data logger readings and physical meter readings to verify correct setup:																
	Input 1		Input 2		Input 3		Input 4		Input 5		Input 6		Input 7		Input 8	
Measured Load: (ex. GAS-MAIN)																
Parameter	Datalogger	Meter	Datalogger	Meter	Datalogger	Meter	Datalogger	Meter	Datalogger	Meter	Datalogger	Meter	Datalogger	Meter	Datalogger	Meter
$m^3_{time\ 1}$																
$m^3_{time\ 2}$																

23 09 13 Reference	**Requirement**	**Confirm Compliance**		**Notes**
3.1.8.7	Have data logger readings and physical meter been verified to correspond?	☐ Yes	☐ No	
3.1.8.8	Have any analog sensors been calibrated?	☐ Yes	☐ No	

7. Training				
23 09 13 Reference	**Requirement**	**Confirm Compliance**		**Notes**
3.1.8.11	Has training been provided to *Region* staff?	☐ Yes	☐ No	
3.1.8.12	Have meter manufacturer's calibration certificate(s), installation, operations and maintenance manuals (for meter(s) and data logger) and recommended meter recalibration interval(s) been provided to the *Region*'s *Project* Manager?	☐ Yes	☐ No	

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 SUMMARY

.1 Section Includes:

  .1 Materials and installation for piping, valves and fittings for gas fired equipment.

  .2 Pressure regulators.

.2 *Shop Drawings* / *Product* Data

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

1.3 REFERENCES

.1 American Society of Mechanical Engineers (ASME)

  .1 ASME B16.5, Pipe Flanges and Flanged Fittings.

  .2 ASME B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.

  .3 ASME B16.22, Wrought Copper and Copper Alloy Solder-Joint Pressure Fittings.

  .4 ASME B18.2.1, Square and Hex Bolts and Screws Inch Series.

.2 American Society for Testing and Materials International (ASTM)

  .1 ASTM A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.

  .2 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc Coated, Welded and Seamless.

  .3 ASTM B75M, Standard Specification for Seamless Copper Tube [Metric].

  .4 ASTM B837, Standard Specification for Seamless Copper Tube for Natural Gas and Liquefied Petroleum (LP) Gas Fuel Distribution Systems.

.3 Canadian Standards Association (CSA International)

  1. CSA W47.1, Certification of Companies for Fusion Welding of Steel.

.4 Canadian Standards Association (CSA)/Canadian Gas Association (CGA)

  .1 CAN/CSA B149.1, Natural Gas and Propane Installation Code.

  .2 CAN/CSA B149.1HB, Natural Gas and Propane Installation Code Handbook.

  .3 CAN/CSA B149.2, Propane Storage and Handling Code.

  .4 CAN/CSA C282, Emergency Electrical Power Supply for Buildings

.5 National Fire Protection Association (NFPA)

  .1 NFPA 54, National Fuel Gas Code

1.4 QUALITY ASSURANCE

.1 Gas system work shall be in accordance with CAN/CSA B149.1, Natural Gas and Propane Installation code, and CAN/CSA B149.2, Propane Storage and Handling Code, and local authority.

.2 Gas system work shall be completed by G1 Gas Technician 1 licensed gas pipe fitter, authorized by TSSA.

.3 Obtain approval of gas system design by TSSA prior to work on site and prior to ordering materials. The *Contractor* shall be responsible for any review fees and associated costs.

1.5 SUBMITTALS

.1 *Product* data

.1 Submit manufacturer's printed product literature, datasheet for piping, fittings, and equipment.

.2 Test reports

.1 Submit pressure testing reports and photos.

.3 Inspection report / Approval by Authority

.1 Submit a copy of the inspection certificate prior to applying for Substantial performance.

.4 Closeout Submittals

.1 Submit maintenance and engineering data for incorporation into O&M manual. Ensure to include monitoring gas valves and pressure regulator maintenance information.

1.6 PERFORMANCE REQUIREMENTS

.1 Minimum Operating Pressure Ratings:

.1 Piping and Valves: 100 psig minimum.

.2 Service Regulators: 65 psig minimum.

PART 2 PRODUCTS

2.1 NATURAL GAS PIPING, BELOW GROUND

.1 Medium-density polyethylene, PE 2708: ASTM D 2513, CSA B137.4, SDR 11. Continuous length, no connections underground except where connecting to anodeless riser.

.1 PE Fittings: ASTM D 2683, socket-fusion type or ASTM D 3261, butt-fusion type with dimensions matching PE pipe.

.2 PE Transition Fittings: Factory-fabricated fittings with PE pipe complying with ASTM D 2513, SDR 11; and steel pipe complying with ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.

.3 Service-Line Risers: Factory fabricated and leak tested.

.1 Underground Portion: PE pipe complying with ASTM D 2513, SDR 11 inlet.

.2 Casing: Steel pipe complying with ASTM A 53 / A 53M, Schedule 40, black steel, Type E or S, Grade B, with corrosion-protective coating covering. Refer to manufacturer instructions for venting casing aboveground.

.3 Tracer wire connection, UV shield, stake supports with factory finish.

.4 Anodeless, where no easy access to factory-connected anode. Confirm use of factory-connected anode with Client prior to installation.

2.2 NATURAL GAS PIPING, ABOVE GROUND

.1 Steel Pipe: ASTM A53, Schedule 40, Grade B mild black carbon steel pipe, electric resistance welded.

.2 Fittings: ASME B16.3, malleable iron threaded fittings for pipe diameters up to 50mm (2”) and ASME B16.9, wrought steel butt welding fittings for pipe diameters over 50mm (2”).

.3 Joints: Steel flanges and fittings to ASME B16.5; unions malleable iron, brass to iron seat, ground joint to ASME B16.9, ASTM A47/A47M; nipples to schedule 40, ASTM A53/A53M.

.4 Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.

.5 Bolts and nuts: to ASME B18.2.1, carbon steel.

.6 Couplings: buna-nitrile seals.

.7 Joint compound and tape: suitable for natural gas.

.8 Welding Filler Metals: to CSA W47.1 and AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

.9 Brazing Filler Metals: Alloy with melting point greater than 540°C (1000°F) complying with AWS A5.8/A5.8M, and ASTM B837. Brazing alloys containing more than 0.05% phosphorus are prohibited.

2.3 PIPING SPECIALTIES

.1 Appliance Flexible Connectors:

.1 Indoor, Fixed-Appliance Flexible Connectors: Comply with ANSI Z21.24.

.2 Indoor, Movable-Appliance Flexible Connectors: Comply with ANSI Z21.69.

.3 Outdoor, Appliance Flexible Connectors: Comply with ANSI Z21.75.

.4 Corrugated stainless-steel tubing with polymer coating.

.5 Operating-Pressure Rating: 0.5 psig (3.45 kPa).

.6 End Fittings: Zinc-coated steel.

.7 Threaded Ends: Comply with ASME B1.20.1.

.8 Maximum Length: 72 inches (1830 mm.)

.2 Weatherproof Vent Cap:

.1 Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

.3 Valves:

.1 CSA-approved, Provincial Code approved, full-port ball type.

.2 Comply with ASME B16.33 or ASME B16.38.

.3 862 kPa (125 psig) minimum rated working pressure.

.4 *Provide* with locking wing as required.

.5 *Provide* position-indicating limit switch as required.

.6 Tamperproof Feature: Locking feature for valves indicated.

.7 Service Mark: Initials "WOG" shall be permanently marked on valve body.

.4 Y-Pattern Strainers:

.1 Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.

.2 End Connections: Threaded ends for 50 mm (2”) and smaller; flanged ends for 65 mm (2-1/2”) and larger.

.3 Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

.4 CWP Rating: 125 psig (862 kPa).

2.4 PRESSURE REGULATORS

.1 Single stage and suitable for natural gas.

.2 Steel jacket and corrosion-resistant components.

.3 Elevation compensator.

.4 End Connections: Threaded for regulators 50 mm (2”) and smaller; flanged for regulators 65 mm (2-1/2”) and larger.

.5 Lock-up (positive shut-off) type.

.6 Suitably rated for inlet and outlet pressures required.

.7 Outdoor vent termination shall have means to prevent entry of water, insects or foreign material.

.8 Line Pressure Regulators: Comply with ANSI Z21.80.

.1 Manufacturers: Subject to compliance with requirements, *Provide* products by one of the following:

.1 Actaris.

.2 American Meter Company.

.3 Eclipse Innovative Thermal Technologies.

.4 Fisher Control Valves & Instruments; a brand of Emerson Process Management.

.5 Invensys.

.6 Itron Gas.

.7 Maxitrol Company.

.8 Richards Industries.

.2 Body and Diaphragm Case: Cast iron or die-cast aluminum.

.3 Springs: Zinc-plated steel; interchangeable.

.4 Diaphragm Plate: Zinc-plated steel.

.5 Seat Disc: Nitrile rubber resistant to gas impurities, abrasion, and deformation at the valve port.

.6 Orifice: Aluminum; interchangeable.

.7 Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.

.8 Single-port, self-contained regulator with orifice no larger than required at maximum pressure inlet, and no pressure sensing piping external to the regulator.

.9 Pressure regulator shall maintain discharge pressure setting downstream, and not exceed 150 percent of design discharge pressure at shutoff.

.10 Includes factory-mounted overpressure protection device or leak limiting system as required per Code and suitable for type of fuel.

.11 Atmospheric Vent: Factory- or field-installed, stainless-steel screen in opening if not connected to vent piping.

.9 Appliance Pressure Regulators: Comply with ANSI Z21.18

.1 Manufacturers: Subject to compliance with requirements, *Provide* products by one of the following:

.1 Canadian Meter Company Inc.

.2 Eaton.

.3 Harper Wyman Co.

.4 Maxitrol Company.

.5 SCP, Inc.

.2 Body and Diaphragm Case: Die-cast aluminum.

.3 Springs: Zinc-plated steel; interchangeable.

.4 Diaphragm Plate: Zinc-plated steel.

.5 Seat Disc: Nitrile rubber.

.6 Seal Plug: Ultraviolet-stabilized, mineral-filled nylon.

.7 Factory-Applied Finish: Minimum three-layer polyester and polyurethane paint finish.

.8 Regulator may include vent limiting device, instead of vent connection, if approved by authorities having jurisdiction.

2.5 LABELING AND IDENTIFYING

.1 Detectable Warning tape:

.1 Acid- and alkali-resistant, PE film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored yellow.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verify existing conditions before starting work.

.2 Verify that excavations are to required grade, dry, and not over-excavated.

.3 Examine roughing-in for natural-gas piping system to verify actual locations of piping connections before equipment installation.

.4 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

.1 Ream pipe and tube ends. Remove burrs.

.2 Piping shall be free of scale and defects. Remove scale, slag, debris and dirt, on inside and outside, before assembly.

.3 Prepare piping connections to equipment with flanges or unions.

.4 Close equipment shutoff valves before turning off natural gas to premises or piping section.

.5 Inspect natural-gas piping according to NFPA 54 to determine that natural-gas utilization devices are turned off in piping section affected.

.6 Comply with NFPA 54 requirements for prevention of accidental ignition.

3.3 INSTALLATION

.1 Only include the following paragraph if a manufacturer actually publishes installation instructions - many do not. If the manufacturer does NOT publish such a document, ensure all install criteria that is important to the project, is specified below.

.2 No gas piping shall be installed below ground beneath the building or through the foundation of the building.

.3 Install to CAN/CSA B149.1 and generator piping to CSA C282.

.4 *Provide* manual shut-off upstream of pressure regulator.

.5 *Provide* clearance from gas vent discharge from regulator to building openings, appliance vent outlets, moisture exhaust ducts, mechanical air intake, appliance air intakes and sources of ignition as required by CAN/CSA B149.1.

.6 Install to manufacturer's written instructions.

.7 Comply with NFPA 54 for installation and purging of natural gas piping.

.8 Install underground PE natural-gas piping according to ASTM D 2774, in continuous length (no joints except at riser). *Provide* containment conduit where shown on drawings.

.9 *Provide* pressure gauge downstream of each service regulator.

.10 Locate valves for easy access by authorized personnel. *Provide* access (doors) where valves and fittings are not exposed.

.11 Install sleeves for piping penetrations of walls and slabs.

.12 Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

.13 Install piping to maintain headroom, conserve space, and not interfere with use of space.

.14 Group piping whenever practical at common elevations.

.15 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 23 05 16.

.16 *Provide* clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 23 07 19.

.17 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

.18 *Provide* support for utility meters to requirements of utility companies.

.19 Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

.20 Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.

.21 Inserts:

.1 *Provide* inserts for placement in concrete formwork.

.2 *Provide* inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

.3 *Provide* hooked rod to concrete reinforcement section for inserts carrying pipe over 100mm (4”).

.4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

.5 Where inserts are omitted, drill through concrete slab from below and *Provide* through-bolt with recessed square steel plate and nut flush with top of slab.

.22 Install piping free of sags and bends.

.23 Extend indoor relief vent connections for service regulators, line regulators, and overpressure protection devices to outdoors and terminate with weatherproof vent cap.

.24 Install manual gas shutoff valve for each gas appliance upstream of connectors.

.25 Install valves with stems upright or horizontal, not inverted.

.26 Install unions downstream of valves and at equipment or apparatus connections.

.27 *Provide* non-conducting dielectric connections wherever jointing dissimilar metals..

3.4 HANGER AND SUPPORT INSTALLATION

.1 Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 230549 "Seismic and Wind Restraint."

.2 Comply with requirements for pipe hangers and supports specified in Section 23 05 29 " Supports and Anchors."

.3 Install to OBC, CAN/CSA B149.1, ASME B31.9 and local Authority.

.4 Install hangers to *Provide* minimum 13mm (1/2”) space between finished covering and adjacent work.

.5 Place hangers within 300mm (12”) of each horizontal elbow.

.6 Use hangers with 40mm (1-1/2”) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.

.7 Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

.8 Where several pipes can be installed in parallel and at same elevation, *Provide* multiple or trapeze hangers.

.9 *Provide* copper plated hangers and supports for copper piping, or *Provide* electrolytic action tape or equivalent if copper pipe attachment is not provided.

.10 Manufactured hangers are normally supplied in black steel.

.11 Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.

.12 *Provide* hangers adjacent to motor driven equipment with vibration isolation; refer to Section 23 05 48.

.13 Support horizontal piping as scheduled.

.14 Pipe Hanger Schedule:

.1 Metal Piping:

.1 Pipe size: 13mm to 32mm (1/2” to 1-1/4”):

.1 Maximum hanger spacing: 2m (6.5’).

.2 Hanger rod diameter: 9mm (3/8”).

.2 Pipe size: 40mm to 50mm (1-1/2” to 2”):

.1 Maximum hanger spacing: 3m (10’).

.2 Hanger rod diameter: 10mm (3/8”).

.3 Pipe size: 65mm to 75mm (2-1/2” to 3”):

.1 Maximum hanger spacing: 3m (10’).

.2 Hanger rod diameter: 13mm (1/2”).

.4 Pipe size: 100mm to 150mm (4” to 6”):

.1 Maximum hanger spacing: 3m (10’).

.2 Hanger rod diameter: 15mm (5/8”).

.2 Plastic Piping:

.1 All Sizes:

.1 Conform to pipe manufacturer’s recommended support spacing.

.2 Hanger rod diameter: 9mm (3/8”).

3.5 IDENTIFICATION

.1 Install tracer wire beside the natural gas piping and secure at both ends where underground piping come up out of ground.

.2 Install yellow flagging tape 250 mm (10”) directly above gas piping.

3.6 FIELD QUALITY CONTROL

.1 Install tracer wire beside the natural gas piping and secure at both ends where underground piping come up out of ground.

.2 Install yellow flagging tape 250 mm (10”) directly above gas piping.

.3 *Site* Tests/Inspection:

.1 Test system in accordance with CAN/CSA B149.1 and requirements of authorities having jurisdiction.

.4 Purging: purge after pressure test in accordance with CAN/CSA B149.1.

.5 Pre-Start-Up Inspections:

.1 Check vents from regulators, control valves, terminate outside building in approved location, protected against blockage, damage.

.2 Check gas trains, entire installation is approved by authority having jurisdiction.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

SUMMARY

.1 Section Includes

.1 Piping.

.2 Refrigerant.

.3 Moisture and liquid indicators.

.4 Valves / Check Valves / Pressure Relief Valves

.5 Filter-driers.

.6 Expansion Valves & Strainers.

.7 Pressure Regulators.

.8 Solenoid valves.

.9 Expansion valves.

.10 Electronic expansion valves.

.11 Flexible connections.

1.2 SUBMITTALS

.1 *Shop Drawings*

.1 Submit shop drawings or product data sheets for all products specified in Part 2 of this Section, except for pipe and fittings. Ensure that shop drawings and product data sheets confirm that products meet all requirements of the *Contract Documents*.

.2 Refrigerant Piping Schematics

.1 Submit in shop drawing form a refrigerant piping schematic for each refrigerant piping system. Include pipe sizes, slopes, valves, traps, and piping specialties. Piping schematics must be reviewed and approved by the refrigeration equipment manufacturers prior to being submitted to the *Consultant* for review.

.3 Certification Reports

.1 Submit letters from equipment suppliers certifying proper installation and start-up of the piping systems and equipment as specified in Part 3 of this Section.

PART 2 PRODUCTS

2.1 PIPING

.1 Line sets:

.1 Equal to Great Lakes Copper Inc. "EZ-Roll" soft annealed copper to ASTM B280, suitable for use with the refrigerant involved, factory cleaned and capped, and with sizes and lengths as required.

.2 Copper Tubing: Type ACR hard drawn seamless copper tubing to ASTM B280.

.1 Fittings: Wrought copper soldering fittings to ASME B16.22.Joints: Brazed joints made with high melting point silver brazing alloy conforming to AWS Classification BcuP-5.

2.2 MOISTURE AND LIQUID INDICATORS

.1 Manufacturers:

.1 Mueller Industries Inc.;

.2 Sporlan Valve Co.;

.3 Superior Refrigeration Products – Sherwood Valve.

.2 Indicators: Forged brass, triple sealed, CSA certified indicators. Each indicator shall:

.1 Be suitable for a maximum working pressure of 3445 kPa (500 psi) and complete with a liquid indicator that shows 'FULL' when system is fully charged and remains blank when there is a restriction or shortage of refrigerant.

.2 Contain a moisture indicator that changes colour from blue to pink when moisture is present in the system.

.3 Contain a plastic dust cover and extended copper tube brazing connections.

2.3 BALL VALVES

.1 Manufacturers:

.1 Mueller Industries Inc.;

.2 Sporlan Valve Co.;

.3 Superior Refrigeration Products – Sherwood Valve.

.2 CSA certified forged brass ball valves, each suitable for a maximum working pressure of 3445 kPa (500 psi) and complete with carbon filled Teflon ball seals, two O-ring stem seals, a gasketed seal cap, a flow direction arrow cast into the body, a ball position indicator on the stem, and extended copper tube connections to permit brazing the valve into the line without disassembling the valve.

2.4 CHECK VALVES

.1 Manufacturers:

.1 Mueller Industries Inc.;

.2 Sporlan Valve Co.;

.3 Superior Refrigeration Products – Sherwood Valve.

.2 Straight Through Type:

.1 Application: For valves 6.4 mm to 16 mm (1/4" to 5/8") diameter.

.2 Complete with a brass gasketed body, phosphor-bronze spring, neoprene seat, and extended tubing for brazing connections.

.3 Globe Type:

.1 Application: For valves 22 mm (7/8”) diameter and larger.

.2 Complete with a cast bronze body, forged brass cap, phosphor-bronze spring, Teflon seat disc, neoprene O-ring seal, and extended tubing for brazing connections.

2.5 PRESSURE RELIEF VALVES

.1 Manufacturers:

.1 Mueller Industries Inc.;

.2 Sporlan Valve Co.;

.3 Superior Refrigeration Products – Sherwood Valve.

.2 Straight Through or Angle Type, as required. Constructed in accordance with the requirements of ANSI Code B9.1 and the ASME Code for Unfired Pressure Vessels, and each complete with a brass body, neoprene seat disc, and lead seal and locking wire.

2.6 FILTER-DRIERS

.1 Manufacturers:

.1 Mueller Industries Inc.;

.2 Sporlan Valve Co.;

.3 Superior Refrigeration Products – Sherwood Valve.

.2 CSA certified filter-driers, each suitable for a maximum 3445 kPa (500 psi) working pressure and complete with a combination of desiccants in a fluted briquette for drying, and a fluted briquette type filter.

2.7 EXPANSION VALVES

.1 Manufacturers:

.1 Mueller Industries Inc.;

.2 Sporlan Valve Co.;

.3 Superior Refrigeration Products – Sherwood Valve.

.2 Factory tested, balanced port design thermostatic expansion valves. Exact selection to suit the application and refrigerant used. Each complete with a replaceable stainless-steel diaphragm and welded element construction thermostatic element charged with hydraulic fluid and removable inlet strainer.

2.8 FLEXIBLE CONNECTORS

.1 Manufacturers:

.1 Senior Flexonics Canada;

.2 The Metraflex Co.

.2 Phosphor-bronze construction, factory cleaned, dried, and sealed flexible piping connections with copper tube brazing end.

PART 3 EXECUTION

3.1 PREPARATION

.1 Ream pipe and tube ends. Remove burrs.

.2 Remove scale and dirt on inside and outside before assembly.

.3 Prepare piping connections to equipment with flanges or unions.

3.2 INSTALLATION

.1 Install refrigeration specialties to manufacturer's written instructions.

.2 Route piping in orderly manner, with plumbing parallel to building structure, and maintain gradient.

.3 Install piping to conserve building space and not interfere with use of space.

.4 Group piping whenever practical at common elevations and locations. Slope piping 1% in direction of oil return.

.5 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

.6 Inserts:

  .1 *Provide* inserts for placement in concrete formwork.

  .2 *Provide* inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

  .3 *Provide* hooked rod to concrete reinforcement section for inserts carrying pipe over 100 mm.

  .4 Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

  .5 Where inserts are omitted, drill through concrete slab from below and *Provide* through-bolt with recessed square steel plate and nut recessed into and grouted flush with top of slab.

.7 Pipe Hangers and Supports:

  .1 Install to ASME B31.5.

  .2 Support horizontal piping as scheduled.

    .1 Install hangers to *Provide* minimum 13 mm space between finished covering and adjacent work.

  .3 Place hangers within 300 mm of each horizontal elbow.

  .4 Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.

  .5 Where several pipes can be installed in parallel and at same elevation, *Provide* multiple or trapeze hangers.

  .6 *Provide* copper plated hangers and supports for copper piping.

.8 Arrange piping to return oil to compressor. *Provide* traps and loops in piping and *Provide* double risers as required. Slope horizontal piping 0.40% in direction of flow.

.9 *Provide* clearance for installation of insulation and access to valves and fittings.

.10 *Provide* access to concealed valves and fittings.

.11 Flood piping system with nitrogen when brazing.

.12 Where pipe support members are welded to structural building frame, brush clean, and apply one coat of zinc rich primer to welding.

.13 Prepare unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 91 10.

.14 Insulate piping; refer to Section 23 07 19.

.15 Follow ASHRAE 15 procedures for charging and purging of systems and for disposal of refrigerant.

.16 *Provide* replaceable cartridge filter-driers, with isolation valves and valved bypass.

.17 Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

.18 *Provide* external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

.19 Install flexible connectors at right angles to axial movement of compressor, parallel to crankshaft.

.20 Fully charge completed system with refrigerant after testing.

.21 *Provide* electrical connection to solenoid valves. Refer to Section 26 05 80.

.22 Where piping insulation surface is installed in a wall within 65 mm (2.5”) from surface of interior wall, the pipe shall be protected by steel shield plates with a minimum thickness of 1.463 mm (0.0575”, 16-ga), concealed behind the drywall. Plates shall cover the piping and bottom and top plates it penetrates to protect piping during drywall installation, and at least 2” beyond each side of the pipe.

3.3 FIELD QUALITY CONTROL

.1 Test refrigeration system to ASME B31.5.

.2 Pressure test system with dry nitrogen to 1470 kPa (200 psig). Perform final tests at 92 kPa (27 inches) vacuum and 1470 kPa (200 psig) using electronic leak detector. Test to no leakage.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

.1 Metal duct work.

.2 Casing and plenums.

.3 Duct cleaning.

1.3 PERFORMANCE REQUIREMENTS

.1 No variation of duct configuration or sizes permitted except by written permission. Size round ducts installed in place of rectangular ducts to ASHRAE table of equivalent rectangular and round ducts.

1.4 SUBMITTALS

.1 Submit shop drawings or product data sheets for all products specified under this Section, except shop fabricated ductwork and fittings.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 All materials and products shall be inspected upon delivery to the site to ensure there is no pre-existing damage due to dust, moisture, or physical impact.

.2 Once on the site, all materials and products shall be stored according to 3.01A.

.3 All materials used to protect (e.g., skids, tarps etc.) materials and products shall be reused as practicable and recycled at the end of their useful life.

1.6 ENVIRONMENTAL REQUIREMENTS

.1 Ambient Conditions:

.1 Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

.2 Maintain temperatures during and after installation of duct sealants.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Galvanized Steel Ducts:

.1 Galvanizing: ASTM A653 hot dipped galvanized steel sheet, lock-forming quality. Bare uncovered ducts to be finish painted shall G60 satin coat to ASTM A90, all other galvanized ducts shall be G90 zinc coated to ASTM A90.

.2 Rectangular: Lock forming grade hot dip galvanized steel, ASTM A653, shop fabricated, minimum #26 gauge.

.3 Round: Factory machine fabricated, spiral, mechanically locked flat seam, single wall duct, fittings and couplings.

.4 Flat Oval: Factory machine fabricated, single wall, 4-ply spiral lock seam duct, fittings and couplings.

.2 Aluminum Ducts: ASTM B209 aluminum sheet, alloy 3003-H14.

.3 Aluminum Connectors and Bar Stock: Alloy 6061- T6 or of equivalent strength.

.4 Flexible Metallic Ducts:

.1 Uninsulated (return air): Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, SMACNA Form "M-UN", 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 (supply air): Spirally wound, semi-rigid, self-supporting corrugated aluminum duct with continuous triple lock seams, SMACNA Form "M-I", 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 (1½") thick, 12 kg/m3 (0.75 lb/ft^3) density fibreglass insulation with a vinyl jacket meeting flame spread and smoke developed requirements of CAN/ULC-S102.

.5 Fasteners: Rivets, bolts, or sheet metal screws.

.6 Sealant: ULC listed and labelled, premium grade, grey colour, water base, non-flammable duct sealer, brush, or gun applied, with a CAN/ULC S102 maximum flame spread rating of 5 and smoke developed rating of 0.

.7 Hanger Rod: ASTM A36, galvanized steel; threaded both ends, threaded one end, or continuously threaded.

2.2 DUCTWORK FABRICATION

.1 Fabricate and support to SMACNA 1966, and as indicated. *Provide* duct material, gauges, reinforcing, and sealing for operating pressures indicated.

.2 Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centreline. Where not possible and where rectangular elbows are used, *Provide* air foil turning vanes. Where acoustical lining is indicated, *Provide* turning vanes of perforated metal with glass fibre insulation.

.3 Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

.4 Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in 100 mm (4 inch) Standard. Joints: minimum cemented slip joint, brazed or electric welded. Prime coat welded joints.

.5 *Provide* standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

.6 Unless otherwise specified, construct and install ductwork in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible to suit the duct pressure class designation of minimum 500 Pa (2" w.c.) positive or negative as applicable. All flat surfaces of rectangular ductwork are to be cross-broken.

.7 Ducts to 450mm wide shall have plain "S" slips on the long sides, and drive cleats on the short sides, folded over. Maximum end joint spacing is 3000mm. Ducts over 450mm wide shall have angle reinforced joints and gaskets, equal to Ductmate or TDS.

2.3 ACOUSTIC LINING

.1 Minimum 25 mm (1") thick acoustic lining material meeting NFPA 90A requirements and flame spread and smoke developed fire hazard ratings of CAN/ULC-S102, flexible for round ducts, board type for rectangular ducts, consisting of a flexible, closed-cell elastomeric insulation equal to Armacell AP Armaflex.

.2 Materials shall be manufactured without the use of CFCs, HFCs, or HCFCs and shall be formaldehyde-free, low VOC, fibre free, dust free and resistant to mold and mildew with Microban coating.

.3 Materials shall have a maximum 0.27 Btu-in./h-ft2-oF at a 75oF mean temperature when tested in accordance with ASTM 177 or ASTM C 518.

.4 Materials shall have a maximum water absorption of 0.2% by volume when tested in accordance with ASTM C 209.

.5 Materials shall be approved for air plenums.

PART 3 EXECUTION

3.1 IAQ MEASURES AND PROCEDURES

.1 Ductwork Protection

- .1 Stockpiled ductwork not yet installed shall be stored in an area that is clean, dry and has minimum exposure to dust. Ductwork shall be elevated a minimum of 4” above the floor and covered using tarps or plastic sheets.
- .2 During ductwork installation, the working area shall be clean, dry and protected from the exterior elements.
- .3 Wipe internal surfaces of ductwork immediately prior to installation to remove dust that has accumulated.
- .4 All open ductwork must be covered at the end of each day or when not being worked on to prevent the entry of debris into the duct. This can be done using plastic sheets or duct end caps.

.2 HVAC Equipment Protection

- .1 HVAC equipment not yet installed shall be stored in an area that is clean, dry and has minimum exposure to dust. Equipment shall be elevated a minimum of 4” above the floor and covered using tarps or plastic sheets.
- .2 Seal supply diffusers and return grills with plastic during construction operations. Ensure that plastic covers remain in place until final building cleaning and prior to HVAC equipment start-up.
- .3 *Provide* temporary exhaust to areas where heavy construction and dust generating activities are expected to take place. Exhaust systems shall be independent of the building HVAC system to minimize ductwork and equipment contamination.
- .4 HVAC equipment should not be operated during construction. If temporary heating, cooling or ventilation is required, this should be done using temporary equipment. Equipment with firing sections located outside the building (e.g. indirect furnaces) should be given preference over standard propane fired construction heaters.

3.2 INSTALLATION OF RIGID DUCTWORK

.1 Install and seal ducts to manufacturer's written instructions and to SMACNA 1966.

.2 Duct Sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.

.3 *Provide* openings in duct work where required to accommodate thermometers and controllers. *Provide* pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated duct work, install insulation material inside a metal ring.

.4 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

.5 Joints:

- .1 Use crimp joints with or without bead for joining round duct sizes 200 mm (8 inch) and smaller with crimp in direction of air flow.
- .2 Where flanged duct joints are used, do not locate the 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.

.6 Buried underground ducts:

- .1 Slope underground ducts to plenums or low pump out points at 1:100. *Provide* access doors for inspection.
- .2 Apply a heavy brush coat of number 8 PVS duct sealer to the exterior surface of duct joints or seams, covering the heads of lock joint stainless steel screws and/or rivets.
- .3 *Provide* adequate tie-down points to maintain duct slope and prevent ducts from floating during concrete placement. Introduce no heat into ducts for twenty (20) days following placement of concrete.
- .4 Set plenum doors 150 to 300 mm (6 to 12 inches) above floor. Arrange door swings so that fan static pressure holds door in closed position.

.7 Connections:

- .1 Connect terminal units to supply ducts with 300 mm (12 inches) maximum length of flexible duct. Do not use flexible duct to change direction.
- .2 Connect diffusers or light troffer boots to low pressure ducts with 2 m (6.5 ft) maximum length of flexible duct held in place with strap or clamp.
- .3 Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

.8 *Provide* residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for clean out. Use stainless steel for duct work exposed to view and where concealed.

.9 During construction *Provide* temporary closures of metal or taped polyethylene on open duct work to prevent construction dust from entering duct work system.

.10 For all supply air grilles mounted directly to side of duct, make duct connection complete with 45 degree entry. Where round ducts connect to supply grilles or square neck diffusers, *Provide* proper rectangular to round transition or *Provide* plenum on back of grille / diffuser and connect round supply duct to side of plenum (not end directly opposite grille).

.11 After final adjustments are made for air handling systems, lock each control device in position and visually indicate required setting. For balancing dampers, *Provide* additional locking screw or bolt to approval.

.12 Ducts Run Within or Through OWSJ: Refer to structural drawings. Where ductwork is to be run within or through open web steel joists, note that ductwork shown on the mechanical drawings is schematic only and is to be altered as required to suit the steel joist configuration, spacing, panel points, and cross-bridging at no additional cost.

3.3 INSTALLATION OF FLEXIBLE DUCTWORK

.1 Flexible ductwork for connections between duct branches and ceiling grilles or diffusers shall be no longer than 2 m. Do not install flexible ductwork through walls, even if shown on the drawings.

.2 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. Do not make 90 deg bends with flex duct. *Provide* long radius sheet metal duct bends where they are required, e.g. at diffuser neck.

.3 Do not penetrate fire barriers with flexible duct.

3.4 INSTALLATION OF ACOUSTIC LINING

.1 *Provide* acoustic lining in ductwork in these locations

.1 wherever shown and/or specified on the drawings;

.2 in 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 as per the detail entitled Flexible Duct Liner Installation found in the ANSI/SMACNA manual referred to above.

.3 Where thermal insulation is specified, it is acceptable to *Provide* an increased thickness of acoustic duct liner to meet the thermal insulation requirement.

.4 Increase the outside diameter of lined ducts so that the interior dimension is as specified on drawings.

3.5 DUCT SUPPORT

.1 Rectangular Ducts Inside Building

.1 Support round and flat oval ducts inside the building in accordance with ANSI/SMACNA HVAC Duct Construction Standards – Metal and Flexible.

.2 For both uninsulated and insulated ducts exposed in finished area, use bands and secure at the top of the duct to a hanger rod, all similar to Ductmate Canada Ltd. type "BA" unless otherwise specified.

.3 If the duct is insulated, size the strap to suit the diameter of the insulated duct.

.4 Vertical circular duct to have 2-piece band clamps of 16 ga (1.6mm or heavier galvanized strap fastened on each side of duct and using 2 galvanized rods per clamp.

.5 Cable stay duct supports equal to Ductmate or DuroDyne are an acceptable alternate.

.6 Use double nuts and lock washers on threaded rod supports.

.2 Round and Flat Oval Duct Support Inside Building:

.1 Support round and flat oval ducts inside the building in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible

.2 for both uninsulated and insulated ducts exposed in finished area, use bands and secure at the top of the duct to a hanger rod, all similar to Ductmate Canada Ltd. type "BA" unless otherwise specified.

.3 If the duct is insulated, size the strap to suit the diameter of the insulated duct.

.4 Vertical circular duct to have 2-piece band clamps of 16 ga (1.6mm or heavier galvanized strap fastened on each side of duct and using 2 galvanized rods per clamp.

.5 Cable stay duct supports equal to Ductmate or DuroDyne are an acceptable alternate.

3.6 DUCT SEALING

.1 Duct system sealing is to meet ANSI/SMACNA Seal Class A and Leakage Classification 6 in accordance with SMACNA 2012 HVAC Air Duct Leakage Test Manual requirements.

.2 All transverse and longitudinal joints, seams, branch and duct connections, taps, end joints, fittings for all heating/cooling and ventilation systems shall be sealed with low-odour, non-solvent base, low VOC duct sealant, such as Carlisle Hardcast Duct-Seal 321 or approved equal, combined with fiberglass mesh tape for larger gaps, applied to the thickness recommended by manufacturer.

.3 Seal joints after assembly except for exposed ductwork where joints shall be interior sealed before assembly, for a neat finished appearance.

.4 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 the sealant.

.5 Duct sealer is not required for fully gasketted joints.

.6 Seal all seams and edges of equipment serving ductwork (e.g. fan coil unit, filter boxes) but not access panels, and not if sealing could damage equipment or void the warranty.

.7 If duct leakage testing shows leakage criteria were not met using the sealing method specified above, Aeroseal duct sealing technology shall be used to achieve them. Alternatively, contractor can consider forgoing most duct sealing and duct leakage testing during construction and instead using Aeroseal technology at end of ductwork construction.

3.7 DUCT PRESSURE TESTING

.1 To test for duct sealing workmanship, leakage test at 500 Pa (2 in w.g.) for maximum 5% leakage, the following ductwork systems when about 25% have been completed:

.1 Fan coil FC-1.1 supply and return system

.2 Fan coil FC-1.2 supply and return system

.3 ERV supply, return, intake, exhaust systems

.2 If duct leakage testing shows leakage well within 5%, duct sealing practices can continue, and leakage rate shall be retested at the end of the project. *Provide* all test reports to *Consultant*.

.3 Pressure test all duct outside the building envelope. For systems inside the building envelope designed to operate in excess of 750 Pa (3” w.g), pressure test 25% of supply duct systems (sections selected by *Owner*), return trunk ducts and exhaust ducts.

.4 The maximum allowable leakage in pressure testing for exterior or medium pressure ductwork shall be:

$$F = C_L * P^{0.65}$$

where

F = measured duct leakage (cfm/ft2)

CL = leakage classification, 6, and

P = duct operating pressure (“.w.g.)

3.8 CLEANING AND START-UP

.1 Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air, clean half the system at a time. Protect equipment which may be harmed by excessive dirt with temporary filters, or bypass during cleaning.

.2 Clean duct systems with high power vacuum machines. Protect equipment which may be harmed by excessive dirt with filters, or bypass during cleaning. *Provide* adequate access into duct work for cleaning purposes.

.3 Prior to starting any supply air handling system *Provide* 50 mm thick glass fibre construction filters at fan equipment in place of permanent filters.

.4 *Provide* cheesecloth over all duct system inlets and outlets and run the system for twenty-four hours, after which remove the cheesecloth, the construction filters, and install new permanent filters.

.5 Include all labour for a complete site walk-through with testing and balancing personnel following the route of all duct systems to be tested, adjusted and balanced for the purpose of confirming the proper position and attitude of dampers, the location of pitot tube openings, and any other work affecting the testing and balancing procedures. Perform all corrective work required as a result of this walk-through.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

  .1 Air turning devices/extractors.

  .2 Backdraft dampers.

  .3 Combination fire and smoke dampers.

  .4 Duct access doors.

  .5 Duct test holes.

  .6 Fire dampers.

  .7 Smoke Dampers.

  .8 Flexible duct connections.

  .9 Volume control dampers.

1.3 SUBMITTALS

.1 *Shop Drawings*/*Product* Data:

  .1 Submit shop drawings/product data sheets for shop fabricated assemblies including hardware used, volume control dampers, duct access doors and duct test holes. Include electrical characteristics and connection requirements.

  .2 Fire Dampers: *Provide* a schedule listing type, size, rating, location and verifying inspection for proper operation.

  .3 Colour Chart(s): Submit manufacturer’s colour chart(s) for all items for which a finish colour is to be selected.

.2 Maintenance Material Submittals

  .1 Extra Stock Materials: *Provide* two (2) of each size and type of fusible link.

  .2 Record Documentation: Record actual locations of access doors and test holes.

PART 2 PRODUCTS

2.1 MOTORIZED DAMPERS

.1 Refer to *Specifications* Section 25 90 00 Control Specification for motorized damper requirements.

2.2 SPLITTER DAMPERS

.1 Minimum #20 gauge damper blade constructed of the same material as the duct, reinforced as required to suit blade size, system velocity, and to prevent "chatter", and complete with operating hardware equal to Dyn Air 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.

2.3 AIR TURNING VANES

.1 For square elbows – single thickness turning vanes, interconnected with bars, adequately reinforced to suit the pressure and velocity of the system, constructed of the same material as the 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 degree opposed blade volume control damper, constructed of the same material as the duct it is associated with and in accordance with requirements and details in ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible.

2.4 MANUAL BALANCING (VOLUME) DAMPERS

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

  .1 a hexagonal or square shaft extension through the 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 the blade from moving more than 90°;

  .4 linkage for multiple blade dampers;

  .5 a locking hand quadrant damper operator with, for insulated ducts 50 mm standoff mounting.

.2 Rectangular Dampers: Nailor Industries Inc. #SP1010 FF 16G LC BS NS, maximum size 1.2 m x 1.2 m (4' x 4') for a single damper.

.3 Round Dampers: Nailor Industries Inc. #1090 BS, 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 the same material as the damper and designed for tight and secure mounting of the individual dampers.

.5 Acceptable manufacturers are:

  .1 Nailor Industries Inc.;

  .2 T.A. Morrison & Co. Inc. "TAMCO";

  .3 NCA Manufacturing Ltd.;

  .4 Greenheck Fan Corp.;

  .5 Ruskin Co.;

  .6 Alumavent.

2.5 BACKDRAFT DAMPERS

.1 T. A. Morrison & Co. Inc. "TAMCO" counterbalanced backdraft dampers, Series 7000 WT for vertical mounting, Series 7000 CW for down (horizontal) mounting, 65 mm (2½") deep, sized as shown and complete with:

.1 extruded aluminum frame and blades, minimum 1.58 mm (1/16") thick, with captive extruded silicone blade gaskets and side seals in slots integral with the aluminum extrusions;

.2 damper blade counterweights internal to the frame and consisting of adjustable weights fastened to brackets which are riveted to the blades;

.3 dual PVC linkage tracks at each end of the blades, and non-corrosive linkage with hard alloy aluminum pivot arm and Ticona "Celcon" acetal copolymer bearings.

.2 Acceptable manufacturers are:

.1 T.A. Morrison & Co. Inc. "TAMCO";

.2 Nailor Industries Inc.;

.3 NCA Manufacturing Ltd.;

.4 Greenheck Fan Corp.;

.5 Ruskin Co.;

.6 Ventex.

2.6 FUSIBLE LINK DAMPERS

.1 Curtain blade type, dynamic, galvanized steel (unless otherwise specified) fusible link dampers, ULC classified to Standard 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 the folded curtain blade out of the air stream.

.3 Fusible link dampers in ductwork other than galvanized steel are to be as specified above but constructed of Type 316 stainless steel.

.4 Acceptable fusible link damper manufacturers are:

.1 Nailor Industries Inc.;

.2 Greenheck Fan Corp.;

.3 NCA Manufacturing Ltd.;

.4 Ruskin Co.;

.5 Alumavent.

2.7 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. Acceptable products are:

.1 Duro Dyne Canada Inc. "DUROLON";

.2 Dyn Air Inc. "HYPALON".

.2 For kitchen exhaust fans or in other high heat ductwork: 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. Acceptable products are:

.1 Duro-Dyne Canada Inc. "THERMAFAB";

.2 Dyn Air Inc. "SILICON HI-T".

2.8 ROOF DUCT SUPPORTS

.1 Equal to Lexcor (Lexsuco Corp.) Series SS-A215 "Flash-Tite" adjustable height, insulated aluminum structural supports, each complete with two-piece telescoping flashing, a aseplate to suit the application, a threaded cap with plate, and a 12 mm x 40 mm (½" x 1½") threaded stainless steel top stud.

2.9 DUCT ACCESS DOORS

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

2.10 DUCTWORK DRAIN POINTS

.1 Equal to Ductmate Canada Ltd. "DUCTMATE MOISTURE DRAIN", 20 mm (¾") diameter moisture drains with galvanized sheet metal funnel, and chrome plated brass threaded drain, nut and cap.

2.11 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.

2.12 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 the drawings, and constructed so as to be removable.

2.13 LOUVRES

.1 Price Industries Inc. DE439 or DE63 100 mm (4") or 150 mm (6") deep (to suit wall thickness) factory assembled stationary, drainable, storm-proof louvres sized as indicated on the drawings, each AMCA water penetration and air performance certified, constructed of welded, extruded, alloy 6063-T5 aluminum with drainable blades, extended sill, mounting and securing hardware to suit the application, and 12 mm (½") mesh aluminum birdscreen in an aluminum frame.

.2 Louvres are to be factory finished with a finish equal to PPG Industries "Duranar" fluoropolymer powder coating over primer with colour as selected from the manufacturer’s standard colour range.

.3 Acceptable manufacturers are:

.1 Price Industries Inc.;

.2 The Airolite Co. LLC;

.3 Construction Specialties;

.4 Nailor Industries Inc.;

.5 Greenheck Fan Corp.;

.6 Ventex.

2.14 BRICK AND BLOCK VENTS

.1 Equal to Price Industries Inc. vents constructed of 6063-T5 alloy extruded aluminum, sized as shown, complete with stainless steel fasteners, aluminum rod vertical supports on minimum 300 mm (12") centres, No. 2 mesh fixed aluminum screen, and all required accessories to suit the application.

.2 The vent(s) to be factory finished with a finish equal to a baked "Kynar 500-XL" colour coat and a clear coat over cleaned and primed metal with colour as selected from the manufacturer's standard colour range.

PART 3 EXECUTION

3.1 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.

3.2 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 the drawings. Install splitter dampers so they cannot vibrate and rattle and so that the damper operation mechanisms are in an easily accessible and operable location. Ensure that operators for dampers in insulated ducts are equipped with stand-off mounting brackets.

3.3 INSTALLATION OF TURNING VANES

.1 *Provide* turning vanes in ductwork elbows where shown on the 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.

3.4 INSTALLATION OF MANUAL BALANCING (VOLUME) DAMPERS

.1 *Provide* manual balancing dampers in all open-end ductwork, in all duct mains, and wherever else shown and/or specified.

.2 Install the dampers so that the operating mechanism is accessible and positioned for easy operation, and so that the dampers cannot move or rattle. Ensure that operating mechanisms for dampers in insulated ducts are complete with stand-off mounting brackets.

.3 Confirm exact damper locations with personnel doing air quantity balancing testing work and install dampers to suit. Include for providing five additional dampers at no additional cost.

3.5 INSTALLATION OF BACKDRAFT DAMPERS

.1 *Provide* backdraft dampers where shown.

.2 Install and secure the dampers so that they cannot move or rattle.

3.6 INSTALLATION OF FUSIBLE LINK DAMPERS

.1 *Provide* fusible link dampers where shown and/or specified on the drawings. Ensure that the damper rating (1½ or 3 hr.) is suitable for the fire barrier it is associated with.

.2 Install dampers with retaining angles on all four sides of the sleeve on both sides of the damper and connect with ductwork in accordance with the damper manufacturer’s instructions and details to meet Code requirements.

.3 *Provide* expansion clearance between the damper or damper sleeve and the opening in which the damper is required. Ensure that the openings are properly sized and located, and that all voids between the damper sleeve and the opening are properly sealed to maintain the rating of the fire barrier.

.4 *Provide* a schedule listing all fire dampers by size, type, rating, location, and verifying inspection for proper installation. Submit with job completion documents.

3.7 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 the flexible fabric and to the fan, duct, plenum, etc., in accordance with ANSI/SMACNA HVAC Duct Construction Standards Metal and Flexible. Ensure that connections to the flexible fabric material are arranged and supported so as to not impose any external forces on the fabric.

3.8 INSTALLATION OF ROOF MOUNTED DUCT SUPPORTS

.1 Supply supports for roof mounted ductwork as indicated.

.2 Hand the adjustable structural supports to the roofing trade on the roof for installation and flashing into roof construction as part of the roofing work. Accurately mark the exact locations and spacing of the structural supports and supervise installation. *Provide* properly sized hot dip galvanized structural steel angles between structural supports and secure in place on support studs. Support ductwork on the angles and *Provide* galvanized steel banding to secure ducts to the angles.

3.9 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 fire dampers and 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 fire damper maintenance with "FIRE" stencil painted or marker type red lettering and ensure that the 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 the ductwork to suit the access door installed.

3.10 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.

3.11 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 the drawings. Rigidly secure in place but ensure the panels are removable.

.2 *Provide* wire mesh panels for open-end return air ducts in ceiling spaces whether shown on the drawings or not.

3.12 INSTALLATION OF LOUVRES

.1 *Provide* louvres for wall openings where shown.

.2 Install louvre assemblies and secure in place in accordance with the manufacturer’s instructions and details.

.3 Confirm exact louvre sizes and finish prior to ordering.

3.13 INSTALLATION OF BRICK AND BLOCK VENTS

.1 Supply brick or block vents for installation in exterior walls where shown.

.2 Hand the assemblies to the masonry trade for installation.

.3 Accurately mark exact locations and coordinate installation.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

.1 Ceiling mounted fans;

.2 Inline centrifugal fans;

.3 Axial fans;

.4 HVLS fans.

1.3 SUBMITTALS

.1 *Shop Drawings*/*Product* Data:

.1 Submit shop drawings/product data sheets for ceiling fans. Shop drawings/product data sheets must confirm that the fans conform to requirements of the *Contract Documents*. Include the following:

.1 certified fan performance curves;

.2 product data for all accessories;

.3 product data for fan motors.

1.4 QUALITY ASSURANCE

.1 Ceiling fan manufacturers are to be current members of the Air Movement and Control Association International Inc. (AMCA), and the fans are to be rated (capacity and sound performance) and certified in accordance with requirements of the following standards:

.1 ANSI/AMCA Standard 210, Laboratory Method of Testing Fans for Certified Aerodynamic Performance Rating.

.2 AMCA Standard 211, *Product* Rating Manual for Fan Air Performance;

.3 ANSI/AMCA Standard 300, Reverberant Room Method for Sound Testing of Fans;

.4 AMCA Standard 311, *Product* Rating Manual for Fan Sound Performance;

.5 AMCA Standard 99-2408, Operating Limits for Centrifugal Fans.

PART 2 PRODUCTS

2.1 CEILING MOUNTED FANS

.1 ULC listed and labelled ceiling mounted centrifugal, exhaust fans as per the drawing schedule, complete with:

.1 ENERGY STAR certification with built-in speed selector (or as indicated on equipment schedule)

.2 ECM or DC motor engineered to run continuously;

.3 26-gauge or thicker housing;

.4 Minimum 2-year warranty;

.5 exhaust grille: for ceiling mounted fans as indicated and/or scheduled, a white exhaust grille;

.6 accessories: factory supplied accessories as per the drawing schedule, as follows:

.1 rectangular to round duct transitions as required on drawings;

.2 a wall cap or louver as per schedule with backdraft damper and birdscreen.

.7 Acceptable manufacturers are:

.1 Panasonic;

.2 Canarm Ltd.;

.3 Or approved equal.

2.2 INLINE CENTRIFUGAL FANS

.1 ULC listed and labelled fans as per the drawing schedule, complete with:

.1 Mixed-flow impeller

.2 100% speed controllable

.3 Integral thermal contacts

.4 Air stream temperatures up to 140°F

.5 External rotor motor, permanent split capacitor type with automatic reset thermal protection and sealed ball bearings to prevent overheating

.6 Compact galvanized steel housing

.7 2-year factory warranty minimum

.8 Acceptable manufacturers are:

.1 Systemair Fantech;

.2 Greenheck;

.3 Or approved equal.

2.3 PROPELLER WALL FANS

.1 ULC listed and labelled propeller exhaust fan, balanced in accordance with AMCA 204-05, exhaust fans as per the drawing schedule, complete with:

.1 housing: minimum #20 gauge galvanized steel housing equipped with duct connection collar(s);

.2 OSHA wire guard;

.3 NEMA 1 for indoor or NEMA 3R for exterior disconnect switches;

.4 Motor shall be NEMA Design B with Class B insulation rated for continuous duty;

.5 Propeller shall have aluminum blades riveted to a painted steel hub securely fastened to the motor shaft utilizing two setscrews.

.6 EC motors.

.7 Acceptable manufacturers are:

  .1 Loren Cook Co.;

  .2 Canarm Ltd.;

  .3 Greenheck Fan Corp.;

  .4 PennBarry;

  .5 Twin City Fan and Blower;

  .6 Soler & Palau.

2.4 HIGH VOLUME LOW SPEED (HVLS) FANS

.1 ULC listed and labelled as per the drawing schedule, complete with:

  .1 Powerfoil winglets to eliminate wind noise

  .2 Industrial-grade motor and gearbox lubricated for life

  .3 UV-resistant materials

  .4 IP55 rating

  .5 Controls: on/off and variable speed control

  .6 Required minimum clearances: 1.8 m (6 ft) from ceiling, 2.7 m (9 ft) from walls.

  .7 Acceptable manufacturers are:

    .1 Big Ass;

    .2 Canarm HVAC;

    .3 or approved equal.

PART 3- EXECUTION

3.1 INSTALLATION

.1 *Provide* fans where shown.

.2 Secure suspended units in place from the structure, level, and plumb, by means of vibration isolation hangers and galvanized steel hanger rods.

.3 Plug fan motors into housing receptacles.

.4 Supply exterior wall/roof discharge caps as indicated.

.5 Hand roof caps to the roof trade for installation and flashing into roof construction as part of the roofing work.

.6 Install wall caps and secure in place. Caulk the perimeter of each wall cap in accordance with caulking requirements specified in Division 07.

.7 Connect fan housings and discharges with ductwork.

.8 Start-Up: Refer to the article entitled Equipment and System Start-up in the mechanical work Section entitled Mechanical *Work* General Instructions.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

.1 Registers/grilles and diffusers.

.2 Door grilles.

.3 Louvres.

.4 Goosenecks.

1.3 SUBMITTALS

.1 Submittals for Review

.1 *Product* Data: *Provide* data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, throw, application, and noise level.

.2 Submittals for Information

.1 Installation Data: Manufacturer's special installation requirements.

.3 Construction Submittals

.4 Close-Out Submittals

.1 Record Documentation: Record actual locations of air outlets and inlets.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 All materials and products shall be inspected upon delivery to the site to ensure there is no pre-existing damage due to dust, moisture, or physical impact.

.2 All materials used to protect (e.g., skids, tarps etc.) materials and products shall be reused as practicable and recycled at the end of their useful life.

PART 2 PRODUCTS

2.1 GRILLES AND DIFFUSERS

.1 Grilles and diffusers of the type, size, capacity, finish, and arrangement as shown on the drawings and as per the drawing schedule, each equipped with all required mounting and connection accessories to suit the mounting location and application.

.2 Manufacturers:

.1 Price Industries Inc.;

.2 Anemostat Air Distribution;

.3 Krueger - HVAC;

.4 Titus- HVAC;

.5 Nailor Industries Inc.;

.6 Metalaire.

2.2 LOUVERS AND LOUVERED PENTHOUSES

.1 Grilles and diffusers of the type, size, capacity, finish, and arrangement as shown on the drawings and as per the drawing schedule, each equipped with all required mounting and connection accessories to suit the mounting location and application.

.2 Manufacturers:

.1 Price Industries Inc.;

.2 Alumavent Ventex Inc;

.3 The Airolite Co.LLC.;

.4 Construction Specialties;

.5 Nailor Industries Inc.;

.6 Greenheck Fan Corp.

2.3 GOOSENECKS

.1 Fabricate to SMACNA, of minimum 1.2 mm (18 ga) galvanized steel.

.2 Terminate end at least 750 mm (30 inches) above roof surface or as noted on drawings/details.

.3 Mount on minimum 300 mm (12 inch) high curb base.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.

.3 Install diffusers to duct work with air tight connection.

.4 *Provide* balancing dampers on duct take-off to diffusers, and grilles and registers, despite whether dampers are specified as part of the diffuser, or grille and register assembly.

.5 Paint ductwork visible behind air outlets and inlets matte black. Refer to relevant Section regarding Painting.

.6 *Provide* grilles and diffusers where shown on the drawings. Wherever possible, grilles and diffusers are to be the product of one manufacturer.

.7 Unless otherwise specified connect grilles and diffusers in accordance with requirements of SMACNA HVAC Duct Construction Standards Metal and Flexible.

.8 Exactly locate grilles and diffusers to conform to the final architectural reflected ceiling plans and detailed wall elevations, and to conform to the final lighting arrangement, ceiling layout, ornamental and other wall treatment.

.9 Equip supply diffusers having a basic four-way or all round air pattern for operation in one, two, or three way pattern where indicated on the drawings.

.10 *Provide* sheet metal plenums, constructed of the same material as the connecting duct, for linear grilles and/or diffusers where shown. Construct and install the 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 the duct connection collar(s) with volume control device(s).

.11 Where linear type diffusers/grilles are installed in suspended T-bar ceilings, clip the diffusers/grilles in place using clip supplied by the diffuser/grille manufacturer.

.12 Confirm grille and diffuser finishes prior to ordering.

3.2 SUPPLY OF DOOR GRILLES

.1 Supply door grilles.

.2 Hand the grilles to the appropriate trade at the site for installation.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

.1 Energy Recovery Ventilators (ERVs)

1.3 PERFORMANCE REQUIREMENTS

.1 No variation of unit performance, duct configuration, or sizes permitted except by written permission.

1.4 SUBMITTALS

.1 Submit shop drawings or product data sheets for all products specified under this Section.

1.5 DELIVERY, STORAGE, AND HANDLING

.1 All materials and products shall be inspected upon delivery to the site to ensure there is no pre-existing damage due to dust, moisture, or physical impact.

.2 All duct inlets and outlets shall be protected with plastic wrap when not actively being worked on and at the end of every day.

PART 2 PRODUCTS

2.1 MODEL

.1 The following manufacturers and models are approved for use:

.1 VanEE Gold Series or equivalent, refer to drawing schedules for exact models.

.2 For considerations of alternates, associated cost savings to the *Owner* must be provided, and equivalent capacities, efficiencies, motor speed control and boost functions must be shown to be equivalent or better. Alternates may not be accepted during shop drawing phase and *Contractor* shall be responsible for any additional cost of providing the basis of design manufacturer and model. All additional costs for all trades associated with such a substitution shall be the responsibility of the installing contractor.

.2 General description

.1 Fabricate as detailed on drawings.

.2 Performance as shown on schedules.

.3 Unit Construction

.1 The housing, made of painted sheet steel, is acoustically and thermally insulated.

.4 Supply / Return Fans

.1 *Provide* thermally protected direct-drive fan(s) with EC motors. Fan assemblies including fan, motor and sheaves shall be dynamically balanced by the manufacturer on all three planes and at all bearing supports.

.2 Supply and extraction fans can be controlled separately and can be precisely adjusted to within one percent by entering the balance air volume.

.3 All electrical components shall bear a UL and CSA safety listing.

.4 Wiring Termination: *Provide* terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. All wires shall be number tagged and cross-referenced to the wiring diagram for ease of troubleshooting.

.5 Particulate Filters

.1 Filter section with filter racks and guides with hinged access doors for side loading and removal of filters

.2 Filter media shall be UL 900 listed, Class I or Class II.

.3 *Provide* MERV 6 Air filters.

.6 Energy Recovery

.1 The core of VanEE Gold Series ERV is the polymerized paper cross flow enthalpy exchanger with up to 75% heat recovery at 0°C (32°F) and 65% at -25°C (-13°F).

.7 Defrost

.1 Recirculating defrost system to prevent depressurization. ERVs with depressurization type defrost will not be acceptable for this project.

.2 Defrost cycling is automatically enabled when outdoor air temperature is less than -10°C (14°F).

.3 Maximum ventilation reduction due to defrost cycle times is 40% at -27°C or less, 29% at -20 to -27°C, 23% at -15 to -20°C, 18% at -10 to -15°C and no reduction when -10°C or warmer.

.8 Controls

.1 *Provide* one (1) VanEE Gold Touch wall control per ERV, located as indicated on the drawings.

.2 *Provide* one (1) humidistat in each washroom containing a shower and/or bathtub.

.3 *Provide* one (1) 20/40/60 push button override in each washroom.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturer's Installation & Maintenance instructions.

.2 Ensure access to unit for maintenance (eg. filter changes) is provided.

.3 *Provide* duct flex connectors at unit to vibrationally separate unit from rest of ductwork system.

3.2 ENVIRONMENTAL REQUIREMENTS

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

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

.1 Infra-Red Heaters – Fuel Fired

.2 General Requirements

.1 Comply with General Requirements of Section 20 05 00

PART 2 PRODUCTS

2.1 MANUFACTURERS

.1 Acceptable Manufacturers:

.1 Brant Radiant;

.2 Roberts Gordon;

.3 Schwank;

.4 Other manufacturers offering equivalent products equal or better will only be accepted as equals.

.2 Unit Construction

.1 Units: Packaged, partially factory assembled, pre-wired unit consisting of cabinet, burner, heat exchanger, radiant tube, reflector, controls; for natural gas.

.2 Heat Exchanger: Aluminized tubular steel combustion chamber with aluminized steel tube with aluminum reflector.

.3 Gas Burner:

.1 Forced draft type.

.2 Gas valve provides 100 percent safety gas shut-off; 24 volt combining pressure regulation, safety pilot, manual set (On-Off), pilot filtration, automatic electric valve.

.3 Modulating capacity output down to 65%.

.4 Gas Burner Safety Controls: combustion air flow monitoring and automatic shut-off; automatic gas shut-off during gas or power interruption; air flow control system-controlled pre-purge and post-purge.

.5 Premium User Interface module capable of connection to BAS and modulating control of the heaters.

.6 *Provide* install kits as required by installation design.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install in accordance with manufacturer's Installation & Maintenance instructions.

3.2 Environmental Requirements

.1 Do not operate units for any purpose, temporary or permanent, until equipment is clean, and fan has been test-run under observation.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

- .1 Server Room Air Conditioning Units

1.3 SUBMITTALS

.1 Section 01 33 00 – Submittals.

.2 *Product* Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for air conditioning components and accessories and include product characteristics, performance criteria, physical size, finish and limitations.

.3 *Shop Drawings*:

- .1 Indicate on drawings:
  - .1 Details of Major components and accessories including sound power levels of units.
  - .2 Type of refrigerant used.

1.4 CLOSEOUT SUBMITTALS

.1 Section 01 77 00: Submission procedures.

.2 Operation and Maintenance Data: submit operation and maintenance data for air conditioning components for incorporation into manual.

1.5 DELIVERY, STORAGE, AND PROTECTION

.1 Deliver, store and handle materials in accordance with Section 01 60 00 - *Product* Requirements and 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 in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 The wireless remote controller, for the wall mounted and floor standing indoor units, shall be shipped inside the carton and packaged with the indoor unit and shall be able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.
- .3 The remote controller, for the ceiling suspended, ceiling recessed and ducted indoor units, either wireless or wired, shall be shipped separately.
- .4 Store and protect air conditioning components from nicks, scratches, and blemishes.
- .5 Replace defective or damaged materials with new.

1.6 QUALITY ASSURANCE

1. The system components shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.
2. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
3. The units shall be rated in accordance with Air-conditioning, Heating and Refrigeration Institute's (AHRI) Standard 240 and bear the AHRI Certification label.
4. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to product and manufacturing quality and environmental management and protection set by the International Standard Organization (ISO).
5. A dry air holding charge shall be provided in the indoor section.

1.7 SYSTEM DESCRIPTION

.1 The air conditioning system basis of design is a Mitsubishi Electric split system with Variable Speed Inverter Compressor technology. The system shall consist of a horizontal discharge, single phase outdoor unit, a matched capacity indoor section that shall be equipped with a wired wall-mounted, wireless wall-mounted, wireless handheld, or other remote controller.

PART 2 PRODUCTS

2.1 GENERAL

.1 All units shall be listed and rated by ANSI/AHRI Standard 1360-2017 and meet all minimum IEER performance requirements as scheduled.

.2 The units shall be CSA approved, ANSI/UL STD 1995 listed and listed by Electrical Testing Labs (ETL) and bear the cETL label.

.3 All wiring shall be in accordance with the National Electric Code (NEC).

.4 The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.

.5 The units and the design shall be in compliance with CSA B52 Mechanical Refrigerant Code including the March 2009 Supplement.

.6 Acceptable alternative manufacturers, assuming compliance with these equipment specifications, are Daikin, Panasonic, LG, and Fujitsu.

.7 Other Alternate manufacturers shall send approval requests to consultant 14 days prior to bid day, and include all information relevant to the alternate system, including but not limited to: unit selections, refrigerant piping layout, refrigerant charge with CSA B52 analysis, heating and cooling capacities at design temperatures and including capacity losses from piping lengths, defrost cycles, and combination ratios, dimensional and weight differences, and any other aspect of the system that differs from the system specified. *Contractor* bidding an alternate manufacturer does so with full knowledge that that manufactures product may not be acceptable or approved and that contractor is responsible for all specified items and intents of this document without further compensation.

2.2 OUTDOOR UNIT (BASIS OF DESIGN MITSUBISHI PUY)

.1 General

.1 The connected indoor unit shall be of the same capacity as the outdoor unit. The outdoor units must have a thermally fused powder coated finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.

.2 If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor. *Contractor* responsible for ensuring alternative brand compatibility in terms of availability, physical dimensions, weight, electrical requirements, etc.

.3 Outdoor unit shall have a sound rating no higher than 53 dB(A). If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.

.4 Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.

.5 The outdoor unit shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.

.6 Four-legged outdoor unit mounting systems shall be equal to Ecofoot Ecoframe, minimum 600 mm (24") above grade. Stand shall be made from 7 gauge plate steel with thermally fused polyester powder coat finish that meets ASTM D3451-06 standards. Stands shall be provided with galvanized mounting hardware and meets all ASCE 7 overturning safety requirement.

.7 The outdoor unit shall be provided with a manufacturer supplied 20 gauge hot dipped galvanized wind baffle. The wind baffle shall allow for continuous cooling to 0FDB without any additional modifications to the unit.

.2 Unit Cabinet:

.1 The casing shall be fabricated of galvanized steel, bonderized, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection. Assembly hardware shall be cadmium plated for weather resistance.

.2 Easy access shall be afforded to all serviceable parts by means of removable panel sections.

.3 Two (2) mild steel mounting feet, traverse mounted across the cabinet base pan, welded mount, providing four (4) slotted mounting holes shall be furnished. Assembly shall withstand lateral wind gust up to 155 MPH to meet applicable weather codes. The casing(s) shall be fabricated of galvanized steel, bonderized and finished.

.3 Fan:

.1 1, 1.5, 2 and 2.5 ton units shall be furnished with a single direct drive propeller type fan. 3, 3.5 ton units shall be furnished with a two (2) direct drive propeller type fans.

.2 The outdoor unit fan motor(s) shall be a direct current (DC) motor and have permanently lubricated bearings.

.3 The fan motor shall be mounted for quiet operation.

.4 The fan shall be provided with a raised guard to prevent contact with moving parts.

.5 The outdoor unit shall have horizontal discharge airflow.

.4 Refrigerant and Refrigerant Piping:

.1 R410A refrigerant shall be required for systems.

.2 Polyolester (POE) oil—widely available and used in conventional domestic systems—shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.

.3 Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the equipment manufacturer and installed in accordance with manufacturer recommendations.

.4 All refrigerant piping must be insulated with ½” closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102. R value of insulation must be at least 3.

.5 Refrigerant line sizing shall be in accordance with manufacturer specifications.

.5 Coil:

.1 The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.

.2 The coil shall be protected with an integral metal guard.

.3 Refrigerant flow from the outdoor unit shall be regulated by means of an electronically controlled, precision, linear expansion valve.

.4 All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ARC Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft / °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1” thick insulation shall have a Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102.

.5 All refrigerant connections between outdoor and indoor units shall be flare type.

.6 Compressor:

.1 The compressor shall be a high performance, hermetic, inverter driven, variable speed, dual rotary type manufactured by Mitsubishi Electric Corporation.

.2 The compressor motor shall be direct current (DC) type equipped with a factory supplied and installed inverter drive package.

.3 The compressor will be equipped with internal thermal overload protection.

.4 To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be automatically, intermittently applied to the compressor motor windings to maintain sufficient heat to vaporize any refrigerant. No crankcase heater is to be used.

.5 Filters, sight glasses, and traps shall not be used, and no additional refrigerant oil shall be required.

.6 The compressor shall be mounted so as to avoid the transmission of vibration.

.7 The outdoor unit shall have an accumulator and high-pressure safety switch.

.7 Operating Range:

.1 Operating Range shall be in accord with the Table below:

Operating Range	Indoor Intake Air Temp	Outdoor Intake Air Temp

Cooling	Maximum	95°F (35°C) DB, 71°F(21°C) WB	115°F (46°C) DB
	Minimum	67°F (19°C) DB, 57°F(14°C) WB	-40°F (-40°C) DB

.8 Electrical

.1 The outdoor unit electrical power supply shall be 208/230 volts, 1-phase, 60 hertz.

.2 The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts.

.3 The outdoor unit shall be controlled by microprocessors located in the indoor unit and outdoor unit. A 12-to-24-volt DC data stream shall communicate between the units providing all necessary information for full function control.

.4 The outdoor unit shall be equipped with Pulse Amplitude Modulation (PAM) compressor inverter drive control for maximum efficiency with minimum power consumption.

2.3 INDOOR UNITS (BASIS OF DESIGN MITSUBISHI PKA WALL MOUNTED INDOOR UNIT)

.1 General

.1 The wall-mounted indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

.2 Unit Cabinet

.1 All casings, regardless of model size, shall have the same white finish

.2 Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining are required.

.3 There shall be a separate back plate which secures the unit firmly to the wall.

.3 Fan

.1 The indoor fan shall be statically and dynamically balanced to run on a single motor with permanently lubricated bearings.

.2 A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).

.3 An integral, motorized, multi-position, horizontal air sweep vane shall *Provide* for uniform air distribution, up and down. Vane shall have 5 selectable positions plus AUTO (Controls position based upon mode, microprocessor shall automatically determine the vane angle to *Provide* the optimum room temperature distribution) and SWING (Continuously moves up and down). In OFF mode the horizontal vane shall return to the closed position.

.4 The indoor unit shall include an AUTO fan setting capable of maximizing energy efficiency by adjusting the fan speed based on the difference between controller set-point and space temperature. The indoor fan shall be capable of five (5) speed settings, Low, Mid1, Mid2, High and Auto.

.4 Filter

.1 Return air shall be filtered by means of an easily removable, washable filter.

.5 Coil

.1 The indoor unit coil shall be of nonferrous construction with smooth plate fins on copper tubing.

.2 The tubing shall have inner groves for high efficiency heat exchange.

.3 All tube joints shall be brazed with silver alloy.

.4 The coils shall be pressure tested at the factory.

.5 A sloped, corrosion resistant condensate pan with drain shall be provided under the coil.

.6 A drain pan level switch (SS610E), designed to connect to the control board, shall be provided, if required, and installed in the condensate pan to prevent condensate from overflowing.

.6 Electrical

.1 The unit electrical power shall be 208-230 volts, 1-phase, 60 hertz.

.2 The system shall be equipped with A-Control – a system directing that the indoor unit be powered directly from the outdoor unit using a 3-wire, 14 gauge AWG connections plus ground.

.3 The indoor unit shall not have any supplemental electrical heat elements.

.7 Controls

.1 The unit shall include an IR receiver for wireless remote control flexibility

.2 Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

.3 Control board shall include contacts for control of external heat source. External heat may be energized as second stage when the space temperature is 1.8°F from set point.

.4 Full BACnet communication, control and monitoring of the indoor unit shall be provided (for Mitsubishi via one IntesisBox each per fan coil).

2.4 CONTROLS

.1 Overview

.1 The control system shall consist of a minimum of one microprocessor on each indoor unit and one in the outdoor unit, communicating via A-Control data over power transmission. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from the wired or wireless controller, providing emergency operation and controlling the outdoor unit. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Indoor units shall have the ability to control supplemental heat via connector CN24 and a 12 VDC output.

.2 For A-Control, a three (3) conductor 14 gauge AWG wire with ground shall *Provide* power feed and bi-directional control transmission between the outdoor and indoor units. If code requires a disconnect mounted near the indoor unit, a TAZ-MS303 3-Pole Disconnect shall be used – all three conductors must be interrupted.

.3 The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller panel.

.4 A remote controller needs to be selected and ordered separately from the unit unless the indoor unit is a wall mounted (excludes PKA), floor mounted or one-way ceiling recessed unit.

.2 Remote Controller

.1 Equal to Mitsubishi Deluxe Wired MA Remote Controller:

.1 On wall mount (excludes PKA), floor mount and one-way ceiling recessed units the Deluxe Wired MA Remote Controller shall require a MAC-334IF-E Interface for communication.

.2 The Deluxe Wired MA Remote Controller shall be capable of controlling up to 16 indoor units (defined as 1 group). When grouping M-Series units each unit requires a MAC-334IF-E Interface.

.3 The Deluxe Wired MA Remote Controller shall only be used in same group with another Deluxe Wired MA Remote Controller, with up to two remote controllers per group.

Wired MA Remote Controller			
Item	**Description**	**Operation**	**Display**
ON/OFF	Run and stop operation for a single group	Each Group	Each Group
Operation Mode	Switches between Cool/Drying/Auto/Fan/Heat. Operation modes vary depending on the air conditioner unit.	Each Group	Each Group
Temperature Setting	Sets the temperature from 40°F – 87°F depending on operation mode and indoor unit.	Each Group	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Group	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model.	Each Group	Each Group
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Vane, Reset filter). *1: Centrally Controlled is displayed on the remote controller for prohibited functions.	N/A	Each Group *1
Display Indoor Unit Intake Temp	Measures and displays the intake temperature of the indoor unit when the indoor unit is operating.	N/A	Each Group

Wired MA Remote Controller			
Item	**Description**	**Operation**	**Display**
Display Backlight	Pressing a button lights up a backlight. The light automatically turns off after a certain period of time. (The brightness settings can be selected from Bright, Dark, and Light off.)	N/A	Each Unit
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed	N/A	Each Unit
Test Run	Operates air conditioner units in test run mode. *2 The display for test run mode will be the same as for normal start/stop (does not display “test run”).	Each Group	Each Group *2
Ventilation Equipment	Up to 16 indoor units can be connected to an interlocked system that has one LOSSNAY unit.	Each Group	N/A
Set Temperature Range Limit	Set temperature range limit for cooling, heating, or auto mode.	Each Group	Each Group
Schedule	Set up to 8 operations per day, 7 days per week. Operations include time on/off, mode and room temperature set point.	Each Group	Each Group

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for air conditioning components installation in accordance with manufacturer's written instructions.

- .1 Visually inspect substrate in presence of Departmental Representative.
- .2 Inform Departmental Representative and *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 *Consultant*.

3.2 GENERAL

.1 Install as indicated, to manufacturer's recommendations, and to EPS 1/RA/2.

.2 Manufacturer to certify installation.

.3 Run drain line from cooling coil condensate drain pan to terminate over nearest floor drain.

3.3 EQUIPMENT PREPARATION

.1 *Provide* services of manufacturer's field engineer to set and adjust equipment for operation as specified.

3.4 CLEANING

.1 Progress Cleaning:

.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 *Contract* Closeout Procedures and Submittals.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by computer room air conditioning installation.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

  .1 Variable Refrigerant Flow (VRF) / Variable Refrigerant Volume (VRV) equipment

    .1 Fan Coil Units

    .2 Air-Cooled Condensing Units

    .3 Branch Selector Boxes

    .4 Controls

1.3 SUBMITTALS

.1 Submittals for Review

  .1 Section 01 33 00: Submission procedures.

  .2 *Product* Data:

    .1 *Provide* literature which indicates dimensions, weights, capacities, turndowns, ratings, efficiencies, fan performance, gauges and finishes of materials, and electrical characteristics and connection requirements.

    .2 *Provide* data of filter media, filter performance data, filter assembly, and filter frames.

    .3 *Provide* fan curves with specified operating point clearly plotted.

    .4 Submit sound power level data for both fan outlet and casing radiation at rated capacity.

    .5 Submit electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

  .3 *Shop Drawings*: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, and electrical characteristics and connection requirements.

.2 Submittals for Information

  .1 Section 01 33 00: Submission procedures.

  .2 Installation Data: Manufacturer's special installation requirements.

.3 Maintenance Material Submittals

  .1 Section 01 78 40: Maintenance and extra material requirements.

  .2 Extra Stock Materials: *Provide* one (1) extra set for each unit of filters.

.4 Close-Out Submittals

  .1 Section 01 78 10: Submission procedures.

  .2 Operation and Maintenance Data: Include instructions for lubrication, filter replacement, motor and drive replacement, spare parts lists, and wiring diagrams.

1.4 DELIVERY, STORAGE, AND HANDLING

.1 Section 01 61 00: Transport, handle, store, and protect products.

.2 Accept products on site in factory-fabricated protective containers, with factory-installed shipping skids and lifting lugs. Inspect for damage.

.3 Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

.4 All materials and products shall be inspected upon delivery to the site to ensure there is no pre-existing damage due to dust, moisture, or physical impact.

.5 All materials used to protect (e.g., skids, tarps etc.) materials and products shall be reused as practicable and recycled at the end of their useful life.

1.5 ENVIRONMENTAL REQUIREMENTS

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

PART 2 PRODUCTS

2.1 GENERAL

.1 This section includes the design, performance, refrigerant details, controls and installation requirements for variable refrigerant flow (VRF) / variable refrigerant volume (VRV) systems.

.2 All units shall be listed and rated by ANSI/AHRI Standard 1230-2010 and meet all minimum IEER performance requirements as scheduled.

.3 The units shall be CSA approved, ANSI/UL STD 1995 listed and listed by Electrical Testing Labs (ETL) and bear the cETL label.

.4 All wiring shall be in accordance with the National Electric Code (NEC).

.5 The system will be produced in an ISO 9001 and ISO 14001 facility, which are standards set by the International Standard Organization (ISO). The system shall be factory tested for safety and function.

.6 The units and the design shall be in compliance with CSA B52 Mechanical Refrigerant Code including the March 2009 Supplement.

.7 Base bid manufacturer: Mitsubishi Electric.

    .1 Acceptable manufacturers:

        .1 Daikin ;

        .2 LG;

        .3 Panasonic;

        .4 Fujitsu.

    .2 For acceptable manufacturers other than base bid, any changes or costs that result in design modifications to meet performance and safety design intent, including but not limited to additional transfer openings due to differences in B52 calculations, additional branch boxes or refrigerant piping, etc. shall be the responsibility of the *Contractor*. Performance (turn down ratios, heating performance in extreme cold ambient temperatures, etc.) must be equal or better to base bid or will not be accepted during shop drawing phase.

2.2 SYSTEM DESCRIPTION

.1 VRV system shall automatically vary the target evaporating and condensing temperatures based on building load and weather conditions to increase part load efficiency (Variable Refrigerant Temperature). The condensing unit shall also feature customizable operating modes which allows for the manual setting of target evaporating and condensing temperatures.

.2 System shall be capable of rapid changeover which allows automatic and alternating mode switching between heating and cooling mode during owner-defined and adjustable ambient temperature ranges.

2.3 START-UP AND WARRANTY

.1 Installing contractor must be certified by VRF manufacturer. The bidders shall be required to submit training certification proof with bid documents and submittal documents. Untrained contractors who wish to bid this project may contact DXS (416-661-3400) to arrange training prior to bid day.

.2 The manufacturer shall *Provide* a factory trained service technician to start-up each unit. Manufacturer shall *Provide* instruction to the owners' personnel on proper unit operation and maintenance.

.3 The warranty period on all parts and compressors shall commence on the date of installation and shall continue for a minimum period of seven (7). Proper maintenance of the equipment shall be conducted by certified technicians as per the manufacturer or manufacturer's representative requirements. Maintenance logs shall be supplied by the owner upon request.

.4 All manufacturer warranty shall be for parts only. All diagnosis and labour warranty shall be carried out by installing contractor as per the warranty requirements of this project.

.5 All manufacturer technical and service manuals shall be readily available for download by any local contractor should emergency service be required. Registering and sign-in requirements are not allowed.

2.4 REFRIGERANT PIPING

.1 Refer and comply to the refrigerant piping specifications, including the special considerations for VRF refrigerant piping section.

.2 Standard T style joints are not acceptable for a variable refrigerant volume system. Manufacturer specific Y joints shall be supplied by the VRF manufacturer.

2.5 WALL-MOUNTED INDOOR FAN COIL UNIT

.1 General:

  .1 The wall-mounted indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

.2 Unit Cabinet:

  .1 Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining are required.

  .2 There shall be a separate back plate which secures the unit firmly to the wall.

.3 Fan:

.1 The indoor fan shall be statically and dynamically balanced to run on a single motor with permanently lubricated bearings.

.2 A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).

.3 A motorized air sweep louver shall *Provide* an automatic change in airflow by directing the air up and down to *Provide* uniform air distribution.

.4 Filter:

.1 Return air shall be filtered by means of an easily removable, washable filter.

.5 Coil:

.1 Basis of design indoor units include factory-installed LEV/EEV. Alternative brands which require field-installed, accessory LEV or EEV kits are permissible only with written Engineer and Architect approval for the location of kits being submitted two weeks prior to bid date. EEV kits mounted in cavities inside fire-rated interior walls shall be mounted inside three hour fire rated enclosures with access panels supplied by the manufacturer. Enclosure type and placement require prior approval.

.2 The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.

.3 The coils shall be pressure tested at the factory.

.6 Electrical:

.1 The unit electrical power shall be 208 volts, 1-phase, 60 hertz.

.2 The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz)

.7 Controls:

.1 The unit shall include a remote controller.

.2 Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

.3 Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.

.4 Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.

.5 Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

.6 Full BACnet communication, control and monitoring of the indoor unit shall be provided (for Mitsubishi via one IntesisBox each per fan coil).

2.6 VERTICAL/HORIZONTAL DUCTED (MULTI-POSITION AIR HANDLER)

.1 General:

.1 The multi-position indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in air handling spaces in accordance with Section 18.2 of UL 1995 4th Edition, be tested in accordance with ANSI/ASHRAE 193 and have less than 2% air leakage at maximum airflow setting.

.2 Unit Cabinet:

.1 The cabinet shall include a fixed bottom return, a fixed vertical discharge supply and be pre-painted, pre-insulated, 22 gauge galvanized steel.

.3 Fan:

.1 The indoor unit fan shall be an assembly with a single, statically and dynamically balanced direct drive fan with a high efficiency DC motor with permanently lubricated bearings.

.2 The fan shall have 3-speeds with the capability to operate between 0.3-0.8 In.WG selectable.

.4 Filter:

.1 The unit shall have a 1” filter rack with a reusable filter.

.5 Coil:

.1 The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.

.2 The coils shall be pressure tested at the factory.

.6 Electric Heat Kit:

.1 *Provide* electric heat coil option for the unit, with capacities noted on drawings to be used as back-up second-stage heating when outdoor condenser is in thermal lock-out or for when themostat setpoint cannot be met.

.7 Electrical:

.1 The unit electrical power shall be 208 volts, 1-phase, 60 hertz.

.2 The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz)

.8 Controls:

.1 Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8 degree F deadband from set point.

.2 One wired remote controller per fan coil for local control and troubleshooting.

.3 Full BACnet communication, control and monitoring of the indoor unit shall be provided (for Mitsubishi via one IntesisBox each per fan coil).

2.7 CONDENSING UNIT

.1 The condensing unit shall be factory assembled and pre-wired with all necessary electronic and refrigerant controls. The refrigeration circuit of the condensing unit shall consist of inverter driven compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports, liquid receiver and suction accumulator.

.2 Each outdoor unit model shall be completely factory assembled, piped and wired, and run-tested at the factory.

.3 Outdoor unit shall have sound rating no higher than 62 dB(A).

.4 The outdoor unit shall have an accumulator with refrigerant level sensors and controls. The outdoor unit shall have a high pressure safety switch, over-current protection, crankcase heater and DC bus protection.

.5 VRF system shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.

.6 The outdoor unit shall be capable of guaranteed operation in heating mode down to -13□F ambient temperatures and cooling mode up to 115□F without additional restrictions on line length & vertical separation beyond those published in respective product catalogs. Models with capacity data for required temperature range published as "for reference only" are not considered capable of guaranteed operation and are not acceptable. If an alternate manufacturer is selected, any additional material, cost, and labor to meet ambient operating range and performance shall be incurred by the contractor.

.7 The system will automatically restart operation after a power failure and will not cause any settings to be lost.

.8 Unit cabinet:

  .1 The casing(s) shall be fabricated of galvanized steel, bonderized, and finished.

  .2 Outdoor unit components shall be coated with the Seacoast Protection Coating (Brine Spray – BS coating) to protect components from premature corrosion due to a seacoast environment. Coating shall be applied to components before original outdoor unit assembly to ensure manufacturer quality standards are not compromised.

  .3 The outdoor unit shall be tested in compliance with ISO9277 such that no unusual rust shall develop after 960 hours of salt spray testing.

  .4 Panels on the outdoor unit shall be scratch free at system startup. If a scratch occurs the salt spray protection is compromised and the panel should be replaced immediately.

.9 Fan:

  .1 Each outdoor unit module shall be furnished with direct drive, variable speed propeller type fan(s) only.

  .2 All fan motors shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.

  .3 All fans shall be provided with a raised guard to prevent contact with moving parts.

.10 Refrigerant and Refrigerant Piping

  .1 R410A refrigerant shall be required for systems.

  .2 Polyolester (POE) oil—widely available and used in conventional domestic systems—shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.

  .3 Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the VRF equipment manufacturer and installed in accordance with manufacturer recommendations.

.4 All refrigerant piping must be insulated with 1” closed cell, elastomeric insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102.

.5 Refrigerant line sizing shall be in accordance with manufacturer specifications.

.11 Coil:

.1 The outdoor coil shall be of nonferrous construction with lanced or corrugated fins on copper tubing.

.2 The coil fins will have a factory applied corrosion resistant finish.

.3 The coil shall be protected with an integral metal guard.

.4 Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.

.12 Compressor:

.1 Each outdoor unit module shall be equipped with only inverter driven scroll hermetic compressors. Non-inverter-driven compressors, which may cause inrush current (demand charges) and require larger generators for temporary power shall not be allowed.

.2 Crankcase heat shall be provided via induction-type heater utilizing eddy currents from motor windings. Energy-wasting “belly-band” type crankcase heaters are not allowed.

.3 Compressor shall have an inverter to modulate capacity.

.4 The compressor shall be equipped with an internal thermal overload.

.13 Controls:

.1 The unit shall be an integral part of the system & control network described in Part 5 (Controls) and react to heating/cooling demand as communicated from connected indoor units over the control circuit. Required field-installed control voltage transformers and/or signal boosters shall be provided by the manufacturer.

.14 Electrical:

.1 The outdoor unit electrical power shall be 208 volts, 1-phase, 60 hertz per equipment schedule.

.2 The outdoor unit shall be controlled by integral microprocessors.

.3 The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair shielded cable to *Provide* total integration of the system

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install condensing units on vibration isolators. Refer to Section 23 05 48.

.2 *Provide* all necessary control wiring as recommended by the manufacturer.

.3 High/low pressure gas line, liquid, and suction lines must be individually insulated between the outdoor and indoor units.

.4 Contact DXS (416-661-3400) prior to installation to review and confirm piping layout and lengths.

.5 Use refrigeration best practice to allow pipes to expand and contract freely. Review manufacturer installation instructions to ensure expansion joints are properly designed.

.6 Pressure test ALL systems to 550 PSI after system was vacuumed and held to below 500 microns for at least one hour. Review manufacturer installation instructions for proper pressure test procedures.

.7 Design and install all piping as per TSSA and CSA B52 regulations and apply and obtain TSSA certification for all systems.

.8 *Provide* condensate drainage to locations as shown on drawings, using gravity drainage, integral condensate pumps, and/or external condensate pumps as required. *Provide* external condensate pumps as required to get to discharge location shown on drawing.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

.1 Electric Unit Heaters

1.3 SUBMITTALS

.1 Section 01 33 00 – Submittals.

.2 *Product* Data: *Provide* typical catalogue of information including arrangements.

.3 *Shop Drawings*:

.1 Indicate cross sections of cabinets, grilles, bracing and reinforcing, and typical elevations.

.2 Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers, and comparison of specified heat required to actual heat output provided.

.3 Indicate mechanical and electrical service locations and requirements.

.4 Heating capacity at voltage provided.

1.4 CLOSEOUT SUBMITTALS

.1 Operation and Maintenance Data: Include start-up instructions, maintenance instructions, parts lists, controls, and accessories.

1.5 MAINTENANCE MATERIAL SUBMITTALS

.1 Maintenance and extra material requirements.

1.6 QUALITY ASSURANCE

.1 Products of This Section: Manufactured to ISO 9000 certification requirements.

.2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

.3 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

1.7 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by CSA testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 DELIVERY, STORAGE, AND PROTECTION

.1 Transport, handle, store, and protect products.

.2 Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors.

.3 Protect coils from entry of dirt and debris with pipe caps or plugs.

PART 2 PRODUCTS

2.1 WALL FAN HEATERS

.1 General

.1 Assembly: CSA listed and labelled.

.2 Heating Elements: High-quality nickel-chrome resistance wire.

.3 Cabinet: 20 gauge steel with 18-gauge steel grille.

.4 Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.

.5 Fan: Quiet helicoidal fan, single or multiple.

.6 Motor: Totally enclosed, permanently lubricated.

.7 Thermal protection with automatic reset.

.8 Control: Remote thermostat with relay for connection to BAS as required by controls sequences.

.9 Electrical Characteristics:

.1 208 volts, single phase, 60 Hz.

.2 Disconnect Switch: Factory mount disconnect switch.

.2 Acceptable Manufacturers

.1 Stelpro;

.2 Ouellet;

.3 Reznor.

2.2 ELECTRIC UNIT HEATERS

.1 General

.1 Assembly: CSA listed and labelled, with terminal control box and cover, splice box, coil, casing, and controls.

.2 Heating Elements: Exposed helical coil of nickel-chrome resistance wire with refractory ceramic support bushings.

.3 Cabinet: 20 gauge steel with easily removed front panel with integral air outlet and inlet grilles.

.4 Element Hangers: Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.

.5 Fan: Direct drive propeller type, statically and dynamically balanced, with fan guard.

.6 Motor: Permanently lubricated, sleeve bearings for horizontal models, ball bearings for vertical models.

.7 Control: Separate fan speed switch and thermostat, factory wired, with switches built-in behind cover. *Provide* thermal overload.

.8 Electrical Characteristics:

.1 208 volts, single phase, 60 Hz.

.2 Disconnect Switch: Factory mount disconnect switch.

.2 Acceptable Manufacturers

.1 Stelpro;

.2 Ouellet;

.3 Chromalox;

.4 Reznor;

.5 Modine.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install to manufacturer's written instructions.

.2 Install equipment exposed to finished areas after walls and ceiling are finished and painted. Avoid damage.

.3 Protection: *Provide* finished cabinet units with protective covers during balance of construction.

.4 Unit Heaters: Hang from building structure, with pipe hangers anchored to building, not from piping. Mount as high as possible to maintain greatest headroom unless otherwise indicated.

.5 Install electric heating equipment including devices provided by manufacturer but not factory-mounted. *Provide* copy of manufacturer's wiring diagram submittal. Install electrical wiring to manufacturer's submittals.

.6 Install units on vibration isolation and seismic isolation/bracing. Refer to sections 23 05 48 and 23 05 49.

.7 *Provide* heating season start-up, cooling season shut-down service, for first year of operation.

.8 Shut-down system if initial start-up and testing takes place in summer and units are to remain inoperative. Repeat start-up and testing operation at beginning of first heating season.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 SUMMARY

.1 Section Includes

  .1 Electric-Resistance Air Coils

1.3 SUBMITTALS

.1 Section 01 33 00 – Submittals.

.2 *Product* Data: *Provide* coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.

.3 *Shop Drawings*: Indicate coil and frame configurations, dimensions, materials, rows, connections, and rough-in dimensions.

1.4 SUBMITTALS FOR INFORMATION

.1 Section 01 33 00: Submission procedures.

.2 Installation Data: Submit manufacturer's installation requirements.

1.5 CLOSEOUT SUBMITTALS

.1 Section 01 77 00: Submission procedures.

.2 Operation and Maintenance Data: Include start-up instructions, maintenance instructions, parts lists, controls, and accessories.

1.6 MAINTENANCE MATERIAL SUBMITTALS

.1 Sections 01 77 00 and 01 78 36: Maintenance and extra material requirements.

1.7 QUALITY ASSURANCE

.1 Products of This Section: Manufactured to ISO 9000 certification requirements.

.2 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

.3 Installer Qualifications: Company specializing in performing the work of this section with minimum three (3) years documented experience and approved by the manufacturer.

1.8 REGULATORY REQUIREMENTS

.1 Products Requiring Electrical Connection: Listed and classified by CSA testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.9 DELIVERY, STORAGE, AND PROTECTION

.1 Section 01 60 00: Transport, handle, store, and protect products.

.2 Protect coil fins from crushing and bending by leaving in shipping cases until installation, and by storing indoors.

.3 Protect coils from entry of dirt and debris with pipe caps or plugs.

PART 2 PRODUCTS

2.1 ELECTRIC POST HEATERS

.1 General

.1 Duct heaters shall be open coil heaters.

.1 Voltage, size, wattage, control type and control voltage shall be as scheduled on the drawings.

.2 Manufacturer shall be capable of furnishing single-phase or three-phase heaters as indicated on mechanical schedules.

.3 Heaters shall be UL listed for zero clearance and meet all applicable requirements of the NEC.

.4 Electric duct heaters shall be independently powered.

.2 Type: Heaters shall be of the flanged mount type for duct mounting.

.3 Duct heaters shall be for indoor use only.

.4 Heating Elements: Open coil of nickel-chrome resistance wire, supported and insulated by floating ceramic bushings. Heating element support structure shall consist of galvanized steel wire formed and constructed to support ceramic bushings through which the heating element passes.

.5 All heating elements shall be made of nickel/chromium resistance wire with ends terminated by means of staking and heliarc welding to machine screws.

.6 Coil Layout: Vertical (air flow horizontal). EH series is only approved for vertical up airflow.

.7 Casing Assembly: Flanged type, galvanized-steel frame

.8 Coil terminals shall be stainless steel plated, terminal insulators and bracket bushings shall be of ceramic and securely positioned.

.9 Control Box: Control cabinet shall have a solid cover also of heavy gauge galvanized steel and held in place with hinges and interlocking disconnect switch.

.10 Orientation: Heaters shall be interchangeable for mounting in a horizontal or vertical duct.

.11 Heaters up to 60 kW shall be capable of being rotated 180°.

.12 Built-in components shall include disconnecting break magnetic contactors, transformer with primary fusing, pressure-type airflow switch set at 0.05" + 0.02" WC all as required by UL, branch circuit fuses per NEC, interlocking disconnect switch and a single terminal block to accept the number, type and size of conductors as required.

.13 Over-Temperature Protection:

.1 Serviceable through electric duct heater without removing heater from duct or unit.

.2 Disk-type, automatic reset, thermal-cutout safety devices for primary over-temperature protection.

.3 Secondary over-temperature protection by built in disc type manually resettable thermal cutouts. These devices must function independently of one another and are not acceptable if series connected in the control circuit wiring.

.4 All duct heaters will require either a fan interlock circuit or an airflow switch. The airflow switch shall be diaphragm operated differential pressure switch to prevent duct heater from operating when there is no air flow.

.14 A disconnecting magnetic control circuit is required.

.15 Over-current protection by means of factory-installed fusing within the control cabinet shall be provided. Heating elements shall be subdivided and fused accordingly.

.16 All wiring, component sizing, component spacing and protective devices within the control cabinet shall be factory installed and comply with CSA and ULC standards.

.17 Control Panel: Mounted on unit, with means of a safety disconnect and overcurrent protection. Include the following controls:

.1 Magnetic contactor.

.2 Silicon Controlled Rectifier (SCR) that shall be capable of accepting 0-10Vdc or 4-20mA as control signal and modulating as required to meet discharge air set point temperature.

.3 Recessed Control Box that shall extend 1" beyond internally insulated duct. Only applicable for installing in internally insulated ducts with an insulation thickness of 1".

.4 Dust tight control box via compression type gasket installed on control box flanges to seal door opening. Control box seams are filled to prevent dust intrusion.

.5 Pilot light to indicate the heater is energized

.6 24VAC control voltage

.18 A wiring diagram depicting layout and connections of electrical components within the control cabinet shall be affixed to the inside of the control cabinet cover.

.19 A rating plate label shall be affixed to the exterior of the control cabinet cover which states model number, serial number, volts, amps, phase, frequency, control volts, volt-amps and minimum airflow requirements.

.2 Manufacturers

.1 Renewaire;

.2 Thermolec;

.3 Nailor;

.4 Chromalox;

.5 Substitutions: Refer to Section 01 60 00.

PART 3 EXECUTION

3.1 ELECTRIC POST HEATER INSTALLATION

.1 Locate, orient, and connect ductwork per AMCA, ASHRAE, and SMACNA guidelines. *Provide* service clearances as indicated on the plans. Locate units distant from sound critical occupancies.

.2 *Provide* a structurally suitable support as necessary for all units. Installation shall meet or exceed all applicable federal, state and local requirements, referenced standards and conform to codes and ordinances of authorities having jurisdiction.

.3 Perform all work required to *Provide* and install the following electric duct heaters indicated by the contract documents with supplementary items necessary for proper installation.

.4 All installation shall be in accordance with manufacturer’s published recommendations.

.5 Inspect areas and conditions under which heater units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.

.6 Do not operate electric heaters for any purpose until ductwork is clean of any possible debris.

.7 Maintain minimum working clearances around the heater electrical panel in accordance with NEC Article 110.

.8 Install duct heaters in metal ducts and casings constructed according to SMACNA "HVAC Duct Construction Standards".

.9 If applicable, anchor duct heaters in position using suitable supports.

.10 Connect duct heaters and components to wiring systems and to ground as indicated and instructed by manufacturer. Tighten connectors and terminals, including screws and bolts, according to equipment manufacturer’s published torque-tightening values for equipment connectors. Where manufacturer’s torque requirements are not indicated, tighten connectors and terminals according to tightening torques specified in UL 486A.

.11 After construction is completed, including painting, clean unit’s exposed surfaces and vacuum clean electric duct heaters and inside of cabinets.

.12 Touch up scratches and marks from handling and placement of equipment with masking enamel to match manufacturer’s color. Refer to Division 09 for site-applied finishes

3.2 ELECTRIC UNIT HEATER INSTALLATION

.1 Install to manufacturer's written instructions.

.2 *Provide* for connection to electrical service.

.3 Install units on vibration isolation. Refer to Section 23 05 48.

.4 *Provide* heating season start-up, cooling season shut-down service, for first year of operation.

.5 Shut-down system if initial start-up and testing takes place in summer and units are to remain inoperative. Repeat start-up and testing operation at beginning of first heating season.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

1.2 SECTION INCLUDES

.1 Electrode Steam Humidifiers

1.3 RELATED SECTIONS

.1 Section 22 10 00 - Plumbing Piping.

.2 Section 23 22 00 - Steam and Steam Condensate Piping.

.3 Section 25 30 00 - Instruments and Control Elements: Humidistats.

.4 Section 26 05 80 - Equipment Wiring: Electrical characteristics and wiring connections.

1.4 SUBMITTALS FOR REVIEW

.1 Section 01 33 00: Submission procedures.

.2 *Product* Data: *Provide* catalogue data indicating rated capacity, dimensions, duct and service connections, electric nameplate data and wiring diagrams.

.3 *Shop Drawings*: Indicate layout of system and components.

1.5 CLOSEOUT SUBMITTALS

.1 Section 01 78 10: Submission procedures.

.2 Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data, and parts listing.

.3 Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in Owners name and registered with manufacturer.

1.6 MAINTENANCE MATERIAL SUBMITTALS

.1 Extra Stock Materials: *Provide* two (2) replacement humidifier cylinders.

PART 2 PRODUCTS

2.1 ELECTRODE STEAM HUMIDIFIERS

.1 Base design manufacturer and model is the Condair Nortec EL.

.2 Humidifier: AHRI 640, self contained, disposable cylinder, microprocessor controlled electrode steam generating unit.

.3 Cylinders: Disposable plastic with electrodes. Water conductivity is measured to control drainage of mineral-laden water to minimize water and energy consumption. Staged electrode use to minimize performance drop over time. Cylinder must have welded seam to ensure watertight and have high water sensor to prevent overfilling. 98% thermal efficiency from startup until end of cylinder life.

.4 Integral fill cup with minimum 1-inch [25 mm] air gap to prevent back siphoning.

.5 Full cylinder indication and pre-notification of automatic shutdown at end of cylinder life.

.6 Automatic pulse feature to clean any obstruction from the drain solenoid valve if required.

.7 Automatic off-season shut-down (e.g. after 3 days of "no call") will completely drain the cylinders and automatically restart on call for humidity. Adjustable on/off and time sequence. Provides extended cylinder life, while ensuring stagnant water does not remain in the system.

.8 Accommodates water inlet pressure from 207 to 552 kPa (30 to 80 psig).

.9 Cabinet: Durable powder coated steel cabinet with zero side clearance requirement for minimal footprint.

.10 Modulating output between 20% and 100% of rated capacity.

.11 Incorporate electrical terminals for installation of humidistat, duct high-limit humidistat, air flow switch.

.12 Steam Distributor: Stainless steel steam dispersion tube suitable for insertion in duct with condensate separator and return leg to remove condensate from distributor return to humidifier fill.

.13 Drain Water Cooling: *Provide* optional Extreme drain water cooling to temper water to 49°C (120°F) during normal and manual operation.

.14 *Provide* external dedicated fused disconnect switch close to unit.

.15 Touchscreen controller with standard building automation:

  .1 Intuitive touchscreen control.

  .2 Standard building automation communication protocols BACnet IP, BACnet MSTP. Additional hardware required for building automation communication not acceptable.

  .3 Embedded web interface for easy configuration and remote monitoring from any computer with a web browser over a local area network (LAN) connection.

  .4 USB interface for new software/feature upload and download of operational information.

  .5 Single or dual channel analog signal acceptance, supporting both demand and transducer control. Ability to control setpoint from humidifier control when using transducer controls.

.16 Manufacturers:

  .1 Condair Ltd.

  .2 Dristeem

  .3 Or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

.1 Install humidifiers per manufacturers' instructions.

.2 Install with required clearance for service and maintenance.

.3 Install accessories in accordance with manufacturer's recommendations.

.4 Insulate steam piping with 1.5” thick insulation and *Provide* jacketing for energy conservation and personnel protection.

END OF SECTION

PART 1 – GENERAL

1.1 General

.1 The purpose of this section is to specify Division 25 responsibilities in the commissioning process.

.2 The systems to be commissioned are listed in Section 01 91 00, Part 1.9.

.3 Commissioning requires the participation of Division 25 to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 01 91 00. Division 25 shall be familiar with all parts of Section 01 91 00 and the commissioning plan issued by the CA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

.4 CA = Commissioning Agent, TAB = Test and Balance.

1.2 Responsibilities

.1 Controls Subcontractor. The Contractor shall ensure that the controls Subcontractor complies with all requirements included in this Section and fulfills the following responsibilities during construction and acceptance phases (all references apply to commissioned equipment only):

.1 Sequences of Operation Submittals. The controls Subcontractor's submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the Specifications. They shall include:

.1 An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components and function.

.2 All interactions and interlocks with other systems.

.3 Detailed delineation of control between any packaged controls and the BAS, listing what points the BAS monitors only and what BAS points are control points and are adjustable.

.4 Written sequences of control for packaged controlled equipment. (Equipment manufacturers' stock sequences may be included, but will generally require additional narrative).

.5 Start-up sequences.

.6 Warm-up mode sequences.

.7 Normal operating mode sequences.

.8 Unoccupied mode sequences.

.9 Shutdown sequences.

.10 Capacity control sequences and equipment staging.

.11 Temperature and pressure control: setbacks, setups, resets, etc.

.12 Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, etc.

.13 Effects of power or equipment failure with all standby component functions.

.14 Sequences for all alarms and emergency shut downs.

.15 Seasonal operational differences and recommendations.

.16 Initial setpoints and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.

.17 Schedules, if known.

.18 To facilitate referencing in testing procedures, all sequences shall be written in concise statements

.2 Control Drawings Submittal

.1 The control drawings shall have a key to all abbreviations.

.2 The control drawings shall contain graphic schematic depictions of the systems and each component (i.e. sensors, dampers, coils, valves, etc.)

.3 The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.

.4 Provide a full points list with at least the following included for each point:

.1 Controlled system

.2 Point abbreviation

.3 Point description

.4 Display unit

.5 Control point or setpoint (Yes / No)

.6 Monitoring point (Yes / No)

.7 Intermediate point (Yes / No)

.8 Calculated point (Yes / No)

.9 Key:

Point Description: DB temp, airflow, etc.

Control or Setpoint: Point that controls equipment and can have its setpoint changed (OSA, SAT, etc.)

Intermediate Point: Point whose value is used to make a calculation which then controls equipment (space temperatures that are averaged to a virtual point to control reset).

Monitoring Point: Point that does not control or contribute to the control of equipment, but is used for operation, maintenance, or performance verification.

Calculated Point: “Virtual” point generated from calculations of other point values.

The Controls Contractor shall keep the CA informed of all changes to this list during programming and setup.

.3 As-Built Controls Package - An updated as-built version of the Controls Drawings and Sequence of Operation, which is to include all items identified above, shall be provided to the CA and included in the final controls O&M manual submittal.

.4 Assist in TAB Work- The Controls Subcontractor shall assist in the TAB work through the following:

.1 Meet with the TAB Subcontractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB Subcontractor any needed unique instruments for setting terminal unit boxes and instruct the TAB Subcontractor in their use (handheld control system interface for use around the building during TAB, etc.).

.2 For a given area, have all required prefunctional checklists, calibrations, startup and selected functional tests of the system completed and approved by the CA prior to TAB.

.3 Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.

.5 Required assistance to the CA - Assist and cooperate with the CA in the following manner:

.1 Using a skilled technician who is familiar with the building, execute the functional testing of the all equipment specified in Section 01 91 00 under direction of the CA. Provide two-way radios during the testing.

.2 Execute all control system trend logs specified in Section 01 91 00.

.3 Written Plan - The controls Subcontractor shall prepare a written plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional performance testing, according to the process in Section 01 91 00. At minimum, the plan shall include the following for each type of equipment controlled by the automatic controls:

.1 System name.

.2 List of devices.

.3 Step-by-step procedures for testing each controller after installation, including:

.1 Process of verifying proper hardware and wiring installation.

.2 Process of downloading programs to local controllers and verifying that they are addressed correctly.

.3 Process of performing operational checks of each controlled component.

.4 Plan and process for calibrating valve and damper actuators and all sensors.

.5 A description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.

.4 A copy of the log and field checkout sheets that will document the process. This log must include a place for initial and final read values during calibration of each point and clearly indicate when a sensor or controller has “passed” and is operating within the contract parameters.

.5 A description of the instrumentation required for testing.

.6 Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the CA and TAB Subcontractor for this determination.

.6 Checkout Certification - Provide a signed and dated certification report to the CA and Consultant upon completion of the checkout of each controlled device, equipment and system prior to functional testing. This report shall serve as confirmation that all system programming is complete in accordance to the Contract Documents, with the exception functional testing requirements. The checkout report shall also include complete point-to-point verification and sequence of operations verification checklists.

.7 List and clearly identify on the as-built duct and piping drawings the locations of all static and differential pressure sensors (air, water and building pressure).

PART 2- PRODUCTS

.1 NOT USED

PART 3- EXECUTION

3.1 Submittals

.1 Section 25 Subcontractors shall provide submittal documentation relative to commissioning to the CA as requested by the CA. Refer to Section 01 91 00 Part 3.3 for additional Section 25 requirements.

3.2 Start-up of Equipment

.1 The Controls Contractor shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in Section 01 91 00, Part 3.4. Section 23 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the CA or the Region.

.2 Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CA and the Consultant. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all pre functional checklists as soon as possible.

.3 Prior to the start up of equipment the Division 25 Subcontractor shall arrange to have the manufacturer of all major equipment inspect the installation to ensure their equipment has been installed in accordance with their recommendations.

.4 The supplier shall submit a written report of their findings.

.5 Upon confirmation that the equipment has been installed in accordance with the manufacturer’s recommendations the equipment may be started.

.6 All equipment shall be started by the manufacturer’s representative.

3.3 Pre-Functional Test Sheets

.1 Pre-functional test sheets contain items for Section 25 Subcontractors to perform. On each checklist, a column is provided that is to be completed by the Contractor assigning responsibility for that line item to a Subcontractor. Those executing the test sheets are only responsible to perform items that apply to the specific application at hand. These test sheets do not take the place of the manufacturer's recommended checkout and start-up procedures or report. Some checklist procedures may be redundant in relation to checkout procedures that will be documented on typical factory field checkout sheets. Double documenting may be required in those cases.

.2 Refer to Section 01 91 00 for additional requirements regarding pre-functional test sheets, startup and initial checkout. Items that do not apply should be noted along with the reasons on the form. If this form is not used for documenting, one of similar rigor and clarity shall be used pending approval from the CA. Contractor's assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their Subcontractors are completed and checked off. "Contr." column or abbreviations in brackets to the right of an item refer to the Subcontractor responsible to verify completion of this item.

3.4 Operations and Maintenance Manuals

.1 The Contractor shall ensure that the Section 25 Subcontractors compile and prepare documentation for all equipment and systems covered in Section 25 and deliver it to the Contractor for inclusion in the O&M manuals

.2 The CA shall receive a copy of the O&M manuals for review.

3.5 Training of Region Personnel

.1 The Contractor shall coordinate and schedule training and ultimately to ensure that training is completed. Refer to Section 01 91 00 for additional details.

.2 The CA will oversee and approve the content and adequacy of the training of Region personnel for commissioned equipment. Refer to Section 01 91 00 for additional details.

.3 <u>Controls Subcontractor.</u> The Contractor shall ensure that the controls Subcontractor fulfills the following training responsibilities:

- .1 Provide the CA with a training plan two weeks before the planned training according to the outline described in Section 01 91 00, Part 3.8.
- .2 Provide designated Region personnel with comprehensive training in the understanding of the systems and the operation and maintenance of the BAS system.
- .3 Training shall start with classroom sessions, if necessary, followed by hands on training on the BAS, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
- .4 During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
- .5 The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
- .6 Training shall include:

.1 Use the printed installation, operation and maintenance instruction material included in the O&M manuals.

.2 Include a review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.

.3 Discuss relevant health and safety issues and concerns.

.4 Discuss warranties and guarantees.

.5 Cover common troubleshooting problems and solutions.

.6 Explain information included in the O&M manuals and the location of all plans and manuals in the facility.

.7 Discuss any peculiarities of equipment installation or operation.

.8 Classroom sessions shall include the use of overhead projections, slides, video and audio taped material as might be appropriate.

.7 Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.

.8 The controls Subcontractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.

.9 Training shall occur after functional testing is complete, unless approved otherwise by the the Region's PM.

3.6 Deferred Testing

.1 Refer to Section 01 91 00, Part 3.9 for requirements of deferred testing.

3.7 WRITTEN WORK PRODUCTS

.1 Written work products of Section 25 Subcontractors will consist of the startup and initial checkout plan as described in Section 01 91 00, as well as completed startup, initial checkout and pre-functional test sheets.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

.2 This document outlines the minimum equipment and performance standards for a completely interoperable Building Automation System (BAS).

.3 The work shall include design, supply, installation, and commissioning a complete microprocessor based automatic control system to achieve the performance specified in the following Sections.

.4 The BAS shall be capable of total integration of facility infrastructure systems with user access to all system data, locally over a secure Intranet within the building and by remote access by a standard Web Browser over the Internet.

.5 The entire BAS shall be peer-to-peer networked, stand-alone, distributed control in accordance with American National Standards Institute/American Society of Heating, Refrigerating and Air Conditioning Engineers (ANSI/ASHRAE) Minimum Standard 135-2015, BACnet – A Data Communication Protocol for Building Automation and Control Networks.

.6 All labour, material, equipment and software not specifically referred to herein or on the plans, but is required to meet the functional intent, shall be provided without additional cost to the *Owner*.

.7 Contractors shall be manufacturers or licensed factory representatives and installers of the manufacturers, specified for the local area in which the *Site* is located.

.8 The automation vendor must have least 2 dealers in Ontario that can *Provide* parts and services to upon request.

.9 The BAS contractor shall *Provide* the necessary engineering, installation, supervision, commissioning and programming for a complete and fully operational system. The contractor will *Provide* as many trips to the job site for installation, supervision, and commissioning as are necessary to complete the project to the satisfaction of the consultant and/or project supervisor.

.10 The controls contractor will specifically read all mechanical and electrical drawings, specifications, and addenda and determine the controls work provided by the mechanical contractor, his subcontractors, and the electrical contractor. The controls contractor is expected to have the expertise to coordinate the work of other contractors and to make a completely coordinated Building Automation Control System (BAS) for the mechanical systems.

.11 The BAS shall be compatible with future control Products for 10 years or more.

.12 When the BAS is installed all devices must be the latest publicly released version of hardware, firm ware and software.

.13 Ensure compliance with all applicable codes and authorities having jurisdiction.

.14 The system shall be installed by trade certified electricians regularly employed by the controls contractor. The system shall be tested and calibrated by factory certified technicians qualified for this type of work and in the regular employment of the BAS manufacturer or its exclusive factory authorized installing contracting field office representative. The installing office shall have a minimum of five years of installation experience with the manufacturer. Supervision, calibration and commissioning of the system shall be by the employees of the factory authorized BAS branch or representative.

1.2 BUILDING MANAGEMENT SYSTEM SUB-CONTRACTOR

.1 All work of this Section shall be coordinated and provided by a single BMS *Subcontractor*.

.2 The work of this Section shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Mechanical Division Sections for details.

.3 The work of this Section shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, warranties, services, and items which are required for the complete, fully functional and commissioned BMS, even if these are not specifically mentioned or fully described under this Section.

.4 If the BMS subcontractor believes there are conflicts or missing information in the project documents, the subcontractor shall promptly request clarification and instruction from the design team.

1.3 ACCEPTABLE BMS CONTRACTORS

.1 The Building Automation System shall be one of the following systems:

.1 Automated Logic

.2 Delta Controls

.3 Reliable Controls.

1.4 SCOPE

.1 This project scope shall include, but not be limited to, the following work:

.1 Preparation of control shop drawings for review and approval. See Submittals.

.2 Supply and install a network of Building Automation Control System (BAS) panels and field devices. See Hardware, Software and Field Devices.

.3 Supply and install customized graphics software as specified. See Software.

.4 Install, wire and label all BAS control system components. See Installation.

.5 Calibrate and commission the installed control system. See Commissioning.

.6 *Provide* maintenance manuals and as-built drawings. See As-Built Documentation.

.7 *Provide* customized training for operations, maintenance and technical staff. See Training.

1.5 DRAWINGS AND SUBMISSIONS

.1 Submit the following information to the consultant and/or the project manager for review and approval:

.1 Control Schematics.

.2 Detailed sequence of operation for each control schematic or controlled system.

.3 System Architecture indicating the proposed interconnection and location of all BAS panels, network connections and key peripheral devices (workstations, modems, printers, repeaters, etc.)

.4 BAS Points List indicating the panel ID, panel location, hardware address, point acronym, point description, field device type, point type (i.e, AO/DO/AI/DI), end device fail position, end device manufacture and model number, and wire tag ID). Terminal identification for all control wiring shall be shown on the shop drawings.

.5 Wiring diagrams including complete power system, interlocks, control and data communications.

.6 Hard copy graphical depiction of the application control programs.

.7 Manufacturers' data / specification sheets for all material supplied.

1.6 MATERIALS

.1 All points shall be available to BACnet.

.2 Points shall be field reconfigurable. No set points shall be hard coded in the programs.

.3 All controllers shall be loaded to a maximum of 80%. 20% of each of the inputs, outputs and variables shall remain unused to allow for future growth and expandability.

.4 The system shall consist of all operator interfaces, microprocessor-based controllers, sensors, wells, automatic control valves, control dampers, transducers, and relays, automatic control valves, and damper actuators.

.5 All equipment, points, etc. shall have common labelling.

.6 Software shall be completely programmable and capable of all control and mathematical functions.

.7 BAS shall come with copies of all software and licenses required to operate and configure the system. Software shall be the latest version as of substantial completion. Software updates, new versions and patches shall be provided to the Region as they are released free of charge for 2 years from substantial completion."

.8 All temperature units for BAS and controlled equipment shall be in °C (degrees Celsius).

.9 Operator Activity Tracking - An audit trail report to track system changes, accounting for operator initiated actions, changes made by a particular person or changes made to a specific piece of equipment designated time frame, shall be printable and archived for future use. The operator activity tracking shall be in a tamper-proof buffer file.

.10 Operator workstation interface software shall optimize operator understanding through the use of English language prompting, English language point identification and industry standard PC application software. The software shall *Provide*, as a minimum, the following functionality:

.1 Real-time graphical viewing and control of environment

.2 Scheduling and override of building operations

.3 Collection and analysis of historical data and dynamic data (trend plot)

.4 Definition and construction of dynamic color graphic displays

.5 Editing, programming, storage and downloading of global controller databases

.6 Alarm reporting, routing, messaging, and acknowledgment

.11 *Provide* a graphical user interface, which shall minimize the use of the keyboard through the use of a mouse or a similar pointing device and a “point and click” approach to menu selection.

.12 Battery backup: Automatic restart after power failure: Upon restoration of power after an outage, the BAS shall automatically, and without human intervention, update all monitored functions, resume operation based on current synchronized time and status and implement special start-up strategies as required.

.13 Refresh rate – The maximum permissible refresh rate is ONE (1) second. The refresh rate is defined as the time it takes the controller central processing unit (CPU) to sample all inputs, calculate all variables, update all timers and proportional integral derivative (PID) controllers, check all schedules, update all trend logs and runtime logs, execute all programs and assign values to all outputs.

.14 The HVAC equipment shall be supplied as “Thermostat-Ready”. The building automation system shall have direct control of dampers, heating and cooling stages without the requirement of BACnet, Lonworks or any other type of communication interface. Factory installed interlocks, safeties and anti-cycle timers shall be provided as required.

.15 Reports shall be generated on demand or via a pre-defined schedule and directed to video displays, printers or hard drive. As a minimum, the system shall allow the user to easily obtain the following types of reports:

- .1 A general listing of all or selected points in the network
- .2 List of all points currently in alarm
- .3 List of all points currently in override status
- .4 List of all disabled points
- .5 List of all points currently locked out
- .6 List of user accounts and access levels
- .7 List all weekly schedules
- .8 List of limits and dead-bands
- .9 Excel reports
- .10 System diagnostic reports including a list of BAS panels on line and communicating, and the status of all BAS terminal unit device points
- .11 List of programs

.16 *Provide* a means for the operator to view the communication status of all controllers connected to the system. The status should show whether the controller is communicating or not.

.17 *Provide* a means for the operator to reset the error count for all controllers to zero.

.18 *Provide* a means for the operator to display and change the system configuration. This shall include, but not be limited to, system time, day of the week, date of day light savings set forward/ set back, printer type and port addresses, modem port and speed, etc. Items shall be modified utilizing easy to understand terminology using simple mouse/cursor key movements.

.19 *Provide* a security system that prevents unauthorized use unless the operator is logged on. Access shall be limited to the operator’s terminal functions unless the user is logged on.

.20 Where possible, utilize Optimized Start features on equipment to reduce hydro demand charges.

.21 During the initial design The *Region* shall supply the controls contractor a range of BACnet addresses the BAS will run on. The BAS network will run either BACnet over IP or BACnet over MSTP. All BAS points will be network visible so that other BACnet systems can auto discover them. *Contractor* shall consult with York *Region Project* Manager during the development of addresses.

1.7 WAN ACCESS

.1 *Provide* necessary interface and cabling to connect the BAS to the YR WAN. Obtain the particular WAN system details from the Engineer or *Project* Supervisor.

.2 The *Region* shall supply the WAN IP address, Gateway and Subnet mask for the BBMD router in the network. The controls contractor will facilitate integration into the *Region*'s existing BAS BACNET network.

.3 On the network a BACnet IP device that is capable of BBMD will route information from other sites and the operator work station. In addition there shall be a CAT6A wire that is run to the *Region*'s IT switch with a 4' pigtail and connector.

1.8 TREND DATA

.1 *Provide* trend logs for every hardware input and output.

.2 All trends should be accessible via the graphical interface.

.3 Trends should contain all related variables of a control loop (i.e. setpoint, measured variable and control output) and have the ability to be plotted simultaneously on the same graph. Field Devices Individual trends should *Provide* an appropriate “snapshot” of the variable. Trends should contain a minimum of 5 days worth of trend data.

.4 *Provide* trending capabilities at 5 minute intervals that allow the user to easily monitor and preserve records of system activity over a one year period. Any system point may be trended automatically at time-based intervals or change of value, both of which shall be user-definable. Trend data may be stored on hard drive for future diagnostics and reporting. Additionally, trend data may be archived to network drives or removable disk media for future retrieval.

.5 Trending shall be accessible from the graphics screens for each point. Each point shall have its associated trend capability accessible from the graphic via an icon located beside the point name on the graphic page.

.6 Trend data reports shall be provided to allow the user to view all trended point data. Reports may be customized to include individual point or predefined groups of at least six points. *Provide* sufficient capacity to allow for trending a minimum of 100 points at 2000 samples each. Reports should be easily transferable on-line to Microsoft Excel. The *Contractor* shall *Provide* custom designed spreadsheet reports for use by the *Owner* to track energy usage and cost, equipment run-times, equipment efficiency, and/or building environmental conditions.

.7 The operator shall be able to change trend log setup information. This includes information to be trend logged as well as the interval at which the information is to be logged. All points in the system may be logged. All operations shall be password protected. Setup and viewing may be accessed directly from any and all graphics where the point is displayed.

.8 Trending shall include the ability to track energy management aspects including, but not limited to, the following:

.1 Daily use

.2 Monthly use

.3 Daily Hi and Low

.4 Monthly Hi and Low

.5 Demand Limiting and Load Shedding Program

.6 Run time accumulation for any specified equipment

.7 After hour use log

.9 The primary input sensor for all control loops must connect to the same panel containing the control loop output.

.10 Trend data storage must be in the same panel as the hardware or logical points being trended.

1.9 ALARMS

.1 The BAS shall be configured to 3 categories: notifications, urgent alarms and critical alarms with different priorities.

.2 Notification alarms will reside on BAS interface only. Urgent and critical alarms will email out to addresses specified by *Owner*. Please consult with *Owner* to develop alarm strategy.

.1 Example email message

Medium : 380 Bayview BAS YR_BYV_GEN_ST (602211.BI1) Normal -> Alarm change-of-state -------- 380 Bayview Ave., generator is running, possibly loss of power. Time@ 2021-02-10 07:21:44

.3 The BAS will be configured to *Provide* for remote alarm capabilities.

.4 Alarms shall be capable of being routed to The *Region*'s IT server so that they can be sent to Operator's email addresses.

.5 The operator workstation shall provided with audible, visual and printed means of alarm indication. The Alarm Dialog box shall always become the Top Dialog box regardless of the application(s) being run at the time (such as a word processor). A printout of all alarms shall be sent to the assigned terminal and port.

.6 *Provide* a log of alarm messages. The alarm log shall be archived to the hard drive of the operator workstation. Each entry shall include a point descriptor and address, time and date of alarm occurrence, point value at the time of alarm, time and date of point return to normal condition and time and date of alarm acknowledge.

.7 The Controls *Contractor* shall work with the *Region* to determine the alarms unless specified otherwise.

.8 Alarm messages shall be in plain English and shall be user definable on site or via remote communication.

1.10 FIELD DEVICES

.1 Automatic Control Valves

.1 Valves used for throttling applications shall have a linear percentage-to-flow characteristic.

.2 Ball valves are the preferred valve type for zone and HVAC control valves. Globe and butterfly valves shall be used where required to *Provide* the desired pressure drop and CV.

.3 Automatic Control valves shall be manufactured by Belimo.

.2 Control Valve Actuators

.1 Size control valve actuators to *Provide* a tight close off against system head pressures and pressure differentials.

.2 Valve actuators shall accept a 0-10VDC control voltage for all proportional applications.

.3 Floating point control of valves is not acceptable under any circumstances.

.4 Heating valves shall spring-return fail open and cooling valves shall spring-return fail closed. Non-spring-return control valves may be used for terminal reheat coils and large HVAC control valves requiring a higher close off pressure.

.3 Damper Actuators

.1 Actuators shall be direct coupled for either modulating or two position control. Actuators shall be powered by an overload-proof synchronous motor. *Provide* 0-10 VDC control voltage for all proportional applications and either line or low voltage actuators for all two position applications.

.2 Damper actuators are to be manufactured by Belimo or approved equal.

.4 Automatic Control Dampers

.1 Motorized control dampers, unless otherwise specified elsewhere, shall be as follows:

.1 Control dampers shall be parallel or opposed blade type as below or as scheduled on drawings

.1 Outdoor and/or return air mixing dampers and face and bypass (F&BP) dampers shall be parallel blade, arranged to direct airstreams toward each other.

.2 Other modulating dampers shall be the opposed blade type.

.3 Two-position shutoff dampers may be parallel or opposed blade type with blade and side seals.

.2 Extruded aluminum damper frame and airfoil blades, EPDM blade gaskets, TPR thermoplastic frame seals, celcon/polycarbonate bearings. Blades are to be suitable for medium velocity performance (10 m/s [2000 fpm]).

.3 Two-position dampers for shutoff service to must be “flanged-to-duct” type, such that there is no reduction in duct cross section through the damper. Dampers may only be “installed-in-duct”type where indicated as such on drawings.

.4 Individual damper sections shall not be larger than 125 cm × 150 cm (48 in. × 60 in.).

.5 Exterior Dampers (intake and exhaust applications) to be Tamco Series 9000 or approved equal insulated dampers and thermally broken frame and leakage Class 1A type at 0.25 kPa (1 in w.g.) static pressure differential with silicon blade and frame seals. Blades are internally insulated with foam and thermally broken with an insulating factor of R-2.29.

.2 All automatic control dampers not furnished with packaged equipment shall be supplied by the controls subcontractor and installed by the sheet metal subcontractor (except for VAV Boxes or line voltage dampers which shall be supplied by the Mechanical *Contractor*).

.5 Room Sensors/Thermostats

.1 Office: Temp Display, Set point Display, Set point Adjust, Schedule Override, High and Low Limit on set points.

.2 All areas except offices: Set point Adjust, Schedule Override, High and Low Limit on set points.

.3 Mount sensors at a height of 1200 mm above finish floor unless otherwise indicated. Confirm exact location and mounting height with architect or *Owner* prior to final installation.

.4 Mount thermostats and space sensors as noted on the drawing. Do not mount on outside walls without permission of consultant.

.5 Thermostats (or with programming through the BAS) shall allow for deadbands of at least 3°C.

.6 Current Switches (Digital)

.1 *Provide* BAS status for fan and pump motors using a mosfet type digital switch. Acceptable manufactures are ACI, Enercorp, Greystone, Veris and Elkor.

.2 All CTs should have a range close to 2 times of rated reading.

.7 Pressure Transmitters

.1 Technical Performance - Solid State design, operating on capacitance principle, with non-interactive fine resolution, zero and span adjustments. End-to-end accuracy +/- 2% of full scale pressure range, including temperature compensation. 4-20mA, 0-5 VDC output, or 0-10 VDC output.

.2 Standard of Acceptance – ACI, Enercorp, Greystone, Modus.

.8 Duct Temperature Sensor

.1 Probe - Technical Performance – 10 k ohm thermistor sensor encapsulated in a 200mm long, 6mm OD copper or stainless stell probe. Operating range 0-60 degrees C. End-to-end accuracy +/- 0.3 degC. Assembly complete with wiring housing and mounting flange.

.2 Averaging - Technical Performance - 10 k ohm thermistor constructed of FT6 plenum rated cable or soft copper tubing, incorporating numerous temperature sensors encapsulated at equal distances along the length of the element. The assembly acts as a single sensor reporting the average temperature from all individual sensors. End- to-end accuracy +/- 0.3°C. Assembly complete with wiring housing and mounting flange. Mount in a zig-zag manner to *Provide* continuous coverage of the entire duct cross-sectional area.

.9 Outdoor Air Temperature Sensor

.1 Two outdoor air temperature sensors shall be installed and shall be programmed to check each other for accuracy. In the event of sensor failure the sensor deemed to be acccurate shall be used to control the systems. The outdoor air sensors shall be located on a north wall if possible and a minimum of three (3) feet from any opening in the building envelope which could affect the sensor readings. The back face of the sensor enclosure shall be insulated to prevent temperature pick up from the building wall.

.2 Technical Performance, 10 k ohm thermistor -50oC to 50oC in a weatherproof enclosure mounted on north exposure. End accuracy of +/- 0.3 °C over the entire operating range.

.10 Pipe Temperature Sensor

.1 Well - Technical Performance - 10k ohm thermistor sensor encapsulated in a 6mm OD, 50mm long probe, with screw fitting for insertion into a standard thermowell. Operating range -10 - +100°C. End-to-end accuracy +/- 0.3°C over the entire operating range. Complete with brass thermowell. Use heat transfer paste when mounting the sensor in thermowell. No surface mount strap on temperature sensors shall be used to monitor fluid temperature unless approved by the engineer.

.11 CO2 Detector

.1 Technical Performance – Infrared CO2 monitor c/w 4-20mA or 0-5 VDC output, accuracy of +/- 40 ppm +3% reading.

.2 Standard of Acceptance – ACI-CO2-D or Telaire duct mount.

1.11 SECURITY SYSTEM MONITORING TO BAS

.1 *Provide* digital input from security system.

.2 All outside lighting control shuts off 20 minutes after building alarm system is armed.

.3 When building security armed, all HVAC system shall be changed to unoccupied mode immediately when armed regardless of scheduled times.

.4 All critical alarms as determined by York *Region*.

1.12 ENCLOSURE

.1 The BAS control and power supply cabinets shall conform with the following:

.1 Panel enclosures shall be a locking type, metal cabinet, with common keying.

.2 CSA certified 150359 and UL listed E109310.

.3 16 or 14 gauge steel.

.4 Slip hinges enabling door removal for easier access and mounting. Door shall be lockable.

.5 1/4 turn keyed latch standardized to G549 keyset.

.6 14 or 12 gauge galvanized steel panel on collar studs natural finish.

.7 Grounding stud on inner cover surface.

.8 Grounding hole on mounting panel with grounding screw.

.9 ANSI/ASA61 grey polyester - epoxy textured powder coating inside out.

.10 3" deep wire duct shall be installed to neatly conceal controller wiring.

.11 Power supply cabinets shall be provided with a ESA Field Evaluation approval.

.12 2-100VA 120/24 Transformers Class II UL5085-3.

.13 Over Current Protection by Circuit Breaker.

.14 Outlet Receptacle for Service Laptop Power.

1.13 BAS DATABASE NAMING CONVENTIONS & PROGRAMS

.1 All BAS programs shall follow the equipment manufacturer’s sequence recommendations.

.2 All BAS programs should include comments embedded in the program to describe the function and steps of the coding.

.3 All BAS programs shall be created in each panel in logical order as determined by the equipment being controlled by each panel on the network.

.4 All programs and program code is to follow proper coding practices including internal comments to describe the function of the statements and also ensure the source code is formatted in a consistent and logical manner. Programming coding should be kept as simple as possible.

.5 System Schedules shall be submitted for approval and will include global and local scheduling.

.6 The Outdoor Air Temperature Program shall be in its own program named OAT PG.

.7 Network Status Panel Naming Conventions should indicate the building, panel location and panel number. The building name can be abbreviated as necessary to fit in the space.

1.14 GRAPHIC DISPLAY SCREENS

.1 All Graphic Display Screens shall have the following common elements and functions regardless of system manufacturer. Every site shall have a graphic display screen for *Site* Graphic, System Architecture, each air handler, boilers, emergency generator, lighting, exhaust fans, heat reclaim, and for each room controlled by the BAS system.

.2 All operator accessible points shall be yellow text and all information points shall be blue.

.3 Trending shall be accessible from the graphics screens for each point. Each point shall have its associated trend capability accessible from the graphic via an icon located beside the point name on the graphic page.

.4 Appendix A at the end of this document shows examples of typical graphic screens. These are examples only. Graphics shall comply with the following specific screen content. Not all equipment and systems are listed below but the format will be the same for other equipment:

.5 Graphic Screens General All Screens

.1 Navigation buttons to each major system in the building which indicate current screen display by a change in button colour

.2 Background colour shall be black

.3 Outdoor air temperature shall be displayed on every graphic screen

.6 *Site* Graphic

.1 The York *Region* Logo on the site or opening graphic screen

.2 Artist concept or scanned in picture of the front of the building

.3 Access links to all global schedules or specific screens affecting entire building operation

.4 Access buttons links to Set Time, Holiday Schedule, Schedule, Alarms, Points on Manual

.7 System Architecture

.1 Control panel layout and network architecture

.2 Indicating BAS panels and panel type(model)

.3 Panel locations room number text on screen

.4 Systems controlled by each panel

.5 Links to points list accessible from each panel

.8 Architecture Panel Layout (Locations on Floor Plans)

.1 Locations of each panel on each floor plan level

.2 Panel types indicated by different icon

.3 Controls transformers locations

.4 Main network wiring and sub-network wiring layout

.9 Floor Plans graphics

.1 Room numbers accurate as per room signage

.2 Mechanical rooms locations & signage tags

.3 Space temperatures for every temperature on each floor in appropriate room

.4 Space focus pick area for individual room control where applicable shall be yellow text

.5 Air Handler symbols indicating areas of the floor plan serviced by each air handler by a corresponding colour

.6 Status of Air Handler by colour change Red for off status, or text indication

.7 Supply air temperature for each air handler

.10 AHU / Fan Coil graphic

.1 Accurate representation of the AHU / Fan Coil design

.2 All associated control points to be displayed

.3 All points to be monitored for automatic mode and shall be displayed when in Manual mode

.4 A calculated percentage of fresh air shall be indicated on the AHU / Fan Coil graphic

.5 Operator offset adjustment of the supply air setpoint, adjustable directly form the graphic

.6 AHU / Fan Coil physical location shall be indicated on the graphic

.7 Weekly occupied time of day schedule for the associated AHU / Fan Coil shall be accessible directly from the graphic by selecting an icon

.8 Trend logs shall be accessible directly form the graphic by selecting an icon

.11 Water Heater graphic

.1 Water heater graphic piping layout shall be accurate as per piping layout

.2 All associated control points for the water heating system to be displayed

.3 Operator offset adjustment of the scheduled water setpoint, adjustable directly form the graphic

.4 Status shall be indicated graphically

.5 Operator offset editable directly from the graphic screen

.6 Weekly time of day schedule for the building occupied schedule shall be accessible directly from the graphic by selecting an icon

.7 Trend logs shall be accessible directly from the graphic by selecting an icon

.12 Exhaust fans graphic

.1 Exhaust fans control shall be editable directly from the graphic

.2 Exhaust fan status shall be indicated in text and a change in the exhaust fan icon

.3 Exhaust fan physical location shall be indicated on the graphic

.4 Area of the building being exhausted shall be indicated on the graphic

.13 ERV graphic

.1 ERV control shall be editable directly from the graphic

.2 ERV status (normal/boost/off) shall be indicated in text and a change in the icon.

1.15 INSTALLATION

.1 All wiring line and low voltage shall be installed in EMT conduit unless specifically specified otherwise.

.2 All wiring shall be in accordance with the Ontario Electrical Code and any applicable local codes. All BAS wiring shall be installed in conduit unless otherwise allowed by the Ontario Electrical Code or applicable local codes. Where BAS plenum-rated cable wiring is allowed, it shall be run parallel to, or at right angles to, the structure, properly supported and installed in a neat and workmanlike manner. BAS wiring that runs in exposed ceiling spaces (eg garages, mechanical rooms) shall be installed in conduit.

.3 In accessible ceilings, wiring from BAS controllers to sensors and actuators, control system network and low voltage wiring only may be installed with plenum-rated yellow jacket cable.

.4 BX or flex conduit may only be used for the final (approximately one meter) run to controls devices, where the controls equipment is mounted on vibrating machinery.

.5 Install EMT and cable at right angles to building lines, securely fastened, and in accordance with the standards set out in Division 16.

.6 No wire smaller than 18 gauge is to be used on the project except for: wiring between terminal computer devices, wire in standard communication cables, such as printers and short haul modems, wire used in communication networks, i.e. any cable transferring digital data, using twisted shielded pairs.

.7 All field wiring including sensor wiring and wiring from panels to devices shall be continuous. The use of wire connectors, wire nuts or splicing is not allowed.

.8 *Provide* wells for all specified temperature sensors in hydronic piping system. Strap-on sensors may be only be used where a well installation is not possible. Obtain approval of Engineer for the use of any strap-on sensors.

.9 Power for control system shall not be obtained by tapping into miscellaneous circuits that could be inadvertently be switched off.

.10 Mount transformers and other peripheral equipment in panels located in serviceable areas. *Provide* line side breakers/fuses for all transformers.

.11 All 120 VAC power for any controls equipment shall be from dedicated circuits. *Provide* a breaker lock for each breaker used to supply the control system. Update the panel circuit directory.

.12 The controller may be powered from the equipment that it is directly controlling (i.e. heat pump, roof-top unit) only if the controller controls no other equipment and the power supply to the controller remains energized independently of unit operation or status. If power for the control system is taken from the equipment it serves, it should be clearly marked “Powered from Equipment”.

.13 All BAS control wiring shall be yellow jacket for identification purposes. BAS control inputs wiring shall be one colour, output should be another, and communication wires another.

.14 The breaker or power isolation location shall be clearly marked on the inside door of each BAS panel enclosure.

.15 Wiring in ceiling spaces to be installed clear of ceiling tiles and lights to allow access and removal of tiles and lights.

.16 *Contractor* shall prepare a wiring mock-up of a typical system/device/main panel to demonstrate quality and workmanship for approval by the *Region*. This approved mock-up quality shall be maintained throughout the entire installation. System requiring mock-up to be discussed with the *Region*’s *Project* Manager.

.17 All wiring shall be routed orthogonally and drops shall have additional wiring coiled in ceilings to facilitate future sensor relocation.

.18 Wiring in ceiling spaces to be secured/tied every 48” minimum.

.19 Surge suppression shall comply, as a minimum, with the manufacturer’s requirements.

.20 All equipment including controllers shall be grounded.

.21 All end-of-wire connectors shall be certified.

.22 All components shall be labelled and detailed in manuals.

.23 All wiring systems shall be colour coded to simplify maintenance.

.24 All equipment shall be located for ease of service access.

.25 *Contractor* shall maintain a list of deficiencies when close to completion, and shall update this list on a regular basis for review by the *Owner's* representative.

.26 If the project is a retrofit of an existing system:

.1 *Contractor* shall remove all old redundant wiring following system verification

.2 Re-use of existing wiring is not allowed. Run continuous new wiring

.3 Re-use of components (eg enclosures, transformers) is not allowed unless approved by the *Region*'s *Project* Manager

1.16 EQUIPMENT LOCATION

.1 All distributed equipment such as VAV boxes, Roof top units, unit ventilators, fan coil units, etc. that utilize dedicated BAS controllers, shall have locally mounted controllers, in accessible locations within the building envelope. All locally mounted controllers shall be installed in enclosures suitable for that location. BAS controllers for mechanical equipment other than those listed above shall be mounted in mechanical rooms as noted below, unless specifically approved by the Engineer for this project.

.2 All other BAS controllers, and interface devices that require regular inspection or that serve multiple HVAC systems shall be located in mechanical rooms, or in pre-approved storage rooms, or janitor closets.

.3 No BAS panel shall be located inside the rooftop fan enclosure under any circumstances. All BAS panels shall be located within the building envelope, and shall be enclosed in a metal locking enclosure, as specified in 16.4.

.4 All equipment located in mechanical rooms, storage rooms or janitor closets shall be installed in metal cabinets with hinged, lockable covers.

.5 Transformers or power supplies shall not be located in ceiling spaces unless approved by the engineer for terminal control valves, actuators or zone controllers. When transformers are installed above ceilings, transformers shall be installed in metal enclosures, and the location shall be clearly labeled on the t-bar ceiling to indicate power transformer location.

.6 A 120 VAC duplex receptacle for laptop power shall be provided if the cabinet is located further than 5' laterally from the nearest outlet.

1.17 IDENTIFICATION AND LABELLING EQUIPMENT

.1 All panels must have a lamacoid tag (min. 3"x1") affixed to the front face indicating panel designation and function (i.e. "BAS Panel 1" or "Relay Panel 3").

.2 All field sensors or devices must have a lamacoid tag (min. 3"x1") attached with tie-wrap or adhesive indicating the point software name and hardware address (i.e. F-1_MAT, 2.IP4).

.3 Room sensors and other sensors in finished areas will require a device tag.

.4 All devices within a field enclosure will be identified via a label or tag.

.5 All BAS panel power sources must be identified by an adhesive label indicating the source power panel designation and circuit number on the outside of the enclosure door (i.e. "120vac fed from LP-2A cct #1).

.6 All field equipment panels fed from more than one power source must have a warning label on the front cover.

.7 All wires will be identified with self-adhesive wire labels or clip-on plastic wire markers at both ends.

.8 All rotating equipment controlled by the BAS will have a tag or label affixed indicating that the equipment may start without warning.

.9 All BAS panels will have a points list sheet (within a plastic sleeve) attached to the inside door. The points list will identify the following for each point: Panel number, panel location, hardware address, software name, point description, field device type, point type (i.e. AI or DO), device fail position, device manufacturer and model number or reference and wire tag reference.

.10 Where required, field panels will have wiring diagrams attached to the inside door.

.11 *Provide* new or modify existing equipment wiring diagrams (i.e. boilers, chillers, etc.) wherever the BAS interfaces to other equipment.

1.18 COMMISSIONING

.1 Perform all necessary calibration, testing and de-bugging and perform all required operational checks to ensure that the system is functioning.

.2 Upon completion of the performance tests, repeat these tests, point-by-point in the presence of the *Owner's* representative, as required. Properly schedule these tests so that testing is completed by the time directed by the *Owner's* representative.

.3 Confirm and demonstrate to the Engineer and the *Owner's* agent that all systems are programmed and operating correctly. When project is complete the contract shall allow sufficient programming time in order to customize the sequences to meet operational needs, fine tuning of the system and other duties as required. The *Owner* shall determine the schedule.

.4 Submit a copy of the system commissioning report to the Engineer for review and approval.

.5 Each analogue input (i.e. temperatures, pressure, etc.) shall be verified with an approved calibration device. All actual temperature readings should be with +/- 1°C of the readings observed at the workstation.

.6 Each analogue output shall be verified by manually commanding the output channel from the operator workstation to two or more positions within the 0-100% range and verifying the actual position of the actuator or device. All devices shall operate over their entire 0-100% range from a minimum control range of 10-90%.

.7 Digital outputs shall be verified by witnessing the actual start/stop operation of the equipment under control.

.8 Digital inputs shall be verified by observing the status of the input point as the equipment is manually cycled on and off.

.9 Record all out-of-season or unverified points in the commissioning report as "uncommissioned".

.10 The BAS field panel power source shall be toggled on and off to ensure reboot functionality and power down memory retention of all parameters. During the power down test, all connected system components should go to their fail-safe state.

.11 All trends should be reviewed to ensure that setpoints are being maintained and excessive cycling of equipment is not occurring.

.12 Control loop tuning parameters can be verified by applying a change to the current setpoint and observing the resulting trend log. Setpoint should be reached in a “reasonable” period of time without excessive cycling or hunting of the controlled device.

1.19 TRAINING

.1 Once 5 consecutive Days of alarm-free operation are complete and documented, operator training may begin.

.2 *Provide* 1 day of instruction to the *Owner's* designated personnel on the operation of the BAS and describe its intended use with respect to the programmed functions. Operator orientation of the BAS shall include, but not be limited to, the overall operation program, equipment functions (both individually and as part of the total integrated system), commands, systems generation, advisories, and appropriate operator intervention required in responding to the system's operation.

1.20 WARRANTY

.1 Warranty all components supplied under this contract for a period of two years from substantial completion. Replace all controls equipment that fails during this period without cost to the owner.

.2 All Controllers shall have a 5 year manufacturer’s warranty.

1.21 AS-BUILT DOCUMENTATION

.1 Within two weeks following substantial completion of the project, update the original submittal documents to reflect the "As Built" conditions of the project and submit four copies as required by the consultant and/or the *Project* Manager.

.2 *Provide* a separate laminated copy of the control drawings for mounting in the mechanical room or in the controls panels.

.3 *Provide* final point lists, shop drawings and all installed equipment data and operations sheets.

.4 Submit USB drive containing up to date copies of the programs in each controller. *Provide* original program disks and documentation proving registration for all software programs provided as a part of this contract including: the BAS operator interface software, and the BAS graphics (bitmap files). *Provide* one set of original disks for every computer supplied under this contract or that the software has been loaded onto.

.5 Submit (4) printed copies of the final programs that include all point definitions, weekly and annual schedule setting, controller setpoints and tuning parameters, and documented programmed sequences of operation.

1.22 CONTROL POINTS AND POINT LIST

.1 A typical points list for system control and monitoring shall be used as a guide for system design.

.2 This points list is not intended to be complete. It is intended to be a typical list to capture all foreseeable equipment types. *Project* specific points list must be created on a project- by-project basis by the BAS contractor and shall be reviewed by York *Region*.

.3 York *Region* staff shall be consulted to develop the sequence of operations. York *Region* will *Provide* the BACnet address range for each building.

.4 All control points shall have built in time delays to prevent short cycling.

.5 Point Naming conventions shall be submitted for review by York *Region Project* team. Names may be changed to comply with the Regions naming conventions.

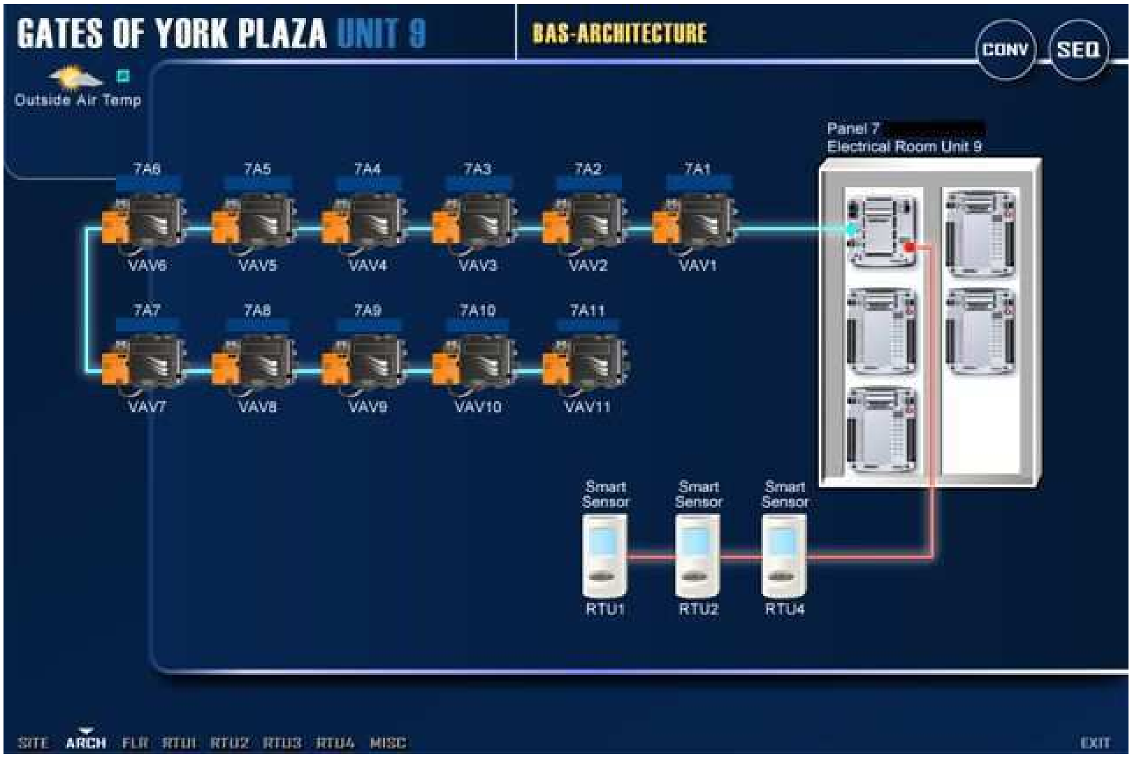
PART 2 PRODUCTS

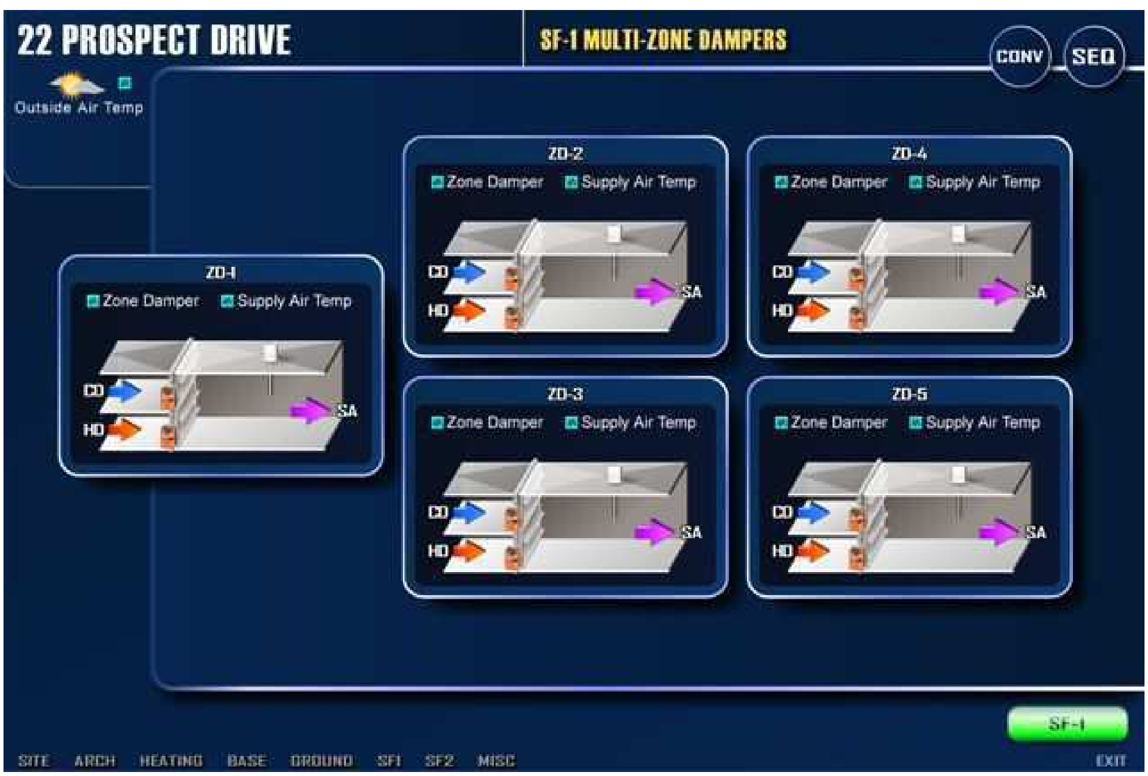
NOT USED

PART 3 EXECUTION

NOT USED.

Appendix A – Typical Graphic Screens






GATES OF YORK PLAZA UNIT 5
NORTH VESTIBULE
CONV
SEQ
Outside Air Temp
Force Flow
ZONE SENSOR
Zone Temp
Occupied Setpoint
Unoccupied Setpoint
SCHEDULE
Weekly
Annual
FLOORPLAN
EXIT


GATES OF YORK PLAZA UNIT 5
FLOORPLAN
CONV
SEQ
Outside Air Temp
EE-Services Team
EE Manager
Vestibule
Reception
RTU2
HPMS Team
Business Centre
Storage
Mail
Enclave
Meeting Room
RTU3
Health & Safety
RTU1
HS Manager
Health & Disability
Office Corporate Learning
Storage Storage
Office Compensation
Kitchenette
Women's Washroom
Men's Washroom
Janitor
Electrical Room
Director
Sprinkler Room
SITE ARCH FLR RTU1 RTU2 RTU3 MISC
EXIT


22 PROSPECT DRIVE
MISCELLANEOUS
CONV
SEQ
Outside Air Temp
DHW PUMP
Stat
Ctrl
SANITARY EF2
Stat
Ctrl
SANITARY EF3
Stat
Ctrl
SITE
ARCH
HEATING
BASE
GROUND
SF1
SF2
MISC
EXIT


GATES OF YORK PLAZA UNIT 9
RTU1
CONV
SEQ
Outside Air Temp
Min. Position
Damper Control
Mixed Temp
OA
Return Temp
Supply Temp
DX COOLING
Stage 1
Stage 2
SUPPLY FAN
Status
Control
GAS HEATING
Stage 1
Stage 2
RA
SA
ZONE TEMP
OCCUPIED SP
SCHEDULES
Fan
High Occ
Annual
Override Timer
Unoccupied Setpoint
SITE
ARCH
FLR
RTU1
RTU2
RTU3
RTU4
MISC
EXIT

END OF SECTION

PART 1 GENERAL

1.1 GENERAL REQUIREMENTS

.1 Read and be governed by conditions of the *Contract Documents,* including sections of Division 01.

.2 Section includes

- .1 Sequence of operation:
  - .1 VRF fan coil units and Air-Source Heat Pump (ASHP)
  - .2 ERV
  - .3 Fresh Air Heater
  - .4 Humidification
  - .5 IT Room Air Conditioning
  - .6 Medical Storage Room
  - .7 Vehicle Bay Ceiling Fan
  - .8 Vehicle Bay Overhead Doors
  - .9 Vehicle Bay Exhaust Fan EF-2
  - .10 CO/NOX Ventilation System for Vehicle Bay
  - .11 Vestibule Heater
  - .12 Mechanical Room Heater
  - .13 Generator Delay
  - .14 Domestic Hot Water System
  - .15 Trending

PART 2 PRODUCTS

.1 VRF fan coil units and Air-Source Heat Pump (ASHP)

- .1 The VRF fan coil units will operate in either heating or cooling mode (simultaneous heating and cooling not available) through a programmable thermostat to maintain room temperature at set point.
- .2 In the mechanical room, the wall-mounted fan coil unit will serve as the first stage of heating and the first stage of cooling. If there is inadequate heating (due to extreme low temperatures leading to condenser unit lockout, or exterior door left open) the second stage of heating by electric unit heat kit will be activated and the BAS will alert the operator. Fan coil unit and electric unit heater is controlled by BAS.
- .3 FCU-1.1 serves the write-up room, medical storage and washrooms. The fan coil unit will heat or cool based on the temperature reading from the fan coil controller located in the Write-up room. The BAS will receive the temperature reading through the fan coil's BAS communication device (Intesis Box).
- .4 FCU-1.2 serves the Kitchen/Dining/Crew room 104 (Crew Lounge), and will heat or cool based on the temperature reading from the fan coil controller located in that space. The BAS will receive the temperature reading through the fan coil's BAS communication device (Intesis Box).

.5 BAS to control temperature setpoint within range with local area control with high limit lockouts. Current temperature and setpoints viewable in BAS by operator.

.6 Thermostats to be supplied and installed by the mechanical contractor. Thermostats shall have deadband of at least 3°C.

.7 BAS will monitor the status to generate an alarm if the fan coil units or ASHP condenser unit fail to operate when commanded on.

.8 Fan status, heating/cooling on/off and mode status is available in BAS, viewable by operator.

.2 ERV

.1 It is expected at this point the ERV will run at all times, but not during defrost mode (controlled by ERV), when ventilation to the building cannot be provided. Fans will run with airflows set locally through ERV, so that supply is greater than exhaust airflow rate (positive pressurization). ERV on/off status is available in BAS, viewable by operator.

.2 ERV has local controller ability via a timer switch or humidistat in each washroom to boost supply airflow and exhaust airflow for 15 minutes to exhaust humidity or smells from the washrooms in less time. (This function is not tied to BAS).

.3 Fresh Air Heater

.1 The on/off status of the fresh air heater, after the ERV will be monitored by the BAS, hourly trending recorded.

.2 The discharge air setpoint is provided by the BAS, set at 16°C (operator adjustable).

.4 Humidification

.1 Humidifier is only enabled when FC-1.2 (Crew Lounge) is running during heating season.

.2 Upon call for humidification through humidity sensor located in Crew Lounge, BAS turns on humidifier unit until fan coil turns off or set point of 30% RH (adjustable) is reached. Status on/off is available in BAS, viewable by operator.

.3 If humidity being monitored in Write-Up Room exceeds 50%RH (adjustable), turn off the humidifier.

.5 IT Room Air Conditioning

.1 In winter there are two stages of cooling. The BAS monitors temperature in the space. The first stage of cooling (shoulder or heating season only) is enabled when the temperature reaches 23°C (adjustable through BAS) and uses a transfer fan to blow warm air to the mechanical room. When the temperature reaches 25°C (adjustable through BAS), the second stage of cooling is enabled. The transfer fan turns off and the split air-conditioning unit turns on until the unit has run for at least 10 minutes (adjustable through BAS) and the setpoint to turn cooling off (22°C, adjustable through BAS) is reached. During cooling season, the transfer fan is not used for cooling, only the split air-conditioning unit is used. Trend fan and air-conditioner usage.

.2 If temperature reaches 27°C (adjustable through BAS) the BAS will generate an alarm to alert building operator. Temperature of room is available at BAS, viewable by operator. Status of transfer fan and split AC unit (on/off) is viewable by operator.

.6 Medical Storage Room

.1 The medical storage room has a dedicated modulating damper that will open/close in increments to maintain a relatively stable temperature between 20 to 25°C. The damper shall have the ability to open and close all the way. If the temperature drops below 18°C, turn on furnace heating even if main thermostat (located in Crew Lounge) is satisfied. If the temperature rises above 27°C, turn on furnace cooling even if main thermostat is satisfied. Track through BAS each time the furnace or air-conditioning is turned on to solely serve the medical storage room, the temperature of the medical storage room, and the outdoor air temperature.

.2 If the temperature reaches below 15°C or above 30°C, the BAS shall generate alarm to alert building operator. Temperature of room is available at BAS, viewable by operator.

.7 Vehicle Bay Ceiling Fan

.1 This fan will be operated through local speed controller installed in the apparatus bay.

.2 The operation of the fans shall be disabled when outdoor air temperature is below 12°C (operator adjustable through BAS; limit may be disabled through BAS. Default is for limit to be disabled).

.3 Timer enabled on-function provided so building occupant turns on fan, which automatically shuts off after specified time (default 3 h, operator adjustable). Building occupant may also turn off fan locally.

.8 Vehicle Bay Exhaust Fan EF-2

.1 EF-2 shall run continuously to slightly negatively pressurize the space, and on/off status shall be monitored by BAS, viewable by operator. If the fan ceases to operate, alert the operator, unless the stoppage is due to generator delay.

.9 CO/NOX Ventilation System for Vehicle Bay

.1 CO and NO2 monitoring system shall be controlled by Honeywell model E3 Point. Upon first alarm the monitoring system shall signal the intake air louver damper and exhaust louver dampers to open. Once open, the exhaust fans (EF-1.1 and EF-1.2) will be allowed to run. If gas concentration continues to rise, upon second alarm audible buzzer will sound. Program a 3-minute relay delay-off. Gas alarm concentrations and placement heights below:

	First Alarm	Second Alarm	Sensor Height
Carbon monoxide (CO)	25 ppm	35 ppm	1200 mm AFF
Nitrogen dioxide (NO2)	0.25 ppm	2 ppm	1500 mm AFF

.2 The CO gas concentration upon alarm will be sent to the BAS via 4-20 mA signal for monitoring time and duration of alarm events for record. If the gas detector alarms due to NO2, use output relay to signal BAS and record that alarm was due to NO2 event at that time.

.10 Vestibule Heater

.1 Vestibule temperature and outdoor air temperature shall be monitored by BAS, with alarm sent to operator if temperature drops below 6°C (default, adjustable). The heater will operate to maintain vestibule at heating set point (15°C default, adjustable). If outdoor air is above 7°C (default, adjustable) the heater will not turn on.

.2 BAS will monitor the status to generate an alarm if the heater fails to operate when commanded on. Temperature of room is available at BAS, viewable by operator.

.11 Mechanical Room Heaters

.1 Mechanical room temperature shall be monitored by BAS.

.2 If the heat drops below 14°C (adjustable), the electric heater will operate.

.3 The temperature of the room is provided to the BAS, viewable by operator. An alarm is generated to alert operator when temperature goes below 12°C (adjustable).

.12 Generator Delay

.1 Upon power outage, BAS receives transfer switch signal and immediately disables the following mechanical equipment: humidifier HUM, mechanical room electric heater EUH-1. After 5 seconds of receiving the transfer switch signal, the abovementioned equipment can be enabled again.

.13 Domestic Hot Water System

.1 There is no direct BAS connection available for the heat pump hot water heaters. BAS monitors temperature at domestic hot water tank via temperature sensors at hot water piping outlets. If the water temperature goes below 40°C (105°F) (operator adjustable), then the BAS alerts the operator there is a problem with the corresponding tank, either HPWH-1.1 or HPWH-1.2.

.2 The BAS monitors the outlet temperature after the master thermostatic mixing valve. If that temperature goes over 10°C (operator adjustable) out of range above or over 20°C (operator adjustable) below the thermostatic set point temperature (adjustable by operator), the operator is alerted that there is a problem with the thermostatic mixing valve.

.3 The BAS monitors the recirculation hot water temperature via temperature sensor. If the temperature goes below 32°C (90°F), operator adjustable, the recirculation pump P-DHWR starts and runs until the return temperature reaches at least 43°C (110°F), operator adjustable.

.14 Trending

.1 *Provide* hourly trending of measured temperatures at each thermostat (Crew Lounge, Medical Storage room, Write-Up Room, IT Room, Vehicle Bay, Mechanical room (and relative humidity at Vehicle Bay, Crew Lounge and Write-Up Room).

.2 *Provide* hourly trending of outdoor air temperature.

2.2 RECOMMENDED BASELINE SETPOINTS

Occupied				
	Heating		Cooling	
	Temperature Setpoint	Relative Humidity	Temperature Setpoint	Relative Humidity
Crew Lounge / Living Area	22°C	30	24°C	50
Vehicle Bay	18°C	-	-	-
IT Room Air Conditioning	-	-	22°C	-

Medical Storage Room	20°C	-	25°C	-
Vestibule Heater	15°C	-	-	-
Mechanical Room	15°C	-	35°C	-

PART 3 EXECUTION

NOT USED.

END OF SECTION

PART 1 – GENERAL

1.1 Related Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 Reference Standards

.1 CSA Group
- .1 CSA C22.1-12, Ontario Electrical Safety Code, Part 1 (27th Edition), Safety Standard for Electrical Installations.
- .2 CSA C22.2 No..
- .3 CAN/CSA-C22.3 No.1-10, Overhead Systems.
- .4 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code *Product* Line (NESC)
- .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.3 Definitions

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.4 Action And Informational Submittals

.1 *Product* Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for distribution equipment, lighting, fire alarm, emergency lighting, exit signs, lighting control, security and access control, and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit for review single line electrical diagrams under plexiglass and locate as indicated.
  - .1 Electrical distribution system in main electrical room.
- .3 Submit for review fire alarm riser diagram, plan and zoning of building under plexiglass at fire alarm control panel and annunciator.
- .4 Shop drawings:
  - .1 Submit for review manufacturer's drawings for all products being furnished except cable (up to 1000V) and wire and conduit.
  - .2 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure coordinated installation.
  - .3 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
  - .4 Indicate on drawings clearances for operation, maintenance, and replacement of operating equipment devices.
  - .5 Submit 2 copies of 600 x 600 mm minimum size drawings and product data to

inspection authorities.
.6 If changes are required, notify *Consultant* of these changes before they are made.

.5 Certificates:
.1 *Provide* CSA certified equipment and material.
.2 Where CSA certified equipment and material is not available, submit such equipment and material to inspection authorities for special approval before delivery to site.
.3 Submit test results of installed electrical systems and instrumentation.
.4 Permits and fees: in accordance with General Conditions of contract.
.5 Submit, upon completion of *Work*, load balance report as described in PART 3 - LOAD BALANCE.
.6 Submit certificate of acceptance from authority having jurisdiction upon completion of *Work* to *Consultant*.

.6 Manufacturer's Field Reports: submit to *Consultant* manufacturer's written report, within 3 days of review, verifying compliance of *Work* and electrical system and instrumentation testing, as described in PART 3 - FIELD QUALITY CONTROL.

.7 Sustainable Design Submittals:
.1 Construction Waste Management:
.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.5 Closeout Submittals

.1 Refer to and comply with Division 1.

.2 Operation and Maintenance Data: submit operation and maintenance data for distribution equipment, lighting, fire alarm, emergency lighting, exit signs, lighting control, security and access control, for incorporation into manual.
.1 *Provide* for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
.2 Operating instructions to include following:
.1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
.2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
.3 Safety precautions.
.4 Procedures to be followed in event of equipment failure.
.5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
.3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
.4 Post instructions where directed.
.5 For operating instructions exposed to weather, *Provide* weather-resistant materials or weatherproof enclosures.
.6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

.3 *Provide* As-Built drawings to *Consultant* upon completion of *Contract Work*, prior to Substantial Performance inspection and after final review by Consultants. The submission shall include:

.1 Updated ACAD R2012 drawings
.2 One (1) set of neatly red lined legible prints. The consultant will review the submission and the contractor shall be responsible to address the comments and re-submit the as-built drawings.

1.6 Delivery, Storage And Handling

.1 Refer to, and comply with Division 1. Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirement: 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 electrical equipment from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan.

1.7 Seismic Restraints

.1 Include all costs related to provision of seismic restraints and equipment as required for the electrical equipment and systems. Include the cost of a professional structural engineer licensed in the Province of Ontario to design the seismic restraints for all electrical equipment included in the contract.

PART 2 – PRODUCTS

2.1 Design Requirements

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: *Provide* identification nameplates and labels for control items in English.

2.2 Materials And Equipment

.1 *Provide* material and equipment in accordance with Division 1.

.2 Material and equipment to be CSA certified. Where CSA certified material and equipment is are not available, obtain special approval from inspection authorities before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.3 Factory assemble control panels and component assemblies.

2.3 Electric Motors, Equipment And Controls

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

.2 *Provide* conduit and wiring except for conduit, wiring and connections below 50 V which are related to control systems specified in mechanical sections and as shown on mechanical drawings.

2.4 Warning Signs

.1 Warning Signs: in accordance with requirements of authority having jurisdiction and inspection authorities.

.2 decal signs, minimum size 175 x 250 mm.

2.5 Wiring Terminations

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or aluminum conductors.

2.6 Equipment Identification

.1 Identify electrical equipment with nameplates and labels as follows:
  .1 Nameplates: plastic laminate lamicoid 3 mm thick plastic engraving sheet melamine, black matt white finish face, black white core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
  .2 Sizes as follows:

NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

.3 Wording on nameplates and labels to be approved by *Consultant* prior to manufacture.

.4 Allow for minimum of twenty-five (25) letters per nameplate and label.

.5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.7 Terminal cabinets and pull boxes: indicate system and voltage.

.8 Transformers: indicate capacity, primary and secondary voltages.

2.7 Wiring Identification

.1 Identify wiring with permanent indelible identifying markings, numbered coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.8 Conduit And Cable Identification

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Type	Prime	Auxiliary
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.9 Finishes

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

PART 3 – EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for electrical installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of York *Region* Representative.
  - .2 Inform York *Region* Representative 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 York *Region* Representative.

3.2 Installation

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise.

3.3 Nameplates And Labels

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.4 Conduit And Cable Installation

.1 Install conduit and sleeves prior to pouring of concrete.
  - .1 Sleeves through concrete: schedule 40 steel pipe plastic sheet metal, sized for free passage of conduit, and protruding 50 mm.

.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.5 Location Of Outlets

.1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

.2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.4 Locate light switches on latch side of doors.
  .1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.6 Mounting Heights

.1 Mounting height of equipment is from finished floor to centre line of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.
  .1 Local switches: 1000 mm.
  .2 Wall receptacles:
    .1 General: 400 mm.
    .2 Above top of continuous baseboard heater: 300 mm.
    .3 Above top of counters or counter splash backs: 175 mm.
    .4 In mechanical rooms: 1400 mm.
  .3 Panelboards: as required by Code or as indicated.
  .4 Telephone and interphone outlets: 400 mm.
  .5 Wall mounted telephone and interphone outlets: 1500 mm.
  .6 Fire alarm stations: 1200 mm.
  .7 Fire alarm horns: in accordance with CAN/ULC S524-14.
  .8 Television outlets: 300 mm.
  .9 Wall mounted speakers: 2100 mm.
  .10 Clocks: 2100 mm.
  .11 Door bell pushbuttons: 1000 mm.

3.7 Co-Ordination Of Protective Devices

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.8 Co-Ordination Study

.1 Employ the services of a qualified engineering company to perform a co-ordination and short circuit study of all electrical distribution equipment which is part of the project. Study to start at main disconnect switch and include down to each breaker feeding panelboards.

.2 The company shall have experience in providing co-ordination studies.

.3 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

.4 Co-ordination and short circuit study shall be sealed and signed by a professional engineer licensed in the Province of Ontario.

.5 Approval of the Co-ordination and short circuit Study must be obtained before any shop drawings for service entrance board, switchboards, distribution panels, panel boards, moulded case circuit breakers or disconnects (fused and non-fused) will be reviewed.

3.9 Arc Flash Hazard Assessment

.1 Employ the services of a qualified engineering company to perform a short circuit and an arc flash hazard assessment of all electrical distribution equipment which is part of the project.

.2 The company shall have experience in providing arc flash assessments.

.3 Ensure that equipment identified in the assessment are provided with approved labelling.

.4 Arc Flash Hazard Assessment shall be sealed and signed by a professional engineer licensed in the Province of Ontario.

.5 The selection of electrical equipment including circuit breakers type and setting shall be selected to reduce the FR Clothing Category to 12 cal/cm2 where possible at equipment down stream from each circuit breaker.

.6 Based on the Arc Flash Study, *Provide* labels for equipment in accordance with ANSI Z535.4-2011(R2017).

.7 *Provide* a protection plan in accordance with CSA Z462-18 Workplace Electrical Safety.

3.8 Field Quality Control

.1 Load Balance:
   .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
   .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
   .3 *Provide* upon completion of work, load balance report as directed in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.

.2 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
   .1 Power generation and distribution system including phasing, voltage, grounding and load balancing.
   .2 Circuits originating from branch distribution panels.
   .3 Lighting and its control.
   .4 Motors, heaters and associated control equipment including sequenced operation of systems where applicable.
   .5 Systems: fire alarm, communications, security.
   .6 Insulation resistance testing:
      .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
      .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
      .3 Check resistance to ground before energizing.

.3 Carry out tests in presence of York *Region* Representative.

.4 *Provide* instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.5 Manufacturer's Field Services:
   .1 Obtain written report from manufacturer verifying compliance of *Work*, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
   .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.

3.9 System Startup

.1 Instruct York *Region* Representative and operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 *Provide* these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

3.10 Cleaning

.1 Progress Cleaning:
   .1 Leave *Work* area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
   .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 *Product* Data

.1 *Provide* product data in accordance with Section 01 33 00 - Submittal Procedures.

1.3 Delivery, Storage And Handling

.1 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 – PRODUCTS

2.1 Building Wires

.1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG.

.2 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE or RWU90 XLPE, Non Jacketted.

.3 Copper conductors: size as indicated, with thermoplastic insulation type T90 Nylon rated at 600 V.

2.2 Teck 90 Cable

.1 Cable: in accordance with Section 26 05 00 - Common *Work* Results for Electrical.

.2 Conductors:
- .1 Grounding conductor: copper as indicated.
- .2 Circuit conductors: copper as indicated, size as indicated.

.3 Insulation:
- .1 Ethylene propylene rubber EP.
- .2 Cross-linked polyethylene XLPE.
- .3 Rating:, 600 V.

.4 Inner jacket: polyvinyl chloride material.

.5 Armour: flat interlocking galvanized steel .

.6 Overall covering: thermoplastic polyvinyl chloride, compliant to applicable Building Code classification for this project.

.7 Fastenings:

.1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
.2 Channel type supports for two or more cables at 1000mm centers.
.3 Threaded rods: 6 mm diameter to support suspended channels.

.8 Connectors:
.1 Watertight, explosion-proof approved for TECK cable.

2.3 Armoured Cables

.1 Conductors: insulated, copper, size as indicated.

.2 Type: AC90.

.3 Armour: interlocking type fabricated from aluminum strip.

.4 Type: ACWU90 PVC flame retardant jacket over thermoplastic armour and compliant to applicable Building Code classification for this project wet locations.

.5 Connectors: anti short connectors.

3 EXECUTION

3.1 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00 - Common *Work* Results for Electrical.

.2 Perform tests using method appropriate to site conditions and to approval of York *Region* Representative and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

3.2 General Cable Installation

.1 Cable Colour Coding: to Section 26 05 00 - Common *Work* Results for Electrical.

.2 Conductor length for parallel feeders to be identical.

.3 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.4 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.

.5 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.

.6 *Provide* numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 Installation Of Building Wires

.1 Install wiring as follows:
  .1 In conduit systems in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.
  .2 In underground ducts in accordance with Section 26 05 43.01.

3.4 Installation Of Teck90 Cable (0 -1000 V)

.1 Group cables wherever possible on channels.

.2 Install cable exposed , securely supported by straps or hangers.

3.5 Installation Of Armoured Cables

.1 Group cables wherever possible on channels.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 Action And Informational Submittals

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

.2 *Product* Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Sustainable Design Submittals:
- .1 Construction Waste Management:
  - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.3 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 hangers and supports from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to *Work* of this Section.

.5 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 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 Support Channels

.1 U shape, size 41 x 41 mm, 2.5 mm thick, surface mounted suspended set in poured concrete walls and ceilings.

PART 3 – EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for hangers and supports installation in accordance with manufacturer's written instructions.
  .1 Visually inspect substrate in presence of York *Region* Representative.
  .2 Inform York *Region* Representative 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 York *Region* Representative.

3.2 Installation

.1 Secure equipment to hollow solid masonry, tile and plaster surfaces with lead anchors or nylon shields.

.2 Secure equipment to poured concrete with expandable inserts.

.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

.4 Secure surface mounted equipment with twist clip fasteners to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.
  .1 One-hole steel straps to secure surface conduits and cables 50 mm and smaller.
  .2 Two-hole steel straps for conduits and cables larger than 50 mm.
  .3 Beam clamps to secure conduit to exposed steel work.

.7 Suspended support systems.
  .1 Support individual cable or conduit runs with 6 mm diameter threaded rods and spring clips.
  .2 Support 2 or more cables or conduits on channels supported by 6 mm diameter threaded rod hangers where direct fastening to building construction is impractical.

.8 For surface mounting of two or more conduits use channels at 1000mm on centre spacing.

.9 *Provide* metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.11 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of York *Region* Representative.

.13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

3.3 Cleaning

.1 Progress Cleaning:
  .1 Leave *Work* area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 Reference Standards

.1 CSA Group (CSA)
  .1 CSA C22.1-18, Canadian Electrical Code, Part 1, 24th Edition.
  .2 Ontario Electrical Safety Code, 27th Edition and all Bulletins

1.3 Action And Informational Submittals

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

.2 *Product* Data:
  .1 *Provide* manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 *Provide* shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
  .1 Submit shop drawings.

1.4 Delivery, Storage And Handling

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

PART 2 – PRODUCTS

2.1 Splitters

.1 Construction: sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Terminations: main and branch lugs connection blocks to match required size and number of incoming and outgoing conductors as indicated.

.3 Spare Terminals: minimum three spare terminals or lugs on each connection or lug block sized less than 400 A.

2.2 Junction And Pull Boxes

.1 Construction: welded steel enclosure.

.2 Covers Flush Mounted: 25 mm minimum extension all around.

.3 Covers Surface Mounted: screw-on flat turned edge covers.

2.3 Cabinets

.1 Construction: welded sheet steel hinged door, handle, latch lock 2 keys and catch

.2 Type E Empty: flush overlapping sides mounting as indicated.

.3 Type T Terminal: flush overlapping sides mounting as indicated containing 19 mm G1S fir plywood backboard.

PART 3 – EXECUTION

3.1 Splitter Installation

.1 Mount plumb, true and square to building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 Junction, Pull Boxes And Cabinets Installation

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m above finished floor except where indicated otherwise.

.3 Install terminal block as indicated in Type T cabinets.

.4 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.3 Identification

.1 Equipment Identification: to Section 26 05 00- Common *Work* Results for Electrical.

.2 Identification Labels: size 2 indicating system name voltage and phase or as indicated.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 Reference Standards

.1 CSA Group (CSA)
  - .1 CSA C22.1-18, Canadian Electrical Code, Part 1, 24th Edition.
  - .2 Ontario Electrical Safety Code, 27th Edition and all Bulletins.

1.3 Action And Informational Submittals

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

.2 Submit samples for floor box in accordance with Section 01 33 00 - Submittal Procedures .

1.4 Delivery, Storage And Handling

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

PART 2 – PRODUCTS

2.1 Outlet And Conduit Boxes General

.1 Size boxes in accordance with CSA C22.1.

.2 102 mm square or larger outlet boxes as required.

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.2 Galvanized Steel Outlet Boxes

.1 One-piece electro-galvanized construction.

.2 Single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.3 Utility boxes for outlets connected to surface-mounted EMT conduit, minimum size 102 x

54 x 48 mm.

.4 102 mm square or octagonal outlet boxes for lighting fixture outlets.

.5 Extension and plaster rings for flush mounting devices in finished plaster tile walls.

2.3 Masonry Boxes

.1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 Concrete Boxes

.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 Conduit Boxes

.1 Cast FS or FD aluminum boxes with factory-threaded hubs and mounting feet for surface wiring of devices.

2.6 Fittings - General

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 35mm and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

PART 3 - EXECUTION

3.1 Installation

.1 Support boxes independently of connecting conduits.

.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.

.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.

.4 *Provide* correct size of openings in boxes for conduit and armoured cable connections. Do not install reducing washers.

.5 Vacuum clean interior of outlet boxes before installation of wiring devices.

.6 Identify systems for outlet boxes as required.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 Reference Standards

.1 CSA Group (CSA)
  .1 CAN/CSA C22.2 No. 18-98(R2003), Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware, A National Standard of Canada.
  .2 CSA C22.2 No. 45-M1981(R2003), Rigid Metal Conduit.
  .3 CSA C22.2 No. 56-04, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
  .4 CSA C22.2 No. 83-M1985(R2003), Electrical Metallic Tubing.
  .5 CSA C22.2 No. 211.2-M1984(R2003), Rigid PVC (Unplasticized) Conduit.
  .6 CAN/CSA C22.2 No. 227.3-05, Nonmetallic Mechanical Protection Tubing (NMPT), A National Standard of Canada (February 2006).

1.3 Action And Informational Submittals

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

.2 *Product* data: submit manufacturer's printed product literature, specifications and datasheets.
  .1 Submit cable manufacturing data.

.3 Quality assurance submittals:
  .1 Test reports: submit certified test reports.
  .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
  .3 Instructions: submit manufacturer's installation instructions.

1.4 Waste Management And Disposal

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

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

PART 2 – PRODUCTS

2.1 Cables And Reels

.1 *Provide* cables on reels or coils.
  .1 Mark or tag each cable and outside of each reel or coil, to indicate cable length, voltage rating, conductor size, and manufacturer's lot number and reel number.

.2 Each coil or reel of cable to contain only one continuous cable without splices.

.3 Identify cables for exclusively dc applications.

.4 Reel and mark shielded cables rated 2,001 volts and above.

2.2 Conduits

.1 Rigid metal conduit: to CSA C22.2 No. 45, galvanized steel

.2 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.

.3 Rigid pvc conduit: to CSA C22.2 No. 211.2.

.4 Flexible metal conduit: to CSA C22.2 No. 56, steel liquid-tight flexible metal.

.5 Flexible pvc conduit: to CAN/CSA-C22.2 No. 227.3.

2.3 Conduit Fastenings

.1 One hole steel straps to secure surface conduits 50 mm and smaller.
  .1 Two hole steel straps for conduits larger than 50 mm.

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits at spacing recommended by manufacturer.

.4 Threaded rods, 6 mm diameter, to support suspended channels.

2.4 Conduit Fittings

.1 Fittings: to CAN/CSA C22.2 No. 18, manufactured for use with conduit specified. Coating: same as conduit.

.2 Ensure factory "ells" where 90 degrees bends for 25 mm and larger conduits.

.3 Watertight connectors and couplings for EMT.
  .1 Set-screws are not acceptable.

2.5 Expansion Fittings For Rigid Conduit

.1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.

.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.

.3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.6 Fish Cord

.1 Polypropylene.

PART 3 - EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms in unfinished areas.

.3 Use rigid galvanized steel threaded conduit except where specified otherwise.

.4 Use electrical metallic tubing (EMT) except in cast concrete, exposed in unfinished areas, above 3.0 m not subject to mechanical injury, and in block walls and stud partitions.

.5 Use rigid PVC conduit underground.

.6 Use flexible metal conduit for connection to motors in dry areas connection to recessed incandescent fixtures without prewired outlet box connection to surface or recessed fluorescent fixtures work in movable metal partitions.

.7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

.8 Use explosion proof flexible connection for connection to explosion proof motors.

.9 Install conduit sealing fittings in hazardous areas.
- .1 Fill with compound.

.10 Minimum conduit size for lighting and power circuits: 19 mm.

.11 Bend conduit cold:
- .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.12 Mechanically bend steel conduit over 19 mm diameter.

.13 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.14 Install fish cord in empty conduits.

.15 Run 2-25 mm spare conduits up to ceiling space from each flush panel.
- .1 Terminate these conduits in 152 x 152 x 102 mm junction boxes in ceiling space or in case of an exposed concrete slab, terminate each conduit in flush concrete surface type box.

.16 Remove and replace blocked conduit sections.

.1 Do not use liquids to clean out conduits.

.17 Dry conduits out before installing wire.

3.3 Surface Conduits

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended or surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.4 Concealed Conduits

.1 Run parallel or perpendicular to building lines.

.2 Do not install horizontal runs in masonry walls.

.3 Do not install conduits in terrazzo or concrete toppings.

3.5 Conduits In Cast-In-Place Concrete

.1 Locate to suit reinforcing steel.
    .1 Install in centre one third of slab.

.2 Protect conduits from damage where they stub out of concrete.

.3 Install sleeves where conduits pass through slab or wall.

.4 *Provide* oversized sleeve for conduits passing through waterproof membrane, before membrane is installed.
    .1 Use cold mastic between sleeve and conduit.

.5 Conduits in slabs: minimum slab thickness 4 times conduit diameter.

.6 Encase conduits completely in concrete with minimum 25 mm concrete cover.

.7 Organize conduits in slab to minimize cross-overs.

3.6 Conduits In Cast-In-Place Slabs On Grade

.1 Run conduits 25 mm and larger below slab and encase in 75 mm concrete envelope.
    .1 *Provide* 50 mm of sand over concrete envelope below floor slab.

3.7 Conduits Underground

.1 Slope conduits to *Provide* drainage.

.2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

3.8 Cleaning

.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 Reference Standards

.1 CSA International
  .1 CAN/CSA-Z809-08, Sustainable Forest Management.

.2 Forest Stewardship Council (FSC)
  .1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.

.3 Insulated Cable Engineers Association, Inc. (ICEA)

.4 Sustainable Forestry Initiative (SFI)
  .1 SFI-2010-2014 Standard.

1.3 Action And Informational Submittals

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

.2 *Product* Data:
  .1 Submit manufacturer's instructions, printed product literature and data sheets for cables and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Sustainable Design Submittals:
  .1 Construction Waste Management:
    .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.4 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 cables from nicks, scratches, and blemishes.
  .3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to *Work* of this Section.

.5 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 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 Markers

.1 Concrete type cable markers: 600 x 600 x 100 mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

PART 3 - EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for cable installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of York *Region* Representative.
  - .2 Inform York *Region* Representative 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 York *Region* Representative.

3.2 Direct Burial Of Cables

.1 After sand bed is in place, lay cables maintaining 75 mm clearance from each side of trench to nearest cable.
  - .1 Do not pull cable into trench.

.2 Include offsets for thermal action and minor earth movements.
  - .1 Offset cables 150 mm minimum for each 60 m run, maintaining minimum cable separation and bending radius requirements.

.3 Underground cable splices not acceptable.

.4 Minimum permitted radius at cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable or in accordance with manufacturer's written recommendations; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.

.5 Cable separation:
  - .1 Maintain 75 mm minimum separation between cables of different circuits.
  - .2 Maintain 300 mm minimum horizontal separation between low and high voltage cables.
  - .3 When low voltage cables cross high voltage cables maintain 300 mm vertical separation with low voltage cables in upper position.
  - .4 At crossover, maintain 75 mm minimum vertical separation between low voltage cables and 150 mm between high voltage cables.
  - .5 Maintain 300 mm minimum lateral and vertical separation for fire alarm and control cables when crossing other cables, with fire alarm and control cables in upper position.
  - .6 Install treated planks on lower cables 0.6 m minimum in each direction at crossings.

3.3 Cable Installation In Ducts

.1 Install cables as indicated in ducts.

.2 Do not pull spliced cables inside ducts.

.3 Install multiple cables in duct simultaneously.

.4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.

.5 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.

.6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.

.7 After installation of cables, seal duct ends with duct sealing compound.

3.4 Markers

.1 Mark cable every 150 m along cable duct runs and changes in direction.

.2 Where markers are removed to permit installation of additional cables, reinstall existing markers.

.3 Lay concrete markers flat and centred over cable with top flush with finish grade.

3.5 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00 - Common *Work* Results for Electrical.

.2 Perform tests using qualified personnel.
  .1 Include necessary instruments and equipment.

.3 Check phase rotation and identify each phase conductor of each feeder.

.4 Check each feeder for continuity, short circuits and grounds.
  .1 Ensure resistance to ground of circuits is not less than 50 megohms.

.5 Pre-acceptance tests:
  .1 After installing cable but before splicing and terminating, perform insulation resistance test with 600 V megger on each phase conductor.
  .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.

.6 Acceptance Tests:
  .1 Ensure that terminations and accessory equipment are disconnected.
  .2 Ground shields, ground wires, metallic armour and conductors not under test.
  .3 Leakage Current Testing:
    .1 Raise voltage in steps from zero to maximum values as specified by ICEA manufacturer for type of cable being tested.
    .2 Hold maximum voltage for specified time period by ICEA manufacturer.
    .3 Record leakage current at each step.

.7 *Provide Consultant* with list of test results showing location at which each test was made, circuit tested and result of each test.

.8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

3.6 Cleaning

.1 Progress Cleaning:
  .1 Leave *Work* area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 Protection

.1 Repair damage to adjacent materials caused by cables installation.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 Scope / Summary

1.2.1 *Provide* labelling of electrical power outlets and receptacles throughout the entire building to *Provide* identification of electrical circuit.

PART 2 - DESIGN REQUIREMENTS / PRODUCTS

1.3 Receptacle Labelling

1.3.1 *Provide* labelling as per photograph below and as follows:

1.3.1.1 Labels for circuits on normal power shall be in black lettering.

1.3.1.2 Labels for circuits on emergency power shall be red lettering.

1.3.1.3 Each label shall contain the distribution panel identification number and circuit number.

1.3.1.4 As-built drawings shall show the distribution panel identification number and circuit number at each receptacle location.

1.3.2 Photograph of typical receptacle labelling:

END OF SECTION

PART 1 – GENERAL

1.1 General

.1 The purpose of this section is to specify Division 26 responsibilities in the commissioning process.

.2 The systems to be commissioned are listed in Section 01 91 00, Part 1.9.

.3 Commissioning requires the participation of Division 26 to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 01 91 00. Division 26 shall be familiar with all parts of Section 01 91 00 and the commissioning plan issued by the CA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

.4 CA = Commissioning Agent.

1.2 Responsibilities

.1 Electrical Subcontractors. The Contractor shall ensure that the electrical Subcontractor complies with all requirements included in this Section and fulfills the following responsibilities (all references apply to commissioned equipment only):

.1 Documentation of all procedures performed shall be provided and forwarded to the Professional Engineer. Written documentation must contain recorded test values of all electrical tests performed per the individual product specification.

.2 The start-up service company shall be present during energization of the electrical equipment. Site and equipment access must be provided by the electrical subcontractor.

.3 The Contractor shall supply a power source, specified by the start-up service company, for on-Site test equipment.

.4 The Contractor is to attend all factory witness testing required within the respective Specification Sections. The Contractor shall cover all their costs and include them in their bid.

.5 Perform tests using qualified personnel. Provide necessary instruments and equipment.

.6 Include the cost of commissioning in the Contract Price, if not yet let.

.7 In each purchase order or subcontract written, include requirements for submittal data, O&M data and training.

.8 Attend a commissioning scoping meeting and other necessary meetings scheduled by the CA to facilitate the commissioning process.

.9 The Contractor shall provide normal cut sheets and shop drawing submittals to the CA of commissioned equipment. Provide additional requested documentation, prior to normal O&M manual submittals, to the CA for development of pre-functional and functional testing procedures.

.1 Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any Region-contracted tests,full factory testing reports (if any), and full warranty information including all responsibilities of the Region to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent.

.2 The Commissioning Authority may request further documentation necessary for the commissioning process. This data request may be made prior to normal submittals.

.10 Provide a copy of the O&M manuals submittals of commissioned equipment, through normal channels, to the CA for review.

.11 Contractors shall assist (along with the design Professional Engineers) in clarifying the operation and control of commissioned equipment in areas where the Specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

.12 Provide assistance to the CA in preparation of the specific functional performance test procedures specified in Section 26. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

.13 Develop a full start-up and checkout plan using manufacturer's start-up procedures and the pre-functional test sheets from the CA. Submit manufacturer's detailed start-up procedures and the full start-up plan and procedures and other requested equipment documentation to CA for review.

.14 During the startup and checkout process, execute and document the electrical-related portions of the pre-functional test sheets provided by the CA for all commissioned equipment.

.15 Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CA.

.16 Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

.17 Perform functional performance testing under the direction of the CA for specified equipment in 01 91 00 Section 1.9. Assist the CA in interpreting the monitoring data, as necessary.

.18 Correct deficiencies (differences between specified and observed performance) as interpreted by the CA and the Consultant and retest the equipment.

.19 Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

.20 During construction, maintain as-built red-line drawings for all drawings. Update after completion of commissioning (excluding deferred testing). Prepare red-line As-Built Drawings for all drawings.

.21 Provide training of the Region's operating personnel as specified in Section 3.8.

.22 Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

.23 Execute seasonal or deferred functional performance testing, witnessed by the CA, according to the Specifications.

.24 Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

PART 2- PRODUCTS

.1 NOT USED

PART 3- EXECUTION

3.1 Submittals

.1 The Contractor shall ensure that Section 26 Subcontractors provide submittal documentation relative to commissioning to the CA as requested by the CA. Refer to Section 01 91 00 Part 3.3 for additional Section 26 requirements.

3.2 Start-up of Equipment

.1 The electrical Subccontractor(s) shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in Section 01 91 00, Part 3.4. Section 26 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning authority or Region.

.2 Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems, or sub-systems at the discretion of the CA and Consultant. Beginning system testing before full completion, does not relieve the Contractor from fully completing the system, including all Pre Functional test sheets as soon as possible.

.3 All equipment shall be started by the manufacturer’s representative.

3.3 Pre-Functional Test Sheets

.1 Pre-functional test sheets contain items for Section 26 Contractors to perform. On each checklist, a column is provided that is to be completed by the contractor assigning responsibility for that line item to a Subcontractor. Those executing the test sheets are only responsible to perform items that apply to the specific application at hand. These test sheets do not take the place of the manufacturer’s recommended checkout and start-up procedures or report. Some checklist procedures may be redundant in relation to checkout procedures that will be documented on typical factory field checkout sheets. Double documenting may be required in those cases.

.2 Refer to Section 01 91 00 for additional requirements regarding pre-functional test sheets, startup and initial checkout. Items that do not apply should be noted along with the reasons on the form. If this form is not used for documenting, one of similar rigor and clarity shall be used pending approval from the CA. Contractor's assigned responsibility for sections of the checklist shall be responsible to see that checklist items by their subcontractors are completed and checked off. "Contr." column or abbreviations in brackets to the right of an item refer to the contractor responsible to verify completion of this item. A/E = Architect/Engineer, All = all Contractors, CA = Commissioning Agent, CC = Controls Contractor, EC = Electrical Contractor, PM/GC = General Contractor, MC = Mechanical Contractor, SC = Sheet Metal Contractor, TAB = Test and Balance Contractor.

3.4 Operations and Maintenance Manuals

.1 The Contractor shall ensure that the Section 26 Subcontractors compile and prepare documentation for all equipment and systems covered in Section 26 and deliver it to the Contractor for inclusion in the O&M manuals

.2 The CA shall receive a copy of the O&M manuals for review.

3.5 Training of Region Personnel

.1 The Contractor shall coordinate and schedule training and ultimately to ensure the training is completed. Refer to Section 01 91 00 for additional details.

.2 The CA will oversee and approve the content and adequacy of the training of Region personnel for commissioned equipment Refer to Section 01 91 00 for additional details.

.3 Electrical Subcontractor: The Contractor shall ensure that the electrical Subcontractor fulfills the following training responsibilities:

.1 Provide the CA with a training plan two weeks before the planned training according to the outline described in Section 01 91 00, Part 3.8.

.2 Provide designated Region personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.

.3 Training shall start with classroom sessions, if necessary, followed by hands on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.

.4 During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

.5 The appropriate Subcontractor or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing Subcontractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.

.6 The training sessions shall follow the outline in the Table of Contents of the Operation and Maintenance (O&M) manual and illustrate whenever possible the use of the O&M manuals for reference.

.7 Training shall include:

.1 Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.

.2 Include a review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.

.3 Discuss relevant health and safety issues and concerns.

.4 Discuss warranties and guarantees.

.5 Cover common troubleshooting problems and solutions.

.6 Explain information included in the O&M manuals and the location of all plans and manuals in the facility.

.7 Discuss any peculiarities of equipment installation or operation.

.8 Classroom sessions shall include the use of overhead projections, slides, video and audio taped material as might be appropriate.

.9 Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.

.10 The electrical Subcontractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.

.11 Training shall occur after functional testing is complete, unless accepted otherwise by the Consultant.

3.6 Deferred Testing

.1 Refer to Section 01 91 00, Part 3.9 for requirements of deferred testing.

3.7 WRITTEN WORK PRODUCTS

.1 Written work products of Section 26 Subcontractors will consist of the startup and initial checkout plan as described in Section 01 91 00, as well as completed startup, initial checkout and pre-functional test sheets.

END OF SECTION

Last Updated: March 25, 2014

26 09 13.01 ELECTRICITY METER INSTALLATION/STARTUP VERIFICATION FORM			
Project Name:		*Project* Number:	
Installing *Contractor*:		Form Completed By (Name):	
Telephone No.:		Date (MM/DD/YY):	

Purpose: The following form is intended to ensure energy meters are correctly and completely set up prior to commissioning verification. Refer to *York Region Building and Facilities Design Standards and Guidelines Division 26 09 13 – Electrical Power Monitoring* for additional requirements.

1. General Information

Manufacturer:	
Model:	
Serial Number:	

2. Physical Installation

26 09 13 Reference	**Requirement**	**Confirm Compliance**		**Notes**
3.1.2	Is the meter in a painted, hinged NEMA 1 (or better) enclosure complete with modular terminal blocks, finger safe fuse holders, fuses and power supply?	☐ Yes	☐ No	
3.1.2	Is the front of the enclosure labelled with meter name, load measured and IP address?	☐ Yes	☐ No	
3.1.3	Has a disconnect been provided for the voltage reference at the panel board?	☐ Yes	☐ No	
3.1.4	Are communication cables continuous (i.e. not spliced)?	☐ Yes	☐ No	
3.1.5	Has a York *Region* Property Services Branch Asset ID Tag been affixed to the meter?	☐ Yes	☐ No	
3.1.7	Has the meter been connected to the *Region*'s IT network?	☐ Yes	☐ No	

Last Updated: March 25, 2014

3. Network Configuration (Note 1 indicates the data is to be provided by the *Region*'s *Project* Manager)		
MAC Address:		
DHCP Disabled?	☐ Yes	☐ No
IP Address:[1]		
Gateway: [1]		
Subnet Mask: [1]		
Primary DNS: [1]		
Secondary DNS: [1]		

26 09 13 Reference	**Requirement**	**Confirm Compliance**		**Notes**
3.1.6 and 3.1.8.2	Has the meter's Network information been obtained from the *Region*'s *Project* Manager?	☐ Yes	☐ No	
3.1.8.10	Is the meter viewable through a web browser on a device connected to the *Region*'s network?	☐ Yes	☐ No	

4. Access	
Administrator User Name:	
Administrator Password:	

5. Meter Configuration (Note 1 indicates the data is to be provided by the *Region*'s *Project* Manager)				
CT Setup:	☐ Single Phase (120 or 347V)	☐ Split Phase (240V)	☐ Three Phase (208 or 600V)	
CT Rating:	___________A			
Voltage Multipliers:	General: _____	Phase A: ______	Phase B: _____	Phase C: _____
Current Multipliers:	General: _____	Phase A: ______	Phase B: _____	Phase C: _____
Meter Name: [1]				
Meter Description/Load Served:				

26 09 13 Reference	**Requirement**	**Confirm Compliance**		**Notes**
3.1.8.1	Has the latest firmware been installed in the meter?	☐ Yes	☐ No	
3.1.8.3	Has the meter's internal clock been set to current local time?	☐ Yes	☐ No	
3.1.8.4	Have email alerts been set up as specified?	☐ Yes	☐ No	
3.1.8.5	Has trend logging been set up as specified?	☐ Yes	☐ No	
3.1.8.6	Has the meter's web based home screen been set to display real-time demand graph and consumption statistics?	☐ Yes	☐ No	
3.1.8.7	Has CT rating been correctly entered into meter setup?	☐ Yes	☐ No	
3.1.8.9	Have CT's been wired to corresponding voltage reference?	☐ Yes	☐ No	

Last Updated: March 25, 2014

3.1.8.9	Have CT's been installed with correct orientation?	☐ Yes	☐ No	

Last Updated: March 25, 2014

6. Meter Data Verification

Complete the following Table with meter readings and voltmeter/ammeter reading to verify correct setup:

	Input 1		Input 2		Input 3		Input 4		Input 5		Input 6		Input 7		Input 8	
Measured Load: (ex. LP-1A)																
Parameter	Meter	Voltmeter/ Ammeter	Meter	Voltmeter/ Ammeter	Meter	Voltmeter/ Ammeter	Meter	Voltmeter/ Ammeter	Meter	Voltmeter/ Ammeter	Meter	Voltmeter/ Ammeter	Meter	Voltmeter/ Ammeter	Meter	Voltmeter/ Ammeter
V_A-N																
V_B-N																
V_C-N																
I_A																
I_B																
I_C																

26 09 13 Reference	Requirement	Confirm Compliance		Notes
3.1.8.8	Has each voltage and current reading displayed on meter software been verified using voltmeter and clamp-on ammeter?	☐ Yes	☐ No	

7. Training

26 09 13 Reference	Requirement	Confirm Compliance		Notes
3.1.8.12	Has training been provided to *Region* staff?	☐ Yes	☐ No	
3.1.8.13	Have meter manufacturer's calibration certificate(s), installation, operations and maintenance manuals and recommended meter recalibration interval(s) been provided to the *Region*'s *Project* Manager?	☐ Yes	☐ No	

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 Reference Standards

.1 American National Standards Institute (ANSI)
  - .1 ANSI C39.1-1981, Requirements, Electrical Analog Indicating Instruments.

.2 CSA International
  - .1 CAN3-C17-M84(R2008), Alternating - Current Electricity Metering.

1.3 Action And Informational Submittals

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

.2 *Product* Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for metering and switchboard instruments and include product characteristics, performance criteria, physical size, finish and limitations.
  - .2 Include meter, instrument, outline dimensions, panel drilling dimensions and installation cutout template.

.3 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.4 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 metering and switchboard instruments from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to *Work* of this Section.

.5 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 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 Metering Equipment

.1 Electricity Meters

.1 Internet Protocol (IP) based meter complete with:

.1 Built-in web server.

.2 Capable of operating with a dedicated IP address (to be provided by the *Region*).

.3 Communications Protocols:

.1 HTTP/Post capable of pushing data to 3rd party applications/databases.

.2 Modbus TCP

.4 Built-in real-time and historic graphics accessible with any HTML 5 internet browser (computer, tablet, phone) on the *Region*'s network. Data to be displayed in local time, adjusted for daylight savings time.

.5 Real-time clock with battery backup and email alert for battery end of life.

.6 Time stamp:

.1 Represent date and time

.2 In UTC time or offset from a specified UTC time

.3 Resolution: Minimum 1 second

.7 Ability to export all stored trend data to comma separated value (.csv) or Microsoft Excel format for importing into spreadsheets. Time-stamps to be exported as a single field with a numeric (non-text) value in local time.

.8 Published application programming interface (API) allowing data to be retrieved from the meter via non-proprietary means, such as JavaScript Object Notation (JSON).

.9 Built-in trending and data storage:

.1 2 years of consumption data (kWh) at 1 minute intervals with time-stamp; and

.2 10 years of consumption data (kWh) at 1 hour intervals with time-stamp.

.3 Stored in non-volatile memory.

.10 No special software required to set up meter or access data.

.11 Security:

.1 Unrestricted access to data and graphics over the *Region*'s network.

.2 Password protection for access to setup, changing settings/parameters and deleting data.

.12 Ability to measure, store and trend the following data complete with time-stamp:

.1 Accumulated energy per phase (kWh)

.2 Accumulated total energy (kWh)

.3 Active power per phase (kW)

.4 Active total power (kW)

.5 RMS voltage per phase

.6 RMS current per phase

.7 Power factor per phase

.8 Total power factor.

.9 Line frequency

.2 Acceptable product: z3 Controls Inc. NetMeter

.2 Current Transformers
.1 Compatible with electricity meter input without the use of transformers or other devices.
.2 Linear accuracy +/-1% of reading
.3 Accuracy at 10% to 130% of rated current.
.4 Unburdened current transformers shall not be permitted.
.5 Acceptable product: Magnelab, Inc. SCT series.

.3 Data Cabling
.1 Cat 5e or Cat 6 unshielded twisted pair (UTP)
.2 Colour: Green

2.2 SHOP INSTALLATION

.1 Install meters and instrument transformers in separate compartment of switchboard.

.2 Install instruments on panel switchboard.

.3 Ensure adequate spacing between current transformers installed on each phase.

.4 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources, electrical supplies.

3 EXECUTION

3.1 Installation Requirements

.1 Optimize electrical distribution to allow reduction in number of meters by grouping similar/like end use loads.

.2 Install meter in a painted, hinged NEMA 1 (or better) enclosure complete with modular terminal blocks, finger safe fuse holders, fuses and power supply. Label front of enclosure with meter name, IP address and load(s) measured.

.3 *Provide* disconnect at panel board for voltage reference.

.4 All communication cables to continuous. No splicing is allowed.

.5 Affix York *Region* Property Services Branch Asset ID tag (to be provided by the *Region*) to meter prior to installation.

.6 Sensor and network configuration to be done in consultation with the *Region*'s Property Services Branch.

.7 Connect meter to the *Region*'s IT network.

.8 Commission meter:
.1 Ensure latest available firmware version is installed in meter.
.2 Obtain Network information from York *Region* project manager and program into meter, including IP address, subnet mask, default gateway, primary and secondary DNS addresses.
.3 Set meter clock to current local time.

.4 Set up email alerts as specified and/or requested by the *Region*'s project manager.

.5 Set up trend logging as specified and/or requested by the *Region*'s project manager. At minimum, set up trend logging per 2.2.1.1.8 and 2.2.1.1.11 above.

.6 Set default homepage to display real-time demand graphs and consumption statistics.

.7 Verify CT rating is correctly entered in meter setup.

.8 Confirm each voltage and current reading displayed on meter software using voltmeter and clamp-on ammeter.

.9 Verify CT's are wired to corresponding voltage reference and that CT's are installed in correct orientation.

.10 Verify meter information is viewable through a web browser on a device on the *Region*'s network.

.11 Complete and submit Energy Meter Installation/Startup Verification Form (26 09 13.01)

.12 *Provide* training on meter software use to *Region* staff including Facilities Operations and Maintenance and Corporate Energy Services.

.13 *Provide* meter manufacturer's calibration certificate(s), installation, operations and maintenance manuals and recommended meter recalibration interval(s).

3.2 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for metering and switchboard instruments installation in accordance with manufacturer's written instructions.
  .1 Visually inspect substrate in presence of York *Region* Representative.
  .2 Inform York *Region* Representative 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 York *Region* Representative

3.3 Field Quality Control

.1 Conduct tests in accordance with Section 26 05 00 - Common *Work* Results for Electrical and in accordance with manufacturer's recommendations.

.2 Perform simulated operation tests with metering, instruments disconnected from permanent signal and other electrical sources.

.3 Verify correctness of connections, polarities of meters, instruments, potential and current transformers, transducers, signal sources and electrical supplies.

.4 Perform tests to obtain correct calibration.

.5 Do not dismantle meters and instruments.

3.4 Cleaning

.1 Progress Cleaning:
  .1 Leave *Work* area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
   .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 Protection

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metering and switchboard instrument installation.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 Summary

.1 Section Includes:
- .1 Materials and installation for low voltage control system designed to *Provide* remote switching of lighting loads by use of:
  - .1 Low voltage momentary contact switches.

1.3 Reference Standards

.1 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

1.4 Action And Informational Submittals

.1 *Product* Data:
- .1 Submit manufacturer's printed product literature, specifications and datasheet in accordance with Section 01 33 00 - Submittal Procedures. Include product characteristics, performance criteria, and limitations.
  - .1 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures. Indicate VOC content.

.2 *Shop Drawings*:
- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop drawings: Submit drawings.

.3 Closeout Submittals:
- .1 Submit maintenance data in accordance with Section 01 77 00 – *Project* Closeout.

.4 Quality assurance submittals: submit following in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Test reports:
  - .1 Submit certified test reports indicating compliance with specifications for specified performance characteristics and physical properties.
- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Manufacturer's Instructions: submit manufacturer's installation instructions.
- .4 Manufacturer's Field Reports: manufacturer's field reports specified.

1.5 Quality Assurance

.1 Health and Safety:
- .1 Do construction occupational health and safety in accordance Health and Safety Requirements.

1.6 Delivery, Storage, And Handling

.1 Packing, shipping, handling and unloading:
- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

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

PART 2 - PRODUCTS

2.1 Materials

.1 Control system: by one manufacturer and assembled from compatible components.

2.2 Remote Control Switches

.1 Single pole, double throw, momentary contact, standard heavy duty, rated A, 25 V, double push-button centre pivot rocker action with pilot lights.

2.3 Low Voltage Relays

.1 Electrically operated by momentary impulse, mechanically latched until activated.

.2 Two coil solenoid type with one coil to close relay contacts and one coil to open relay contacts.

.3 Operating voltage: 24 V, AC rectified AC.

.4 Load contacts: 20 A, 120 V, AC.

.5 Auxiliary contacts for pilot light.

.6 Coloured pre-stripped leads.

2.4 Control Transformer

.1 Low voltage power Class 2, input 120 347 V, AC, 60 Hz, output 20 35 VA at 24 V.

2.5 Single/Dual Relay Wall Switch Occupancy Sensors

.1 Manual-on, Automatic-off, dual technology (passive infrared and ultrasonic) wall switch occupancy sensor. *Provide* model suitable for the room size, the wattage requirement and for LED lighting. Watt Stopper model DW-100, DW-200, DW-103, DW-203

2.6 Dual Technology Ceiling Mounted Occupancy Sensor

.1 Digital Occupancy Sensor shall *Provide* graphic LCD display for digital calibration and electronic documentation. Features include the following:

.2 Digital calibration and pushbutton configuration for the following variables:
.1 Sensitivity, 0-100 percent in 1 minute increments.
.2 Increments. Time delay, 0-30 minutes in 1 minute.
.3 Test Mode, five second time delay.
.4 Detection technology, PIR, Ultrasonic or Dual Technology activation and/or re-activation
.5 Walk-through mode.

.3 Load parameters including Auto/Manual-On, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.

.4 Programmable control functionality including:
.1 Each sensor may be programmed to control specific loads within a local network.
.2 Sensor shall be capable of activating one of 16 user-definable lighting scenes.
.3 Adjustable retrigger time period for (turn on) manual-on loads. Load will retrigger automatically within a configurable period of time (default 10 seconds) after turning off.
.4 On dual technology sensors, independently configurable trigger modes are available for both Normal Hours (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
.1 Ultrasonic and Passive Infrared
.2 Ultrasonic and Passive Infrared
.3 Ultrasonic only
.4 Passive Infrared only

.5 One or two RJ-45 port(s) for connection to DLM local network.

.6 Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.

.7 Device Status LEDs, which may be disabled for selected applications, including
.1 PIR detection
.2 Ultrasonic detection
.3 Configuration mode
.4 Load binding

.8 Assignment of occupancy sensor to a specific load within the room without wiring or special tools.

.9 Manual override of controlled loads.

.10 All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.

.11 BACnet object information shall be available for the following objects:
.1 Detection state
.2 Occupancy sensor time display
.3 Occupancy sensor sensitivity, PIR and ultrasonic

.12 Units shall not have any dip switches or potentiometers for field settings.

.13 Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.

2.7 Digital Wall Switches

.1 Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configurations. Wall switches shall include the following features:
.1 Two-way infrared (IR) transceiver for use with personal and configuration remote controls
.2 Removable buttons for field replacement with engraved buttons and/or alternate colour buttons. Button replacement may be completed without removing the switch from the wall.
.3 Configuration LED on each switch that blinks to indicate data transmission.

.2 Load/Scene Status LED on each switch button with the following characteristics:
.1 Bi-level LED
.2 Dim locator level indicates power to switch
.3 Bright status level indicates that load or scene is active
.4 Diming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.

.3 Programmable control functionality including:
.1 Button priority may be configured to any BACnet priority level, from 1-16 corresponding to networked operation allowing local actions to utilize life safety priority.
.2 Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.

.4 All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.

.5 BACnet object information shall be available for the following objects:
.1 Button state
.2 Switch lock control
.3 Switch lock status

.6 Two RJ-45 ports for connection to DLM local network.

.7 Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration shall be required to achieve multi-way switching.

.8 Load and Scene button function may be reconfigured for individual buttons from Load to Scene and vice versa.
.1 Individual button function may be configured to Toggle, On only or Off only
.2 Individual scenes may be locked to prevent unauthorized change.
.3 Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours
.4 Ramp rate may be adjusted for each dimmer switch
.5 Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependent; each button may be bound to multiple

loads.

2.8 Hand Held Remote Controls

.1 Watt stopper part number LMRH-101, LMRH-102, LMRH-105.

2.9 Room Controllers

.1 Dual voltage (120/277 VAC, 60 Hz) capable or 347 VAC, 60 Hz. 120/277 volt models rated for 20A total load.

.2 Built in real time current monitoring.

.3 One, two or three relays configurations.

.4 Smart 250 mA switching power supply.

.5 Four RJ-45 DLM local network ports. *Provide* integral strain relief.

.6 One dimming output per relay.

.1 0-10V dimming – where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting.

.7 Plug load controller where required.

.8 Watt Stopper product numbers: LMRC-211, LMRC-212, LMRC-213, LMRC-201, LMRC-311, LMRC-312, LMRC-313.

.9 Room Controllers shall be provided to match the room lighting load and control requirements.

.10 Room controllers shall be plenum rated.

.11 Optional Network Bridge for BACnet MS/TP communications (LMRC-3xx).

2.10 Digital Sensors

.1 Digital daylighting sensors shall work with load controllers and relay panels to *Provide* automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to the controller or panel. Daylighting sensors shall be interchangeable without the need for re-wiring.

.1 Closed loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.

.2 Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.

.3 Dual loop sensors measure both ambient and incoming daylight in the space to ensure that proper light levels are maintained as changes to reflective materials are made in a single zone.

.2 Digital daylighting sensors shall include the following features:

.1 Sensor's internal photodiode shall only measure light waves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. Photodiode shall not measure energy in either the ultraviolet or infrared spectrums. Photocell shall have a sensitivity of less than 5 percent for any wavelengths less than 400 nanometers or greater than 700 nanometers.

.2 Sensor light level range shall be from 1-6,553 foot candles (fc)

.3 Capability of on/off, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of load controller(s) and load binding to controller(s)

.3 For switching daylight harvesting, the photosensor shall *Provide* a field-selectable dead band, or a separation, between the ‘On setpoint’ and the ‘Off setpoint’ that will prevent the lights from cycling excessively after they turn off.

.4 For dimming daylight harvesting, the photosensor shall *Provide* the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.

.5 Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.

.6 Photosensors shall *Provide* adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut off.

.7 Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.

.8 Configuration LED status light on device that blinks to indicate data transmission.

.9 Status LED indicates test mode, override mode and load binding.

.10 Recessed switch on device to turn controlled load(s) ON and OFF.

.11 BACnet object information shall be available for the following daylighting sensor objects, based on the specific photocell’s settings:
.1 Light level
.2 *Day* and night setpoints
.3 Off time delay
.4 On and Off setpoints
.5 Up to three zone setpoints
.6 Operating mode – on/off, bi-level, tri-level or dimming

.12 One RJ-45 port for connection to DLM local network.

.13 A choice of accessories to accommodate multiple mounting methods and building materials. Photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox. Standard tube photosensors accommodate mounting materials from 0-0.62 inches thick (LMLS-400, LMLS-500). Extended tube photosensors accommodate mounting materials from 0.62 to 1.25 inches thick. Mounting brackets are compatible with J boxes and wall mounting. Photosensor to be mounted on included bracket below skylight well.

.14 Any load or group of loads in the room can be assigned to a daylighting zone.

.15 Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).

.16 All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory withing the photosensor itself. Memory shall have an expected life of no less than 10 years.

.17 Open loop digital photosensors shall include the following additional features:

.1 An internal photodiode that measures light in a 60-degree angle (cutting off the unwanted light from the interior of the room).

.2 Automatically establishes application-specific setpoints following manual calibration using a wireless configuration tool or a PC with appropriate software. For switching operation, an adequate dead band between the ON and OFF setpoints for each zone shall prevent the lights from cycling; for dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone.

.3 Each of the three discrete daylight zones can include any non-overlapping group of loads in the room.

2.11 Room Network

2.12 Configuration Tools

.1 Each lighting control panel system shall be supplied with at least (1) handheld IR remote programming interface consisting of a keypad and associated OLED display screen. The user interface shall allow setup, configuration, and diagnostics of the panel without the need for software or connection of a computer. The user interface shall have the following functions as a minimum:

.1 Set network parameters including panel device ID, MS/TP MAC address, baud rate and max master range.

.2 Relay Group creation of up to 99 groups. Group creation shall result in programming of all seven key relay parameters for member relays. The seven parameters are as follows: After-hours Override Time Delay, Normal Hours Override Time Delay, Action on Transition to Normal Hours, Action on Transition to After Hours, Sensor Action During Normal Hours, Sensor Action During After Hours, Blink-Warn Time for After Hours.

.3 Program up to 254 separate scheduled events. Events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays. Holidays are also defined through the User Interface.

.4 Program up to 32 separate Dark/Light events. Events shall have a selectable source as either calculated Astro with delay, or a digital IO module with an integral 0-5V or 0-10V analog photocell. Dark/Light events shall occur on seven day intervals with each day selectable as active or inactive, and shall be configurable as to whether the event is active on holidays.

.5 Button binding of digital switches to groups shall be accessible via the handheld IR remote and accomplished from the digital switch station.

.6 Programming of panel location information shall be accomplished by the handheld IR remote and include at a minimum LAT, LON, DST zone, and an approximate city/state location.

.7 An additional handheld IR remote may optionally be specified to be permanently mounted to the panel interior via a retractable anti-theft lanyard to allow for convenient programming of the panel while assuring that the handheld programmer is always present at that panel. An unlimited number of handheld IR remotes may also be purchased for facilities staff as seen fit by the end user's representative.

2.13 Lighting Control Panels

.1 *Provide* lighting control panels in the locations and capacities as indicated on the plans and schedules. Each panel shall be of modular construction and consist of the following components:

.1 Enclosure/Tub shall be NEMA 1, sized to accept an interior with 1 – 8 relays, 1 – 24 relays and 6 four-pole contactors, or 1 – 48 relays and 6 four-pole contactors.

.2 Cover shall be configured for surface or flush wall mounting of the panel as indicated on the plans. The panel cover shall have a hinged and lockable door with restricted access to line voltage section of the panel.

.3 Interior assembly shall be supplied as a factory assembled component specifically designed and listed for field installation. The interior construction shall *Provide* total isolation of high voltage (Class 1) wiring from low voltage (Class 2) wiring within the assembled panel. The interior assembly shall include intelligence boards, power supply, DIN rails for mounting optional Class 2 control devices, and individually replaceable latching type relays. The panel interiors shall include the following features:

.1 Removable, plug-in terminal blocks with screwless connections for all low voltage terminations.

.2 Individual terminal block, override pushbutton, and LED status light for each relay.

.3 Direct wired switch inputs associated with each relay and group channel shall support two-wire, momentary or maintained contact switches.

.4 Digital inputs (four RJ-45 jacks) shall support 1-, 2-, 3-, 4-, and 8-button digital switches, digital IO modules capable of receiving 0-5V or 0-10V analog photocell inputs, digital IO modules capable of receiving momentary or maintained contact closure inputs, digital photocell modules, and digital occupancy sensors.

.5 True relay state shall be indicated by the on-board LED and shall be available to external control devices and systems via BACnet.

.6 Automatically sequenced operation of relays to reduce impact on the electrical distribution system when large loads are controlled simultaneously.

.7 Group, channel, and pattern control of relays shall be provided through a simple keypad interface from a handheld IR programmer. Any group of relays can be associated with a channel for direct on/off control or pattern (scene) control via a simple programming sequence using the relay and channel override pushbuttons and LED displays for channels 1-9 or a handheld IR programmer for channels 1-99.

.8 Relay group status for each channel shall be provided through red LED indicators for groups 1-9 and via BACnet for groups 1-99. Solid red indicates that the last group action called for an ON state and relays in the group are on or in a mixed state.

.9 Single-pole latching relays with modular plug-in design. Relays shall *Provide* the following ratings and features:

(1) Electrical:

(a) 30 amp ballast at 277V

(b) 20 amp ballast at 347V

(c) 20 amp tungsten at 120V

(d) 30 amp resistive at 347V

(e) 1.5 HP motor at 120V

(f) 14,000 amp short circuit current rating (SCCR) at 347V

(g) Relays shall be specifically UL listed for control of plug loads

(2) Mechanical:

(a) Individually replaceable, ½" KO mounting with removable Class 2 wire harness.

(b) Actuator on relay housing provides manual override and visual status indication, accessible from Class 2 section of panel.

(c) Dual line and load terminals each support two #14 – #12 solid or stranded conductors.

(d) Tested to 300,000 mechanical on/off cycles.

(3) Isolated low voltage contacts *Provide* for true relay status feedback and pilot light indication.

.4 Power supply shall be a multi-voltage transformer assembly with rated power to supply all electronics, occupancy sensors, switches, pilot lights, and photocells as necessary to meet the project requirements. Power supply to have internal over-current protection with automatic reset and metal oxide varistor protection.

.5 Lighting control panels shall be WattStopper model LMCP8, LMCP24 or LMCP48 as shown on the plans.

.2 The lighting control panel shall support digital communications to facilitate the extension of control to include interoperation with building automation systems and other intelligent field devices. Digital communications shall be RS485 master/slave token passing-based using the BACnet® protocol.

.1 The panel shall have provision for an individual BACnet device ID. The device ID description property shall be writable via the network to allow unique identification of the lighting control panel on the network.

.2 The panel shall support MS/TP MAC addresses in the range of 0 – 127 and baud rates of 9600k, 38400k, 76800k, and 115.2k bits per second.

.3 Lighting control relays shall be controllable as binary output objects in the instance range of 1 – 64. The state of each relay shall be readable and writable by the BAS via the object present value property.

.4 Lighting control relays shall report their true on/off state as binary input objects in the instance range of 1 – 64.

.5 The 99 channel groups associated with the panel shall be represented by binary value objects in the instance range of 201 – 299. The occupancy state of each channel group shall be readable and writable by the BAS via the object present value property. Commanding 1 to a channel group will put all relays associated with the channel into the normal hours mode. Commanding 0 or NULL shall put the relays into the after hours mode.

.6 Setup and commissioning of the panel shall not require manufacturer-specific software or a computer. All configuration of the lighting control panel shall be performed using standard BACnet objects or via the handheld IR programming remote. *Provide* BACnet objects for panel setup and control as follows:

.1 Binary output objects in the instance range of 1 – 64 (one per relay) for on/off control of relays.

.2 Binary value objects in the instance range of 1 – 99 (one per channel) for normal hours/after hours schedule control.

.3 Binary input objects in the instance range of 1 – 64 (one per relay) for reading true on/off state of the relays.

.4 Analog value objects in the instance range of 1 – 64 (one per relay) shall assign relays to channel groups in the range of 1 – 99.

.5 Analog value objects in the instance range of 101 – 199 (one per channel group) shall assign a blink warn time value to each channel. A value of 5 shall activate the blink warn feature for the channel and set a 5-minute grace time period. A value of 250 shall activate the sweep feature for the channel and enable the use of sweep type automatic wall switches.

.6 Analog value objects in the instance range of 201 – 299 (one per channel) shall assign an after hours time delay value to the channel in the range of 1 – 240 minutes.

.7 Multi-state value objects in the instance range of 1 – 99 (one per channel) shall *Provide* the state of the relays assigned to the channel. Valid states shall be ALL ON, MIXED, BLINK, and ALL OFF.

.7 The description property for all objects shall be writable via the network and shall be saved in non-volatile memory within the panel.

.8 The BO and BV 1 – 99 objects shall support BACnet priority array with a relinquish default of off and after hours respectively. Prioritized writes to the channel BV objects shall propagate prioritized control to each member relay in a way analogous to the BACnet Channel object.

.9 Panel-aggregate control of relay Force Off at priority 2 shall be available via a single BV5 object. Force On at priority 1 shall be available via a single BV4 object.

.10 Lockout of all digital switch buttons connected to a given panel shall be command-able via a single BV2 object. The lock status of any connected switch station shall be represented as BV101-196.

.11 Lighting control accessory devices connected to the panel shall be represented via BACnet objects including but not limited to the following:

.1 Digital occupancy sensor detection states shall be readable as BI objects ranging from BI1-96.

.2 Digital occupancy sensor configuration parameters shall each be accessible as BACnet objects when applicable to a given product.

.1 Occupancy sensor time delay in minutes shall be writeable via AV101-196.

.2 Occupancy sensor passive infrared (PIR) sensitivity percentage shall be writeable via AV201-296.

.3 Occupancy sensor ultrasonic (US) sensitivity percentage shall be writeable via AV301-396.

.3 Digital switch buttons shall be readable and writeable as BI objects ranging from BI101 – 9608.

.4 Digital daylight sensors foot-candle readings shall be readable as follows:

.1 Analog 0-5V/0-10V sensors connected to a digital input module shall be represented as AI1-96.

.2 Digital closed loop sensors shall be represented as AI4001-4096.

.3 Digital open loop sensors shall be represented as AI5001-5096.

.5 Digital dual loop sensors shall be represented as follows:

.1 The upward facing open loop sensor shall be represented as AI6001-6096.

.2 The downward facing closed loop sensor shall be represented as AI6101-6196.

12 Digital daylight sensor configuration shall be exposed as BACnet objects as follows:

.1 Digital closed loop sensors shall be represented as follows:

.1 Daylight Sensor *Day* Setpoint (ftcd) AV4201-4296.

.2 Daylight Sensor Night Setpoint (ftcd) AV4301-4396.

.3 Daylight Sensor Off Setpoint Delay (minutes) AV4401-4496.

.4 Daylight Sensor On Setpoint (ftcd) AV4501-4596.

.5 Daylight Sensor Off Setpoint (ftcd) AV4601-4696.

.3 Each panel shall include a digital clock capability able to issue system wide automation commands to up to (11) eleven other panels for a total of (12) twelve networked lighting control panels. The clock shall *Provide* capability for up to 254 independent schedule events per panel for each of the ninety-nine system wide channel groups.

.1 The clock capability of each panel shall support all of the energy saving features required of ASHRAE 90.1 - 2001, IECC 2003, as well as all state and local energy codes.

.2 The clock module shall *Provide* astronomic capabilities, time delays, blink warning, daylight savings, and holiday functions and will include a battery back-up for the clock function and EEPROM for program retention. Clocks that require multiple events to meet local code lighting shut off requirements shall not be allowed.

.3 The clock capability of each panel shall operate on a basis of ON/OFF or Normal Hours/After Hours messages to automation groups that implement pre-configured control scenarios. Scenarios shall include:

.1 Scheduled ON / OFF
.2 Manual ON / Scheduled OFF
.3 Astro ON / OFF (or Photo ON / OFF)
.4 Astro and Schedule ON / OFF (or Photo and Schedule ON / OFF)

.4 The user interface shall be a portable IR handheld remote control capable of programming any panel in the system.

.5 The clock capability of each panel shall employ non-volatile memory and shall retains user programming and time for a minimum of 10 years.

.6 Schedules programmed into the clock of any one panel shall be capable of executing panel local schedule or Dark/Light (photocell or Astro) events for that panel in the event that global network communication is lost. Lighting control panels that are not capable of executing events independently of the global network shall not be acceptable.

.7 The lighting control panel shall be WattStopper model LMCP8-115/347-8HD or approved equivalent.

PART 3 – EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Locate and install equipment in accordance with manufacturer's recommendations and as indicated.

3.3 Field Quality Control

.1 *Site* Tests:
 .1 Perform tests in accordance with Section 26 05 00 - Common *Work* Results for Electrical.

.2 Actuate control units in presence of York *Region* Representative to demonstrate lighting circuits are controlled as designated.

.3 Manufacturer's Field Services:
 .1 Obtain written report from manufacturer verifying compliance of *Work*, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
 .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*, as directed in PART 1 - QUALITY ASSURANCE

.4 Third Party Testing:
 .1 The contractor is responsible to *Provide* third party testing of the lighting system in accordance with ASHRAE Standard 90.1-2010, Section 9.4.4 Functional Testing. The party 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 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.
 .3 When sensors, time switches, programmable schedule controls or photosensors are installed, 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. Where an auto-on mode has been selected, lights do not turn on unless the space is occupied.

.2 Confirm that the time switches and programmable schedule controls are programmed correctly to turn the lights off.

.3 Where daylight harvesting capability has been installed, confirm that photosensor controls reduce electric light levels based on the amount of usable daylight in the space as specified.

3.4 Cleaning

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

.2 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 Reference Standards

.1 CSA International
    .1 CSA C22.2 No.29-11, Panelboards and Enclosed Panelboards.

1.3 Action And Informational Submittals

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

.2 *Product* Data:
    .1 Submit manufacturer's instructions, printed product literature and data sheets for panelboards and include product characteristics, performance criteria, physical size, finish and limitations.

.3 *Shop Drawings*:
    .1 Submit drawings.
    .2 Include on drawings:
        .1 Electrical detail of panel, branch breaker type, quantity, ampacity and enclosure dimension.

.4 Sustainable Design Submittals:
    .1 Construction Waste Management:
        .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.4 Closeout Submittals

.1 Submit in accordance with Section 01 77 00 – *Project* Closeout.

.2 Operation and Maintenance Data: submit operation and maintenance data for panelboards for incorporation into manual.

1.5 Delivery, Storage And Handling

.1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.2 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 panelboards from nicks, scratches, and blemishes.
    .3 Replace defective or damaged materials with new.

.3 Develop Construction Waste Management Plan related to *Work* of this Section.

.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 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 Panelboards

.1 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.
  .1 Install circuit breakers in panelboards before shipment.
  .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

.2 250V panelboards: bus and breakers rated for 22,000 A (symmetrical) interrupting capacity or as indicated.

.3 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

.4 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

.5 Minimum of 2 flush locks for each panel board.

.6 Two keys for each panelboard and key panelboards alike.

.7 Copper bus with neutral of same ampere rating of mains.

.8 Mains: suitable for bolt-on breakers.

.9 Trim with concealed front bolts and hinges.

.10 Trim and door finish: baked enamel air dried enamel as per colour schedule.

.11 Isolated ground bus.

.12 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.

.13 Surge Protective Devices as noted.

2.2 Breakers

.1 Breakers: to Section 26 28 16.02 - Moulded Case Circuit Breakers.

.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

.3 Lock-on devices for 10% of 15 to 30 A breakers installed as indicated. Turn over unused lock-on devices to York *Region* Representative.

.4 Lock-on devices for receptacles, fire alarm clock outlet, emergency, door supervisory, intercom, exit and night light circuits.

2.3 Equipment Identification

.1 *Provide* equipment identification in accordance with Section 26 05 00 - Common *Work* Results for Electrical.

.2 Nameplate for each panelboard size 4 engraved as indicated.

.3 Nameplate for each circuit in distribution panelboards size 2 engraved as indicated.

.4 Complete circuit directory with typewritten legend showing location and load of each circuit, mounted in plastic envelope at inside of panel door.

3 EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for panelboards installation in accordance with manufacturer's written instructions.
  - .1 Visually inspect substrate in presence of York *Region* Representative.
  - .2 Inform York *Region* Representative 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 York *Region* Representative.

3.2 Installation

.1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

.2 Install surface mounted panelboards on plywood backboards in accordance with Section 06 10 53 - Rough Carpentry. Where practical, group panelboards on common backboard.

.3 Mount panelboards to height specified in Section 26 05 00 - Common *Work* Results for Electrical or as indicated.

.4 Connect loads to circuits.

.5 Connect neutral conductors to common neutral bus with respective neutral identified.

3.3 Cleaning

.1 Progress Cleaning:
  - .1 Leave *Work* area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with

Section 01 74 19 - Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 Protection

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by panelboards installation.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 Reference Standards

.1 CSA International
  .1 CSA C22.2 No.42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
  .2 CAN/CSA C22.2 No.42.1-00(R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
  .3 CSA C22.2 No.55-M1986(R2008), Special Use Switches.
  .4 CSA C22.2 No.111-10, General-Use Snap Switches (Bi-national standard, with UL 20).

1.3 Action And Informational Submittals

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

.2 *Product* Data:
  .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.

.3 *Shop Drawings*:
  .1 Submit drawings.

.4 Sustainable Design Submittals:
  .1 Construction Waste Management:
    .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.4 Closeout Submittals

.1 Submit in accordance with Section 01 77 00 – *Project* Closeout.

.2 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

1.5 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 wiring devices from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to *Work* of this Section.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 Switches

.1 15 or 20 A, 120 V , single pole, double pole, three-way, four-way switches to: CSA C22.2 No.55 and CSA C22.2 No.111.

.2 Manually-operated general purpose AC switches with following features:
.1 Terminal holes approved for No. 10 AWG wire.
.2 Silver alloy contacts.
.3 Urea or melamine moulding for parts subject to carbon tracking.
.4 Suitable for back and side wiring.
.5 Ivory toggle.

.3 Toggle operated locking fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads and or heating loads.

.4 Switches of one manufacturer throughout project.

2.2 Receptacles

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:
.1 Ivory 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 rivetted grounding contacts.

.2 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
.1 Ivory urea moulded housing.
.2 Suitable for No. 10 AWG for back and side wiring.
.3 Four back wired entrances, 2 side wiring screws.

.3 Other receptacles with ampacity and voltage as indicated.

.4 Receptacles of one manufacturer throughout project.

2.3 Special Wiring Devices

.1 Special wiring devices:
.1 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic jewel lens flush type.

2.4 Cover Plates

.1 Cover plates for wiring devices to: CSA C22.2 No.42.1.

.2 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.

.3 Stainless steel, vertically brushed, 1 mm thick cover plates for wiring devices mounted in flush-mounted outlet box.

.4 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

.5 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.

.6 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

2.5 Source Quality Control

.1 Cover plates from one manufacturer throughout project.

PART 3 - EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wiring devices installation in accordance with manufacturer's written instructions.
   .1 Visually inspect substrate in presence of York *Region* Representative.
   .2 Inform York *Region* Representative 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 York *Region* Representative.

3.2 Installation

.1 Switches:
   .1 Install single throw switches with handle in "UP" position when switch closed.
   .2 Install switches in gang type outlet box when more than one switch is required in one location.
   .3 Mount toggle switches at height in accordance with Section 26 05 00 - Common *Work* Results for Electrical as indicated.

.2 Receptacles:
   .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
   .2 Mount receptacles at height in accordance with Section 26 05 00 - Common *Work* Results for Electrical as indicated.
   .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
   .4 Install GFI type receptacles as indicated.

.3 Cover plates:
  .1 Install suitable common cover plates where wiring devices are grouped.
  .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.3 Cleaning

.1 Progress Cleaning:
  .1 Leave *Work* area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 Protection

.1 Protect installed products and components from damage during construction.

.2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.3 Repair damage to adjacent materials caused by wiring device installation.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 Reference Standards

.1 CSA International
  - .1 CSA C22.2 No. 5-09, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, and NMX-J-266-ANCE-2010).

1.3 Action And Informational Submittals

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

.2 *Product* Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for circuit breakers and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Include time-current characteristic curves for breakers with ampacity of 100 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

.4 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.4 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 circuit breakers off ground indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
  - .2 Store and protect circuit breakers from nicks, scratches, and blemishes.
  - .3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to *Work* of this Section .

.5 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 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 Breakers General

.1 Moulded-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 moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

.3 Common-trip breakers: with single handle for multi-pole applications.

.4 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.

.5 Circuit breakers with interchangeable trips as indicated.

.6 Circuit breakers to have minimum 22,00 symmetrical rms interrupting capacity rating.

2.2 Thermal Magnetic Breakers Design A

.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to *Provide* inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 Optional Features

.1 Include:
  .1 On-off locking device.
  .2 Handle mechanism.

PART 3 - EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for installation in accordance with manufacturer's written instructions.
  .1 Visually inspect substrate in presence of York *Region* Representative.
  .2 Inform York *Region* Representative 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 York *Region* Representative.

3.2 Installation

.1 Install circuit breakers as indicated.

3.3 Cleaning

.1 Progress Cleaning:

.1 Leave *Work* area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 Reference Standards

.1 CSA International
  - .1 CAN/CSA C22.2 No.144-M91(R2006), Ground Fault Circuit Interrupters.

.2 National Electrical Manufacturers Association (NEMA)
  - .1 NEMA PG 2.2-1999(R2009), Application Guide for Ground Fault Protection Devices for Equipment.

1.3 Action And Informational Submittals_

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

.2 *Product* Data:
  - .1 Submit manufacturer's instructions, printed product literature and data sheets for ground fault circuit interrupters and include product characteristics, performance criteria, physical size, finish and limitations.

.3 *Shop Drawings*:
  - .1 Submit drawings.

.4 Test and Evaluation Reports: submit test report for field testing of ground fault equipment to York *Region* Representative and certificate that system as installed meets criteria specified.

.5 Sustainable Design Submittals:
  - .1 Construction Waste Management:
    - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.4 Closeout Submittals

.1 Submit in accordance with Section 01 77 00 – *Project* Closeout.

.2 Operation and Maintenance Data: submit operation and maintenance data for ground fault circuit interrupters for incorporation into manual.

1.5 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 ground fault circuit interrupters from nicks, scratches, and blemishes.
  .3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to *Work* of this Section.

.5 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 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 Materials

.1 Equipment and components for ground fault circuit interrupters (GFCI): to CAN/CSA C22.2 No.144 NEMA PG 2.2.

.2 Components comprising ground fault protective system to be of same manufacturer.

2.2 Breaker Type Ground Fault Interrupter

.1 Single pole ground fault circuit interrupter for 15 or 20 A, 120 V, 1 phase circuit c/w test and reset facilities.

2.3 Ground Fault Protector Unit

.1 Self-contained with 15 or 20 A, 120 V circuit interrupter and duplex receptacle complete with:
  .1 Solid state ground sensing device.
  .2 Facility for testing and reset.
  .3 CSA Enclosure 1, surface or flush mounted as required with stainless steel face plate.

PART 3 - EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for ground fault circuit interrupters installation in accordance with manufacturer's written instructions.
  .1 Visually inspect substrate in presence of York *Region* Representative.
  .2 Inform York *Region* Representative 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 York *Region* Representative.

3.2 Installation

.1 Connect supply and load wiring to equipment in accordance with manufacturer's recommendations.

3.3 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00 - Common *Work* Results for Electrical and co-ordinate with Section 01 45 00 - Quality Control if required.

.2 Arrange for field testing of ground fault equipment by *Contractor* before commissioning service.

.3 Demonstrate simulated ground fault tests.

3.4 Cleaning

.1 Progress Cleaning:
 .1 Leave *Work* area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01**.**

1.1 Reference Standards

.1 CSA Group
  .1 CAN/CSA-C22.2 No.4-04(R2009), Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162-2004 and UL 98).
  .2 CSA C22.2 No.39-13, Fuse holder Assemblies.

1.2 Action And Informational Submittals

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

.2 *Product* Data:
  .1 Submit manufacturer's instructions, printed product literature and data sheets for disconnect switches - fused and non-fused and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Sustainable Design Submittals:
  .1 Construction Waste Management:
    .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1
.3 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 disconnect switches - fused and non-fused from nicks, scratches, and blemishes.
  .3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to *Work* of this Section.

.5 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 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 Disconnect Switches

.1 Fusible, Non-fusible, Horsepower rated where required, disconnect switch in CSA enclosure 3R, to CAN/CSA-C22.2 No.4 size as indicated.

.2 Provision for padlocking in off switch position by 3 locks.

.3 Mechanically interlocked door to prevent opening when handle in ON position.

.4 Fuses: size as indicated.

.5 Fuse holders: to CSA C22.2 No.39relocatable and suitable without adaptors, for type and size of fuse indicated.

.6 Quick-make, quick-break action.

.7 ON-OFF switch position indication on switch enclosure cover.

2.2 Equipment Identification

.1 *Provide* equipment identification in accordance with Section 26 05 00 - Common *Work* Results for Electrical.

.2 Indicate name of load controlled on size 4 nameplate.

PART 3 - EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for disconnect switches - fused and non-fused installation in accordance with manufacturer's written instructions.
  .1 Visually inspect substrate in presence of York *Region* Representative.
  .2 Inform York *Region* Representative 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 York *Region* Representative.

3.2 Installation

.1 Install disconnect switches complete with fuses if applicable.

3.3 Cleaning

.1 Progress Cleaning:
  .1 Leave *Work* area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 Reference Standards

.1 International Electrotechnical Commission (IEC)
    .1 IEC 947-4-1-2002, Part 4: Electromechanical contactors and motor-starters.

1.3 Action And Informational Submittals

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

.2 *Product* Data:
    .1 *Provide* manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 *Shop Drawings*:
    .1 *Provide* shop drawings: in accordance with Section 01 33 00 - Submittal Procedures.
        .1 Submit drawings.
        .2 *Provide* shop drawings for each type of starter to indicate:
            .1 Mounting method and dimensions.
            .2 Starter size and type.
            .3 Layout and components.
            .4 Enclosure types.
            .5 Wiring diagram.
            .6 Interconnection diagrams.

1.4 Closeout Submittals

.1 *Provide* maintenance materials in accordance with Section 01 77 00 – *Project* Closeout.

.2 Submit operation and maintenance data for each type and style of motor starter for incorporation into maintenance manual.

.3 Extra Materials:
    .1 *Provide* listed spare parts for each different size and type of starter.
        .1 3 contacts, stationary.
        .2 3 contacts, movable.
        .3 1 contacts, auxiliary.
        .4 1 control transformers.
        .5 1 operating coil.
        .6 2 fuses.
        .7 10% indicating lamp bulbs used.

1.5 Delivery, Storage And Handling

.1 Deliver, store and handle in accordance with manufacturer’s recommendations.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 Materials

.1 Starters: to IEC 947-4 with AC4 utilization category.

2.2 Manual Motor Starters

.1 Single and Three phase manual motor starters of size, type, rating, and enclosure type as indicated, with components as follows:
- .1 Switching mechanism, quick make and break.
- .2 One or Three overload heaters, manual reset, trip indicating handle.

.2 Accessories:
- .1 Toggle switch: heavy duty labelled as indicated.
- .2 Indicating light: heavy duty type and colour as indicated.
- .3 Locking tab to permit padlocking in "ON" or "OFF" position.

2.3 Full Voltage Magnetic Starters

.1 Magnetic and combination magnetic starters of size, type, rating and enclosure type as indicated with components as follows:
- .1 Contactor solenoid operated, rapid action type.
- .2 Motor overload protective device in each phase, manually reset from outside enclosure.
- .3 Wiring and schematic diagram inside starter enclosure in visible location.
- .4 Identify each wire and terminal for external connections, within starter, with permanent number marking identical to diagram.

.2 Combination type starters to include fused disconnect switch with operating lever on outside of enclosure to control disconnect, and provision for:
- .1 Locking in "OFF" position with up to 3 padlocks.
- .2 Independent locking of enclosure door.
- .3 Provision for preventing switching to "ON" position while enclosure door open.

.3 Accessories:
- .1 Selector switches: heavy duty labelled as indicated.
- .2 Indicating lights: heavy duty type and Colour as indicated.
- .3 1-N/O and 1-N/C spare auxiliary contacts unless otherwise indicated.

2.4 Control Transformer

.1 Single phase, dry type, control transformer with primary voltage as indicated and 120 V secondary, complete with secondary fuse, installed in with starter as indicated.

.2 Size control transformer for control circuit load plus 20% spare capacity.

2.5 Accessories

.1 Pushbutton: heavy duty, oil tight as required.

.2 Selector switches: heavy duty, oil tight as required.

.3 Indicating lights: heavy duty, oil tight, type and colour as indicated.

2.6 Finishes

.1 Apply finishes to enclosure in accordance with Section 26 05 00 - Common *Work* Results for Electrical.

2.7 Equipment Identification

.1 *Provide* equipment identification in accordance with Section 26 05 00 - Common *Work* Results for Electrical.

.2 Manual starter designation label, white plate, black letters, size 1, engraved as indicated.

.3 Magnetic starter designation label, white plate, black letters, size 3 engraved as indicated.

PART 3 - EXECUTION

3.1 Installation

.1 Install starters and control devices in accordance with manufacturer's instructions.

.2 Install and wire, starters and controls as indicated.

.3 Ensure correct fuses installed.

.4 Confirm motor nameplate and adjust overload device to suit.

3.2 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00 - Common *Work* Results for Electrical and manufacturer's instructions.

.2 Operate switches and contactors to verify correct functioning.

.3 Perform starting and stopping sequences of contactors and relays.

.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.

3.3 Cleaning

.1 Cleaning:
    .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

PART 1 GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

.2 It is the intent of this specification to secure an engine-driven generator set that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.

.3 Any exceptions to the published specifications shall be subject to the approval of the engineer.

.4 It is the intent of this specification to secure a generator set system that has been tested during design verification, in production, and at the final job site. The generator set will be a commercial design and will be complete with all of the necessary accessories for complete installation as shown on the plans, drawings, and specifications herein. The equipment supplied shall meet the requirements of the Ontario Electrical Safety Code and applicable local codes and regulations.

.5 All equipment shall be new and of current production by an international, power system manufacturer of generators and transfer switches. The manufacturer shall be a supplier of a complete and coordinated system. There will be single-source responsibility for warranty, parts, and service through a factory-authorized representative with factory-trained technicians.

.6 The equipment shall be produced by a manufacturer that is ISO 9001 certified for the design, development, production and service of its complete product line.

.7 The generator manufacturer shall maintain a service organization that is available 24 hours per day throughout the year and has produced this type of equipment for at least 10 years.

1.2 Action and Informational SUBMITTALS

.1 Action Submittals
- .1 *Product* Data
  - .1 The submittal shall include prototype test certification and specification sheets showing all standard and optional accessories to be supplied; schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch, and the remote annunciator panel if it is included elsewhere in these specifications.

1.3 Reference Standards

.1 CSA C22.2, No. 14-M91 Industrial Control Equipment.

.2 EN50082-2, Electromagnetic Compatibility-Generic Immunity Requirements, Part 2: Industrial.

.3 EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.

.4 IEC8528 part 4, Control Systems for Generator Sets.

.5 IEC Std 61000-2 and 61000-3 for susceptibility, 61000-6 radiated and conducted electromagnetic emissions.

.6 IEEE446 Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.

.7 CSA-282-15 Emergency Electrical Power Supply for Buildings. The generator shall include emergency lighting, dampers, heaters and a distribution panel in accordance with this standard. All requirements of this standard shall be met by the generator including alarms, shutdowns, and indications shown on Table 2 of the standard.

.8 CSA-149.1-10 National Gas and Propane Installation Code.

.9 IBC and OSHPD seismic certification.

1.4 Delivery, Storage and Handling

.1 Deliver, store and handle materials in accordance with Section 01 61 00 – Common *Product* Requirements 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 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 19 – Waste Management and Disposal.

1.5 Warranty and Maintenance

.1 The generator set shall include a standard one-year warranty to guarantee against defective material and workmanship in accordance with the manufacturer’s published warranty from date of start-up. Optional warranties shall be available upon request.

.2 The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner’s maintenance log of repairs made and function tests performed on all systems.

PART 2 – PRODUCTS

2.1 Equipment

1. The generator set shall be a Kohler model KG150 with a 4S12X alternator. It shall *Provide* 187.50 kVA and 150.00 kW when operating at 120/208 volts, 60 Hz, 0.80 power factor. The generator set shall be capable of a 130°C Standby @40C rating while operating in an ambient condition of less than or equal to 104 °F and a maximum elevation of 500 ft above sea level. The standby rating shall be available for the duration of the outage.

.1 Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying 400.00 LRKVA for starting motor loads with a maximum instantaneous voltage dip of 35%, as measured by a digital RMS transient recorder in accordance with IEEE Standard 115. Motor starting performance and voltage dip determination that does not account for all components affecting total voltage dip, i.e., engine, alternator, voltage regulator, and governor will not be acceptable. As such, the generator set shall be prototype tested to optimize and determine performance as a generator set system.

.2 *Provide* vibration isolators between the engine alternator and heavy duty steel base.

2.2 Engine

.1 The minimum 10.3-liter displacement engine shall deliver a minimum of 329 HP at a governed engine speed of 1800 rpm, and shall be equipped with the following:

- .1 Electronic isochronous governor capable of .75% steady-state frequency regulation
- .2 12-volt positive-engagement solenoid shift-starting motor
- .3 130-ampere automatic battery charging alternator with a solid-state voltage regulation and negative ground polarity
- .4 Positive displacement, full-pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain
- .5 Dry-type replaceable air cleaner elements for normal applications
- .6 The engine shall be turbocharged and fueled by Natural Gas
- .7 Operating fuel pressure for natural gas shall be between 7.0 and 11.0 inches of H20
- .8 Natural gas fuel consumption at 100% load shall not exceed 1873.5 cubic feet per hour when operating in standby configuration
- .9 The exhaust manifold shall be dry.
- .10 Exhaust flow shall not exceed 1081 cubic feet per minute at rated kW.
- .11 Exhaust temp shall not exceed 1287F at rated kW.
- .12 The engine shall have a minimum of 8 cylinders in a V configuration and be liquid-cooled

.2 The engine shall be EPA certified from the factory

.3 The generator must accept rated load in one-step.

2.3 Alternator

.1 The alternator shall be salient-pole, brushless, 2/3-pitch, with 4 bus bar provision for external connections, self-ventilated, with drip-proof construction and amortisseur rotor windings, and skewed for smooth voltage waveform. The ratings shall meet the NEMA standard (MG1-32.40) temperature rise limits. The insulation shall be class H per UL1446 and the varnish shall be a vacuum pressure impregnated, fungus resistant epoxy. Temperature rise of the rotor and stator shall be limited to 130°C Standby. The PMG based excitation system shall be of brushless construction controlled by a digital, three phase sensing, solid- state, voltage regulator. The AVR shall be capable of proper operation under severe nonlinear loads and *Provide* individual adjustments for voltage range, stability and volts-per-hertz operations. The AVR shall be protected from the environment by conformal coating. The waveform harmonic distortion shall not exceed 5% total RMS measured line-to-line at full rated load. The TIF factor shall not exceed 50.

.2 The alternator shall have a maintenance-free bearing, designed for 40,000 hour B10 life. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.

.3 The generator shall be inherently capable of sustaining at least 300% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current-support devices.

.4 Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying 400.00 LRKVA for starting motor loads with a maximum instantaneous voltage dip of 35%, as measured by a digital RMS transient recorder in accordance with IEEE Standard 115. Motor starting performance and voltage dip determination that does not account for all components affecting total voltage dip, i.e., engine, alternator, voltage regulator, and governor will not be acceptable. As such, the generator set shall be prototype tested to optimize and determine performance as a generator set system.

2.4 Vibration Isolation

.1 Vibration isolators shall be provided between the engine-alternator and heavy-duty steel base.

2.5 Controller

.1 The controller shall include an alarm horn as required by NFPA and shall meet the requirement of CSA-282-15

.2 UL 508 listed.

.3 Alarms, shutdowns and indications as per Table 2 of CSA-282-15

.4 Shall include a key switch to meet local code requirements and shall be removable only in the AUTO position.

.5 Advanced Power Management 402 (APM402) Generator Set Controller

1. The generator set controller shall be a microprocessor-based control system that will *Provide* automatic starting, system monitoring, and protection.
2. The controller shall be mounted on the generator set and shall have integral vibration isolation. The controller shall be prototype and reliability tested to ensure operation in the conditions encountered.

.6 Codes and Standards

1. The generator set controller shall meet NFPA 110 Level 1 requirements and shall include an integral alarm horn as required by NFPA.
2. The controller shall meet NFPA 99 and NEC requirements.
3. The controller shall be UL 508 recognized.

.7 Applicability

1. The controller shall be a standard offering in the manufacturer's controller product line.
2. The controller's environmental specification shall be: -40°C to 70°C operating temperature range and 5-95% humidity, non-condensing.

.8 Controller Buttons, Display, and Components

1. The generator set controller shall include the following features and functions:
    1. Master Control Push Buttons – the buttons shall be tactile-feel membrane with an indicator light to initiate the following functions:
        1. Run Mode – when in Run mode the generator set shall start.
        2. Off/Reset Mode – when in Off/Reset mode, the generator set shall not accept any remote start commands and shall be capable of resetting all faults, allowing for the restarting of the generator set after a shutdown.
        3. Auto Mode – when in Auto mode, the generator set shall be ready to accept a signal from a remote device.
    2. Emergency Stop Switch – the latch type stop switch shall be red in color with a “mushroom” type head. Depressing the stop button will immediately stop the generator set and lockout the generator set for any automatic remote starting.
    3. Alarm Horn – the horn sounds when any faults or warnings are present. The horn shall also sound when the controller in not in the Auto mode.
    4. Push Button/Rotary Selector Dial – the dial shall be used for selection of all menus and sub-menus. Rotating the dial moves through the menus, pushing the dial selects the menu and function/features in the menu.
    5. Display – the digital display shall be alphanumeric, with 2 lines of data and approximately 24 characters. The display shall have back lighting for ease of operator use in high and low light conditions. The display shall enter a sleep mode to reduce the demand on the battery when the generator set is not running, and the rotary dial is not in use for a period of time. The generator will wake up from sleep mode when the generator set starts, or the rotary dial is in use.
    6. Fault Light – the controller shall have an annunciator fault light that glows red for faults and yellow for warnings. The warning light will also illuminate when not in Auto.
    7. Alarm Silence/Lamp Test Button – when this button is held, it shall test all controller lamps. This button will also silence the alarm horn when the unit is not Auto or has a fault.
    8. Mini-USB Connection – the controller shall have a mini-USB connection port for a PC connection that is accessible on the front of the control panel without having to open any electrical enclosure panels on the generator. This connection shall allow a certified technician to service the generator controller using a dedicated PC program. The program shall allow for servicing of generator set parameters, faults diagnostics and viewing of controller information. The program shall allow for uploading of software and firmware as well as downloading of parameter settings and the event log.

.9 Controller Engine Control Features and Functions
1. User-programmable time delay for engine start.
2. User-programmable time delay engine cool down.
3. Capability to start and run at user-adjustable idle speed during warm-up for a selectable time-period until engine reaches preprogrammed temperature.
4. The idle function including engine cooldown at idle speed.
5. Output with adjustable timer for an ether injection starting system.
6. Programmable cyclic cranking that can adjust on time, off time, and number of cycles.

.10 Controller Alternator Control Features and Functions
1. Patented High-speed RMS Digital Voltage Regulation – the system shall have integral microprocessor-based voltage regulator system that provides + 0.5% voltage regulation no-load to full load with three phase sensing. A separate voltage regulator is not acceptable. The digital voltage regulator shall be applicable to single- or three-phase systems. The system shall be prototype tested and control variation of voltage to frequency. The voltage regulator shall be adjustable at the controller with maximum + 10% adjustable of nominal voltage.
2. Alternator Thermal Overload Protection – the system shall have integral alternator overload and short circuit protection matched to each alternator for the particular voltage and phase configuration.

.11 Other Control Features and Functions
1. Event Logging – the controller keeps a record of up to 1,000 events with date and time locally for warning and shutdown faults. This event log can be downloaded onto a PC through the service program.

.12 Control Monitoring Requirements
1. The generator controller shall display and monitor the following engine and alternator functions.
    1. The following generator set functions shall be monitored:
        1. All output voltages - single phase, three phases, line to line, and line to neutral
        2. All single phase and three phase currents
        3. Output frequency
        4. kVA total and per phase
        5. kW hours
    2. Engine parameters listed below shall be monitored (engine dependent):
        1. Engine Speed
        2. Oil Pressure
        3. Coolant Temperature
        4. Battery Voltage
        5. Runtime Hours
    3. Operational records shall be stored in the control beginning at system start-up
        1. Total Run Time Hours
        2. Total Loaded Hours
        3. Total kW Hours
        4. Number of Starts

.13 Generator Set Warning, Shutdown Alarm and Status

1. The generator set shall have alarms and status indication lamps that show Non-Automatic Status, Warning, and Shutdown conditions. The controller shall indicate with a warning lamp and/or alarm, and on the digital display screen any shutdown, warning, or engine fault condition that exists in the generator set system.
2. All shutdowns and alarms to meet CSA-282-19
3. Conditions, as a minimum, resulting in generator shutdown (engine dependent):
    1. AC Sensing Loss
    2. Alternator Protection
    3. ECM Address Conflict
    4. ECM Communications Loss
    5. ECM DTCs
    6. Emergence Stop
    7. Overspeed
    8. Underspeed
    9. High Coolant Temperature
    10. kW Overload
    11. Locked Rotor
    12. Loss of Fuel
    13. Low Coolant Level
    14. Low Engine Oil Level
    15. Low Fuel Level
    16. Low Oil Pressure
    17. No Coolant Temperature Signal
    18. No Oil Pressure Signal
    19. Overcrank
    20. Overfrequency
    21. Underfrequency
    22. Overvoltage
    23. Undervoltage
4. Conditions, as a minimum, resulting in generator warning (generator will continue to operate) (engine dependent):
    1. AC Sensing Loss (short period of time)
    2. Battery Charger Communication Loss
    3. Battery Charger Fault
    4. Battery Fault
    5. Low Fuel Pressure
    6. High Battery Voltage
    7. Low Battery Voltage
    8. Low Cranking Voltage
    9. High Coolant Temperature
    10. Low Coolant Temperature
    11. Low Engine Oil Level
    12. Low Oil Pressure
    13. Not in Auto
    14. Speed Sensor Fault

.14 Inputs and Outputs

1. Standard Dedicated User Inputs – the controller shall have dedicated inputs for:
    1. Two-Wire Input
        1. Remote Engine Start
    2. Digital Input - Fixed

1. Auxiliary Fault (Shutdown)
2. Remote Emergency Stop

3. Digital Input – Programmable
    1. 3 Dry Contact

2. Standard Dedicated User Outputs – the controller shall have dedicated outputs for:
    1. Relay Driver Output - Programmable
        1. 1 Relay

3. Optional Configurable User Inputs and Outputs
    1. User Configurable Inputs
        1. 2 Dry Contact Digital
    2. User Configurable Relay Outputs
        1. 5 NO/NC Relays

.15 Communications

1. CAN
    1. If the generator set engine is equipped with an ECM, the controller shall communicate with the ECM for control, monitoring, diagnosis, and meet SAE J1939 standards.
2. Modbus®
    1. Isolated for Modbus devices
    2. Generator Overcurrent and Fault Protection

2.6 Accessories

.1 Air Restriction Indicator. The air cleaner restriction indicator shall indicate the need for maintenance of the air cleaners.

.2. Battery Charger. The generator set shall be supplied with a 10-ampere automatic float/equalize battery charger capable of charging both lead-acid and ni-cad type batteries, with the following features:

1. Automatic 3-stage float to equalization charge
2. Voltage regulation of 1% from no to full load over 10% AC input line voltage variations
3. Battery charging current Ammeter and battery voltage voltmeter with 5% full-scale accuracy
4. LED lamp for power ON indication
5. Current limited during engine cranking, short circuit, and reverse polarity conditions
6. Temperature compensated for ambient temperatures for -40°C to 60°C
7. Alarm circuit board featuring alarm contacts for low battery voltage, high battery voltage, and battery charger malfunction.
8. UL 1012 Listed
9. CSA Certified

.3 Battery Rack and Cables. Battery rack and battery cables capable of holding the manufacturer's recommended batteries shall be supplied.

.4 Circuit Breaker. The generator shall come with a primary, factory installed, 100% rated line circuit breaker of 200 amperes that is UL2200 listed. Line circuit breakers shall be sized for the rated ampacity of the genset. Load side lugs shall be provided from the factory. The line circuit breaker shall include auxiliary contacts, shunt trip, undervoltage trip, alarm switch, and overcurrent switch functionality. Load side breaker connections made at the factory shall be separated from field connections. When GFI breakers are required, additional neutrals shall be factory installed.

.5 Dry Contact Kits. The 10 Dry Contact Kit shall *Provide* normally open and normally closed, gold-plated contacts in a form C configuration to activate warning devices and other customer-provided accessories allowing remote monitoring of the generator set. Typically, lamps, audible alarms, or other devices signal faults or status conditions.

.6 Failure Relay.

1. The common failure relay shall remotely signal auxiliary faults, emergency stop, high engine temperature, low oil pressure, over-crank, and overspeed via one single-pole, double-throw relay with 10 amps at 120 VAC contacts.
2. The relay contacts shall be gold flashed to allow use of low current draw devices (100ma @ 28VDC min.).
3. Once energized the relay shall remain latched until the system is reset by the main controller switch.

.7 Remote Annunciator Panel. The remote annunciator shall meet CSA-282-15 Table 2 requirements and enable remote viewing of the generator status. The panel shall be connected to the generator controller via either network communication wires or via hard wired connections. Options shall be available to *Provide* ATS source availability, contactor position, and loaded or unloaded test for up to four transfer switches. The panel shall have the capability to be either flush- mounted or surface-mounted. The annunciator shall meet UL508 requirements.

.8 Rodent Guards. Generator rodent guards shall prevent intrusion and protect internal components.

.9 Run Relay. The run relay shall *Provide* a three-pole, double-throw relay with 10-amp/ 250 VAC contacts to indicate that the generator is running. The relay provides three sets of dry contacts for energizing or de-energizing customer devices while the generator is running (e.g. louvers, indicator lamps, etc.)

.10 Skid End Caps. The generator shall include skid end caps.

.11 Standard Air Cleaner. The air cleaner shall *Provide* engine air filtration which meets the engine manufacturer's specifications under typical operating conditions.

.12 Block Heater. The block heater shall be thermostatically controlled and sized to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements CSA-282-15

2.7 Sound Enclosure

.1 The enclosure shall be constructed from high strength, Aluminum Sound Attenuated Enclosure, providing a sound level of 69.1 dB(A) while the generator is operating at 100% load at 7 meters (23 feet) using acoustic insulation and internally mounted and insulated muffler.

.2 The acoustic insulation used shall meet UL 94 HF1 flammability classification.

The enclosure shall be manufactured from bolted panels to facilitate service, future modifications, or field replacement. The enclosure shall use a vertically louvered air inlet and outlet hood with 90-degree angle to discharge air up and reduce noise. The enclosure shall have an integral rodent guard and skid end caps. The snow load rating shall be 70 lbs./ sq. ft. or greater. The enclosure components and skid shall be cleaned with a two-stage alkaline cleaning process to remove grease, grit, and grime from parts. Components shall then be subjected to a Zirconium-based conversion coating process to prepare the metal for electrocoat (e-coat) adhesion. All enclosure parts shall receive an 100% epoxy primer electrocoat (e-coat) with high-edge protection. Following the e-coat process, the parts shall be finish coated with powder baked paint for superior finish, durability, and appearance with a Power ArmorTM industrial finish that provides heavy duty durability in harsh conditions, and is fade-, scratch- and corrosion-resistant.

.3 The enclosure must surpass a 3,000-hour salt spray corrosion test per ASTM B-1117. The enclosure shall be finish coated with powder baked paint for superior finish, durability and appearance. Enclosures will be finished in the manufacturer's standard color.

.4 The enclosure shall be equipped with sufficient side and end doors to allow access for operation, inspection, and service of the unit and all options. Minimum requirements are two doors per side. When the generator set controller faces the rear of the generator set, an additional rear facing door is required. Access to the controller and main line circuit breaker must meet the requirements of the Ontario Electric Code.

.5 Doors shall be equipped with lockable latches. Locks must be keyed alike.

.6 A duct between the radiator and air outlet shall be provided to prevent re-circulation of hot air.

.7 The complete exhaust system shall be internal to the enclosure.

.8 All acoustical insulation shall be fixed to the mounting surface with pressure sensitive adhesive or mechanically fastened. In addition, all acoustical insulation mounted on a horizontal plane shall be mechanically fastened. The acoustical insulation shall be flame retardant.

.9 The enclosure shall include an exhaust scoop to direct the cooling air in a vertical direction.

.10 The enclosure shall include a mounted load centre to be fed from the buildings normal electrical supply. The load centre shall include individual feeder breakers pre-wired to all engine and enclosure electrical devices requiring normal supply power including, but not limited to: block heater, battery heater, battery charger, enclosure space heater, enclosure dampers, and 2-hour battery back-up emergency light pack (as specified in CSA-282-15.)

.11 The enclosure dampers and space heater shall be configured so as to keep the interior space of the enclosure at 10°C at all times when the engine is not running. Dampers shall be installed in a fail-safe to open configuration. The dampers shall be configured to open upon failure of normal power. Dampers shall also be configured to open upon engine running, regardless of the condition of normal supply power.

.12 If the plans show the generator is not being installed on a solid concrete pad and will be elevated in any way such the bottom of the generator set enclosure will be open to the elements, *Provide* a solid sheet metal bottom to the enclosure. The solid bottom shall be installed in such a way that it does not compromise the enclosure heating, engine cooling, or sound emissions of the unit, while also preventing rodent intrusions.

2.7 Source Quality Control

.1 Non-Conforming *Work*

1. To ensure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer and/or local representative shall be responsible for three separate tests: design prototype tests, final production tests, and site tests.

.2 Design Prototype Tests. Components of the emergency system, such as the engine/generator set, transfer switch, and accessories, shall not be subjected to prototype tests because the tests are potentially damaging. Rather, similar design prototypes and preproduction models shall be subject to the following tests:

1. Maximum power (kW)
2. Maximum motor starting (kVA) at 35% instantaneous voltage dip.
3. Alternator temperature rise by embedded thermocouple and/or by resistance method per NEMA MG1-32.6.
4. Governor speed regulation under steady-state and transient conditions.
5. Voltage regulation and generator transient response.
6. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
7. Three-phase short circuit tests.
8. Alternator cooling air flow.
9. Torsional analysis to verify that the generator set is free of harmful torsional stresses.
10. Endurance testing.

.3 Final Production Tests. Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:

1. Single-step load pickup
2. Safety shutdown device testing
3. Rated Power @ 0.8 PF
4. Maximum power
5. Upon request, a witness test, or a certified test record sent prior to shipment.

.4 *Site* Tests. The manufacturer's distribution representative shall perform an installation check, startup, and building load test. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:

1. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
2. Accessories that normally function while the set is standing by shall be

checked prior to cranking the engine. These shall include: block heaters, battery chargers, alternator strip heaters, remote annunciators, etc.

3. Generator set startup under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during operation, normal and emergency line-to-line voltage and frequency, and phase rotation.
4. Automatic start by means of a simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator set voltage, amperes, and frequency shall be monitored throughout the test.
5. Perform all tests required by CSA-282-15.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 Qualifications

.1 Transfer switch producer shall be ISO 9001 certified and have produced this type of equipment for at least 10 years.

.2 The manufacturer must have a service organization available 24 hours per day, 365 days of the year.

1.3 Reference Standards

.1 UL Standards

- .1 UL 1008 – Standard for Transfer Switch Equipment

.2 CSA International

- .1 CSA C22.2 No.5-09, Moulded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, NMX-J-266-ANCE-2010).
- .2 CSA C22.2 No.178.1-2007, Automatic Transfer Switches.
- .3 CAN/CSA C60044-1-07, Instrument Transformers.
- .4 CSA/C282 (current edition) Emergency Electrical Power Supply for Buildings.

.3 National Electrical Manufacturers Association (NEMA)

- .1 NEMA ICS 2-1996(R2009), Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC, Part 8: Disconnect Devices for Use in Industrial Control Equipment.
- .2 NEMA Standard ICS-2005, Electromechanical AC Transfer Switch Equipment

.4 IEC Standards

- .1 IEC 947-6-1 Low-Voltage Switchgear and Control Gear; Multifunction equipment; Automatic Transfer Switching equipment EN55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.

1.4 Action And Informational Submittals

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

.2 *Product* Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for transfer switches and include product characteristics, performance criteria, physical size, finish and limitations.

.3 *Shop Drawings*:
  .1 Submit drawings.
    .1 Indicate on drawings:
      .1 Make, model and type.
      .2 Load classification:
        .1 Tungsten lamp load: kW.
        .2 Ballast lamp load: kW.
        .3 Motor load: kW.
        .4 Restricted use: resistance and general loads, 0.8 pf or higher kW.
      .3 Single line diagram showing controls and relays.
      .4 Description of equipment operation including:
        .1 Automatic starting and transfer to standby unit and back to normal power.
        .2 Test control.
        .3 Manual control.
        .4 Automatic shutdown.

.4 Sustainable Design Submittals:
  .1 Construction Waste Management:
    .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.5 Closeout Submittals

.1 Submit in accordance with Section 01 77 00 – *Project* Closeout.

.2 Operation and Maintenance Data: submit operation and maintenance data for transfer switches for incorporation into manual.

.3 Detailed instructions to permit effective operation, maintenance and repair.

.4 Technical data:
  .1 Schematic diagram of components, controls and relays.
  .2 Illustrated parts lists with parts catalogue numbers.
  .3 Certified copy of factory test results.

1.6 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 transfer switches from nicks, scratches, and blemishes.
  .3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan Waste Reduction Workplan related to *Work* of this Section.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 19 - Waste Management and Disposal.

1.7 Manufacturer's

.1 A factory trained service organization shall be maintained by the manufacturer that is on call 24 hours a day, 365 days per year.

.2 Records of the transfer switch shall be maintained by serial number for a minimum of 20 years.

.3 The transfer switch manufacturer shall be responsible for the design, coordination, and testing of the complete system.

PART 2 - PRODUCTS

2.1 System Description

.1 Automatic load transfer equipment to:
- .1 Monitor voltage on phases of normal power supply.
- .2 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.
- .3 Transfer load from normal supply to standby unit when standby unit reaches rated frequency and voltage pre-set adjustable limits.
- .4 Transfer load from standby unit to normal power supply when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period.
- .5 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

2.2 Materials

.1 Instrument transformers: to CAN/CSA C60044-1.

.2 Contactors: to NEMA ICS2.

2.3 Circuit Breaker Type Transfer Equipment

.1 Circuit Breaker Type Transfer Equipment: to CSA C22.2 No.5.

.2 Rated: 208 V, 60Hz, 600 A, 4 wire, solid neutral.
- .1 Fault withstand rating: 25 kA symmetrical for 3 cycles with maximum peak value of 25 kA.
- .2 Double-throw, mechanically interlocked design (break before make power contacts)
- .3 NEMA type 1 enclosure
- .4 IBC and OSHPD seismic certification.
- .5 Electrically operated, mechanically held mechanism.
- .6 Silver alloy main contacts
- .7 Operated by a momentarily energized solenoid driven mechanism.
- .8 Standard transition operation with either automatic or non-automatic control.

.9 Front Accessible contacts for easy inspection
.10 Internal manual operating handle.
.11 Designs utilizing components of moulded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources, are not acceptable.
.12 *Provide* Kohler Model KCS, Transfer Switch
.13 The ATS shall be the same manufacturer as the generator set for maximum compatibility and single source supply.
.14 Auxiliary contact: to initiate emergency generator start-up on failure of normal power.

2.4 Controls

.1 LCD Display, 4 lines x 20 characters, backlit

.2 Complete programming and viewing capability at the door using the keypad and LCD display.

.3 LED Indicator: source available, transfer switch position, service required (fault), and ‘not-in-auto’

.4 Programmable voltage and frequency pickup and dropout settings.

.5 Programmable time delays

.6 Time-based load control

.7 Two programmable inputs and two programmable outputs.

.8 Able to accept up to four I/O extension modules

.9 Modbus communication

.10 RS-485 communication

.11 Ethernet communication

.12 Kohler Decision Maker MPAC 1200 Controller

2.5 Accessories

.1 Programmable Exerciser: A programmable exerciser shall be supplied to allow programming of up to 56 on/off events.

2.6 Equipment Identification

.1 Identify equipment in accordance with Section 26 05 00 - Common *Work* Results for Electrical.

2.7 Warranty

.1 Manufacture Warranty
  .1 The ATS shall include a standard warranty covering two (2) years or

2000 hours, whichever occurs first, to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from the date of initial startup.

.2 The ATS manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall regularly engage in maintenance contract programs to perform preventive maintenance and service on equipment similar to that specified. A service agreement shall be available and shall include system operation under simulated operating conditions; adjustment to the generator set, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and functional tests performed on all systems.

PART 3 - EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for transfer switches installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of York *Region* Representative.

.2 Inform York *Region* Representative 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 York *Region* Representative.

3.2 Installation

.1 Locate, install and connect transfer equipment as indicated.

.2 Check relays solid state monitors and adjust as required to ensure correct operation.

.3 Install and connect battery and remote alarms.

3.3 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00 - Common *Work* Results for Electrical.

.2 Energize transfer equipment from normal power supply.

.3 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.

.4 Set selector switch in "Manual" position and check to ensure proper performance.

.5 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.

.6 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for 10 minutes, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown.

.7 Repeat, at 1 hour intervals, times, complete test with selector switch in each position, for each test.

3.4 Cleaning

.1 Progress Cleaning:
 .1 Leave *Work* area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
 .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 Source Quality Control

.1 Test and Inspection
 .1 Upon request, the manufacturer shall *Provide* a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specification, other than those stipulated at the time of the submittal, shall be included in the certification.
 .2 The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, installation and servicing in accordance with ISO 9001

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 Reference Standards

.1 American National Standards Institute (ANSI)
  - .1 ANSI C82.1-04, Lamp Ballasts-Line Frequency Fluorescent Lamp Ballast.
  - .2 ANSI C82.4-02(R2007), Ballasts for High-Intensity-Discharge and Low-Pressure Sodium Lamps Multi Supply Type.

.2 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
  - .1 ANSI/IEEE C62.41-1991, Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.

.3 ASTM International Inc.
  - .1 ASTM F 1137-00(2006), Standard Specification for Phosphate/Oil and Phosphate/Organic Corrosion Protective Coatings for Fasteners.

.4 CSA Group (CSA)

.5 ICES-005-07, Radio Frequency Lighting Devices.

.6 Underwriters' Laboratories of Canada (ULC)

1.3 Action And Informational Submittals

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

.2 *Product* Data:
  - .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 luminaires where specified, for approval review by York *Region* Representative.
  - .3 Photometric data to include: VCP Table where applicable spacing criterion.

.3 Quality assurance submittals: *Provide* following in accordance with Section01 45 00 - Quality Control.
  - .1 Manufacturer's instructions: *Provide* manufacturer's written installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.4 Quality Assurance

.1 *Provide* mock-ups in accordance with Section 01 45 00 - Quality Control.

1.5 Delivery, Storage And Handling

.1 Deliver, store and handle materials in accordance with manufacturer’s recommendations.

.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets crates padding and packaging materials in accordance with Section 01 74 19 - Waste Management and Disposal.

.4 Divert unused metal materials from landfill to metal recycling facility.

PART 2 - PRODUCTS

2.1 LED Fixtures

.1 3500K CCT

.2 Minimum 85 Colour Rendering Index (CRI)

.3 Exterior LED fixtures shall have a minimum warranty of 5 years for LED and driver and a minimum L70 of 70,000 hours when tested to IESNA LM 79 standard at ambient temperature of 25 degrees C.

2.2 Finishes

.1 Light fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

2.3 Optical Control Devices

.1 As indicated in luminaire schedule.

2.4 Luminaires

.1 As indicated in luminaire schedule.

PART 3 - EXECUTION

3.1 Installation

.1 Locate and install luminaires as indicated.

.2 *Provide* adequate support to suit ceiling system.
.

3.2 Wiring

.1 Connect luminaires to lighting circuits:
  .1 Install flexible or rigid conduit for luminaires as indicated.

3.3 Luminaire Supports

.1 For suspended ceiling installations support luminaires independently of ceiling.

3.4 Luminaire Alignment

.1 Align luminaires mounted in continuous rows to form straight uninterrupted line.

.2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.5 Cleaning

.1 Cleaning:
  .1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 Reference Standards

.1 CSA Group (CSA)
  .1 CSA C22.2 No.141-10, Emergency Lighting Equipment.

1.3 Action And Informational Submittals

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

.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.

.3 Sustainable Design Submittals:
  .1 Construction Waste Management:
    .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.4 Closeout Submittals

.1 Submit in accordance with Section 01 77 00 – *Project* Closeout.

.2 Operation and Maintenance Data: submit operation and maintenance data for emergency lighting for incorporation into manual.

1.5 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.

.4 Develop Construction Waste Management Plan, related to *Work* of this Section.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan Waste Reduction Workplan in accordance with Section 01 74 19 -

Waste Management and Disposal.

2 PRODUCTS

2.1 Equipment

.1 Emergency lighting equipment: to CSA C22.2 No.141.

.2 Supply voltage: 120 V, AC.

.3 Output voltage: 12 V DC.

.4 Operating time: 30 minutes.

.5 Battery: sealed, maintenance free.

.6 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.

.7 Solid state transfer circuit.

.8 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.

.9 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.

.10 Lamp heads: integral on unit and remote, 345 degrees horizontal and 180 degrees vertical adjustment. Lamp type: LED, 5W.

.11 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit. Removable or hinged front panel for easy access to batteries.

.12 Finish: white.

.13 Auxiliary equipment:
 .1 Test switch.
 .2 Time delay relay.
 .3 Battery disconnect device.
 .4 AC input and DC output terminal blocks inside cabinet.
 .5 Shelf or Bracket.
 .6 Cord and single twist-lock plug connection for AC.
 .7 RFI suppressors.

2.2 Wiring Of Remote Heads

.1 Conduit: type EMT, in accordance with Section 26 05 34 - Conduits, Conduit Fastenings and Conduit Fittings.

.2 Conductors: RW90 type in accordance with Section 26 05 21 - Wires and Cables (0-1000 V), sized as indicated in accordance with manufacturer's recommendations.

PART 3 - EXECUTION

3.1 Examination

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for emergency lighting installation in accordance with manufacturer's written instructions.
  .1 Visually inspect substrate in presence of York *Region* Representative.
  .2 Inform York *Region* Representative 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 York *Region* Representative.

3.2 Installation

.1 Install unit equipment and remote mounted fixtures.

.2 Direct heads.

.3 Connect exit lights to unit equipment.

3.3 Cleaning

.1 Progress Cleaning:
  .1 Leave *Work* area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 Protection

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by emergency lighting installation.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the *Contract Documents*, including sections of Division 01.

1.2 Reference Standards

.1 CSA Group
  .1 CSA C22.2 No.141-15, Emergency Lighting Equipment.
  .2 CSA C860-11(R2016), Performance of Internally-Lighted Exit Signs.

.2 National Fire Protection Association (NFPA)
  .1 NFPA 101-2015, Life Safety Code.

.3 International Organization for Standardization (ISO)
  .1 ISO 3864-1 2011, Graphical symbols - Safety colours and safety signs - Part 1: Design principles for safety signs and safety markings.
  .2 ISO 7010 2011, Safety colours and safety signs - Registered safety signs.

1.3 Action And Informational Submittals

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

.2 *Product* Data:
  .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Submit WHMIS MSDS - Material Safety Data Sheets.

.4 Quality Assurance Submittals: submit following in accordance with Section01 45 00 - Quality Control.
  .1 Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

1.4 Waste Management And Disposal

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

PART 2 - PRODUCTS

2.1 Self-Powered Units

.1 Exit lights: to CSA C22.2 No.141 and CSA C860.

.2 Housing: extruded aluminum housing.

.3 Face and back plates: extruded aluminum.

.4 Lamps: LED-3W, 100,000 hours.

.5 Green Pictogram 'Running Man' type.

.6 Supply voltage: 120 V, ac.

.7 Operating time: 120 minimum.

.8 Recharge time: 12 hours

.9 Battery: sealed, maintenance free, nickel-cadmium.

.10 Charger: solid state, voltage/current regulated, inverse temperature compensated, short circuit protected, with regulated output of plus or minus 0.01 V for plus or minus 10% V input variation.

.11 Solid state transfer circuit.

.12 Signal lights: solid state, for 'AC Power ON' and 'High Charge' condition.

.13 Mounting: suitable for universal mounting directly on junction box and c/w knockouts for conduit.
  .1 Removable or hinged front panel for easy access to batteries.

.14 Cabinet: finish: white.

.15 Auxiliary equipment:
  .1 Lamp disconnect switch.
  .2 Test switch.
  .3 AC/DC output terminal blocks inside cabinet.
  .4 Cord and single twist-lock plug connection for AC power supply.

2.2 Design (X1)

.1 wall, end to wall, ceiling mounting.

.2 Single or Double face as indicated on drawings.

.3 Arrow: right, left knock-outs.

PART 3 - EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

.1 Install exit lights to manufacturer's recommendations, listing requirements, NFPA standard and local regulatory requirements.

.2 Connect fixtures to exit light circuits.

.3 Connect emergency lamp sockets to emergency circuits.

.4 Lock exit light circuit breaker in on position.

3.3 Cleaning

.1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 – GENERAL

1.1 GENERAL INSTRUCTIONS

.1 Read and be governed by conditions of the *Contract Documents,* including Sections of Division 01.

1.2 SECTION INCLUDES

.1 1.1 General Instructions
.2 1.2 Section Includes
.3 1.3 Administrative Requirements
.4 1.4 Submittals
.5 1.5 Closeout Submittals
.6 1.6 Scope Of Work
.7 1.7 Introduction
.8 1.8 Objectives
.9 1.9 Scope Of Standard
.10 1.10 Education & Training
.11 1.11 Structured Cabling Technical Specification
.12 1.12 Recognized Media
.13 1.13 Regulatory References & Standards
.14 1.14 Documentation
.15 1.15 Warranty
.16 2.1 I.T Equipment List
.17 2.2 Backbone Cabling
.18 2.3 Termination Specification
.19 2.4 Connectivity
.20 2.5 Communications Rack & Cabinet
.21 2.6 General Enclosure Requirements
.22 2.7 Enclosure Wiring
.23 2.8 Rack/Cabinet Installation
.24 2.9 Environmental Specifications
.25 2.10 Cable Access And Support
.26 3.1 Installation - General
.27 3.2 Installation Of Network Wiring - General
.28 3.3 Cable Installation And Fastening
.29 3.4 Separation Of Data Communications Cables From Sources Of Electromagnetic Interference
.30 3.5 Work Area Outlets
.31 3.6 Horizontal Cable Installation
.32 3.7 Labeling Guidelines
.33 3.8 Category Patch Panel Identification

1.3 ADMINISTRATIVE REQUIREMENTS

.1 Sequencing and Scheduling

  .1 Coordinate installation of work with Contractor.

1.4 SUBMITTALS

.1 Submit required submittals in accordance with Section 01 33 00.

.2 Product data sheets:

  .1 Submit product data sheets, which show dimensions, appearance, and specifications for equipment and accessories. Include cables, faceplates outlets, cabinets and patch panels.

1.5 CLOSEOUT SUBMITTALS

.1 Submit closeout submittals in accordance with Section 01 77 00.

.2 Operation and maintenance data:

  .1 Submit manufacturer’s operation and maintenance instructions for inclusion in the operation and maintenance manuals.

1.6 SCOPE OF WORK

.1 The provision of materials and installation to put in place a structured cabling system to support 1000 mb (1Gb) ethernet which shall include the following:

  .1 Provision of cabling systems for a complete network within the building, which can support the use of intelligent switches and network management capabilities.

  .2 Organize wiring in a structured cabling system using point to point distribution and incorporating modular terminations; Provision of horizontal cabling, data communications outlets, patch panels, and associated equipment.

  .3 Supply and install data rack as specified

  .4 Supply and install prewire coax to all required locations

  .5 Install Medix shelves, Owner to supply

  .6 Supply and install I.T Cabling to security tubs only, all other security cabling shall be completed by the Security Contractor.

  .7 Supply and install I.T Cabling to meters and submeters for hydro, water and gas.

.8 Supply and install I.T Cabling to BAS system

.9 Supply and Install I.T Cabling to Fire monitoring panel

.2 I.T Cable Contractor shall provide all necessary diagrams for cable installation

.3 Graphic of finished station will be provided by the Owner

.4 Walkthrough and Reviews:

.1 Initial walkthrough shal be completed by the *Contractor* and *Owner* to ensure that the scope of work is understood and for clarifications regarding ITS Network cabling standards. Shop drawings for scope of work shall be submitted and reviewed by *Owner* and *Consultant* prior to walkthrough.

.2 A 50% walkthrough to review completion on site and to confirm project is on track.

.3 A 100 % walkthrough review for acceptance (cabling is completed, I.T Room is free of all cabling debris, testing results have been provide) with Owner, Contractor and Cabling contractor.

.4 Cable contractor is expected to remove all garbage from site

1.7 INTRODUCTION

.1 This specification defines the technical and quality requirements for wiring of voice and data communications rooms in all buildings that are managed by the *Owner.*

.2 This specification includes:

.1 Data centres that are managed by or on behalf of the Owner. The purpose of inclusion is to provide requirements and guidelines for the design and installation of a data centre or computer room. These requirements and guidance are found in ANSI/TIA-942: Telecommunications Infrastructure Standard for Data Centres.

.2 The Cabling of buildings for wireless access points. The purpose of inclusion is to provide requirements and guidelines on the installation of a customer premises cabling system infrastructure for an array of coverage areas that form a wireless network grid within a building. These requirements and guidelines are found in TIA TSB-162: Telecommunications Cabling Guidelines for Wireless Access Points.

.3 Specific adherence to the IEEE 802.3 standards for the implementation of power over Ethernet or data lines within the plant owned by or managed on behalf of the Regional Municipality of York.

.4 Specifies a uniform administration approach to the management of a telecommunications cabling system as found in ANSI/TIA -606: Administration Standard for Telecommunications Infrastructure.

.3 Network equipment:

.1 Cabling Contractor shall supply and install network racks, cables, patch panels, cable trays and any associated supplies for cabling.

.2 Cabling Contractor shall provide any emulated Wi-Fi surveys with input, review, and acceptance for the *Owner*.

.3 Cabling Contractor shall install racks, run network cables, and terminate to patch panels, install UPS and WAPs based on instructions provided by the Owner.

.4 Backbone and horizontal infrastructure cabling shall be completed by an installer certified by the cabling system manufacturer, and the cabling shall be certified upon completion.

.5 Category cable patch panels be from manufacturers that meets or exceeds ANS/ITIA 568.2 Category 6A performance requirements and design specifications.

.4 Securing Network Devices on York Network:

.1 All devices that require connectivity to Owners Network shall be direct network run.

.2 A list of all devices not issued by the Owner that will connect to the Owners Network must be provided to the Owner. The list must include the make, model and specification and function.

.3 The Owner must conduct security testing on all devices prior to connection to the Owners Network.

.4 If testing of device is not done prior to connection, then it is done when the first device is added to the network.

.5 In the event that the Owner identifies security issues, these issues need to be resolved by the Cabling Contractor.

.6 Owners security and Enterprise Architecture will review and make recommendations as well as provide a path to ensure that the device is a safe device to be on the Owners network.

1.8 OBJECTIVES

.1 The Objectives of this specification is to:

.1 Provide safe, reliable, uniform and up to date facilities for the convenient connection of telephones, computers, computer terminals and other communications related technologies utilizing cabling and wiring in the Owners offices.

1.9 SCOPE OF STANDARD

.1 The following platforms, and facilities are in scope of this specification.

.1 Horizontal and vertical structured cabling platforms

.2 Data centre structured cabling platforms

.3 In-building facilities including

.1 Main telecommunications room

.2 Workstations

1.10 EDUCATION & TRAINING

.1 Data Centre and technical staff shall be trained and experienced on the technologies used pertaining to structure cabling infrastructure.

1.11 STRUCTURED CABLING TECHNICAL SPECIFICATION

.1 The Cabling contractor shall provide a complete and operating Structured Cabling Platform to support existing and future communication systems in the Owners facilities. This includes all horizontal cabling for voice and data applications as well as backbone.

.2 If product specifications, design and installation guidelines are not provided or in conflict with references listed below. The more stringent requirement shall apply.

.3 The Horizontal Structured Cabling Platform installed shall meet or exceed the channel requirements for voice and data transmissions as defined by ANSI/TIA-568.2.

.4 Any Structured Cabling Platform installed in a I.T Room shall follow the mandatory requirements, guidelines and best practices for data centre cabling systems, pathways and design considerations found in Regulatory References and Standards: Telecommunications Infrastructure Standard for Data Centres. Category 6A UTP (500MHz) 23AWG cabling shall be used as the rated twisted pair cable. Horizontal cabling shall be installed point-to-point, no network consolidation point.

.5 Cables, associated connecting hardware, jumpers, patch cords, equipment cords and zone area cords shall meet all applicable requirements specified in ANSI/TIA-568.2.2 and ANSI/TIA-568.3.

1.12 RECOGNIZED MEDIA

.1 100 ohm twisted-pair cable, ANSI/TIA-568.2, Category 6A UTP 23AWG.

.2 Patch cables of shall be Category 6A F/UTP 26AWG.

.3 Multimode optical fibre cable OM4, ANSI/TIA-568.3.

.4 Single-mode optical fibre cable, ANSI/TIA-568.3.

1.13 REGULATORY REFERENCES & STANDARDS

.1 This specification defines specific categories of cabling, components, transmission performance, system models, and measurement procedures. These are needed for verification of cabling performance that shall be used at a minimum wiring of data and voice communications in the Owners buildings. These requirements are found in recognized telecommunications industry standards:

  .1 Cabling Systems

    .1 ANSI/TIA-568-C.0: Generic Telecommunications Cabling for Customer Premises

    .2 ANSI/TIA-568.1: Commercial Building Telecommunications Infrastructure Standard

    .3 ANSI/TIA-568.2: Balanced Twisted Pair Telecommunications Cabling and Components Standard

    .4 ANSI/TIA-568.3: Optical Fibre Cabling and Component Standard

  .2 Spaces and Pathways

    .1 ANSI/TIA-569: Telecommunications Pathways and Spaces.

  .3 Cabling Administration

    .1 ANSI/TIA606: Administration Standard for Telecommunications Infrastructure.

.4 Telecommunications Infrastructure Standard for Industrial Premises

.1 ANSI/TIA-1005: Telecommunications Infrastructure for Industrial Premises.

.5 Telecommunications Infrastructure Standard for Data Centers

.1 ANSI/TIA-942: Telecommunications Infrastructure Standard for Data Centres.

.6 Wireless Access Points

.1 TIA TSB-162: Telecommunications Cabling Guidelines for Wireless Access Points

.2 All work shall conform to industry accepted practices, manufacturer's component installation guidelines, the Ontario building code, the Canadian Electrical Code, and all applicable standards. The following referenced documents are indispensable for the application of this specification. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document applies. Furthermore, compliance with the AHJ will supersede all other specifications.

1.14 DOCUMENTATION

.1 Documentation related to the installation, maintenance and disposal of cabling plant shall be created and maintained by the parties responsible for installing and maintaining the cabling infrastructure on behalf of the Owner. This administration of the cabling plant is governed by the mandatory use of Standard Update to Administration for the telecommunications infrastructure; and the labelling convention described in Regulatory References and Standards under Cabling Administration.

.2 The following line items describe individual requirements that shall be applied to the project. The line items are meant to serve as a guideline for the Owners requirements.

.3 All horizontal cabling shall be installed from the workstation location, or on modular patch panels installed into racks or cabinets.

.1 Allowances

.1 Devices, racks, cabinets, backboards or outlets may be relocated, prior to installation, from the location shown on the Contract Documents, to a maximum distance of 3.05 meters (10 feet) without adjustment to the Contract Price.

.2 Waste Management & Disposal

.1 The cabling contractor shall remove and dispose of all abandoned horizontal voice, data and coaxial cabling. If the cabling contractor is unsure of the status of the cables, they shall confirm the removal with the Owner prior to performing the work.

.3 Testing & Commissioning

.1 Provide two copies of testing and commissioning documentation for all items and their related components to the Owner prior to the completion of the project or at the Owners request. Include maintenance manuals, operating instructions for the Owners staff. All test data, including daily equipment reference checks, shall be submitted in native tester format (e.g. FLW files for Fluke) and summary in PDF.

.4 Warranty

.1 The structure cabling platform in each individual building or site shall be manufactured and warranted by a single manufacturer for all components of the structured cabling platform including backbones.

.2 The Contractor shall install a complete structured cabling platform that is manufactured and warranted by a single vendor. The successful bidder shall be authorized by the cable vendor to install and warranty the system. If a sub-contractor is used for the installation, it is mandatory that the sub-contractor be currently authorized to install and warranty the system.

1.15 WARRANTY

.1 Warrant work of this Section in accordance with Section 01 78 36 – Warranties for a period of two years as specified in Article A-15 of the Agreement Between *Owner* and *Contractor*.

PART 2 – PRODUCTS

2.1 I.T EQUIPMENT LIST

.1 The following items listed below shall be supplied and installed as noted below.

Equipment Type	Detail	Total
Server Rack 2-posts	General Contractor will provide rack based on this requirement. 2-post open frame pan style network rack • 77” 2-Post Pan Base Network Rack • 2 x Vertical Cable Management • 1 x Shelf Network Rack will be attached to a wall so that you can work around.  	1

Narcotics Safe Brackets Installation	Mount up to 2 narcotics brackets in the medical supply room at a wall location to be determined by the Region during cabling. Bottom of the shelf should be 48 inches above the finish floor. See photo below 	2

.1 Supply and install patch panel

.2 Supply all patch cables 3 for each port

.3 Install supplied WAPS

.4 Install all data jacks for to 30 data ports for York Region network throughout the building (this includes datajacks for Medisafe, WAPS, computers, Digital display and any other network components that need data jacks)

.5 Cables for digital display for outside shall be rated appropriately (direct burial even though housed in conduit) and locate in a conduit

.6 Run an assigned telephone line from the BIX block to the network patch panel for use by the Owners network

.7 Hang Owners Cisco phone in the garage

.8 MOH Telephone_cables

  .1 Run the assigned MOH Bell telephone from the Bix block to the MOH equipment located in the network room

  .2 Run all required Cat6a cables for Ministry of Health Phone lines for maximum of 6 phone locations

  .3 Test the line and confirm that telephone signal is available on all MOH phones

.4 Provide up to 6 brackets to hang wall mount phones at the designated MOH phone locations

.9 COAX Cable

.1 1. Install Coax cable from the IT network closet (where a conduit has been provide for future TV) to the designated television area and ensure that it can be used higher or lower on the wall.

.2 Alternatives to these items will not be accepted.

.3 Contractor shall coordinate and review installation of all items with York Region prior to commencement on site.

2.2 BACKBONE CABLING

.1 Optical Cabling Backbone

.1 OM4 fibre backbone cabling shall comply to ANSI/TIA-568.3.

.2 Each Fibre backbone cable shall have a minimum of 12 strands OM4 distribution type fibre. The OM4 distribution type fibre will perform as per industry standards over the required distance defined for the site. Mated connector loss for OM4 shall not to exceed 0.25 dB.

.2 Conduits

.1 Conduit fill ratios shall never exceed the recommendations of ANSI/TIA-569.

.3 Backbone Interconnect

.1 All connectors for the termination of the fibre optic backbone cable shall be duplex LC connectors.

.2 Fibre optic enclosure shall meet the following requirements:

.1 Enclosure shall include a slide-out drawer for front access of the terminations.

.2 Enclosure shall support LC connectors.

.3 For multimode fibre optic terminations inside I.T Room fibre patch panels the connectors shall be preloaded adapters configured with LC duplex multimode adapters.

.4 Provide duplex OM4 fibre optic patch cables LC to LC.

2.3 TERMINATION SPECIFICATION

.1 Category Patch Panels

.1 All horizontal cables shall be terminated on RJ45 jacks, inserted into modular category patch panels, and placed in the I.T room. The modular patch panel should minimize the rack space used and should not exceed two rack units in height.

2.4 CONNECTIVITY

.1 Category Patch Cord

.1 Three patch cords seven feet in length per drop shall be provided on site, two for the IP phone/desktop connectivity, and one for the patch panel to network switch. These cords shall match the cabling category being installed. Further small OD patch cords shall be used where the performance of the network will not be negatively affected: i.e. channel length and configuration, data transmission and power delivery.

.2 The Owner shall determine and put forth request if additional lengths are required.

2.5 COMMUNICATIONS RACK & CABINET

.1 All racks and cabinets to be supplied and installed shall be bolted to the floor or otherwise secured to prevent tipping, 19" floor mounted with 44U of rack mounting space. Both racks and cabinets shall be tapped both front and back with mounting holes as per EIA-310-C, size 10-32, as well as include a ground lug to accept a #6 AWG grounding wire.

.2 Vertical Cable Managers

.1 Network cabinet shall come complete with two vertical cable managers installed: one mounted on each side. Network rack cable managers shall be one of two dimensions. Micro and small sites four inches wide by four inches deep. Medium and large sites 7.5 inches width by six inches deep. The vertical cable manager shall have hinged front door(s), back and side cut outs to allow for patch cords. It shall also have lancets along the back of the cable manager to allow for the fastening of the horizontal cable to the outside of the manager itself. Higher density drops may require vertical cable management with increased width and depth.

.3 Overhead Cable Manager & Chimney

.1 Each cabinet and rack shall come complete with a hinged overhead cable manager installed, with minimum dimensions of eight inches wide by two inches deep. Where racks are ganged, the overhead cable manager is to be continuous across the gang of racks; both ends of the ganged racks are to be completed with end caps. At the right side of each rack a cable management chimney shall be installed. They shall extend from the top of the overhead cable manager to the underside of the ladder tray/ceiling tile above.

.4 Equipment Shelves

.1 Each cabinet and rack shall be supplied with, at a minimum, one equipment shelf if requested; this is to be installed at the direction of the customer. The equipment shelf is to be centre mounted and have a minimum of 18 inches of depth.

.5 Vertical Switched Zero PDU

.1 Each cabinet and rack shall come complete with two vertical switched Zero U PDU mounted to the back of the rack. Each PDU is to have a minimum of eight outlets rated at 110V, 15A. The power bars are to have a minimum power cord length of six feet. The power bars are not to have reset breakers or an on/off switch.

2.6 GENERAL ENCLOSURE REQUIREMENTS

.1 All indoor enclosures containing network components are to be installed in a two-post, four-post open rack frame, or cabinet.

.2 All screws, bolts, fasteners etc. are to be corrosion resistant stainless steel.

.3 All wall-mounted panels are to be separated from the wall by stainless steel spacers or galvanised steel struts.

.4 Doors shall have continuous hinges with removable pin and oil resistance cellular neoprene gasket secured by gasket retainers. Door handles shall be recessed type (freestanding enclosures) or three-point external latch wall mount, complete with key locks. All key locks are to be identically keyed. The key number shall be provided to the Contractor during construction.

.5 Cable bundles shall be neatly laced, run in ducting or approved cable managers and secured to 19-inch rack or mounting back-panel.

.6 All enclosure doors shall open through 180 degrees without restriction.

.7 Enclosure layout and equipment spacing shall be constructed to allow for device removal, calibration and maintenance without disassembly of adjacent devices.

.8 All freestanding, floor-mounted enclosures shall have removable CSA eyebolts to facilitate sling handling of each enclosure. Eyebolt mounting shall be a part of the structural support bracing to distribute stresses and enclosure weight while sling handling enclosures during installation.

.9 All enclosures shall have sufficient structural reinforcements to ensure a limited plane surface vibration and to provide rigidity during shipment, installation and operation without distortion or damage to the enclosure, mounting panel or mounted instruments.

.10 All enclosure seams shall be continuously welded and ground smooth to be undetectable after painting.

.11 Devices shall be installed on the enclosure back-panel or 19-inch rack.

.12 There shall be no devices installed on the side plates of the enclosure.

2.7 ENCLOSURE WIRING

.1 All enclosure wiring shall run through cable management. All cabling is managed, protected, and enclosed.

.2 Cable managers shall not be filled to more than 50 percent of their volume upon initial installation.

.3 All wires and cables, including spares, shall be identified at each end and at any connection. Use durable non-fading sleeve type wire markers to identify all network cables as follows:

  .1 Labels for cabling shall be laser printed, self-laminating, adhesive, polyester (indoor/outdoor).

  .2 Hand-written labels will not be accepted.

  .3 Lettering shall be black on a white background. Characters shall be a minimum of four millimetre high.

  .4 Wire markers are required on each conductor in panel board gutters, and at load connections. The identification shall include branch circuit or feeder number for power and lighting circuits, and control wire numbers for control wiring.

  .5 All field wires and cables terminated within enclosures shall be identified at each termination with a marking that corresponds with the drawings and supporting documentation.

  .6 Power wiring insulation shall be rated at 600 volts at 90 C and be type RW 90 THHN. Conductors shall be stranded copper. No wire smaller than 12 AWG shall be used for power wiring, unless noted otherwise on the drawings.

2.8 RACK/CABINET INSTALLATION

.1 All cable is to enter through the bottom or top of the cabinets.

.2 Provide a 12” wide minimum cable tray segregated for power, fibre and horizontal UTP cables for overhead cabling as shown on the Contract Documents. Cable management is to be provided from the cable tray to the enclosure to ensure that the minimum bend radius for each cable is maintained and the cable is rigidly supported.

.3 Electrical

.1 Provide the electrical distribution for each core and server closet as per the related Electrical Distribution drawings and relevant standards.

.2 UPS Receptacle shall be:

UPS Receptacle Option	UPS Series	Input Power
Option 2	APC UPS 2200	NEMA L5-20R

.3 Secure each rack and cabinet to ground.

.4 The duplex receptacles shall be mounted in such a manner as not to interfere with access to or removal of other equipment within the enclosures.

.5 Power distribution within the enclosure shall be via vertically mounted power bars.

.6 Redundant power supplies, within the same device, shall not be connected to the same UPS circuit.

2.9 ENVIRONMENTAL SPECIFICATIONS

.1 Contractor shall satisfy environmental requirements that include, but not be limited to power supply, heating, ventilation, and air conditioning.

.2 The I.T Room should maintain a room temperature between 19 to 23 degrees Celsius for the cold zone with the assumption that air flow is from front to back (cold to hot) when all LAN equipment is in full operation and a relative humidity of between 30 to 50 percent.

.3 There shall be no water or steam pipes running through or above the room, except for the sprinkler system.

2.10 CABLE ACCESS AND SUPPORT

.1 Cabling should be run through four-inch sleeves that are placed above the door level. To ensure proper support, the cable should be run from the sleeve directly onto a 12-inch ladder racked in the room.

.2 Supply and install all horizontal wiring, jack boxes, raceway, wall plates, telephone punch-down blocks and identification labels.

.3 Identify all wring at both ends, at the jack end and in wiring closet.

.4 Terminate, test and certify all installed wiring in accordance with industry standards.

PART 3 – EXECUTION

3.1 INSTALLATION - GENERAL

.1 All installation work shall be performed in a neat and workmanlike manner and in accordance with applicable building codes.

.2 All equipment supplied and installed shall be new and unused. Should any materials and equipment required for the work not be fully covered by the specifications and/or contract documents, the latest applicable Specifications of the Canadian Standards shall apply. Materials shall be delivered to the site in original wrappings or containers, with the manufacturer's labels and seals intact.

.3 The Contractor is responsible to provide protection for materials on site during the implementation. Should the Work be suspended for any cause, the Contractor shall remain responsible for the protection of materials during the period of suspension.

.4 Upon completion of work, all rubbish and refuse created by the Contractor shall be removed by the Contractor. This includes repair and/or replacement of damage to walls, floor, ceiling, electrical systems, and furniture if caused by the Contractor.

.5 The Contractor and sub-contractors shall be responsible for all damages to the building and/or contents, caused by his forces for whatever cause and shall indemnify and save the Owner harmless for injury to all pupils and employees when working within and around buildings, while under contract with the General Contractor as agent for the client.

.6 The responsible party shall make good any damage to the satisfaction of Owner and/or Consultant. Each Contractor involved carries this responsibility.

3.2 INSTALLATION OF NETWORK WIRING - GENERAL

.1 All cables must be properly handled and installed in accordance with the Manufacturer's specifications. Undue pulling tension (for example, in excess of 25 lb.-ft), abrasion, or rough handling must be avoided to ensure that the cables will permit transmission up to the design speed of 1000mb/sec. All cables must be installed without splices or cuts to ensure the elimination of reflections, discontinuities, impedance mismatches, etc. The maximum horizontal length from the workstation to the patch panel shall not exceed 90 meters.

3.3 CABLE INSTALLATION AND FASTENING

.1 Provide all components and appurtenances necessary to ensure that the I.T Room are functional and meet the intent of this specification.

.2 All horizontal, UTP cables shall be continuous from end to end with no splices. Horizontal cables shall be installed in a star topology, emanating from the rack/cabinet mounted patch panels and terminating on faceplate jacks at the workstation locations.

.3 Locate work area outlets where the length of the horizontal cable runs from the access closet interconnect to the work area outlet shall be less than 90 meters. For work area outlets where this proves impossible the Consultant will authorize in writing an exception if the link still meets the performance requirements of this specification.

.4 The Consultant reserves the right to relocate access closets and work area outlets within three metres of the locations identified in the Contract Documents at no additional cost to the Owner.

.5 The Contractor is responsible to size all power supply cables to meet the requirements of the Ontario Hydro Safety Code based on field verified length of cable run and power supply load.

.6 Every effort should be made to conceal wiring above ceilings and in partition walls where possible.

.7 Horizontal cables above ceilings shall be bundled with a maximum of 30 cables. Cable bundles shall be zoned according to location. All bundles shall be fastened with one piece, VELCRO cable tie wraps. Bundles should be tie wrapped and supported every metre along the run. Tie wraps shall be tight enough to contain the cables but shall not deform or crush the outer sheath.

.8 Cable bundles and/or conduits shall be installed following building lines. Under no circumstance shall cables or conduits be fastened to suspended ceiling support systems. Cable bundles and/or conduits shall be supported to building structure independent of other support systems, using CAT 6a caddy hangers.

.9 All conduit systems and cable bundles shall be left with a nylon fish string to allow for future additional cables.

.10 Bending radius shall not be tighter than four (4) times the cable diameter.

.11 Terminations shall involve as little outer jacket removal as possible and cable pairs "untwisting" shall not exceed 1/2".

.12 Cable and Conduit

.1 Provide one Category 6A UTP, horizontal cables to each work area outlet from an I.T Room in an Electric Magnetic Tube (EMT) conduit, sized to accommodate quantity of cabling and a minimum trade size of 35 1-1/4.

.2 Conduit carrying horizontal cables shall enter the work area outlet through the top or bottom.

.3 Conduit shall be Electric Magnetic Tube conduit (EMT). Corrosive environments will be noted on the access closet Installation drawings. Conduit running through corrosive environments shall be Rigid PVC.

.4 Each 90-degree conduit bend shall be considered as the equivalent to 9 metres of conduit length.

.5 A pull box must be installed when more than the equivalent of two 90-degree bends exist in the conduit run or if the run exceeds 80 metres.

3.4 SEPARATION OF DATA COMMUNICATIONS CABLES FROM SOURCES OF ELECTROMAGNETIC INTERFERENCE

.1 All data communications cables shall be separated from sources of electromagnetic radiation in accordance with TIA Standard Proposal SP-2072 and the following table:

.1 Electromagnetic Interference Source Minimum Separation Small branch circuit for lights, receptacles - 6 in. (type 15A @ 120V)

.2 Large 3 phase feeders (up to 400A) in metallic conduit - 6 in.

.3 Large single conductor cables (i.e. - corflex) - 40 in.

.4 Fluorescent lighting fixtures - 12 in.

.5 Transformers and motors - 40 in.

.6 Power panels - 40 in.

.2 Cables must also be routed to avoid direct contact with steam piping, hot water piping, or other heat sources to avoid any thermal degradation to the cables.

3.5 WORK AREA OUTLETS

.1 Work Area Outlets

.1 Horizontal cabling installed using wall outlets and floor boxes are to use single gang, or double gang if required, and they are to match the decora straps. Each decora style strap is to have a minimum of two positions for communications modules. Each outlet is to be equipped with the appropriate modules. Any unused communication positions in wall outlets shall be filled with a blank. The colours of the UTP modules and furniture adapter plates may be changed at the discretion of the Owner.

.2 Provide one one-port, single-gang, metal work-area outlets, connectors and appurtenances for termination of the horizontal Category 6A UTP cables. If four Category 6A UTP cables are consolidated at the Work Area Outlet, then one four-port work-area outlet is required. If eight Category 6A UTP cables are consolidated at the Work Area Outlet, then one eight-port work-area outlets is required.

.3 Each work-area outlet will be associated with a one-port, snap-in faceplate installed in the access closet or Core Closet patch panel.

.4 All Category 6A UTP connectors shall be modular jacks and wired for a T568A wire-map.

.5 All Category 6A UTP shielded connectors shall be bonded to ground.

3.6 HORIZONTAL CABLE INSTALLATION

.1 All horizontal cabling from the I.T Room to the work area shall comply with the manufacturer's certification requirements and recommendations; as well as meet the performance parameters of ANSI/TIA-568.2 and the design requirements of ANSI/TIA-568.1.

.2 Pathways shall be in EMT conduit minimum trades size 1-1/4 or as specified by the AHJ. Pathways shall be sized according to the requirements of the AHJ in addition to the recommendations of ANSI/TIA-569 with a planned capacity threshold of initial installation requirements +20%.

.3 All labeling to confirm to ANSI/TIA-606 and a sample of the proposed labeling scheme to be submitted to the client for approval.

3.7 LABELING GUIDELINES

.1 All wires and cables shall be identified at each end, and at any connection. Use durable non-fading sleeve type wire markers to identify all network cables as follows:

.1 Labels for cabling shall be laser printed, self-laminating, adhesive, polyester suitable for indoor and outdoor use.

.2 Hand-written labels will not be accepted.

.3 Lettering shall be black on a white background. Characters shall be a minimum of four millimeters high.

.4 Wire markers are required on each conductor in panel board gutters, and at load connections. The identification shall include branch circuit or feeder number for power and lighting circuits, and control wire numbers for control wiring.

.5 All field wires and cables terminated within enclosures shall be identified at each termination with a marking that corresponds with the drawings and supporting documentation.

3.8 CATEGORY PATCH PANEL IDENTIFICATION

.1 Owner Category and fibre patch panels identification shall be followed as outlined below. Any exceptions to the following requirements shall be approved by the Owners project manager.

.1 Labels for patch panels shall be laser printed, self-laminating, adhesive, and polyester or polyolefin.

.2 Hand-written labels will not be accepted.

.3 Lettering shall be black on a white background, and shall be a minimum of six millimetres high.

.4 Labels shall be applied to be readily visible, and not obscured by structured cabling or patch cords.

.5 The tagging convention for network closet patch panels will employ a six-character alphanumeric tag. The first three characters will indicate location consisting of floor and access closet identifier. The last three characters shall use a unique number incrementing with each drop within each closet.

3.9 FACE PLATE IDENTIFICATION

.1 Owner UTP patch panel termination point identification shall follow the standards outlined below. Any exceptions to the following requirements shall be approved by the Owner’s project manager.

.1 Labels for faceplate shall be laser printed, self-laminating, adhesive, and polyester or polyolefin.

.2 Hand-written labels will not be accepted.

.3 Lettering shall be black on a white background and shall be a minimum of four millimetres high.

.4 A label shall be applied to the top of each faceplate indicating the destination of the faceplate.

3.10 BACKBONE AND HORIZONTAL IDENTIFICATION

.1 Owner network cable identification shall follow the standards outlined below. Any exceptions to the following requirements shall be approved by the Owner’s project manager.

.1 Use durable non-fading sleeve type wire markers to identify all network cables.

.2 Labels for cabling shall be laser printed, self-laminating, adhesive, and polyester for indoor and outdoor use.

.3 Hand-written labels will not be accepted.

.4 Lettering shall be black on a white background and shall be a minimum of four millimeters in height.

.5 Fibre Optic Backbone Cables

.1 All fibre optic backbone cables are to be labelled at both ends of the cable.

.2 The fibre backbone cables are to be labelled at each transition. A transition is defined as: a change in ducting (e.g. cable tray to conduit), a change in direction of more than 45 degrees, or an entrance and exit of ducting through a wall or floor.

.3 If the fibre cable is run in conduit, then the transition labels shall be applied to the conduit.

.4 The tagging convention for identification of fibre optic backbone cables shall indicate the source and destination of the cable.

.6 Horizontal Cables

.1 As a minimum, all horizontal Category 6A UTP cable is to be labelled at both ends of the cable.

.2 The tagging convention for identification of horizontal cables shall indicate the drop sequence and I.T Room of the cable.

3.11 HORIZONTAL CABLE LABELLING FORMAT

.1 Ground Floor I.T Room

.1 D1-0000 to D1-nnnn

3.12 NAMING CONVENTION FOR WI-FI ACCESS POINT (AP)

.1 Staff Wi-Fi

.1 AP should be labelled: **Site_FL-RM_AP#**. Where Site is Site Name, FL is the floor, RM is the I.T Room Number, AP# is the number of AP on that floor and numbering should restart on each floor.

.1 Ie: AP number 16 on the first floor in the Annex that is cabled back to room 1-006 would be labelled as follows: ANNEX_1_1-006_AP16

.2 Data Jack labelling: **RM_AP#**

.1 Ie: data jack that is used for AP number 16 on the first floor of the Annex that is cabled back to room 1-006 would be labelled as follows: 1-006_AP16

.3 Patch Panel should be labelled: **AP#**

.1 Ie: patch panel that is used for AP number 16 on the first floor of the Annex that is patched back to room 1-006 would be labelled as follows: AP16

.2 Public Wi-Fi

.1 Public AP should be labelled: **PUB_FL-RM_AP#.** Where PUB represents Public WiFi, FL is the floor, RM is the I.T Room Number, AP# is the number of AP on that floor and numbering should restart on each floor.

.1 Ie: Public WiFi AP number 16 on the first floor in the Annex that is cabled back to room 1-006 would be labelled as follows: PUB_1_1-006_AP16

.2 Data Jack labelling: **PUB_ RM_AP#**

.1 Ie: data jack that is used for Public WiFi AP number 16 on the first floor of the Annex that is cabled back to room 1-006 would be labelled as follows: PUB_1-006_AP16

.3 Patch Panel should be labelled: **PUB_AP#**

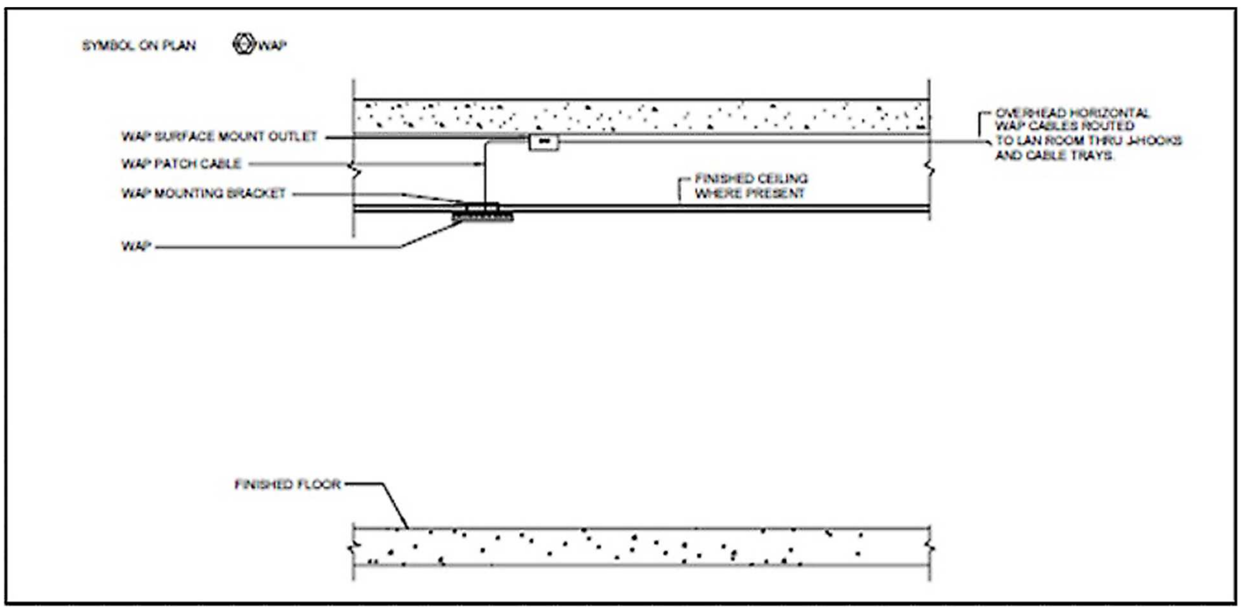
.1 Ie: patch panel that is used for Public AP number 16 on the first floor of the Annex that is patched back to room 1-006 would be labelled as follows: PUB_AP16

.4 Cabling for Public WiFi must on a separate patch panel from the Owners internal network.

3.13 WIRELESS ACCESS POINT (WAP) INSTALLATION/MOUNTING

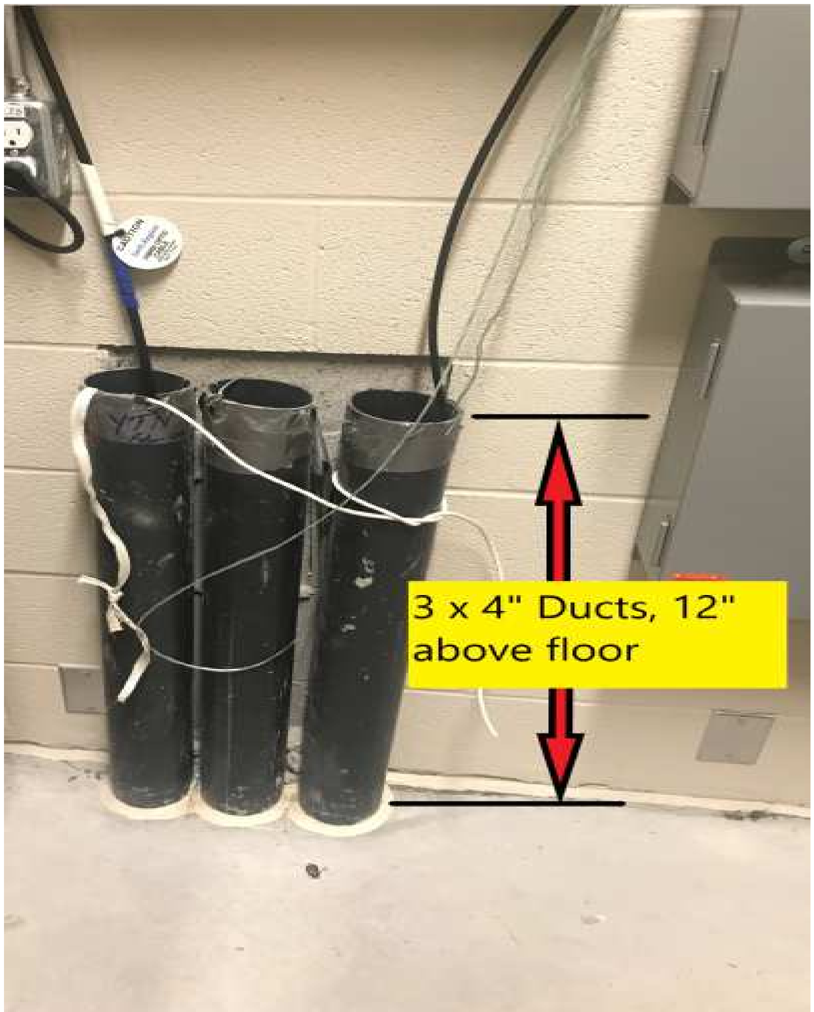
.1 Installation of WAP shall meet the requirements of manufacturer and follow recommendations of TIA-TSB-162.

- .1 The Cabling Contractor shall install all wireless access points (WAP) which shall be supplied by Owner.
- .2 Provide patch cable and all necessary hardware to mount WAP’s as shown.
- .3 Cabling Contractor shall:
  - .1 Receive WAP’s
  - .2 Unpack the WAP’s
  - .3 Attach the WAP’s mounting bracket
  - .4 Mount the WAP’s
  - .5 Patch the WAP’s at both ends
  - .6 Record AP MAC address and WAP Cable ID that AP was patched into. Record this into the AP Connectivity Table that shall be submitted upon AP installation completion of each floor.



3.14 WAN/ISP DUCTS INSIDE COMMUNICATION ROOM

.1 Three 4” ducts stubbed inside I.T Room, preferred height minimum 12” above the floor.



3.15 CABLE TESTING AND SYSTEM CERTIFICATION

.1 The structured cable system certification shall include 100% cable testing and verification for a 1000 mb/sec solution.

.2 The verification of each cable shall be performed by the Contractor and shall be documented on a cable-testing sheet, which shall form part of the hard copy documentation supplied at the end of installation.

.3 Test requirements:

  .1 End-to-end testing for UTP copper shall be conducted from both ends for 100% of pairs and shall identify pair reversal opens and shorts. The test results shall be documented; corrections implemented, and re-testing conducted and documented. In addition, documentation shall be presented to show the length of the cable between the I.T Room and the work area. Testing shall be per TIA/EIA-568b.1 category 6a standard. All testing shall be done with a class Fluke 4300 series equal accepted by Panduit Certification Plus Warranty program.

.4 Length, Wire Map, PSNEXT, PSELFEXT, RL, ATTN, PSACR.

.5 Verify labeling of all wiring at all termination points.

.6 Provide written verification confirming that transmission performance testing and inspection has been completed and that all cable runs have passed. Also, document that all failures have been identified, corrected, and re-tested successfully.

.7 Final Testing shall be carried prior to Substantial Performance.

END OF SECTION

ITS Networking Provisioning Checklist

Date:

Walkthrough: 100% ☐

Final Operational Sign-off ☐

Address:	**PRS 32 – 53 Jacob Keffer Pkwy**
Substantial Completion Date	
ITS Vendor Onboarding	
ITS Final Walkthrough (page 2)	
First Move in Date	
ITS Operational Date	

ITS Operationalization Approvals		
Cable Testing Acceptance	**Date:**	**Name & Signature:**
Network Testing Acceptance	**Date:**	**Name & Signature:**
Site Operationalization	**Date:**	**Name & Signature:**

For ITS and Cabling Contractor Use
Walkthrough: 100% ☐ **Final** ☐

Network Closet : location room number / description			
Details (Y/N)	**T1**	**T2**	**Comment**
Cabling Trays or J hooks			
Fire Rated Plywood Wallboard			
Power Receptacles NEMA L5-20R			
HVAC (with central monitoring)			
Rack Installation (clearance for vertical and horizontal cable management)			
Patch Panels			
Fibre Backbone (York Net Sites Only) (shielded/protected/labeled)			
Copper/analog line installed			
Verify that network closets are secure by lock or proximity scanners			
Electrical Grounding			
Room sweep/clean and all refuse/garbage is removed			
Network Closet ready for setup			
Network Closet setup complete			
Cabling Test Submitted and Accepted			
As-Built Diagram Submitted and Accepted			

For ITS Use Only
Walkthrough: 100% ☐ **Final** ☐

LAN Fibre Backbone			
Details	**Yes**	**No**	**Comment**
OM4 Fibre Patch cables provided			Only for YorkNet Sites
Confirm fibre connection between floors			Not Applicable
Confirm fibre connection between closets			Not Applicable

Network Cabling			
Details	**Yes**	**No**	**Comment**
Confirm Cabling completed according to Standards			
Workstation CAT 6A patch cables (set of 3 per workstation - 3’, 7’, 10’)			
Naming convention for data jacks aligned with floor plans (Primary DIA-nnn, Secondary DIB-nnn)			
Wi--Fi cabling • Installed per survey • Terminated • Labelled with matching labeling at switch			Applicable – only for York Net Sites

Cable Testing by Contractor			
Details	**Yes**	**No**	**Comment**
CAT6a cabling test result provided by Contractor received and verified			
Fibre cabling test result from Contractor received and verified			
Verification of end-to-end testing between each riser room and WAN connectivity			

Equipment - ITAM			
Details	**Yes**	**No**	**Comment**
Equipment received at site			
Equipment asset tagged			

Equipment Setup - Network			
Details	**Yes**	**No**	**Comment**
UPS			
Network Switches			
Fibre Backbone			
BIX Blocks			
VLAN – voice, data, wi-fi, security, BAS			
Wi-Fi APs			Only for YorkNet sites

Equipment Setup - Security only for YorkNet sites			
Details	**Yes**	**No**	**Comment**
Server Name			
Asset Tag #			
IP Details(6 cameras &2 for door access)			
Ports assigned			

Equipment Setup – BAS Existing Server			
Details	**Yes**	**No**	**Comment**
IP Details			
Ports assigned			

Equipment Setup – Medix Safe (5 IP ports)			
Details	**Yes**	**No**	**Comment**
IP Details			
Ports assigned			

Equipment Setup – Digital Display (5 IP ports)			
Details	**Yes**	**No**	**Comment**
IP Details			
Ports assigned			

PART 1 – GENERAL

1.1 GENERAL INSTRUCTIONS

.1 Read and be governed by conditions of the *Contract Documents,* including Sections of Division 01.

1.2 SECTION INCLUDES

.1 1.1 General Instructions

.2 1.2 Section Includes

.3 1.3 Introduction

.4 1.4 Overview

.5 1.5 Access Control Systems Value Added Resellers

.6 1.6 Applicable Standards

.7 1.7 Standardised Abbreviations

.8 1.8 Standardised Terminology

.9 1.9 Software/System Configuration

.10 1.10 Network TCP/IP Coordination

.11 1.11 Submittals – General Requirements

.12 1.12 Submittals – *Shop Drawings*

.13 1.13 Submittals - As-Built Documentation

.14 1.14 *Product* Substitutions

.15 1.15 Testing and Quality Assurance

.16 1.16 Regional Approved Commissioning Form

.17 1.17 Training

.18 1.18 Warranty

.19 1.19 Close Out

.20 2.1 Security, Access Control and Intrusion Detection

.21 2.2 Performance Criteria

.22 2.3 Environmental Requirements

.23 2.4 Surveillance

.24 2.5 Video Recording Requirements

.25 2.6 Network and Video Cabling

.26 2.7 List of Approved Security Equipment

.27 2.8 Access Control Equipment

.28 2.9 Intrusion Detection Equipment

.29 2.10 Intercom Equipment

.30 2.11 Credential and Credential Reading Equipment

.31 2.12 Miscellaneous Security Devices

.32 2.13 Digital Video Management System

.33 2.14 Conduits, Fittings and Accessories

1.3 INTRODUCTION

.1 This document provides all of the General Requirements applicable to any security related project undertaken by or on behalf of *York Region*. These requirements are at all times subordinate to the requirements as defined in the *Project Specifications* and related documents, i.e., be it in the *Specifications*, the drawings or the *Contract Documents*.

.2 If there is any perceived lack of clarity or confusion, the *Contractor* has the responsibility to obtain clarification from *York Region*.

.3 The contractor is responsible for ensuring the reference documents, standards and specifications are the most recent version applicable to the current project.

.4 *York Region* will ensure that, as may occur, any modifications to its General Requirements are communicated to the *Contractor*.

.5 The *Contractor* shall use the General Requirements as provided in this document as a reference describing the design and installation procedures to be used for delivery of the project. These procedures generally follow industry Best Practices applicable to Information Technology and Security Applications.

.6 Contractors are invited to advise *York Region* of any suggestions for improvements that could be made to the design or specifications.

.7 As technology evolves the *Region* will continue to upgrade software and hardware in order to ensure the highest levels of security and reliability for all of its properties and facilities. Hence the contractors working on new projects are responsible to validate the versions of software, firmware and hardware currently in service and to validate the compatibility of any new installations with the existing installations.

.8 All equipment installed during the execution of any security projects shall be acquired through manufacturer approved dealers and installed by factory trained and approved technicians.

.9 The contents of this document are to be considered confidential and remain the property of *York Region* and prior permission shall be obtained for any use or copying of the contents which is unrelated to work which is being undertaken for *York Region*.

1.4 OVERVIEW

.1 The Regional Municipality of *York* (*York Region*) is committed to operating a single security system for the all the *Region*'s properties. The state-of-the-art system is configured using industry standard products as specified here. The implementation is currently in operation at many locations but will continue to be deployed at additional locations as opportunities arise.

.2 The Regional security system has 3 distinct components, and these components are described further below. The components are designed to monitor and control:

   .1 Access Control (AC) using personal access cards;

   .2 Intrusion Detection (ID) using multiple sensors and detectors;

   .3 Closed Circuit Television (CCTV) cameras used to monitor key locations;

   .4 Intercoms which allow for those wishing access at a gate or door to communicate with the operations centre; and

   .5 Panic alarms which are sometimes inaccurately referred to as “Life Safety” devices and which are generally located in areas where “disruptions” may occur, e.g., reception areas, judicial services, social services, health services, etc. Some of the panic alarm buttons are wired and others are wireless.

.3 The independent, commercial products are integrated so that the system operators are able to control and manage all the security functions enumerated above from the single user interface which is connected only to the Access Control System. The diagram below (Figure 1) is intended to *Provide* a high-level overview of how the key components of the *Region*'s security system are interconnected.

.4 Figure 2, below shows how *York Region*'s remote sites are interconnected with the Main Regional Control Centre. Key aspects are that the security system at each site functions locally but all activities and exceptions are communicated to the primary equipment which is located at the Main Regional Control Centre. The architecture is fully scalable and is the same at all sites as appropriate, e.g., the water treatment facilities use SCADA displays for local alarm monitoring which are different than at other sites.

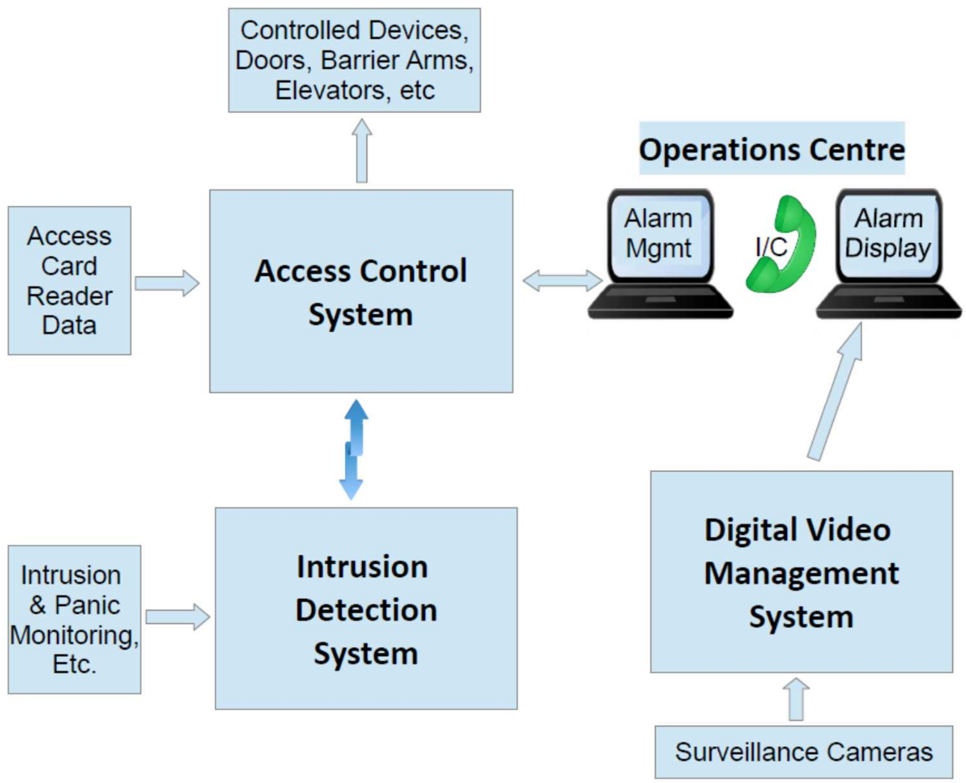


Figure 1: Overview of *York Region*'s Security System Architecture

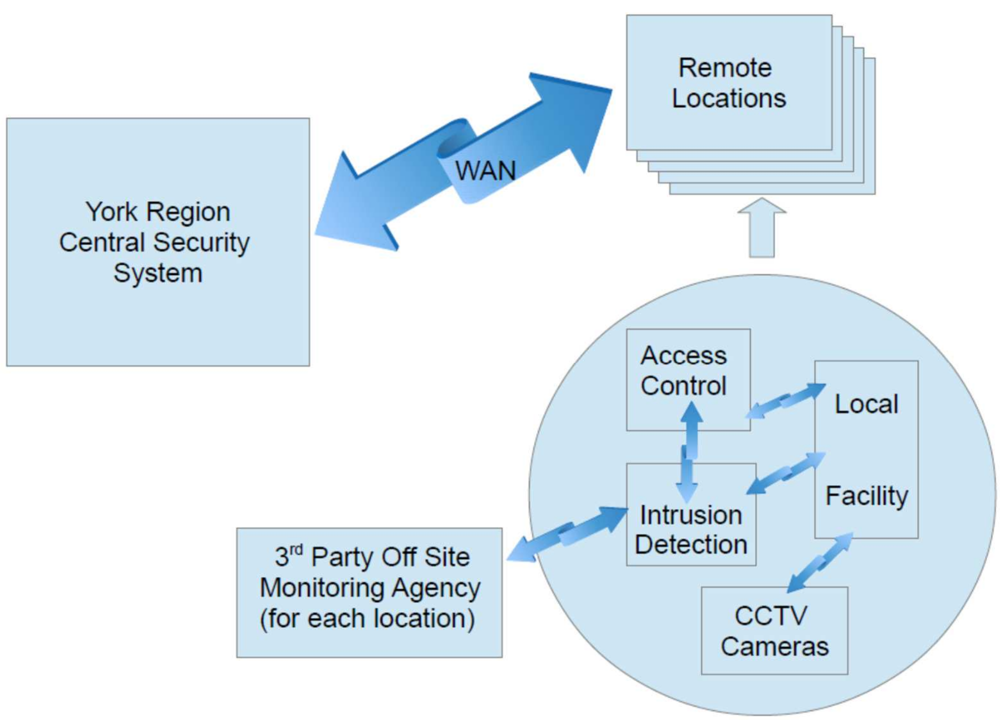


Figure 2: Architecture for the Sites Connected to the Main Regional Control Centre

.5 The Access Control System and also its User Interface are based on a single, previously approved, security system. The door hardware is controlled by the most recent available interfaces available from the same single manufacturer or supplier. Power supplies are all provided by a single manufacturer, who must be approved by the security system manufacturer. More details regarding these devices may be found in 2.7 List of Approved Security Equipment.

.6 The integration of the Access Control and the Intrusion Detection aspects of the security system shall be achieved via the network for full control of both components via the server as well as at a local level for seamless offline operation.

.7 The CCTV System shall be based on a standard, commercial, digital video management system as detailed in this section 2.13 Digital Video Management System.

.8 The *Contractor* shall work with *York Region* on the technical design of the proposed system or contract work, clarification of technical requirements and shall *Provide* a full set of Technical *Shop Drawings* for approval before proceeding to installation. The Technical *Shop Drawings* shall include, but not be limited to, network connectivity diagrams, high level riser diagram(s), system riser diagram(s), vertical and horizontal wiring diagrams, typical and site specific device termination/wiring schematic(s) and diagrams, hardware DIP Switch setting configuration(s), device landing schedule(s), system integration wiring diagrams, intrusion detection point schedule(s), tub/enclosure layout diagram(s), electrical connections and wiring diagrams, explanation of the sequence of operation, integration techniques and operational scenarios. The *Contractor* shall adhere to the *Region*'s conventions including the allocation of sequential addresses commencing from “1” and avoidance of any reserved addresses. The *Contractor* shall clearly identify any dependencies which are not included in these Drawings, such as wall space, electrical requirements, air conditioning.

.9 In addition to the foregoing *Shop Drawings*, the *Contractor* shall *Provide* addressing charts, product specifications, and cut-sheets, and other relevant information, required by *York Region* to complete the full evaluation of the design and to *Provide* for the contractor’s installation.

.10 Following approval by *York Region*, the *Contractor* shall deliver one hard copy and one electronic copy of the Technical *Shop Drawings* to the security system installer for review and comment. The hard copy of these documents shall be printed so that they may be readily read and marked up as may be required.

.11 The electronic documents shall be delivered both in editable form, i.e., AutoCAD or Word and also in PDF formats.

.12 The *Contractor* shall at all times certify that all the electronic documents and the media which are being submitted have all been checked for all forms of malware prior to their submission for any purpose to any other party using any means of transmission.

.13 The comments made by the security system installer are to be shared with *York Region* so that it is aware of any concerns which may have been expressed by the installer. *York Region* shall approve or as may be appropriate, justify adoption of the original design or a modified variation before any changes are incorporated. The costs and schedule impact of any such changes shall be clearly identified in these documents.

.14 The *Contractor* shall be fully responsible for the work completed by its employees as well as its sub-contractors, including the security system installers, electrical contractor, locksmith and door hardware subcontractors. The *Contractor* shall employ the installation services of one of the *Region*'s approved security system installers, as listed in section 1.5 Access Control Systems Value Added Resellers; to perform the installation and configuration of the security system.

.15 The installation and termination of all required conduit, cabling, network equipment, communication lines and devices, security devices and head end equipment shall be completed by a pre-qualified security system installer (See 1.5 Access Control Systems System Value Added Resellers). All necessary cable, conduit, fittings, and other general installation hardware shall be specified by the *Contractor* and supplied and installed by the security system installer or by other specialist sub-contractors retained by the security system installer, e.g., network installers or electricians.

.16 The *Contractor* shall be responsible for supplying the system equipment, licensing, and hardware in accordance with the *Contract Documents*, including *Specifications* and Drawings provided by the *Region*. The *Contractor* shall be responsible for the final design, supply, installation, configuration, testing and commissioning of the fully operational system to the satisfaction of the *Region*.

.17 Where an item is shown on the Drawings and is specified in this Specification, such item shall conform to the requirements of this Specification Section.

.18 The *Contractor* and all others working for the *Contractor* shall conform to all of the requirements of this Specification.

.19 The *Contractor* shall *Provide* design (shop) drawings prior to the execution of the work, identifying all physical security devices which are to be installed at each field location in accordance with the requirements in the *Contract Documents* as provided by *York Region*.

.20 All work undertaken in this project shall conform to the standards and practices identified in these security specifications and as noted in 1.6 Applicable Standards.

.21 As required, the *Contractor* shall submit the necessary number of working drawings and specifications to any applicable authority for examination and approval prior to commencement of work. Any changes required by the examining authority shall be reviewed and approved by *York Region*.

.22 Carry out all changes and alterations required by an authorized inspector of the ESA and any other authority having jurisdiction without delay to the progress of the *Work*. All such changes shall be reviewed and approved by *York Region*.

.23 The *Contractor* shall fully train the *Region*'s personnel (and contractors if applicable) to operate and to perform routine maintenance on the systems and equipment which is installed under the current contract.

.24 The *Contractor* shall *Provide* all warranty services for facility security system for a period of two (2) years from the date of *Total Performance of the Work* and shall *Provide* all necessary material required to replace any defective products during this period. The warranty period shall restart from the date of the completion of such replacement.

1.5 ACCESS CONTROL SYSTEMS VALUE ADDED RESELLERS

.1 Security Systems shall be provided by one of the VARs prequalified under Request for Pre-qualification No. PQ-19-214 listed below. The *Contractor* shall ensure that the VAR provides the services as detailed in the *Contract Documents*:

.2 The following are the pre-qualified Lenel Security System Value Added Resellers (as of December 2020):

Chubb, UTC Fire and Security Canada Inc.
Stephen Yates
stephen.yates@chubbedwards.com

(416) 659-1754

Extravision Security Technologies Inc.
Andrew Reedman
andrew.reedman@extravision.ca
(416) 704-7434

Paladin Technologies Inc.
Marc Kingsbury
mkingsbury@paladintechnologies.com
(647) 459-5691

Securitas Electronic Security (Canada) Inc.
Tom Nanou
Tom.nanou@securitasES.com
(416) 678-7353

.3 Installation and integration of the Lenel security system(s) shall be completed by one of the Lenel System Installers pre-qualified under Request for Pre-qualification No. PQ-19-215 listed below.

.4 The following are the pre-qualified Lenel Security System Installers (alphabetical order)

Electro-Works Ltd.
Dondi Keough
dondi@tcsecure.ca
Phone: (416) 529-7180

OZZ Electric Inc.
Dave Burlo
dburlo@ozzelectric.com
Phone: (905) 326-2534/ 416-455-1727

Plan Group Inc.
Mike Van Steendelaar
mvansteendelaar@plan-group.com
Phone (416) 635-9040

1.6 APPLICABLE STANDARDS

.1 All work performed for *York Region* must be inspected and approved prior to being commissioned. Such work must be compliant with all of the applicable Standards.

.2 It is the contractor's responsibility to ensure that the most recent version of such Standards or Codes is being used. Should there be any conflicts which arise in the interpretation of such documents the *Region* of *York* shall be the final authority.

.3 This list is not intended to be exhaustive but is intended to guide contractors. Contractors shall be responsible for adhering to all required and customary standards, best practices and are responsible for obtaining clarification if required.

.4 The primary authoring agencies of the Codes which may be encountered are identified below.

  .1 ANSI - American National Standards Association,

  .2 BICSI - Building Industry Consulting Service International

  .3 CCIR - Consultative Committee for International Radio

.4 CE - Conformity for Europe

.5 CSA - Canadian Standards Association

.6 EEMAC - Electrical Equipment Manufacturers Association of Canada

.7 EIA - Electronic Industry Association

.8 ETL - Electrical Testing Laboratories

.9 FCC - Federal Communications Commission

.10 IEEE - Institute of Electrical and Electronic Engineers

.11 ISO - International Organization for Standardization

.12 JPEG - Joint Photographic Experts Group

.13 MPEG - Moving Picture Experts Group

.14 NFPA - National Fire Prevention Association

.15 NRC - National Research Council (of Canada)

.16 NTSC - National Television Systems Committee

.17 PAL - Phase Alternating by Line

.18 TIA - Telecommunications Industry Association, 568, 569, 606, 607 etc

.19 UL - Underwriters Laboratories Inc.

.20 ULC - Underwriter's Laboratories of Canada

.21 CEC - Canadian Electrical Code 2018, Part 1, C22.1-18

.22 OESC - Ontario Electrical Safety Code 2018

.23 OBC - Ontario Building Code 2012 updated 2020

.24 NBC - National Building Code 2015

.25 NFPA - National Fire Prevention Association 70E, 101, 2021

.26 ULC - Underwriter's Laboratories of Canada, 437 etc

.27 TIA - Telecommunications Industry Association, 568, 569, 606, 607 etc

.28 EEMAC - TC3 PVC Fittings for use with Rigid PVC Conduit and Tubing.

.29 CSA - C22.2 No. 211.2-06 Rigid PVC (Unplasticized) Conduit.

.30 CAN/CSA - C22.2 No. 18-06, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.

.31 Canadian ICES-003 (Interference Causing Equipment Standard Policy)

.32 ANSI / TIA-606-C Cable Labelling Standards (July 2017)

.33 TIA-568.0-D Generic Telecommunications Cabling for Customer Premises

.34 TIA-568.1-D Commercial Building Telecommunications Cabling Standard

.35 TIA-568.2-D Balanced Twisted-Pair Telecommunications Cabling and Components Standard

.36 TIA-568.3-D Optical Fibre Cabling Components

.37 TIA-569-D Telecommunications Pathways and Spaces

.38 TIA-606-C Administration Standard for Telecommunications Infrastructure

.39 TIA-607-C Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

.40 TIA-862-B Building Automation Systems Cabling Standard

.41 TIA-942-B Telecommunications Infrastructure Standard for Data Centers

.42 TIA-1005-A Telecommunications Infrastructure Standard for Industrial Premises

.43 TIA-1179-A Healthcare Facility Telecommunications Infrastructure Standard

.44 ISO/IEC 11801 Generic Cabling for Customer Premises

.45 IEEE 802.3 Standards

.46 IEEE 802.3af Power over Ethernet (PoE) Standard

.47 IEEE 802.3at Power over Ethernet+ (Plus) Standard

.48 IEEE 802.3bt 4-Pair Power Over Ethernet (4PPoE) Standard

.49 IEEE 802.3an Physical Layer and Management Parameters for 10 Gbps Operation Type 10GBASE-T

.50 IEEE 802.3ba Media Access Control Parameters, Physical Layers and Management Parameters for 40 Gbps and 100 Gbps Operation

.51 IEEE 802.11 Wireless Standard

.1 IEEE 802.11, the Wi-Fi standard, denotes a set of wireless LAN/WLAN standards developed by Working Group 11 of the IEEE LAN/MAN standards committee (IEEE 802). The term 802.11x is also used to denote this set of standards and is not to be mistaken for any one of its elements. There is no single 802.11x standard.

.2 IEEE 802.11 details a wireless interface between devices to manage packet traffic (to avoid collisions, etc.). Some common specifications and their distinctive attributes include the following:

.3 IEEE 802.11a – Operates in the 5 GHz frequency range (5.125 to 5.85 GHz) with a maximum 54 Mbps signalling rate. The 5 GHz frequency band isn’t as crowded as the 2.4 GHz frequency because it offers significantly more radio channels than the 802.11b and is used by fewer applications. It has a shorter range than 802.11g, is actually newer than 802.11b and is not compatible with 802.11b.

.4 IEEE 802.11b – Operates in the 2.4 GHz Industrial, Scientific and Medical (ISM) band (2.4 to 2.4835 GHz) and provides signalling rates of up to 11 Mbps. This is a commonly used frequency. Microwave ovens, cordless phones, medical and scientific equipment, as well as Bluetooth devices, all work within the 2.4 GHz ISM band.

.5 IEEE 802.11e – Ratified by the IEEE in late September 2005, the 802.11e quality-of-service specification is designed to guarantee the quality of voice and video traffic. It is particularly important for companies interested in using Wi-Fi phones.

.6 IEEE 802.11g – Similar to 802.11b, this standard supports signalling rates of up to 54 Mbps. It also operates in the heavily used 2.4 GHz ISM band but uses a different radio technology to boost overall throughput. Compatible with older 802.11b.

.7 IEEE 802.11i – Also sometimes called Wi-Fi Protected Access 2 (WPA 2), 802.11i was ratified in June 2004. WPA 2 supports the 128-bit-and-above Advanced Encryption Standard, along with 802.1x authentication and key management features.

.8 IEEE 802.11k – Passed in June 2008, the 802.11k Radio Resource Management Standard will *Provide* measurement information for access points and switches to make wireless LANs run more efficiently. It may, for example, better distribute traffic loads across access points or allow dynamic adjustments of transmission power to minimize interference.

.9 IEEE 802.11n – Ratified in September 2009, 802.11n is a set of standards for wireless local area network (WLAN) communications, developed by the IEEE LAN/WAN Standards Committee (IEEE 802) in the 5 GHz and 2.4 GHz public spectrum bands. The proposed amendment improves upon the previous 802.11 standards by adding multiple-input multiple-output (MIMO) and many other newer features.

.10 IEEE 802.11ac – Published in January 2014 by the IEEE 802.11 LAN/WAN Standards Committee, the standard increases WLAN multi-station throughput from the previous 802.11n standard to at least 1 gigabit per second and to a single link throughput of at least 500 megabits per second (500 Mbit/s). The increased throughput is achieved by utilizing wider RF bandwidth (up to 160 MHz), more MIMO spatial streams (up to eight), downlink multi-user MIMO (up to four clients), and high-density modulation (up to 256-QAM).

.11 IEEE 802.11ad – This amendment defines modifications to both the IEEE 802.11 physical layers (PHYs) and the IEEE 802.11 medium access control layer (MAC) to enable operation in frequencies around 60 GHz and capable of very high throughput up to 7 Gbps.

.12 For further information on cabling standards, please obtain the full versions of the original standards documents.

.13 TIA-568.0-D (2009) - Generic Telecommunications Cabling for Customer Premises

.14 TIA-568.1-D (2009) - Commercial Building Telecommunications Cabling Standard

.15 TIA-568.2-D 2009) - Balanced Twisted-Pair Telecommunications Cabling and Components Standard

.16 TIA-568.3-D (2009) Optical Fibre Cabling Components

.17 TIA-569-D (2015) - Telecommunications Pathways and Spaces

.18 TIA-606-C (2012) - Administration Standard for Telecommunications Infrastructure

.19 TIA-607-C (2015) - Generic Telecommunications Bonding and Grounding (Earthing) for Customer Premises

.20 TIA-862-B (2011) - Building Automation Systems Cabling Standard

.21 TIA-942-B (2012) - Telecommunications Infrastructure Standard for Data Centres

.22 TIA-1005-A (2012) - Telecommunications Infrastructure Standard for Industrial Premises

.23 TIA-1179-A (2010) - Healthcare Facility Telecommunications Infrastructure Standard

.24 IS0/IEC 11801 (2002) - Generic Cabling for Customer Premises

.25 IEEE 802.3af (2003) - Power over Ethernet (PoE) Standard

.26 IEEE 802.3at (2009) - Power over Ethernet+ (Plus)

.27 IEEE 802.3an (2006) - Physical Layer and Management Parameters for 10 Gbps Operation Type 10GBASE-T

.28 IEEE 802.3ba (2010) - Media Access Control Parameters, Physical Layers and Management Parameters for 40 Gbps and 100 Gbps Operation

.29 IEEE 802.3bm (2015) - Physical Layer specifications and management parameters for 40 Gbps operation over single-mode fibre (40GBASE-ER4) and for 100 Gbps operation over multimode fibre (100GBASE-SR4)

.30 IEEE 802.3bq (2016) - Physical Coding Sublayer (PCS) interfaces and new Physical Medium Attachment (PMA) sublayer interfaces for 25 Gbps Ethernet and 40 Gbps Ethernet

.31 IEEE 802.3bz (2016) - Physical Layer specifications, and management objects for the transfer of Ethernet format frames at 2.5 Gbps and 5 Gbps over balanced twisted-pair transmission media

.32 IEEE 802.3bs (2017) - Physical Layer specifications, and management parameters for the transfer of IEEE 802.3 format frames at 200 Gbps and 400 Gbps.

.33 IEEE 802.3bt (2018) - Physical Layer and Management Parameters for Power over Ethernet over 4 pairs

.34 IEEE 802.11 Wireless Standard

- .1 802.11ac (2014)
- .2 802.11n (2009)
- .3 802.11k (2008)
- .4 802.11e (2005)
- .5 802.11i (2004)
- .6 802.11a (2003)
- .7 802.11b (2003)
- .8 802.11ac (2014)
- .9 802.11ad (2012)
- .10 802.11g (2003)

1.7 STANDARDISED ABBREVIATIONS

.1 The following abbreviations are provided for the convenience of the reader. Note that some of the abbreviations are case sensitive and may be used in conjunction with other units.

A	Amps (Amperes)
AC	Access Control
AC	Alternating Current (see DC)
ACS	Access Control System
ADO	Automatic Door Operator
ADSL	Asymmetric Digital Subscriber Line
AM	Amplitude Modulation (as in broadcast radio)
ANSI	American National Standards Institute
API	Application Programming Interface
ASCII	American Standard Code for Information Interchange
ASHRAE	American Society of Heating, Refrigeration and Air-Conditioning Engineers
ATM	Asynchronous Transfer Mode
A to D	Analog to Digital conversion
b	bit (digital bit)
B	Byte
BCP	Business Continuity Plan
BICSI	Building Industry Consulting Service International
BIT	Burn-In Testing
BMP	Best Maintenance Practices
BSA	Business System Analyst)
bps	bits per second
C	Celsius, Degrees
C	Common (as in electrical connection)
C and D	Collection and Distribution
CA	*Contract* Administrator
CAC	Common Access Card
CBRN	Chemical, Biological, Radiological and Nuclear (as in threat)
CBRNE	Chemical, Biological, Radiological, Nuclear and Explosive (as in threat)
CCIR	Consultative Committee for International Radio
CCTV	Closed Circuit Television
CCVE	Closed Circuit Video Equipment
CE	Conformity for Europe (as in European Common Market)
CEC	Canadian Electrical Code

cm	Centimetre
CMMI	Capability Maturity Model Integration
CMP	Plenum Rated Cable
CMR	Riser Rated Cable
CPU	Central Processing Unit
CPTED	Crime Prevention Through Environmental Design
CSA	Canadian Standards Association
CSV	Comma Separated Values (Comma Separated Variables)
dB	decibels (logarithmic ratio of sound levels, usually relative to 1 mW)
DC	Direct Current (see AC)
DIN	Deutsche Institut für Normung i.e., German Institute for Standardisation
DSL	Digital Subscriber Line
DTMF	Dual Tone Multi-Frequency
D to A	Digital to Analog Conversion
DVMS	Digital Video Management System
DVR	Digital Video Recorder, a precursor to the NVR
EC	Environment Canada
EEMAC	Electrical Equipment Manufacturers Association of Canada
EIA	Electronic Industry Association
EN	European Standards (European Norms)
ENV	Environmental Department (*York Region*)
EOL	End of Line (Supervision Resistor)
ESA	Electrical Safety Authority (Ontario)
ETL	Electrical Testing Laboratories
F	Fahrenheit, Degrees
F	Farad, the unit of Capacitance
FAR	False Alarm Ratio
FAR	False Alarm Rate
FCC	Federal Communications Commission (US Government Agency)
FDDI	Fibre Distributed Data Interface
FIPPA	The Freedom of Information and Protection of Privacy Act provides individuals with a right of access to certain records and personal information under the custody or control of institutions covered by the Act.
FM	Frequency Modulation (as in broadcast radio)
FM	Facility Management
fps	frames per second, number of individual still images recorded or shown per second.

ft	Foot or Feet
FT-4	Flame Test Level 4 (Riser Rated Cable)
FT-6	Flame Test Level 6 (Plenum Rated Cable)
G	Abbreviation for Giga, see Giga
GFCI	Ground Fault Circuit Interrupter (see GFI)
GFI	Ground Fault Interrupter (see GFCI)
Giga	The prefix to a value meaning 1,000 000 000 or 10^9
HTML	Hyper Text Mark-up Language
H	Henry, the unit of inductance
Hz	Hertz (frequency in cycles/second)
IDS	Intrusion Detection System
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers (A standards organisation)
in or ins	Inch or Inches
IP	Internet Protocol, also Intellectual Property
IR	Infra-Red
IS	Intrinsically Safe
ISC	Intelligent System Controller
ISO	International Organization for Standardization
ISP	Internet Service Provider
IT	Information Technology
ITS	Information Technology Services
ITU	International Telecommunication Union (A UN Agency)
ITU-T	ITU Telecommunication Standardisation Sector
JPEG	Joint Photographic Experts Group
k	kilo (as in 1,000 of subsequent unit)
K	Kelvin, Degrees
LAN	Local Area Network
LPR	Licence Plate Recognition
LTE	Long Term Evolution
m	Metre
m	milli (as in 0.001 of subsequent unit)
M	Mega (as in 1,000,000 of subsequent unit)
MFIPPA	The Municipal Freedom of Information and Protection of Privacy Act provides individuals with a right of access to certain records and personal information under the custody or control of institutions covered by the Act.
micro	a value of 0.000 001 or a millionth of the subsequent unit (μ)

mm	millimetre
MPEG	Moving Picture Experts Group
MSDS	Material Safety Data Sheet (see SDS)
MTBF	Mean Time Between Failures
MTTF	Mean Time to Failure
MTTR	Mean Time To Repair
nano	a value of 0.000 000.001 or 10^{-9}
NBC	National Building Code (of Canada)
NC	Normally Closed
NEC	National Electrical Code (US Electrical Code)
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Prevention Association
NO	Normally Open
NPT	National Pipe Thread
NTSC	National Television Systems Committee (also form of TV encoding)
NVR	Network Video Recorder
O&M	Operations and Maintenance
OBC	Ontario Building Code
ODBC	Open Database Connectivity
OEM	Original Equipment Manufacturer
OESC	Ontario Electrical Safety Code
OHSA	Occupational Health and Safety Act (Ontario)
OHSS	Ontario Health and Safety Standards
OMM	Operations Maintenance Monitoring (*York Region*)
OSI	Open Systems Interconnection (model)
p	pico, the prefix to any unit to indicate 10^{-12}, i.e., 0.000 000 000 001
Pa	Pascal (Unit of Pressure - see PSI)
PAL	Phase Alternating by Line (form of TV encoding)
PDC	Power Distribution Centre
PIT	Pre-Installation Testing
PPI	Pixels per Inch
PPM	Preventive Maintenance (same as Preventative)
PMPP	Point to Multipoint Protocol
POD	Probability Of Detection
POE	Power Over Ethernet
POP	Proof Of Performance Testing

PPP	Point-to-Point Protocol
PSAR	Physical Security Assessment Report
PSI	Pounds per Square Inch (see Pascal)
PTZ	Pan, Tilt and Zoom (3 axes of motion for a surveillance camera)
QC / QA	Quality Control / Quality Assurance
QAM	Quadrature Amplitude Modulation (as in digital TV)
RAID	"Redundant Array of Inexpensive Disks" or "Redundant Array of Independent Disks" is a data storage virtualization technology that combines multiple physical disk drive components into one or more logical units for the purposes of data redundancy, performance improvement, or both.
RH	Relative Humidity, expressed as a percentage, indicates a present state of absolute humidity relative to a maximum humidity given the same temperature.
RTD	Resistive Temperature Detector
RU	Rack Unit, also abbreviated as “U”.
SAE	Society of Automotive Engineers
SCADA	Supervisory Control And Data Acquisition
SDS	Safety Data Sheet (formerly MSDS)
SDK	Software Development Kit
SI	International System of Units (Metric system)
SIL	Safety Integrity Level, 1, 2, 3 or 4 (IEC 61508)
SIT	System Integration Test
SMTP	Simple Mail Transfer Protocol
SPICE	Software Process Improvement and Capability dEtermination
SQL	Structured Query Language
T	Temperature
T	Abbreviation for Tera (see Tera)
TCP/IP	Transmission Control Protocol (TCP) / Internet Protocol (IP)
Tera	is the prefix to indicate 10^{12}
TIA	Telecommunications Industry Association (standards agency)
TRA	Threat and Risk Assessment
TSSA	Technical Standards and Safety Authority. The Technical Standards and Safety Authority (TSSA) promotes and enforces public safety in Ontario.
TTR	Time To Repair
U	Rack Unit also abbreviated as “RU”.
UL	Underwriters Laboratories (USA)
ULC	Underwriters Laboratories of Canada
UPS	Uninterruptible Power Supply
UTP	Unshielded Twisted Pair, generally referring to Cat 4, Cat 5 or Cat 6 cables

UV	Ultra Violet
V	Volt
VAR	Value Added Reseller
VMS	Video Management System
WAN	Wide Area Network
WHMIS	Workplace Hazardous Materials Information System

1.8 STANDARDISED TERMINOLOGY

.1 **ACCESS CARD** is generally a plastic card, the size of a standard Credit card, with a chip or magnetic stripe containing encoded data that is read by passing the card through or over an electronic device which in turn transmits the encoded data to an electronic controller. From this data the controller identifies the card user and allows or denies access to restricted or secure areas or systems. There any many different forms of card encoding and card reading in common use.

.2 **ACCESS CONTROL** see Access Control System.

.3 **ACCESS CONTROL SYSTEM** is an electronic system which controls the status of control locations in accordance with the rules and inputs which have been programmed.

.4 **ACCEPTANCE** is the process by which the security system is deemed to have passed the Commissioning test and when required the Burn-In testing. The Warranty period will then commence.

.5 **ALARM** is the name given to the Intrusion Detection System status when a situation occurs which requires immediate on-site investigation, generally because of an unauthorised entry or because a sensor has notified the detection system of an unacceptable status. An Alarm may originate from either the Access Control System or from the Intrusion Detection System. The nature of the alarm notification is not defined and can be a loud siren, stroboscopic lights, electronic messaging or any combination of these and other alternatives. The IDS is normally expected to *Provide* a sequential time stamped log to allow for forensic investigations following an alarm.

.6 **ALERT** is a low priority notification which may originate from either the Access Control System or from the Intrusion Detection System. Alerts are normally activated in order to “alert” security staff that something is not “quite as expected” and may in some cases be followed by an Alarm when the status has extended from “not quite as expected” to “seriously out of order”. As examples consider that

  .1 The temperature in a food freezer has warmed from -20°C to a threshold of -10°C at which temperature an alert is signalled and when the temperature rises to -3°C, an Alarm is signalled.

  .2 An access-controlled door is held open for 2 minutes longer than the programmed “opening time” causing an Alert to be issued and sound locally but if the door remains open for 4 minutes longer than expected, the Alarm will be activated.

  .3 If the “panic alarm” is activated by a staff member in a washroom or at a service counter there will be no alert, but the Alarm will immediately be activated.

  .4 As soon as the power fails in a building an alert will be issued but the alarm will only be issued when the failure has lasted for, say 2 hours.

.7 **ASSETS** are tangible or intangible things of the *Region* of *York*. Assets include but are not limited to information in all forms and media, networks, systems, material, real property, financial resources, employee trust, public confidence and reputation.

.8 **ATTACK** is any action to execute a threat.

.9 **AUTOMATIC DOOR OPERATOR** is a motorised device used to activate a door thereby allowing those with restricted strength or mobility to open doors which might otherwise be too heavy. These are also referred to as Handicapped Door Operators although this term is generally no longer used.

.10 **AVAILABILITY** is the condition of being usable on demand to support operations, programs and services.

.11 **BACnet** is a communication protocol for Building Automation and Control (BAC) networks that leverage the ASHRAE, ANSI, and ISO 16484-5 standard protocol. BACnet was designed to allow communication of building automation and control systems for applications such as heating, ventilating, and air-conditioning control (HVAC), lighting control, access control, and fire detection systems and their associated equipment.

.12 **BASE BUILDING SECURITY** is a description of the security safeguards provided to protect a facility but not the necessarily the assets contained in the building. Basic building security provides a base or starting point for other security requirements (i.e., minimum and enhanced safeguards) to be added to protect the specific assets held by the facility. This is dependent on a TRA and a specific business requirement.

.13 **BASELINE SECURITY REQUIREMENTS** are the mandatory provisions of the *Region* of *York* and its associated operational standards and technical documentation.

.14 **BINARY DIGIT** is the smallest unit of data in a computer and is often abbreviated to “bit”. A bit has a single binary value, either 0 or 1 (see also Byte).

.15 **BITS PER SECOND** is the speed of data transmission measured in bits per second and is often referred to as “baud”. Network speeds are generally measured in bps and have risen sharply with a tenfold increase for each new technology ranging from 1 Mbps through 10, 100 Mbps and 1Gbps and 10 Gbps.

.16 **BOND SENSOR** see Hold Force Sensor.

.17 **BURN-IN TESTING** is an extended form of “in service” System Integration Testing. For the period which has been defined for this test the system shall be left operational and shall endure all normal in-service characteristics. This may include power outages, weather extremes, etc. The Burn-In Test is designed to prove the operational capabilities of the entire system. This test may, therefore, require that the system function through a normal range of weather and perform in the manner which is expected for a minimum of 30 days. Thus, some burn-in tests can only be performed during the summer or during the winter seasons. No adjustments, configuration changes or maintenance of any kind should be performed during this period. The details of the BIT which is to be performed shall be noted in the *Contract Documents*.

.18 **BUSINESS CONTINUITY PLANNING** is an all-encompassing term which includes the development and timely execution of plans, measures, procedures and arrangements to ensure minimal or no interruption to the availability of critical services and assets.

.19 **BY-PASS** indicates that either one or more sensors or zones are by-passed or off-site monitoring has been “disabled”. While all of these options are generally invoked during testing, the purpose in all cases is to allow for the testing of an alarm system without activating a response from security agents responsible for such investigations. In some situations, if the security system is malfunctioning and the problem has been reduced to a particular sensor or zone, the sensor or zone may be bypassed to allow the remainder of the system to function normally pending the repair of the defect, a by-passed sensor or zone does not *Provide* any signalling. If the entire security system is by-passed, the monitoring service will not activate any response plan for the duration of the "by-pass". It is common practice, in these circumstances for the monitoring service will *Provide* a detailed listing of all the alarms received to the client so that the client or the security contractor can compare the report with the stimuli applied to the security system.

.20 **BYTE** consists of a number of bits and has generally been associated with 8 bits leading to its common nomenclature of an "octet" and allowing for values from 0 to 255. Most modern computers use 4 or 8 bit "words" yielding 32-bit or 64-bit architectures.

.21 **BYTES PER SECOND** or the number of bytes transmitted per second. There are commonly 8 bits per byte so that a speed of 110 baud is equivalent to approximately 10 characters per second when allowing for parity and other error correction bits.

.22 **COMMON ACCESS CARD** is a term describing the particular form of access card used by all US Government and military personnel. It should not be confused with any other form of commonly used access cards.

.23 **CBRN** a general term covering attacks using "Chemical", "Biological", "Radiological" or "Nuclear" weapons.

.24 **CBRNE** this term adds "Explosives" to the possible threats (see CBRN).

.25 **CLOSED CIRCUIT TELEVISION**, often referred to as "Surveillance".

.26 **CENTRAL STATION** see Monitoring Station.

.27 **CIVIL DISTURBANCES** Means acts of violence and or disorder prejudicial to the public law and order. Civil disturbances most often arise from political grievances, urban economic conflicts, community unrest, terrorist acts, or foreign influences. They can range from peaceful picketing to full-blown riot situations.

.28 **CODE** can refer to the most recent enacted version of any of a number of Codes which govern the construction and operation of buildings and systems. Typically, the pertinent Codes will include at least the Ontario Electrical Safety Code, the Ontario Building Code, the Elevator Code and the Fire Code.

.29 **COMMISSIONING** describes the activity of commissioning which is the measured process of placing the security system into its initial operation and may include Proof of Performance and System Integration Tests sufficient to demonstrate the operational status of the entire system under operating conditions. Following the completion of the Commissioning process, the security system shall, if required, complete the Burn-In testing to qualify for Acceptance.

.30 **COMPROMISE** is the unauthorized disclosure, destruction, removal, modification, interruption or use of assets. Also used to classify the unauthorised opening of a portal, door etc. i.e., an intrusion.

.31 **CONTACT ID** is the number of the Monitoring Station information in the security system reference list of numbers and alternatives to be called when notification of an alarm is to be transmitted.

.32 **CONTINUOUS LIGHTING** consists of a series of fixed lights arranged to flood an area continuously with overlapping cones of light.

.33 **CONTRACT DOCUMENTS** are the documents describing the construction project and the responsibilities of the parties to the agreement. Generally, these documents will include either a detailed design including drawings or may define the performance requirements thereby requiring the contractor to perform the detailed design. In some construction projects the contract documents may include work to be performed by more than one discipline and in other circumstances the project work relates to only a single discipline.

.34 **CONTROL OF ACCESS** describes the process of ensuring authorized access to assets within a facility or restricted areas by screening visitors and material at entry points by personnel, guards or automated means and, where required, monitoring their movement within the facility or restricted access areas by escorting them.

.35 **CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN** defines territories and how they are controlled and managed based on the use of "concentric rings of control and protection." Outermost rings are supported by additional inner rings of protection. Each of these concentric rings will be addressed as layers of protection within these guidelines and are intended to sequentially deter, deny access to, and slow down possible malefactors.

.36 **CREDENTIALS** are a means of identifying a user in to order to manage the "privileges" accorded to that individual. The most common credential is an access card but other credentials technically include keys (mechanical or electronic), fobs (with microchips), voice signatures, finger prints, retinal patterns, hand geometries and other evolving technologies. Credentials are used both in Physical Security settings (doors, windows etc) and in Cyber Security settings (remote access, banking etc).

.37 **CANADIAN STANDARDS ASSOCIATION** is the Author and Authority who originate the standards, (including the Ontario Electrical Safety Code), which govern most of the devices, particularly the electrical devices used in Canada. The CSA symbol (or approved equivalent) must be permanently attached to every electrical device used with any regular power supply.

.38 **CATEGORY 4, 5, 5e, 6 etc** define the performance of unshielded twisted pair (UTP) ethernet cables as specified by the Standards developed by the ISO/IEC and ANSI/TIA/EIA 568. These standards define the cable length as limited to 90m (300 ft), a characteristic impedance of 100 ohms. The cable Categories have increased in ordinal and in performance in response to network demands moving from 10 Mbps to 100 Mbps to 1 Gbps to 10 Gbps and rendering older wiring systems obsolete.

.39 **CYBER SECURITY** is the practice of defending computers, servers, communications links, mobile devices, electronic systems, networks, and data from malicious attacks. It is also known as information technology *security* or electronic information *security*. This is quite distinct from Physical Security which is the focus of this document.

.40 **DETECTION** refers to the use of appropriate devices, systems and procedures to signal that an attempted or actual unauthorized access has occurred.

.41 **DIN RAIL** is a commonly used device for mounting many types of modules inside enclosures. It was originally specified by the Deutsches Institut für Normung (DIN) in1928 and has since been adopted internationally (Top Hat Rail IEC/EN 60715).

.42 **DOCUMENTATION** shall include shop drawings, catalogue sheets, calculations, drawings, diagrams, test print outs, photographs or/and text. Specific references may limit the particular documentation to specific criteria. All documentation submitted to the *Owner* shall be in English. The format of the Documentation shall be in accordance with the requirements as specified in the *Contract Documents*.

.43 **EMERGENCY LIGHTING** depends on alternative power sources, and therefore, is reserved for times when regular lighting is not available. Typically, such lights are selected luminaires or fixtures which are selected from the continuous lighting fixtures and which are provided with an alternative source of power.

.44 **END OF LINE or END OF LINE RESISTOR** refers to the placement of one or sometimes more than 1 resistor at the remote end of the sensor communications line. See Supervision for more details.

.45 **ENVIRONMENTAL THREATS** refers to natural phenomena/disasters that have the potential to damage resources or services or to interrupt activities or operations, e.g., hurricanes, floods, heat waves.

.46 **EXPLOSION PROOF** refers to the certification required of electrical and related safety devices used in hazardous locations. In electrical and safety engineering, hazardous locations are places where particular fire or explosion hazards may exist. Sources of such hazards include gases, vapours, dust, fibres, and airborne particles, which are combustible or flammable. Electrical equipment installed in such locations could *Provide* an ignition source, due to electrical arcing, or high temperature. Standards and regulations exist to identify such locations, classify the hazards, and design equipment for safe use in such locations.

.47 **EXTERNAL THREATS** refer to threats to the integrity and security brought about by individuals or circumstances outside of the *Region* of *York*.

.48 **FACILITY** - a physical setting used to serve a specific purpose. A facility may be part of a building, a whole building, or a building plus its site; or it may be a construction that is not a building. The term encompasses both the physical object and its use (for example, weapons ranges, agriculture fields).

.49 **FAIL OPEN** indicates that a failure of the control system will lead to the door or portal being uncontrolled and unlocked. See FAIL SAFE for a further discussion.

.50 **FAIL SAFE** is a term which may be confusing to the casual user as the term “SAFE” may relate to a portal (door) being “safe for humans”, i.e., open or “safe for property”, i.e., closed. The terms, “FAIL OPEN” and “FAIL SECURE” are less ambiguous and therefore preferred. The reference to “FAIL” refers to the state assumed by the door or portal when control is lost, e.g., when the power has failed, a cable is cut or software malfunctions. It should be noted that while the establishing of a desirable “FAILURE” mode is desirable, unforeseen circumstances may prevent this mode being achieved, e.g., when a mechanical component seizes up or breaks.

.51 **FAIL SECURE** indicates that a failure of the control system will lead to the door or portal being uncontrolled and locked. See FAIL SAFE for a further discussion.

.52 **FALSE ALARM** refers to alarm systems being triggered by something other than the expected trigger-event. Examples of those applications include residential burglar alarms, smoke detectors, industrial alarms, and signal detection theory. False alarms are, correctly, limited to those alarms caused by a system not behaving in accordance with the system programming, e.g., a smoke detector activated by dust, a motion sensor activated by a mouse, s glass shock sensor activated by a tree branch hitting the window. (See Nuisance Alarm).

.53 **FALSE ALARM RATE**, is defined as the number of false alarms (in which an alarm, or warning, is given in spite of a non-event) per the total number of ‘non-events’ (times the event didn’t happen). A false alarm rate is also known as the probability of false detection.

.54 **FALSE ALARM RATIO**, is the number of false alarms (in which an alarm, or warning, is given in spite of a non-event) per the total number of warnings or alarms in a given study or situation.

.55 **HAZARDOUS LOCATIONS** refer to electrical and safety engineering locations where fire or explosion hazards may exist. Sources of such hazards include gases, vapors, dust, fibers, and air borne particles, which are combustible or flammable. Electrical equipment installed in such locations could *Provide* an ignition source, due to electrical arcing, or high temperature. Standards and regulations exist to identify such locations, classify the hazards, and design equipment for safe use in such locations.

.56 **HOLD FORCE SENSOR** (also referred to as a “Bond Sensor”) is a Hall Effect device mounted in an Electromagnetic lock to monitor the force between the solenoid (coil) and the armature (steel plate). This force which is frequently either 600 lbf (3,000 N) or 1,200 lbf (5,300 N) diminishes rapidly if there is an accumulation of dirt (e.g., rust) on the surface or any other obstacle which prevents the 2 components mating properly. The Hold Force Sensor (HFS) can detect any such holding force reduction and initiate an alarm indicating that the door is closed improperly.

.57 **INSIDER THREATS** refers to trusted persons, possibly employees of the *Region* of *York*, who have been granted access to secured resources or services but could have ulterior motives.

.58 **INTERNATIONAL STANDARDS ORGANISATION** which defines standards of many kinds and which are implicitly used by the national standards organisations such as CSA etc. These international standards are crucial for example to allow for communications or for manufacturing.

.59 **INTEGRITY** refers to the accuracy and completeness of assets, and the authenticity of transactions.

.60 **INTRINSICALLY SAFE** is a protection technique for safe operation of electrical equipment in hazardous areas by limiting the energy, electrical and thermal, available for ignition. In signal and control circuits that can operate with low currents and voltages, the intrinsic safety approach simplifies circuits and reduces installation cost over other protection methods. Areas with dangerous concentrations of flammable gases or dust are found in applications such as petrochemical refineries and mines. As a discipline, it is an application of inherent safety in instrumentation. The alternative to using Intrinsically Safe techniques is to use equipment which is certified as “Explosion Proof”. High-power circuits such as electric motors or lighting cannot use intrinsic safety methods for protection.

.61 **INTRUSION DETECTION SYSTEM** is a system to monitor, detect and notify unauthorised access or the deviation of sensor observations from acceptable values, e.g., a door which has opened with the presentation of an approved credential or a motion sensor detecting movement in a room which is thought to be closed.

.62 **LATCH or LATCHING** relates to a lock being set electronically to simulate a “latched door”. In this mode the door is insecure and can be opened without using credentials. The status change may be automated, as in the scheduled opening of an office main entrance, may occur as a result of a manual action at the system console or may be activated by a specially authorised credential.

.63 **LOCAL AREA NETWORK** is a computer network that interconnects computers within a limited area such as a residence, school, laboratory, university campus or office building. In such an environment the single network can be managed and it is often true that all of the computers belong to a single person or entity, thereby providing for enhanced security. Similarly, the network infrastructure generally all belongs to the same entity thereby ensuring adherence to the same technical criteria.

.64 **LOCKDOWN** can be used to protect people inside a facility or, for example, a computing system, from a threat or other external event. In buildings, doors leading to the outside are usually locked so that no person may enter or exit. A “full lockdown” usually means that people must “stay where they are and may not enter or exit a building or rooms within it, needing to go to the nearest place designated safe if not already in such a place." Lockdowns can be defined as "Exit permitted", "Entrance permitted" or "Full lockdown" thereby defining how access cards will function during the emergency.

.65 **MAINTENANCE CONTRACTOR** means the *Contractor* who, following the supply and installation of the Security System, will be responsible for the Maintenance or Modification of the system.

.66 **MATERIAL**- any tangible object with the exclusion of those embodying information.

.67 **MATERIAL SAFETY DATA SHEETS**, have been renamed to SDS, Safety Data Sheets (See Safety Data Sheets).

.68 **MEAN TIME BETWEEN FAILURES** is the predicted, mean or average elapsed *time between* inherent *failures* of a mechanical or electronic system, during normal system operation. This is usually measured in hours, days or weeks. The term is used for repairable systems.

.69 **MEAN TIME TO FAILURE** denotes the expected time to failure for a non-repairable system. Because Mean Time to Failure is relevant only for assets and equipment that cannot or should not be repaired, MTTF can also be thought of as the average lifespan of an asset. This is usually measured in hours, days or weeks.

.70 **MEAN TIME TO REPAIR** is a measure of the maintainability of a repairable item, which tells the average time required to repair a specific item or component and return it to working status. It is a basic measure of the maintainability of equipment and parts. This includes the notification time, diagnosis and the time spent on actual repair as well as other activities required before the equipment can be returned to service. This is usually measured in hours, days or weeks.

.71 **MONITORED** is to watch for or detect a breach of security.

.72 **MONITORED CONTINOUSLY** is to confirm on a continuous basis that there has not been a breach of security. Examples include electronic intrusion detection system, or someone guarding a particular point on a constant basis.

.73 **MONITORED PERIODICALLY** is to confirm on a regular basis that there has not been a breach of security. The frequency and diligence of monitoring is based on the recommendations of a Threat and Risk Assessment. Examples of monitoring periodically include by means of a guard patrol, or through employees working at the location.

.74 **MONITORING STATION** is the contracted agency to who all alarms which have been programmed for external notification are sent. The monitoring station will then follow the Response Plan provided by the customer for each Reporting ID which may include calling phone numbers until a contact is reached or dispatching suitable response personnel.

.75 **MULTI MODE FIBRE** is a type of optical fibre mostly used for communication over short distances, such as within a building or on a campus. Multi-mode links can be used for data rates up to 100 Gbit/s. Multi-mode fibre has a fairly large core diameter that enables multiple light modes to be propagated and limits the maximum length of a transmission link because of modal dispersion. (See also Single Mode Fibre).

.76 **NORMALLY CLOSED** identifies that when a momentary switch is not actuated, it is in its "normal" state. Similarly, a relay is in its "normal" state when it is NOT powered. Depending on how the device is constructed, its "normal" state can be either an "open" circuit or a "short" circuit. When a contact is "open" until the button is actuated, it's said to be "normally open" (abbreviated NO) and conversely when the contact is "closed" until the button is activated it is said to be "normally closed" (abbreviated NC). Unfortunately, the security industry has corrupted these explanations and, for example, a door contact's normal state is defined by the status of the door, i.e., the "normal state" of the door corresponds with the door being closed at which time the door contact is "energised" by the magnet or by the door and is referred to as "normally closed" although, in its "at rest" or normal state, the contact will generally be "open". The lesson is that the function of normally open and normally closed contacts must be reviewed with caution and varies by specific trades.

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.78 **NUISANCE ALARM** is intended to reflect the correct operation of a security system which is however triggered by the incorrect operation of the system without any malicious intent, e.g., furniture movers wedging doors open so that they can work more quickly, opening a window in an already secured area, i.e., such alarms are reporting correctly but the cause is generally "human error".

.79 **ONTARIO ELECTRICAL SAFETY CODE**, the Canadian Electrical Code as modified and approved for use in Ontario. This modification is generally enacted about 18 months following the issue of the CSA electrical code.

.80 **OPEN SYSTEMS INTERCONNECTION**, (ISO 7498) a joint ISO and ITU-T standard for computer networks and communication protocols. The OSI model, is a 7 layered description for communications and computer network protocol design, (Physical, Data Link, Network, Transport, Session, Presentation, Application).

.81 **OPERATIONS AND MAINTENANCE** shall mean all services and materials necessary for the functioning of the ACS and IDS Systems.

.82 **PHYSICAL SECURITY** refers to the use of physical safeguards to prevent or delay unauthorized access to assets, to detect attempted and actual unauthorized access and to activate appropriate responses. This may be amplified to describe security measures that are designed to deny unauthorized access to facilities, equipment and resources and to protect personnel and property from damage or harm (such as espionage, theft, or terrorist attacks). Physical security involves the use of multiple layers of interdependent systems that can include CCTV surveillance, security guards, protective barriers, locks, access control, perimeter intrusion detection, deterrent systems, fire, and other systems designed to protect persons and property.

.83 **PHYSICAL SECURITY ASSESSMENT REPORT** which is essentially equivalent to a Threat and Risk Assessment report and is generally provided prior to designing a security solution.

.84 **PLENUM RATED** is a designation used in conjunction with cable insulation. Code requirements demand that any cable placed without suitable conduit in an air return plenum, such as is commonly done, shall have a low smoke generation capability. Such cables are said to Plenum Rated, FT-6 or CMP certified. (See Riser Rated)

.85 **PRE-INSTALLATION TESTING** includes all testing undertaken prior to the installation of equipment and may also include testing of mock-ups, prototypes and normal factory production testing. This is generally required for any New Equipment, i.e., equipment which is specially manufactured, but may be waived for Standard Equipment, i.e., equipment which is production manufactured.

.86 **PREVENTIVE MAINTENANCE** (or preventative maintenance) is maintenance that is regularly performed on a piece of equipment or on a system to lessen the likelihood of failure. It is performed while the equipment is still working so that it does not break down unexpectedly. For example, door closers are required to ensure that doors close properly after a controlled entrance but may need inspection and adjustment to ensure that the air pressure from the HVAC system does not impact this function during seasonal changes.

.87 **PROBABILITY OF DETECTION** is used in to establish the capability of a system to detect intrusions. The use of analytics in combination with CCTV and other sensors are known to have some limitations and therefore to sometimes fail to *Provide* alarms or alerts when expected.

.88 **PROOF OF PERFORMANCE TESTING** includes all testing undertaken following the field installation of equipment to verify the physical and operational features of each item of equipment and each sub system. This is required for all equipment.

.89 **PROTECTION** in the context of physical security means the use of physical, procedural and psychological barriers to delay or deter unauthorized access, including visual and acoustic barriers.

.90 **PROVEN EQUIPMENT** shall mean equipment, other than specified in the project specifications which has been supplied and installed by the vendor for a different but similar purpose. To comply with this definition, the equipment shall have been installed, in at least, five sites in the last ten years, currently be operational and references shall be available from such Agencies.

.91 **RACK UNIT** is a commonly used measure of height or width when referencing 19 or 23 inch electronic equipment racks as well as the modular equipment installed in them. It is defined in the IEC 60297 as 1.75 inches (44.45 mm) so that a full height rack is often referred to as 42 RU or 42 U high, i.e., 6 ft 1.5 ins (1.8669m).

.92 **RECOVERY** is the term used to describe the restoration of full levels of service delivery following an interruption in such service.

.93 **REPORTING ID** is the internally programmed number identifying the location and nature of the alarm and which forms part of the information sent to the Monitoring Station.

.94 **RESPONSE** is the implementation of measures to ensure that security incidents are reported to appropriate security officials and that immediate and long-term corrective action is taken.

.95 **RESPONSE PLAN** is the document provided by the client to the Monitoring Station which identifies the action to be taken by the Monitoring Station for each of the Reporting ID's. Typically, the response plan will *Provide* alternatives to address urgent situations if certain individuals are not available.

.96 **RESTRICTED**, when applied to an Access Area, describes areas where access is limited to authorized individuals and generally includes Operations, Security and High Security Zones.

.97 **RISER RATED** cables may be used without conduit in fire rated risers or riser rooms but may not be used in air return plenums where the smoke which the insulation would generate under fire conditions would be hazardous. Such cables are referred to as Riser Rated, FT-4 or CMR.

.98 **RISK** is the measure of probability of a particular mode of "attack" by an intruder to be successful in gaining entry. It may also be summarised as the chance of a vulnerability being exploited.

.99 **SAFETY DATA SHEETS** are required to *Provide* information regarding all the potentially dangerous chemicals which may be on site as well as the required emergency procedures to be followed in the event of a misadventure. See Material Safety Data Sheets.

.100 **SECURITY CONTRACTOR** will be the *Contractor* providing and installing the system described in this Specification and who is trained and certified on the equipment which is being installed under this project.

.101 **SENSOR** is any device used to monitor a parameter which provides remotely monitored information, e.g., door contact, glass break sensor, water leakage sensor, power failure or motion sensor.

.102 **SIMPLE APPARATUS** is considered not to appreciably affect the safety of an Intrinsically Safe system. This apparatus is exempted from the requirement for certification. The simple requirements are clearly specified in the apparatus standard. “Simple Apparatus” should always be readily demonstrable to be adequately safe. The usual examples of “Simple Apparatus” are switches, thermocouples, resistive temperature detectors and junction boxes

.103 **SINGLE MODE FIBRE** is a fibre optic cable which has a smaller diameter core than the Multi-Mode Fibre and allows only one mode of light to propagate. Because of this, the number of light reflections occurring as the light passes through the core decreases, lowering attenuation and creating the ability for the signal to travel further. This application is typically used in long distance, higher bandwidth runs by Telco’s, CATV companies, and Colleges and Universities. (See also Multi Mode Fibre).

.104 **STANDARD EQUIPMENT** see PROVEN EQUIPMENT.

.105 **STAND-BY POWER** is often a generic term referring to the availability of both a short term, battery-based power source designed to last for a brief period (see Uninterruptible Power Supply) and also a longer-term power source which may be from a local generator or an alternative feeder from a sub-station or transformer.

.106 **STRUCTURED CABLING** is the communications cabling architecture defined by standards so that the cabling can be maintained and the associated networks can be modified and upgraded as may be required. This architecture defines 6 components, Entrance Facilities, Equipment Rooms, Backbone Cabling, Horizontal Cabling, Telecommunications Rooms (or Enclosures) and *Work* Area Components.

.107 **SUBSTITUTION** is the process of requesting and justifying the use of equipment other than that specified by the project specifications. The contractor may request the substitution but must follow the process for submission and justification of the alternative equipment. The *Region of York* is the final arbiter with regard to the request for a substitution.

.108 **SUPERVISION** is the term given to the use of resistors in different configurations to monitor the connections between remote sensors and the panels to which they are connected. Most sensors switch between “open” and “closed”, i.e., between “infinite resistance” and “zero resistance”, when they change state. By placing resistors in series and in parallel with the “sensor”, the system will generate alerts if the wires are cut, shorted or the resistance measured by the terminating panel differs from the expected configuration. This supervision ensures that any “tampering” with the infrastructure will be identified and the alarms triggered by such situations are generally referred to as “tamper alarms”. See TAMPER ALARMS.

.109 **SUPERVISORY CONTROL AND DATA ACQUISITION** protocol and associated equipment which is used, particularly in association with the water and waste water equipment used by the *Region* and which is interconnected with the security system. Many of the devices or parameters associated with the monitoring of water and waste water relate to analogue data such as temperature, pressure and flow rates as opposed to most security monitoring which is digital, i.e., the door is open or it is closed.

.110 **SURREPTITIOUS ATTACK** is a secret unauthorized attack to breach or circumvent a defensive system or some of its components in such a manner that the custodians and/or security force cannot readily detect the attack.

.111 **SURVIVABILITY** is the ability for the equipment to be subjected to the conditions which are referenced for an indefinite period without being operated and then returned to normal operation under different conditions without suffering any degradation or damage, e.g., keeping electronic equipment in a storage facility which is at -40°C when the operational requirement might call for a minimum to -20°C could affect the equipment survivability.

.112 **SYSTEM INTEGRATION TESTING** includes all testing required to verify the harmonious operation of all designated subsystems. In the case where the larger system consists of individually approved sub components, partial testing shall be carried out on selected samples of equipment only.

.113 **TAMPER** is the general process of attempting to make unauthorised modifications to a security system, generally in order to defeat the system's ability to detect a planned intrusion. The term “tamper” is often used colloquially to refer to a “tamper switch” which is contact attached to an equipment panel door to detect any unauthorised opening of the cabinet, i.e., tampering with the equipment.

.114 **TAMPER SWITCH** see TAMPER

.115 **TEST REPORT** is a pre-programmed call made from the Client site to the Monitoring Station, typically once per day and generally during “silent hours”. The Reporting ID is defined as a “Test Report” and the Response Plan will confirm that no action is required. If the scheduled Test Report is not received, the Monitoring Station will typically generate a notification to the Client indicating the absence of the Test Report at the agreed upon scheduled time.

.116 **THREAT** The perceived imminence of intended aggression by a capable entity to harm any aspect or all of a facility or its contents. THREAT can also be considered as any potential event or act, deliberate or accidental, that could cause injury to employees or assets.

.117 **THREAT AND RISK ASSESSMENT** i.e., an evaluation of the vulnerability of a facility or asset which is generally provided as a report prior to designing a security solution.

.118 **TIME TO REPAIR** is the time measured from informing the maintenance provider of a problem to the correction and the return to full service of the defective system.

.119 **TOGGLE** generally refers to the ability to activate a control function repeatedly thereby changing the output state between 2 alternative conditions. This may be the control of lights, i.e., turning them on and then off, or the control of a door, i.e., latching a door open and closed. Such toggling may, for example, be activated by activating a button or by using a specially programmed access card

.120 **TROUBLE INPUTS** are internal inputs defined within a security system which generate “alerts” to notify the system operators of an internal fault or “trouble”. Such “troubles” need attention even if the reported problem does not appear to be causing any immediate concerns. Typical trouble inputs may include battery failure, AC power failure, power supply failure, LAN communications failure, phone line failure excess temperatures in the cabinet, system restart etc.

.121 **UNDERWRITERS LABORATORIES or UNDERWRITERS LABORATORIES OF CANADA** is one of a number of global industry-based safety testing and certification laboratories which has been approved to perform tests of equipment where otherwise CSA testing would be required.

.122 **UNINTERRUPTIBLE POWER SUPPLY** is an alternative source of main electrical power which is always available in the event that the primary source of power fails. Generally, the UPS power is on line at all times thereby ensuring that the power to the equipment never fails for even an instant. In many circumstances the UPS is associated with a Standby Generator which stars up and can generate power for a long time after about 1 minute thereby providing power for a long time if the Utility power is absent.

.123 **VLAN "virtual LAN"** is any broadcast domain that is partitioned and isolated in a computer network at the data link layer (OSI layer 2). LAN is local area network and in this context virtual refers to a physical object recreated and altered by additional logic. VLANs work by applying tags to network frames and handling these tags in networking systems thereby creating the appearance and functionality of network traffic that is physically on a single network but acts as if it is split between separate networks.

.124 **VULNERABILITY** - an inadequacy related to security that could permit a threat to cause injury.

.125 **WALK TEST** is a method for testing sensors, generally in an operational security system, without causing false, system alarms. During a walk test, a person will go through each area and intentionally activate sensors so that they are recognized by the system. Arguably, the most important sensors to check during a Walk Test are motion sensors. This is because motion sensors are particularly prone to false alarms when they are mounted improperly. However, the testing process should also include all other sensors which are being monitored. During the Walk Test, the faulted zones will be displayed, but no alarms will be reported to the central station.

.126 **WARRANTY** is the requirement for the contractor to *Provide* a reliable system with an acceptable "return to service" response time. Typically, this requirement will define availability of parts and trained technicians for a specified period.

.127 **WHMIS** The Workplace Hazardous Materials Information System are laws, created in 1988 to: give employers and workers information about the hazardous products or chemicals they may be exposed to at work. By international agreement this is now synonymous with a global system known as the Globally Harmonized System for the Classification and Labelling of Chemicals (GHS).

.128 **WIDE AREA NETWORK** is a computer network spanning regions, countries, or even the world and which may be partially made of infrastructure belonging to many and possibly unknown partners. The application is generally to *Provide* for sharing of data or for the networking of computers.

.129 **Wi-Fi** is a family of wireless network protocols, based on the IEEE 802.11 family of standards, which are commonly used for area networking of devices and Internet access. Wi-Fi is a trademark of the non-profit Wi-Fi Alliance which restricts the use of the term Wi-Fi Certified to products that successfully complete interoperability certification testing. Communication using Wi-Fi allows for wireless local area networking (See 1.6 Applicable Standards for details of 802.11)

.130 **ZONES** defines a series of clearly discernible and securable spaces to progressively control access.

1.9 SOFTWARE/SYSTEM CONFIGURATION

.1 The Security System installed as part of this *Contract* or any modifications to the existing installation shall be reflected in the existing security system database. All programming and configuration for the work under this *Contract* must be consistent with the existing programming to guarantee consistent functionality of the system and all of its components across the *Region*.

.2 The *Contractor* is only responsible for the work related to this *Contract* and shall NOT adjust or alter the existing configuration for any other facilities within the system without written authorization from the *Region*. The *Contractor* shall NOT alter, modify, delete or interfere in any way with any settings, configuration or variables that may affect the functionality of the existing facilities, systems or their components without prior written authorization from the *Region*.

.3 The installed Security Access Control system must be configured to meet all existing Regional standards (Security, Operational, IT). The *Contractor* shall be responsible for identifying the requirements, developing a custom solution to meet those requirements, and presenting available options in the form of an implementation plan to the *Region* for approval before implementing the proposed solution.

.4 All software licencing must be detailed, supplied and installed to operate the security solution. The *Contractor* shall supply and install all of the necessary proprietary integration licences, card reader licences and workstation licences, as may be required. It is the *Contractor*'s responsibility to quantify and *Provide* the number of licences required based on the Drawings and *Specifications* provided in the *Contract Documents*. All costs associated with provision of the required licences shall be included in the *Contract Price* including any modifications to the *Contract Price*.

.5 The *Contractor* shall work with the *Region*'s IT department to perform application or database server programming and configuration and network device security penetration testing. The contractor shall supply copies of all network device specifications and data sheets to IT when requested in preparation for the penetration testing. All work requiring access to the database and/or application servers must be coordinated with the *Region* a minimum of one week in advance.

.6 All changes to the network configuration and network attached devices must be approved by the ITS department to ensure that the network complies with ITS's "penetration" resistance requirements. It is noted that IT maintains a list of approved devices which may therefore not require individual testing. In the event that penetration testing is required, the costs of the testing incurred by the *Contractor*, and of any remediation which may be required by IT, will be borne by the *Region* if the deficiency is encountered after the award of contract.

.7 All server, network, and other requirements shall be coordinated with the Regional IT Services department and validated by the security system manufacturer prior to installation. All servers and network switches shall be provided by the *Region* unless otherwise specified in the *Contract Documents*.

.8 The software and/or system deployment and configuration shall be overseen and validated by the Regional representative(s) from the Capital Delivery Coordinator department. The *Contractor* shall use manufacturer provided software applications to program, configure and test the system. No configuration shall be completed utilizing any client applications on the client servers.

.9 There shall be a single, integrated, Audit Trail log which records all of the actions and activities for the entire site. The integration of the activities at each site shall be similar, subject only to the configuration of the site, and shall include:

.1 Local date and time (using Canadian - ISO style and 24 hour clock);

.2 All access card activities including name, action granted or denied and reason;

.3 Logging in and out of operators;

.4 Schedule activations and deactivations;

.5 Trouble and alarm reports;

.6 All failures, arming and disarming of systems; and

.7 System resets and restarts.

.10 The intrusion detection system at each Facility (or group of buildings) must be armed by using a card swipe on the card reader on the secure side of the door followed by pressing a button which is labelled for this purpose. The intrusion detection system must disarm automatically when access is granted at a perimeter door, i.e., an access which is granted, at a perimeter door will disarm the intrusion detection system unless otherwise specified. Note that the door does not have to be opened for the alarm system to be disarmed. The intrusion detection system shall not permit arming until all intrusion points are “fault free”, i.e., closed. This arming process may proceed if trouble alarms, which generally are not operational, are present. All relevant information related to the current status of the area shall be displayed on the local intrusion detection system keypad(s). The same information shall also be displayed by means of dynamic icons on the local and the central, access control interface Alarm Monitoring software client interactive map. Integration between the access control hardware, the access control software and the intrusion system must be seamless in both online and offline modes. The contractor shall create custom alarms for each facility which shall properly display any intrusion events using the access control Alarm Monitoring application.

.11 The intrusion detection system Alarm Keypads shall display the name of the facility and the nature of any faults in the system but shall not be used for “Arming” the system, “Disarming” the system or clearing any faults. All the keypads in each facility shall also annunciate any active alarms occurring in that facility using its internal sounder, e.g., intrusion alarms, panic alarm, system failure.

.12 Arming shall be implemented locally by a valid card swipe on an adjacent, dedicated, internal card reader followed by a button press or, alternatively, through the access control system Interactive Map utilizing dynamic icons.

.13 Disarming shall be performed locally by a valid card swipe on any of the external, perimeter readers or, alternatively, through the access control Interactive Map utilizing dynamic icons.

.14 The intrusion detection system shall allow persons to exit from the facility without triggering an event until the system is fully armed after the exit delay time. The system shall alarm instantaneously when any intrusion zone is faulted while the system is in the armed state and shall record details in the Audit Trail log. All intrusion alarms shall be annunciated:

.1 Locally on all the keypad(s) at the corresponding Facility;

.2 On the local access control system graphic map(s) where available;

.3 Remotely on the access control system Alarm Monitor client application;

.4 To the 3rd party Central Monitoring Station; and

.5 To the SCADA Control Panel for ENV OMM facilities.

.15 The *Contractor* shall create or update a graphical map interface for the system reflecting any work performed under the current contract, making it the same or similar in appearance and functionality to the existing graphical maps (see 3.10 Sample Graphic Alarm Map, Regional Layout and Icons). The graphical map interface shall be implemented as a multilayer hierarchy with the highest level or main map displayed as a map of *York Region* identifying all the municipal boundaries.

.16 The Regional facilities shall be represented on the display using distinct icons depicting corporate, environmental, transportation, paramedic and other departments (see section 3.10 Sample Graphic Alarm Map, Regional Layout and Icons). Each facility shall be represented by the applicable architectural floor plan, (multilayered, if necessary), to identify the areas, floors and buildings. The facility graphical map shall be created by the *Contractor* from the CAD or PDF files which are provided by the *Region*, in a resolution which displays properly on a typical 24" display configured at 1920 x 1080 PPI resolution unless otherwise specified. Pixilated, blurred and/or illegible maps shall not be accepted. See section 3.10 Sample Graphic Alarm Map, Regional Layout and Icons for further information.

.17 The graphical interface shall show all field devices together with their associated status dispositions. Typical status options shall include but are not limited to Armed, Disarmed, Normal, Alarmed, Forced, Held Open, Locked, Unlocked, Tamper, Faulted, Active, On schedule, Offline, AC Fail, Battery Trouble, etc. (see Section 1.8 Standardized Terminology for meaning of foregoing terms). All required status symbols are already available and may be reused for this project. Some of the symbols developed specifically for *York Region* are shown in 3.10 Sample Graphic Alarm Map, Regional Layout and Icons

.18 Each facility's graphical map shall contain a displayed control /status panel allowing direct control with functions, such as Arm, Disarm, Door control operations, intrusion area operations, map navigation, etc., and at all times displaying the real-time status of the facility, such as Armed/Disarmed Status, Ready to Arm Status, Intrusion Alarm Status, System Components Status etc. (see section 1.8 Standardized Terminology for meaning of terms). The *Contractor* shall use the existing custom dynamic icons to populate the graphical interface or, if necessary, create additional icons. The existing custom icons will be provided to the contractor on request.

.19 Whenever a panic alarm is activated, the local graphic map display and the central graphic map display (as may be available) will immediately both be updated to identify the location of the active alarm by showing a flashing red icon at the alarm location and display a text message on the keypad which will also be sounding. The screen will have an icon "Panic Clear" which both clears the map display and also silences the keypad.

.20 The *Contractor* shall create new and update existing Schedules (Time Zones), Access Levels and Monitor Zones (to enable remote monitoring by system administrators), as may be required for each contract. The *Region* shall *Provide* the *Contractor* with the initial configurations for these options.

.21 All system components shall be configured using the Regional Security System Naming Conventions Standards as outlined in section 3.11 Regional Security System Naming Conventions Standards. Naming conventions shall be consistent throughout the system.

.22 All security panels shall report AC Fail, AC Restore, Battery Trouble and enclosure tamper events to the Access Control System Software by using the Alarm Monitoring application and this information shall be displayed on the graphical maps by means of the corresponding dynamic icons.

.23 Batteries included in any panels or modules which are supplied or installed in the course of the *Contract*, shall be labelled identifying the date of initial deployment using the ISO 8601 format, i.e., YYYYMMDD or YYYY-MM-DD.

.24 The *Contractor* shall update all system hardware components with the latest manufacturer approved firmware versions prior to final commissioning. The *Contractor* shall ensure that any firmware updates are fully compatible with the existing software releases prior to performing such upgrades. Where firmware versions are indicated by the manufacturer on the devices or in the devices, updates performed by the *Contractor* shall be reflected by modifying the original labelling so as to show the installed version or release of the firmware.

1.10 NETWORK TCP/IP COORDINATION

.1 The *Region*'s *Project* Manager will coordinate the installation of any required network system components or modifications with ITS (Information Technology Services) Department and the appropriate BSA (Business System Analyst) at the *Site*. Such changes may be required to allow for communications between the new security installation and the database server(s) which are located at *Region*'s Central Monitoring Station so as to *Provide* the requisite tie in and commissioning of the security system.

.2 The *Contractor* is reminded that all equipment which is being installed to the network must comply with ITS's penetration approval requirements (see Section 1.4.6).

.3 If local, wired, IT Wide Area Network infrastructure is not present on a site, Wireless network equipment shall be used. *York Region* ITS will supply the contractor with the pre-configured Wireless Modem and network switch as well as specific installation instructions.

.4 The *Contractor* shall install all required conduits and junction boxes as well as the exterior antenna for the Wireless equipment, in a location which has been identified by ITS to *Provide* suitable network performance for this application. If required, the *Contractor* shall *Provide* such additional infrastructure as may be required to ensure that the complete communications system performs in accordance with the design. Note that, in accordance with Code requirements, conductive data and high power cables (120 V or higher) cannot be placed in the same conduits.

.5 The wide area network data switch shall be located within the access control system cabinet. Both the modem and the data switch shall be powered from the UPS power supplies being used by the access control system.

1.11 SUBMITTALS – GENERAL REQUIREMENTS

.1 All submittals to the *Region* will be reviewed by the *Region* and *Consultant* and must be accepted by the *Region* before any construction is permitted.

.2 Submissions shall be made in accordance with the schedule developed and approved for the project and shall comply with all of the requirements as stated in this document and in the *Contract Documents*.

.3 All submissions shall be in English and spell checked in accordance with normal Canadian spelling and grammatical practices. The text documents shall use Times Roman font in 11 point as the body font with a minimum of single line spacing.

.4 The submission shall be provided in at least one hard copy and one electronic copy. The former shall be printed single sided and suitably bound and indexed on 8.5 x 11 ins. Drawings shall be printed in a size to be agreed to between the parties and provided with a suitable cover page and index page. The electronic copy shall be provided both in an editable format using Microsoft Word for text and AutoCAD for drawings and also in Adobe PDF. These files may be transferred via a secure link or on a portable storage medium. The *Contractor* is responsible to certify that all of the electronic files are free of any malware and the files shall have no electronic locks, encryption or restrictions.

.5 Documentation submissions

.1 All documents are to be submitted to *York Region* using:

.1 Microsoft Office 2019 or later as appropriate

.2 AutoCAD 2019 or later as appropriate

.3 Photographs shall be formatted in JPG but shall be no larger than 10 MB each.

.2 Unless otherwise agreed to or documented in the *Contract Documents*, hardcopy submittals shall:

.1 Be printed single side, 8.5 x 11 inches and bound;

.2 The binding system which is used shall be sufficiently durable for the purpose, i.e., for review or for ongoing reference. Typical binding systems are 3 rings binders, Cerlox and Wire Binding Spines. Note that only the 3 rings binder can be easily updated;

.3 Pages shall be numbered in the format of “page 23 of 120”, i.e., indicating the total number of pages in the document; and

.4 Where colour is used to explain any aspect of the documentation the submittal must be printed in colour.

.3 Unless otherwise agreed to or documented in the *Contract Documents*, Digital submittals shall:

.1 Be provided in both Adobe’s Portable Document Format (PDF) and in the source document editing format, e.g., Microsoft Word etc. using software and versions which comply with the *Region*’s Standards as defined in this Specification Section;

.2 The submittal of the digital information my be provided on a portable media, e.g., a thumb drive or a Digital Video Disk (DVD), or through an e-mail or File Transfer Protocol (FTP) exchange;

.3 Be certified by the sender to be free of all forms of malware, including trojan horses, viruses, worms etc;

.4 Be free of any encryption, locks, passwords or devices to restrict access unless this is acknowledged and documented prior to the document transmission; and

.5 Not be subject to any form of proprietary restrictions or copyright.

.6 *York Region* shall review the documents and *Provide* comments to the *Contractor* indicating in particular if the *Contractor* may or may not proceed with the project and if a modified submittal is required. These comments shall be provided to the *Contractor* within 15 working days, unless an alternative schedule is agreed to by all parties.

.7 *York Region* and its agents shall be the final arbiter with regard to the suitability of the submissions.

.8 Prior to the start of construction, the *Contractor* shall submit a complete set of all relevant technical documentation, and technical shop drawings and specifications for approval by the

Region and also for review by the Security Installation *Contractor* prior to the implementation phase of the project.

1.12 SUBMITTALS – *SHOP DRAWINGS*

.1 Submit required submittals in accordance with Section 01 33 00 – Submittal Procedures.

.2 *Product* data sheets:

- .1 Submit manufacturer's *Product* data sheets for *Products* proposed

.3 Submit shop drawings showing the proposed location of all equipment to be installed under this *Contract*.

.4 The *Contractor* shall *Provide* one full hardcopy and one digital copy of shop drawings which shall cover the entire scope of the *Work* as defined by the *Contract Documents*, including but not limited to:

- .1 System riser diagram(s)
- .2 System layout/floorplan
- .3 Network connectivity diagrams
- .4 Vertical and horizontal wiring diagrams
- .5 Typical and site-specific termination/wiring schematic(s) and diagrams
- .6 DIP Switch and similar configurations
- .7 Device landing schedule(s)
- .8 System integration schematic(s) and wiring diagrams
- .9 Intrusion detection point schedule(s)
- .10 Tub/enclosure layout diagram(s)
- .11 Electrical connections and wiring diagrams
- .12 Explanation of the sequence of operation
- .13 Integration techniques and operational scenarios
- .14 Addressing charts
- .15 *Product* specifications and cut-sheets
- .16 Complete Bill of Materia
- .17 Description of test methodology
- .18 Other relevant information required for the installation

.5 Additional Shop Drawing Requirements:

- .1 For devices containing DIP switches, jumpers or programming keypads include with the shop drawings, as appropriate:
  - .1 Functional description.
  - .2 Performance data.

.3 Physical, electrical and environmental requirements.

.4 Location drawing.

.5 Equipment descriptive literature.

.6 Wiring details.

.2 For programmable equipment, communication links and networks, submit a Bill of Materials. Include the hardware documentation with the Bill of Materials.

.1 For hardware items include and clearly identify: Description, make, model, part number and serial number (once this available).

.2 For documentation include: Title, version, date and publisher for each item.

.3 For Programmable Hardware Equipment include:

.1 *Product* description for each item including:

.1 Wiring and installation instructions.

.2 Functional description.

.3 Performance data.

.4 Physical, electrical and environmental requirements.

.5 Adapters and controllers.

.2 Equipment layout drawings showing location of hardware, boards, jacks, cables and terminals.

.3 Related field tag numbers and wire numbers, module tag assignment, rack module assignment, and terminal numbers.

.4 Location, identifier and pin assignment of plugs, jacks, and cables.

.5 Switch settings and addresses, firmware.

.6 Interconnection Diagrams including wiring, cables, jacks between internal and external components, power supplies, processors, communications modules, racks, input/output modules and peripherals. Label terminals, jacks and pins. Show settings for jumpers and switches. Show address for each hardware module and point.

.7 Any backup or other maintenance requirements.

.8 Listing (hard and digital copies) of all programming details.

.6 The review of shop drawings shall only be in reference to general design. The review of the shop drawings shall not, in any way, relieve the *Contractor* of responsibility for errors, omissions or physical interference, or from the necessity of furnishing such work and materials as may be required for the completion of the work at any time prior to formal acceptance. The *Contractor* shall be cognisant that the shop drawings may require resubmission before the contractor may proceed to the next phase of the project.

1.13 SUBMITTALS - AS-BUILT DOCUMENTATION

.1 Submit required submittals in accordance with Section 01 78 39 – As-Built *Documents* and as noted herein.

.2 The AS-Built Drawings, *Documents* and Materials as described here shall be submitted no later than 15 *Working Day*s after the substantial completion of *Work*, i.e., after the commissioning of the system has been completed and any identified deficiencies have been resolved.

.3 All as-built documentation must use the *Region* defined naming convention for all system components and must be consistent with the naming convention used in the software.

.4 The *Contractor* shall submit detailed documentation describing the entire scope and extent of the *Work* which has been performed in accordance with the *Contract Documents*, in compliance with the requirements identified in section 1.6 Applicable Standards. The requirement is that this documentation shall be sufficient for “a person knowledgeable in the industry and familiar with the technology to have the ability to perform the work described in the *Contract Documents* without the need for further instruction”. These documents shall include, as may be appropriate, some or all of the following but are not limited to:

.1 As-built drawings, documents and materials: In conformity with the requirements noted in section 1.6 Applicable Standards, the documentation shall cover the entire scope of work, including but not limited to the items listed below and detailed commissioning documentation, as well as other relevant information, e.g., firmware versions, warranty details. In practice the *Contractor* is expected to resubmit the shop drawings, which were submitted earlier, with the incorporation of the modifications to reflect the actual work which has been completed.

.1 System riser diagram(s)

.2 System layout/floorplan

.3 Network connectivity diagrams

.4 Vertical and horizontal wiring diagrams

.5 Typical and site-specific termination/wiring schematic(s) and diagrams

.6 DIP Switch and similar configurations

.7 Device landing schedule(s)

.8 System integration schematic(s) and wiring diagrams

.9 Intrusion detection point schedule(s)

.10 Tub/enclosure layout diagram(s)

.11 Electrical connections and wiring diagrams

.12 Explanation of the sequence of operation

.13 Integration techniques and operational scenarios

.14 Addressing charts

.15 *Product* specifications and cut-sheets

.16 Complete Bill of Material

.17 *Documents* recorded during the testing and acceptance activities

.18 Other relevant information

.2 One additional hard copy of the as-built drawings with all relevant drawings and documentation shall be provided by the *Contractor* and stored on-site inside or near to the main system enclosure along with warranty/contact information.

.3 All technical notes, software scripts, firmware details and other documentation covering the IT portion of the *Work* covered under this *Contract*. All configuration modifications and configuration backup files shall be documented as a part of the as-built package.

.4 Lists of all passwords, keywords, serial numbers, licenses and/or configurations that are encountered during the installation and configuration of the system.

.5 Complete set of manufacturers' installation manuals, maintenance manuals and specifications for all system software and hardware components by make and model. This information shall include comprehensive, descriptive data sheets, brochures, installation, and technical manuals for all systems and equipment forming part of the contract. The manuals shall include operational and schematic diagrams for the System and all related components.

.6 Detailed commissioning documentation in the format approved by the *Region* (see section 1.16 Regional Approved Commissioning Form), populated with all relevant information and worksheets identifying all testing and commissioning procedures which were undertaken. The commissioning documentation must be completed by the *Contractor* and signed by the Regional representative. An example of the *Region* approved commissioning form is presented section 1.16 Regional Approved Commissioning Form.

.7 Theory of Operation – system outline and overview.

.8 Operational manuals explaining the system operator's available features, functions and capabilities.

.9 System administration manuals including operational and maintenance requirements and procedures associated with the proposed solution. Description of administrative functions required to supervise and manage the integrated system(s).

.10 Full schedule of maintenance which is to be carried out on each system component during the warranty period of 24 months after the date of *Total Performance of the Work* and for the entire lifetime of the system and its components.

.11 The *Contractor* shall commit to the *Region* that the *Contractor* will meet the *Region*'s requirements for response time and return to service time in regard to any service calls made during the Warranty period and that suitable spare parts will be readily available to meet those commitments.

.12 The contractor shall propose an inventory of spare parts which the *Region* may wish to acquire for the system following expiry of the Warranty period.

1.14 *PRODUCT* SUBSTITUTIONS

.1 Submit requests for substitution immediately upon discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals and in accordance with section 01 25 00 - *Product* Substitution Procedures.

.2 Definitions

.1 *Substitutions:* Changes in products, materials, equipment, and methods of construction from those required by the *Contract Documents* and proposed by *Contractor*.

.2 *Consultant:* Reference to *Consultant* in this Specification Section is a reference to the authorized *Contract* Administrator.

.1 Substitutions for Cause: Changes proposed by *Contractor* that are required due to changed *Project* conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.

.2 Substitutions for Convenience: Changes proposed by *Contractor* or *Owner* that are not required in order to meet other *Project* requirements but may offer advantage to *Owner*.

.3 Documentation: Show compliance with requirements for substitutions and the following, as applicable:

.1 Statement indicating why specified product or fabrication or installation cannot be provided, if applicable.

.2 Coordination information, including a list of changes or modifications needed to other parts of the *Work* and to construction performed by *Owner* and separate Contractors, that will be necessary to accommodate proposed substitution.

.3 Detailed comparison of significant qualities of proposed substitution with those of the *Work* specified. Include annotated copy of applicable specification section. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the *Work* specified.

.4 *Product* Data, including drawings and descriptions of products and fabrication and installation procedures.

.5 Samples, where applicable or requested.

.6 Certificates and qualification data, where applicable or requested.

.7 List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners.

.8 Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.

.9 Research reports evidencing compliance with building code in effect for *Project*, from ICC-ES.

.10 Detailed comparison of *Contractor*'s construction schedule using proposed substitution with products specified for the *Work*, including effect on the overall *Contract Time*. If specified product or method of construction cannot be provided within the *Contract Time*, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.

.11 Cost information, including a proposal of change, if any, in the *Contract* Sum.

.12 *Contractor*'s certification that proposed substitution complies with requirements in the *Contract Documents* except as indicated in substitution request, is compatible with related materials, and is appropriate for applications indicated.

.13 *Contractor*'s waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

.4 *Consultant Action*: If necessary, *Consultant* will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify *Contractor* of acceptance or rejection of proposed substitution within 10 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.

.1 Forms of Acceptance: *Change Order*, Construction *Change Directive*, or Consultants *Supplemental Instruction*s for minor changes in the *Work*.

.2 The *Consultant* shall identify costs which may be associated with the revisions to the *Contract* documents or *Contract* Drawings and identify who shall be responsible for paying such costs.

.5 Quality Assurance

.1 Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage qualified testing agency to perform compatibility tests recommended by manufacturers.

.6 Procedures

.1 Coordination: Modify or adjust affected work as necessary to integrate work of the approved substitutions.

.7 *Consultant* will consider *Contractor*'s request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, *Consultant* will return requests without action, except to record noncompliance with these requirements:

.1 Requested substitution is consistent with the *Contract Documents* and will produce indicated results.

.2 Substitution request is fully documented and properly submitted.

.3 Requested substitution will not adversely affect *Contractor*'s construction schedule.

.4 Requested substitution has received necessary approvals of authorities having jurisdiction.

.5 Requested substitution is compatible with other portions of the *Work*.

.6 Requested substitution has been coordinated with other portions of the *Work*.

.7 Requested substitution provides specified warranty.

.8 If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the *Work*, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

.8 Substitutions for Convenience: *Consultant* will consider requests for substitution if received within 60 days after commencement of the *Work*. Requests received after that time may be considered or rejected at discretion of *Consultant*.

.9 Architect will consider *Contractor*'s request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

.1 Requested substitution offers *Owner* a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities *Owner* must assume. *Owner's* additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by *Owner*, and similar considerations.

.2 Requested substitution does not require extensive revisions to the *Contract Documents*.

.3 Requested substitution is consistent with the *Contract Documents* and will produce indicated results.

.4 Substitution request is fully documented and properly submitted.

.5 Requested substitution will not adversely affect *Contractor*'s construction schedule.

.6 Requested substitution has received necessary approvals of authorities having jurisdiction.

.7 Requested substitution is compatible with other portions of the *Work*.

.8 Requested substitution has been coordinated with other portions of the *Work*.

.9 Requested substitution provides specified warranty.

.10 If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the *Work*, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

1.15 TESTING AND QUALITY ASSURANCE

.1 The *Contractor* shall ensure that, upon completion of the contract, all hardware and software components are functioning as intended within the *Region*'s IT and the security network environments.

.2 At the discretion of the *Region*, final acceptance testing shall be carried out at any or all of the following defined levels:

.1 per point basis;

.2 per system component basis;

.3 per software function basis; and

.4 per total system basis.

.3 The *Contractor* shall document, test and verify the proper installation and functionality of the system and all of its components including integration to the systems described in this Section, application and database integration as well as online and offline operation. Upon request, these functionalities shall be demonstrated to the satisfaction of the *Region* which shall be performed without extra cost to the *Region*.

.4 The *Contractor* shall inspect all installed devices and equipment to ensure that all of these devices will achieve the intended system functionality. Any devices which are not capable of fulfilling the required system functionality shall be documented to the *Region* in writing. Any corrective measures which are required shall be approved by the *Region* and the *Contractor*. The costs for any modifications are to be borne by the *Contractor* unless the equipment configuration was selected by the *Region*.

.5 The *Contractor* shall test all field devices and system components which are configurable or adjustable to ensure that they achieve optimal performance and fulfill the performance requirements as installed. All configurable settings must be approved by the *Region* prior to installation and shall be documented for the *Region*. Upon request, this shall be demonstrated to the satisfaction of the *Region* without extra cost to the *Region*.

.6 All tests shall be performed to the satisfaction of the *Region* and, if any tests are repeated and then achieve different results, the *Region* has the option of requesting device replacement. If any adjustments are made in order to achieve the required test results, the *Region* or the *Contractor* shall identify if other tests need to be repeated to ensure that the adjustment does not prejudice any other test results. All such retesting and adjustments shall be performed without extra costs to the *Region*.

.7 Once the *Contractor* has established that the System is operating as required, on-site commissioning shall be scheduled with the Regional representative(s). The contractor shall demonstrate to the satisfaction of the *Region* that the system and all of its components are functioning, as intended by the approved design. This approval process shall be performed in 2 phases:

.1 A pre-commissioning demonstration with the *Region*'s Security System Administrator who may be reached at (905) 830-4444 ext.76900 and:

.2 A final commissioning with the *Region*'s Capital Delivery *Project* Coordinator.

.8 The testing and commissioning shall be completed and accepted both by the on-site Regional *Project* Coordinator and by the remote Regional Security and *York Region* System Administrators. It is the responsibility of the *Contractor* to arrange and carry out commissioning sessions with the *Region* and to *Provide* all parties with suitable records of the commissioning and minutes of the activities.

.9 In the event that the testing and commissioning activities do not meet with the approval of any of the Regional representatives, the *Contractor* is required to address the matters that led to the rejection of the system. Such alterations and repeating of the test and commissioning processes, in part or in whole, shall be performed expeditiously and without extra charges to the *Region*.

.10 The *Contractor* shall assist the *Region* in configuring, and/or reconfiguring, and populating, and/or repopulating all System related databases. As may be required, the *Contractor* shall also assist with any modifications which may be required to the existing integrations, configuring and/or reconfiguring all the system parameters to the *Region*'s satisfaction. All the procedures and activities required to accomplish such changes shall be fully documented and shall, as may be applicable, follow existing procedures.

.11 The *Contractor*'s assistance shall continue until initial configurations and integrations are complete and functional, and/or until all affected systems are working to the *Region*'s satisfaction and the related documentation has been accepted by the *Region*. In the event of any matters arising during the 12 months immediately following the acceptance of the system by the *Region*, the *Contractor* shall *Provide* suitable assistance to achieve resolution under the terms of the Warranty.

.12 The assistance, referenced in the above paragraphs, shall be provided by a single technician working physically side by side with the *Region*'s representative(s) assisting and instructing the *Region*'s representative(s) step by step in configuring system parameters and integration configurations to the systems outlined in the *Contract Documents*.

1.16 REGIONAL APPROVED COMMISSIONING FORM

.1 The commissioning procedure is described in the Specification Section 1.5 Testing and Quality Assurance.

.2 The appropriate Commissioning Forms are to be completed and submitted to the *York Region Project* Manager for approval no later than 48 hours prior to the proposed commissioning. The *Contractor* is responsible to ensure that the forms correctly identify the quantity and description of the elements which are associated with a particular project. Note that the forms are available in Excel format and should be submitted in that format. There are 3 forms, one provides the Legend which is to be used and the Overall *Project* Summary, the second provides a record of the Individual Security Devices and the third form identifies changes to the video surveillance system. The sample forms are to be replaced by those included with the contract documents. Additional copies of these forms shall be created as may be required.

.3 The contractor shall obtain copies of these forms directly from the *Region* so as to ensure that the forms being used reflect the latest version of the forms and incorporate the latest updates and reflect any technology changes.

SECURITY DEVICE LEGEND

DEVICE	DESCRIPTION	QUANTITY	MODEL NO.
DC	Door Contact		
MD	Motion Sensor		
CR	Card Reader		
REX	Request-To-Exit Motion Sensor		
GB	Glass Break Sensor		
PHB	PhotoBeam Detector		
ES	Electric Strike		
ML	Magnetic Lock		
OHD	Overhead Door Contact		
PB	Panic Button		
DU	Door Unlock/Lock Button		
FC	Fixed Camera		
PTZ	PTZ Camera		
KP	Keypad		
AB	Arming Button		
SS	Access Control Panel		
INTCOM	Aiphone Entry System		
SI	Intrusion System Panel		

SECURITY SYSTEM SUMMARY AND SIGN-OFFS

Building Name, Code, Address:	
120VAC Panel and Circuit Breaker Number for Security Panel:	
Network Information documented (ie.IP Addresses, Ports, switch etc.)	

General Inspections	**YES**
All devices and modules are labelled.	yes
All Graphic Devices/Design completed	yes
Access Levels, Cards/Schedules uploaded/functioning	yes
Batteries are hooked-up/ UPS test completed	yes
Tampers/Locks installed	yes
ESA Inspection passed	yes
OnGuard Panel notes complete with service information	yes
3rd party CMS connected and tested	yes

Names of Personnel that performed the commissioning	Date	Signature
Names of York Region Personnel that performed the commissioning	Date	Signature
Warranty start:		

				Installation			Functionality													
Item	Description/Location	Device ID	Bosch Zone	Door Hardware matches spec and installed correctly	All Devices Installed Correctly	Requires Service, Repairs, Missing or Cleaning	Access Granted - Door Open	Door Forced Alarm received by OnGuard, displayed on Map	Door Held Alarm received by OnGuard, displayed on Map	Door Open - Not Ready to Arm displayed on Map	Armed - Exit without Alarm	Intrusion Alarm received by OnGuard, displayed on Map	Armed/Disarmed Status received by OnGuard, displayed on Map	Intrusion Alarm received by Bosch, Zone displayed on Keypad(s)	ARMED Status received by SCADA	Intrusion Alarm received by SCADA	All Signals Received by 3rd party CMS	Access Granted Disarms Armed Building	Arming Station works as intended	Notes
1	Well 16, Ammonia Room	N021D001	Z-1	yes	yes	no	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	n/a	yes	
2	Well 16, Ammonia Room Arming Re	N021D000 W16	Z-6	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	yes	
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CCTV Commissioning document

Building Name:	
Project Number:	
Date:	

Camera name	Camera server name	Camera address location	Description	DVM#	IP address	Camera part number	Live View frame rate (15FPS)	Background recording duration(24hrs)	Background record rate(Full frame)	Background delete after(1 month)	compression format(H.264)	compression Ratio(Medium)	Resolution
						AxisQ6045	YES	YES	YES	YES	YES	YES	1920 x 1080
						AxisP3365-V/VE	YES	YES	YES	YES	YES	YES	1280 x 720

Notes:

1- Following parameters must be provided to Honeywell before starting the programming; **Camera name, Camera server name, Camera address Location, Description, IP addresses**

2- Honeywell tech can suggest the **Camera name, Camera address Location, Description, and YR provides sign off if they are acceptable**

3- Honeywell tech to create PTZ presets and tour based on YR's required field of view of a PTZ

4- Followings are the YR standards for programming unless otherwise suggested by YR:

Live View frame rate	15 frame per second
Background recording duration	24 hours
Background record frame rate	Full frame-rate
Background delete after	1 month
compression format	H.264
compression Ratio	Medium
resolution for PTZ	1920 x 1080
resolution for Fixed	1280 x 720
PTZ preset Speed	20
PTZ Preset Dwell Time	1s

Sign-Off Summary

	Name	Signature
Honeywell tech performed the commissioning		
YR personnel accepted the commissioning		

1.17 TRAINING

.1 The purpose of the training is to allow the local and the Regional staff to safely and reliably:

.1 Perform all routine operations and maintenance functions required for the systems;

.2 Make minor changes to the system configurations;

.3 Address any intrusions, access card management issues, emergencies, accommodate visitors, manage issues related to parking and deliveries; and

.4 Recognize when more expert advice is required and to identify the nature of that requirement.

.2 Training of the Regional staff shall be provided by *Contractor* staff familiar with the project and equipment and experienced in delivering such training courses in English. If the training is considered inadequate by the *Region*, it shall be repeated without extra charges to the *Region*.

.3 All necessary supplies and documentation for the training course shall be supplied by the *Contractor*. The *Region* shall *Provide* a location with basic audio-visual equipment, i.e., a screen, tables, chairs and internet accessibility. Other equipment and network access can be requested but might not be provided by the *Region*.

.4 The training program shall *Provide* suitable training for those at the *Region* responsible for operation, the administration and the supporting of the "security systems". The scope of the training shall cover the entire scope of work defined by the *Contract Documents* as well as its interaction with previously existing systems.

.5 The *Contractor* shall *Provide* a detailed description and syllabus of the training program to the *Region* for review at least 2 weeks ahead of the proposed training session. This description shall identify:

.1 The intended audience for the upcoming training session, i.e., system operators, system administrators or support staff;

.2 The material to be presented;

.3 The supplies being provided by the *Contractor*;

.4 Any supplies (other than the training room) to be provided by the *Region*; and

.5 The anticipated duration of the training program.

.6 The *Region* shall review the proposed training program and *Provide* comments to the *Contractor*. If the comments are significant the *Region* may elect, without incurring any extra charges to delay the training program and to undertake a further review of the edited training program.

.7 The *Region* shall identify the number of individuals anticipated at the planned training session at least 1 week prior to the start of the training session.

.8 Training documentation shall be developed by the *Contractor* in adequate quantities to satisfy the requirements of the training; and shall be submitted by the *Contractor* for future reference by the *Region* in printed and digital formats (see section 1.6 Applicable Standards). At the discretion of the *Region*, the training session may be recorded. Such a recording shall be used only by the *Region* and its employees for internal training purposes, e.g., additional employees.

.9 Training may not take place using the *Region*'s live system but the *Contractor* may, by mutual agreement between the *Contractor* and the *Region*, use the *Region*'s live system to show the reality of a "live system".

.10 The *Contractor* shall ask the attendees partaking in the training session to complete an evaluation of the training program to help with improvements to future training sessions. The results of this survey shall be provided to the *Region*.

1.18 WARRANTY

.1 The entire passive network shall be accepted by the manufacturer after certification under its “lifetime warranty” program.

.2 The beneficiary of the Warranty shall be the Regional Municipality of *York*.

.3 The *Contractor* shall be responsible to ensure that installation complies with the warranty conditions. The general requirements are that:

.1 All components shall be from a single manufacturer.

.2 The installation is performed by Factory Trained installers.

.3 The installation is tested and certified to meet the required standard.

.4 During the Warranty period and as may be determined thereafter, the *Region* requires that the *Contractor* ensure that the service and repairs to the security system shall meet the following target service levels for the entire security system installed under the contract.

.5 Response Time, Repair Time and Overall System Availability

.1 The *Contractor* will respond to warranty work in reasonable time such that overall requirements for system availability are met. Availability of replacement components will support a reasonable response time. The *Contractor* shall be penalized when, during the warranty period, an incident involving a failure of any part of the system results in more than 48 hours of down-time or if the *Contractor* fails to commence warranty service within 12 consecutive hours from the first notification (being “Made Aware”) of the incident by *York Region* personnel or by system diagnostics.

.2 “Made Aware” means when the *Contractor* has been advised by any party or when detected by or should have been detected by the *Contractor*. Additionally, the cumulative downtime shall not exceed 220 hours in any 6 month period or a penalty for each additional 24 hour period of downtime shall be applied.

.3 Failure of any part of the system is defined as, but not limited to, any loss of functionality, malfunction of the security system or failure to attain the performance requirements as defined in this specification, in the *Contract Documents* or described in the training provided to the *York Region* staff or any on-line terminal malfunction, or communications failure which is not the result of a utility company to *Provide* their service, under normal usage, vandalism, or traffic damage. These considerations clearly apply to the components which are referenced as the Security system or the surveillance camera system.

.4 The following table summarizes incident response times, incident repair times, and cumulative downtimes:

Target Response	Response Time	Penalty Rate
Maximum Time to respond to an incident	24 hours	$250.00 per 24-hour period or portion thereof.
Maximum Time to repair problem causing an incident	48 hours	$250.00 per 24-hour period or portion thereof.

Cumulative down time during any 6-month period	220 hours	$250.00 per 24-hour period or portion thereof.

.5 The *Contractor* shall submit system Diagnostic Reports to the *York Region* Security Coordinator on a monthly basis throughout the warranty period within 14 days of each month end. These reports shall validate the performance during the previous month and certify compliance with the performance and up time requirements.

.6 The *Contractor* shall make available qualified technical support during normal working hours and emergency support at all times 24 hours a day for each day throughout the warranty period.

1.19 CLOSE OUT

.1 Close Out of the project shall require that the some or all of the following documents and miscellaneous items shall be provided to the *Region*, addressed to the Security *Project* Coordinator, via e-mail or to 145 Harry Walker Parkway, Newmarket, ON, L3Y 7C5.

.1 One copy of all signed and dated test results as approved by the *Consultant*. This shall only be done after any aberrations uncovered during the testing have been rectified;

.2 A written list of all passwords, keywords, serial numbers and/or configurations that were encountered during the installation of the operating system and application software;

.3 Assignment of all warranties, licences and product registrations to the “Regional Municipality of *York*” and documentation to this effect;

.4 Ensure that any permits or temporary configurations of any kind are returned to their permanent “operational” status and appropriate documentation is provided confirming this status;

.5 All installation software, user manuals, accessory cables, calibration units and any other material accompanying the installed equipment; and

.6 All keys, special tools, spare parts, unused components, permits, approvals, as-built drawings and project related documentation.

.7 All documentation shall be provided in both hard copies and also in soft copies (using bother source document format and PDF format). Source documents shall be in AutoCAD or Word format. There shall be no locks, keys or restrictions preventing the use of these documents by the *Region* and the documents shall be certified to be free of viruses or other malware of any kind.

PART 2 - PRODUCTS

2.1 SECURITY, ACCESS CONTROL AND INTRUSION DETECTION

.1 The *Contractor* shall ensure that all supplied systems which are to be deployed are compatible with the existing security installation. Hence the general industry guideline of using the most recent versions of software, firmware and hardware may lead to unsatisfactory performance due to incompatibility. It should be noted that the existing installation may not have been updated to the latest versions because of prior, known incompatibilities. The contractor is responsible to validate all such equipment and ensure full compatibility between newly supplied equipment and the already installed components. Any proposed firmware or software updates must therefore be reviewed with the *Region* before any updates are undertaken. If any modifications or upgrades are required, these changes must be included in the project budget and identified in the proposal.

.2 The use of any equipment which is not approved by the *Region* shall constitute a Breach of *Contract* and grounds for terminating the *Contract* in progress and lead to an Action to complete the contract in accordance with the approved design as well as consequential damages.

2.2 PERFORMANCE CRITERIA

.1 Contractors shall recognise that the purpose of installing any Security System is to ensure that intruders cannot enter and that any attempt to bypass or otherwise defeat the hardening which has also been installed in order to deter intruders must successfully report all details of this attempt.

.2 The *Region* is therefore adopting suitable criteria which will be use to determine the effectiveness of the Security Systems.

.3 The Probability Of Detection (POD) is a measure which recognizes that some Security Systems do not detect every attempt at compromise. The *Region* expects however that the POD shall meet or exceed 97% with suitable information being provided in a timely manner to the security staff for them to investigate.

.4 The corollary to an effective detection system is that the system must have a very low False Alarm Rate (FAR). It is well known in the industry that false alarms are a major cause of the failure to detect intrusion attempts. When an alarm is reported and the security patrol determines that this was caused by “acceptable events” it is either classified as a false alarm or as a “nuisance alarm”. Both of these situations generate distrust in the alarm system ultimately leading to the failure of responders to pay attention to alarms.

.5 The *Region* will not accept a false alarm rate which exceeds 2% i.e., no more than two out of every hundred reported alarms may be classified as a false alarm or as a nuisance alarm.

2.3 ENVIRONMENTAL REQUIREMENTS

.1 The following requirements are identified for all Security equipment provided to *York Region* unless otherwise identified.

.2 Unless specifically identified all indoor and outdoor equipment should be capable of performing and or surviving the following operational conditions. Note that particularly in moist or wet locations the contractor has the responsibility to minimise or eliminate all electro chemical potentials which are a primary cause of corrosion. These specifications are intended to address only the requirements in “normal” spaces and do not extend to the special requirements which may exist in “special” locations, such as sewage or water treatment facilities.

.1 Outdoor Operational Environments

.1 Air Temperature Minimum: -40 °C (-40 °F)

.2 Air Temperature Maximum +40 °C (105 °F)

.3 Ambient Humidity 10% to 80% (RH)

.4 Wind 240 km/hr (150 mph)

.5 Rain / Snow 6 mm/min

.6 Solar Radiation 1000 W/m^2

.7 Vibration 1.5 mm displacement,

20 m/s^2 acceleration,

2 – 200 Hz frequency)

.8 Dust — 3.0 mg / m^2h

.2 Indoor Operational Environments

.1 Air Temperature Minimum: — 10 °C (50 °F)

.2 Air Temperature Maximum — 35 °C (95 °F)

.3 Ambient Humidity — 10% to 80% (RH)

.4 Vibration — 1.5 mm displacement,

20 m/s^2 acceleration,
2 – 200 Hz frequency)

.3 Storage Environments

.1 Air Temperature Minimum: — -45 °C (-50 °F)

.2 Air Temperature Maximum — 45 °C (115 °F)

.3 Ambient Humidity — 10% to 90% (RH)

2.4 SURVEILLANCE

.1 Because of the existing deployment of devices which have been designed to *Provide* a uniform surveillance solution for all properties belonging to *York Region*, there are pre-approved devices and solutions which should be used wherever possible.

.2 Surveillance cameras shall be installed so that they can observe locations which would otherwise require regular security guard patrols. The images stored on the DVMS system must be of sufficient quality to fulfill the expectations of the designer. There are many factors which affect the quality of the image and these need to be clearly defined for a satisfactory outcome of the *Contract*. The following identifies a number of the key factors which may need consideration:

.1 Stability

.1 If a surveillance camera is mounted on an unstable base, the image may be very hard to interpret. This applies much more to outdoor cameras where the camera may be mounted on a pole or a building roof and wind plays a major role. Indoors there can be issues related to a wall in which there is a frequently used door which may slam shut with vibrations affecting the stability of the camera. It is clear that a minor vibration on a wide-angle lens may be barely perceived at an image distance of 15 m (50 ft) but if the same installation is used with a telephoto lens looking at an image distance of 1,500 m (~5,000 ft) the same deflection caused by the vibration will cause 100 times the distortion of the image. There are different forms of stabilization which can reduce the impact of any vibration transmitted to the images if the source of the vibration cannot be eliminated.

.2 Pixels on Target

.1 The effectiveness of an image by which to identify an intruder when using a surveillance camera is determined by the number of image pixels used to *Provide* the image of the topic of interest. In security surveillance applications this is usually defined in terms of a requirement, such as the resolution of the viewing screen, the resolution of the camera, the size of the screen, the height of the “target human intruder” and the minimum acceptable image size, e.g., “the minimum height of the human who is 1.8 m (~6 ft) at a distance of 30 m (~100ft) shall be 7.5 cms (~3 ins) on a 21 inch screen. This may be calculated for a particular configuration such as an 18 mm lens with a 15 μ pixel pitch to have a “Detection” range of 537 m (~1,750 ft), a “Recognition” range of 134 m (~440 ft) and an “Identification” range of 84 m (~275 ft).

.3 Recognition vs Detection

.1 The camera designer must answer the question as to the purpose of any surveillance camera installation. The criteria for an acceptable surveillance image are often based, at least in part, Johnson’s Criteria. Generally, the purpose of surveillance in a security setting may be defined as one of the following:

.1 Detection: an object is present – 2 pixels on target.

.2 Recognition: discern the type of object, a human versus a vehicle – 8 pixels on target.

.3 Identification: discern specific objects, a man versus a woman, a car model – 12.8 pixels on target.

.2 The above examples are simplified and ignore the image quality which is affected by lighting, contrast and other issues such as moving trees which can *Provide* additional challenges.

.4 CIF vs Frame Rate

.1 When recording images there are a number of terms which are used and which should be understood;

.1 CIF is Common Intermediate Format (360 x 240 pixels) and is a common format used for recording digital images to be played back in any standard format.

.2 4CIF is an enhanced quality image over CIF and provides data at 704 x 480 pixels.

.3 Frames per second reflects the rate at which images are refreshed and is the term which was widely used with Analog(ue) Cameras which are now no longer current. Common values are 30 or 60 fps (the latter of consequence with high-speed action). This is of course the speed at which the older film technology moved the “celluloid” through the projector.

.5 Illumination and Shadows

.1 Illumination by artificial sources always generates shadows in the same place whereas illumination by the sun or even the moon causes shadows which vary by time of day and also by season. From a security perspective the shadows are a potential hiding place for any malfeasant. Hence great care is required to ensure that shading hiding places are minimised as is the basis of CPTED.

.6 Infra Red

.1 Many security cameras are now available with integrated IR illuminators which allow the cameras to “see in the dark”. Infra red illuminators are harmless to humans and animals and are invisible without technological aids so that such surveillance can be considered “covert”. The images provided by these cameras are monochrome (generally appearing as black and white) as the lighting source is a single frequency.

.7 Thermal Cameras

.1 Thermal cameras, which are sometimes incorrectly referred to as infra red cameras because they detect “heat” (which is related to infra red waves), will display images based on the heat signature of any item in the field of view which differs from the background. These cameras can *Provide* very effective imaging with no artificial light during any time of day and are oblivious to the shadows or glare caused by natural or artificial lighting. Generally, because of optical considerations, zoom lenses are not available for thermal cameras. One popular option is to co-locate a thermal camera with an optical camera thereby providing versatile and reliable imaging at any time of day.

.8 Direct Sunlight

.1 The glare caused by direct or reflected sunlight will cause optical camera images to “be blinded” and therefore the images to be unsuitable for surveillance use. Placement of the outdoor cameras can possibly reduce the impact but in some instances, thermal cameras *Provide* an alternative because the sensor does not respond to “visible light” of any kind.

.9 Colour v Black & White Images

.1 To an ever-increasing extent, surveillance cameras of all kinds are being offered with colour imaging. Such images are very attractive and make recognition much more convenient. There are challenges for colour imaging under low light conditions and some colour cameras change automatically to black and white images when the light conditions are reduced. If artificial lighting is used it must have frequency spectrum and colour temperature representative of sunlight to ensure that the images are comparable with day lighting. Sodium (HPS) or mercury (HID) lights, which have long been used in outdoor applications, make colour recognition essentially impossible.

.10 PTZ v fixed lens v multi unit cameras v 360° cameras

.1 PTZ (Pan, Tilt and Zoom) cameras are attractive to some designers but are an anathema to other designers. Such cameras can cover a very large field of view using pre-programmed “tours” in which they move automatically through a pre-configured inspection of the landscape being surveyed. As the image is being recorded it is clear that only the current image is recorded and depending on the frequency and nature of the tour, coverage of the landscape will be far from continuous. In other situations, PTZ cameras are used by staff who may have reason to steer the camera image to look carefully to an aspect of an image observed on a fixed camera, e.g., a fixed camera image shows an apparent moving shadow along a security fence line which can be observed in greater detail by directing the PTZ camera to the same place at a much longer focal length (telephoto). Some address situations of this kind by using multiple, single lens, fixed cameras instead of a PTZ cameras and manufacturers are now manufacturing single camera housings which include multiple imaging devices which can be configured independently or as a single defined group. There is one other group of cameras which also have a very special feature in that they can *Provide* a single 360° image. Such cameras often include recording playback software allowing, for example, tracking of a person walking through an art gallery. It is clear that selecting the correct camera configuration for any job is crucial.

.11 Analogue v Digital Cameras

.1 The cameras which are currently being used are digital, meaning that they include a direct connection on to the available LAN and no transformation of the video data is required. Analogue Cameras are also defined by their encoding systems, such as NTSC and PAL. The older, now largely outdated, cameras use analog signals which need to be converted to a digit signal to be transmitted over the LAN which is generally used as the means of interconnecting buildings and equipment.

.3 The design should be evaluated by using a camera simulation package to ensure that the resulting images meet all of the design intent before the construction is completed.

.4 These pre-approved surveillance devices are listed in the section 2.13 Digital Video Management System.

.5 The Digital Video Management System (“DVMS”) is now, and shall continue to be, capable of supporting a further future expansion of the reconfigured system by a further 20% of cameras following completion of the current project.

.6 As a minimum, the system must support the most recent, currently available network cameras, encoders and camera streamers as may be available and are being used during the project execution.

.7 The *Contractor* shall use the latest generation of the equipment listed in 2.13 Digital Video Management System. The contractor must ensure that all equipment which is being supplied will be compatible with the existing and previously installed components. If any modifications or upgrades are required, these changes must be included in the project budget and identified in the proposal.

.8 It is the responsibility of the contractor to ensure that any upgrades or modifications of any kind to the existing equipment which is being proposed to accommodate the current project will in no way degrade or modify the performance of the existing installation.

.9 Hence the general industry guideline of using the most recent versions of software, firmware and hardware may lead to unsatisfactory performance due to incompatibility. It should be noted that the existing installation may not have been updated to the latest versions because of prior, known incompatibilities. The contractor is responsible to validate all such equipment and ensure full compatibility between newly supplied equipment and the already installed components. Any proposed firmware or software updates must therefore be reviewed with the *Region* before any updates are undertaken.

.10 The DVMS shall, as a minimum, support the industry-standard Motion JPEG (MJPEG), MPEG-4, H.264, and H.265 as well as Axis’s proprietary Zipstream video compression technology formats.

.11 The DVMS system shall continue to be fully integrated with the Access Control system version currently in use by *York Region* and shall also be fully compatible with all announced updates to that system at the time of installation. This system is being used as the primary user interface to monitor all surveillance cameras.

.12 *York Region* uses fixed lens cameras for surveillance unless otherwise stated. All design decisions shall be made in consultation with *York Region* Capital Projects.

2.5 VIDEO RECORDING REQUIREMENTS

.1 The recording system must *Provide* faithful and reliable recordings of all the cameras which are connected to it. The recording system must use some form of RAID technology or equivalent technology so as to ensure that in the event of any drive failure the data will continue to be available. Redundancy and fail over options must be included in the network to ensure that recording cameras is never at risk.

.2 Recording of a camera image is generally performed if there is motion in the field of view, although in some cases, recording can be performed continuously at a very slow rate until there is motion at which time the frame rate accelerates. The recording is intended to analyse events after they have occurred and therefore it is important that the time prior to an incident can be recorded. Such recording from before the event is often configurable to allow for the 2 minutes or for the 15 seconds before the "alarm went off". This is generally achieved by continuously recording to volatile memory. Typically, recording is at a fixed rate, e.g., 15 fps and continuously erasing the data which is older than the configured time "before the incident". While cameras are continuously increasing their resolution, the current trend is to generally record at "1080" resolution for most surveillance applications. The higher the resolution, the quicker the disks will fill when recording.

.3 It is by no means unusual to upgrade street or other lighting when surveillance is implemented. Cameras are using more and more sensitive detectors but for high contrast and high quality images there may be a strong justification to *Provide* lighting to eliminate shadows.

.4 Care must be taken when allowing for the amount of power which is required and the distance to the power source is mostly provided by POE data switches.

.5 While the recording of up to 300 cameras per NVR is normal, there can of course be unlimited numbers of NVRs. The NVRs must have an accurate source of time so that images can be synchronised across the network. Typically, the recorded image from each camera includes a burn-in, i.e., an image which is configured to show the date and time and the camera description on every frame of the recording.

.6 The recordings should be "searchable", i.e., the NVR has an interface which allows for searching for specific images using a number of different criteria, such as:

   .1 Date and time

   .2 Alarms

   .3 Facial recognition

   .4 Location

   .5 Analytics, such as when a car drove into the driveway etc.

.7 While reviewing recordings to perform an investigation, security staff may review many images from many cameras and there needs to be mechanism to quickly return to the most useful images. A good NVR will *Provide* a "bookmarking" tool to effectively allow for the storage of particular scenes.

.8 Archiving of the recorded images should be performed automatically from the live NVRs several times (e.g., 4 times) during the day in order to offload the recorders to ensure optimal hardware performance. The archived data can remain on the network where it is readily accessible for a limited period.

.9 The use of surveillance cameras and the retention of the recordings should be reviewed for compliance with the requirements of the FIPPA and MFIPPA which may have limitations on these activities.

.10 While it is commonplace to erase recordings which have "no significance" after a period such as 30 days, there are also situation such as a pending investigation which may take months to unfold. The recordings associated with that investigation may need to be kept, protected and not available for review by any “unauthorised” person. Such evidence will be secured with an “evidence lock”.

.11 If a recording is required by a law enforcement authority in order to prosecute a case, there may be a requirement to apply a digital signature so that, it can be shown in court, that the recording has not been modified or “contaminated”.

.12 There should be tools allowing for the security staff at the main control centre to forward the image of an incident which has occurred to “mobile colleagues” via their cell phones or tablets. A similar operation must be available to send video images as files in e-mail messages.

.13 The NVR and its related components should not use proprietary hardware but adhere to industry standard configurations so that all computers used by the *Region*, can be maintained and procured from a single source.

.14 It is almost universal to incorporate an LPR program in the surveillance management software, with the ability to recognise any licence plate from Canada or the USA. This function should *Provide* for searching the recordings or monitoring for the appearance of a particular vehicle. Note that the inconsistent requirement of one or two licence plates on a car can make such applications relatively challenging.

.15 The video system manufacturer should be able to supply an API or and an SDK. These tools will allow developers to create tools to facilitate the use of the video recordings, e.g., transfer a video clip to a specific security guard or to notify a security officer each time when a particular entrance is used.

.16 The foregoing list is intended to identify the manner in which a modern video surveillance recorder can be configured and implemented. The options are not exhaustive and have omitted the questions of reliability and ease of use which is taken for granted.

2.6 NETWORK AND VIDEO CABLING

.1 Network and Video Cabling devices are not defined specifically for a particular project and shall adhere to the industry standards and performance criteria as identified in 1.6 Applicable Standards or, as may be otherwise defined by the *Region* and by the ITS department as in its Corporate ITS Cabling & Wiring Standard (February 8, 2021). The information cited here is, in part, extracted from that document.

.2 The form of communications between the proprietary components of the security system is not mandated by this section but shall address the requirements of the security system. The cabling for such communications will generally be based on similar standards to those advocated here. Sharing of any pathways, labelling and termination considerations shall follow the same guidelines as for the Local or Wide Area Networks as described here.

.3 A Local Area Network (LAN) shall be provided for communication as may be required between the security system elements and the existing ITS infrastructure. All interfaces which are attached to the LAN shall be configured, where possible, for a minimum of 1000BaseTX Ethernet (1Gbps). It is noted that some security equipment functions with lower data rates and all high-speed equipment can operate at lower interface speeds. The LAN may need to use additional technologies within the backbone for greater speed or distance. Acceptable technologies are:

.1 FDDI (Fibre Distributed Data Interface)

.2 1000BaseSX or 1000BaseLX Gigabit Ethernet (fibre)

.3 Asynchronous Transfer Mode (ATM)

.4 1000BASE-TX UTP

.4 The LAN shall use industry standard network cables. Acceptable cable types are:

.1 OM4 Optical Multi-Mode, 50 µ Core diameter / 125 µ cladding diameter, Class 1a, graded index optical waveguide Fibre. All connectors shall be LC compliant and conform to ANSI/TIA-492AAAC.

.2 Category 6 (250 MHz) or better, Unshielded Twisted Pair (UTP) terminated using TIA 568A configuration.

.5 Each fibre backbone cable shall have a minimum of 12 strands OM4 distribution type fibre. The OM4 distribution type fibre shall perform as per industry standards over the required distances defined for the site.

.6 Where there is a requirement for backbone interconnection between wiring closets on the same floor or multiple floors, such interconnection shall use a minimum of a 6 fibre strand, duplex, multi-mode 50 / 125 µ (OM4) rated fibre optic backbone terminated with:

.1 1 U x 19 ins rack mounted fibre patch panel

.2 Connectors shall be OM4 (minimum), LC style;

.3 ¾ inch fibre inner duct (corrugated) rated at FT-6 for ceiling plenum or FT-4 if the plenum is not used as a return air plenum;

.4 Pulling force shall be limited to the maximum force permitted by the manufacturer;

.5 Bend radius of the conduit and inner duct shall not be smaller than permitted by manufacturer's specifications; and

.6 The inner duct shall be restrained so that the fibre inside of it is protected and not unnecessarily stressed.

.7 Cable Distances in excess of 100 m (330 ft) shall use multi-mode fibre (as opposed to UTP).

.8 All connectors for the termination of fibre optic backbone cables shall use duplex LC connectors.

.9 Fibre optic enclosures shall meet the following requirements:

.1 Enclosures shall include a slide out drawer for frontal access of the terminations.

.2 Enclosures shall be compatible with LC connectors.

.10 For multi-mode fibre optic terminations inside access closets fibre patch panels the connectors shall be preloaded adapters configured with LC duplex, multimode, adapters.

.11 The LAN used for surveillance and security applications shall be logically and/or physically separate from any other existing LAN infrastructure. Interconnection to other LANs shall only be through one of the following:

.1 A router;

.2 A Layer 3 capable network switch; or

.3 As an additional VLAN to the existing LAN equipment.

.12 Where the design requires an interconnection between VLANs, a router or a Layer 3 capable switch shall be provided by the *Contractor* and be approved by the ITS department.

.13 Network video cables shall not be connected individually to the Camera Server. All communications with the Camera (DVMS) Server shall use the LAN. Each network camera or video streamer shall have a single Ethernet network connection which is to be used both for video and also for camera control, e.g., for Pan/Tilt/Zoom (PTZ) communications.

.14 Cameras shall be powered using POE switches and, only in exceptional cases, will power injectors or local power sources be approved by the *Region*.

.15 Supply a complete and working Closed-Circuit Television System (CCTV) System and Digital Video Management System (DVMS).

.16 All camera passwords shall be changed from their factory defaults to a password provided by the *Region*.

2.7 LIST OF APPROVED SECURITY EQUIPMENT

.1 The following equipment is pre-approved and detailed equipment submission is not required. Note, however that the contractor is responsible to ensure that the version of equipment must be fully compatible with the environment currently in use or envisaged for imminent use at the *York Region*. Note that in those categories where multiple manufacturers and models are identified, the contractor is responsible to identify to *York Region*, the model and manufacturer which is to be used for any given project.

.2 If the contractor requires to use equipment not shown in this listing, full details and justification shall be provided in accordance with the procedures set out in the *Contract Documents*. *York Region* has the authority to accept or to reject the use of the proposed substitute equipment.

.3 If the function to be provided by the “proposed equipment” is addressed by any equipment which is not listed, then the proposed equipment must be processed through a Substitution Procedure.

.4 Some of the door contacts used by *York Region* need to comply with the requirements of Hazardous Locations and therefore shall be certified for use in such areas (Explosion Proof). Even for use in such areas, an approach referred to as “Intrinsically Safe” may be used. This approach requires the use of a certified “barrier” which ensures very low current levels when used with devices which themselves comply with the requirements of a “simple apparatus” and do not need certification. For example, when using a SIL rated barrier, regular door contacts (not explosion proof) may be acceptable for use in a hazardous location. This document is not the place to undertake a detailed design or to recommend solutions. The list of approved equipment which follows includes alternative devices which may be considered for Hazardous Locations.

.1 Access Control Components

Part#	Description
LNL-2220	Intelligent Dual Reader Controller
LNL-3300	Intelligent System Controller
LNL-4420	Advanced Dual Reader Controller
LNL-1300	Single Reader Interface Module
LNL-1320	Dual Reader Interface Module
LNL-1100	Input Control Module
LNL-1200	Output Control Module
RP15/RP40/RPK40	HID Corporation, multiCLASS SE technology card reader to suit application
SD-72, … SD-84	Magnetic Door Contact by Tane Alarm
184-12, 194-12	Magnetic Door Contact by George Risk Industries (GRI)

MET-44 WG	Overhead Door Contact by Tane Alarm
4532D-36	Overhead Door *Contract* by George Risk Industries (GRI)
LSX Series Micro Switches	Explosion Proof Mechanical Door Contact by Honeywell
TA-4106-ES	Magnetic Door Contact, Manufacturer unknown; available from K M Thomas
EA800, EA880	Explosion Proof Limit Switches by NAMCO, Available from Galco
HSS-L25-800, HSS-L1.5-101	Simple Apparatus Contacts in an Intrinsically Safe Scheme, by Magnasphere
D5030 I.S. SIL3	Relay Out Repeater by GMInternational, available from Exloc Instruments
IS310/IS320	Request-to-Exit (RTE) motion sensors
2966906 Phoenix	SPST Relay 12VDC with base DIN rail-mount or equivalent
2900329 Phoenix	DPDT Relay 12VDC with base DIN rail-mount or equivalent
IM-1270	12V/7Ah Backup Battery
LSP MCLASS FlexPower	Life Safety Power MCLASS FlexPower Power Supply, Enclosure, Door with
Hoffman NEMA 2 Enclosure	Hoffman Concept Series enclosure to suit application and to fit corresponding LSP Enclosure. Shall be lockable with Medeco CLIQ Systems or AWP Padlock and to work with the *Region* owned Medeco Electronic Keys.
Hoffman NEMA 3 Enclosure	Hoffman Concept Series enclosure to suit application and to fit corresponding LSP Enclosure. Shall be lockable with Medeco CLIQ Systems or AWP Padlock and to work with the *Region* owned Medeco Electronic Keys.
Hoffman NEMA 4 Enclosure	Hoffman Concept Series enclosure to suit application and to fit corresponding LSP Enclosure. Shall be lockable with Medeco CLIQ Systems or AWP Padlock and to work with the *Region* owned Medeco Electronic Keys.
Hoffman Enclosure Accessories	Hoffman Enclosures shall be completed with ADP2, CWHPTO padlock handle, LED24V15 LED Enclosure Light, and full-conductive back panel or equivalent.
R991RBPTD9	Pneumatic delay arming Button, w/delay RED Blank by RCI (Dormakaba)
HES 1006 KD	HES 1006 KD 630 Electric Strike (provided by Locksmith)
HES 9600	HES 9600 The surface mounted, windstorm rated solution for rim exit devices (Provided by Locksmith)
Smart Pac III	In-Line Power Controller for electric strikes by HES (Assa-Abloy)
1N 4007	Snubbing (Snubber) Diodes (any manufacturer)

.2 Intrusion Detection System Components

Part#	Description
B9512G	Bosch D9512G Control Panel Alarm Panel
B208 SDI2	Bosch B208 SDI2 8-Input Expansion Module
B308 SDI2	Bosch B308 SDI2 8-Output Expansion Module
B942	Bosch B942 Touch Screen Keypad
B930 ATM	Bosch B930 ATM Style-Alpha Numeric Keypad (SD12)
B56	B56 Keypad Surface Mount Box

B426	Bosch B426 Conettix Ethernet Communication Module
B443	Bosch Plug-in Cellular, HSPA+ (3G+)
B440	Bosch Plug-in Cellular module
FG-1625F or equivalent	Glass Break Detector
DS940Q, Optex DX40 or equivalent	Motion Detector

2.8 ACCESS CONTROL EQUIPMENT

.1 Control Panel

.1 Lenel Intelligent System Controllers (To be specified by the *Contractor* during the design of the security system).

.1 LNL-2220 Intelligent Dual Reader Controller (IDRC) provides a single board solution for interfacing one or two doors to an OnGuard® system. On-board Ethernet 10/100Base-T port, 6 MB on-board, non-volatile flash memory, Battery-backed, non-volatile storage of 50,000 events, 16 different formats, 12 or 24 VDC input power, 32 downstream devices.

.2 The LNL-3300 Intelligent System Controller (ISC) by Lenel is designed for advanced access control applications. On-board Ethernet 10/100Base-T port, 15 MB on-board, non-volatile flash memory, Battery-backed, non-volatile storage of 50,000 events, 16 different formats, 12 or 24 VDC input power, 64 downstream devices via two individual downstream RS-485 ports.

.3 The LNL-4420 is an Advanced Dual Reader Controller by Lenel that provides a single-board solution for interfacing up to 64 doors, plus auxiliary inputs and outputs, to an OnGuard® system.

.2 Input/Output Modules

.1 LNL-1100: Series 3 Lenel® Input Control Module (ICM) provides the access control system with high-speed acknowledgement of critical alarm points in monitored areas.

.2 LNL-1200 Series 3: Lenel® Output Control Module (OCM). 16 Form-C 5 A, 30 VDC contacts for load switching, 2 dedicated digital inputs for tamper and power failure status, Elevator control, support for 128 floors, Advanced Encryption Standard (AES) 128-bit or 256-bit encryption.

.3 Reader Interface Unit

.1 LNL-1300 Series 3: Single Reader Interface (SRI) Module. Access control card readers, keypads, or readers with keypads that use standard Wiegand Data1/Data0, Supervised or Unsupervised F2F, or Clock/Data communication are supported, as are those supporting the bidirectional RS-485 Open Supervised Device Protocol (OSDP™). 12 or 24 VDC power supply, Two Form-C relay outputs (5 A door strike and 1 A aux relays), Up to 16 different card formats, Door contact and REX open or closed, supervised or non-supervised, Strike control output**.**

.2 LNL-1320 Series 3: Dual Reader Interface (DRI) Module: Access control card readers, keypads, or readers with keypads that use standard Wiegand Data1/Data0, Supervised or Unsupervised F2F, or Clock/Data communication are supported, as are those supporting the bidirectional RS-485 Open Supervised Device Protocol (OSDP™). 12 or 24 VDC power supply, **s**ix Form-C 5 A at 28 VDC relay outputs, **u**p to 16 different formats, **d**oor contact and

REX open or closed, supervised or non-supervised, **s**trike control output, dedicated tamper and power failure circuits, **o**n-board regulator allows 12 VDC reader support from 24 VDC power source

.3 LNL-8000: The Star Multiplexer from Lenel is designed to implement star topology on a downstream port of any Lenel® Intelligent System Controller or on any host communication port of any OnGuard® server. Up to eight RS-485 (2-wire) connections or four RS-485 (4-wire) connections can be made downstream of the LNL-8000. Host communications - 38.4 kbps direct wire (RS-232/RS-485 multi-dropped), 12 VDC input power, Status LEDs for heartbeat, upstream and downstream communication.

2.9 INTRUSION DETECTION EQUIPMENT

.1 Control Panel

.1 Bosch B9512G Control Panel Alarm Panel for intrusion devices: Burglary, Commercial Panel has 599 individually identified points, 32 areas. ULC listed. To be used in combination with Bosch B426 Conettix Ethernet Communication Module and/or application appropriate B44x cellular communicator module. Each Bosch panel shall have a minimum of 2 paths of communication to support 3rd party monitoring and integration with Lenel OnGuard.

.2 Keypad

.1 Bosch B942 Touch Screen Keypad for office and corporate sites.

.2 Bosch B930 ATM Style-Alphanumeric keypad (SD12) for environmental services non-office facilities.

.3 Input / Output Modules

.1 Bosch B208 SDI2 8-Input Expansion Module connects to a control panel through the SDI2 bus. This module is supervised and communicates back to the control panel all point status changes. The module’s expansion points operate the same as the points on the control panel.

.2 Bosch B308 SDI2 8-Output Expansion Module. The B308 Octo-output Module provides eight programmable outputs. Each relay provides dry contact switching rated for 1.0 A at 5-24 VDC. The outputs are accessed through on-board screw terminal connections. The B308 is compatible with the SDI2 bus. The onboard switches are used to specify module addresses. Control panel programming will determine output response to specific events.

2.10 INTERCOM EQUIPMENT

.1 TOA Electronics

.1 **TOA N8000** IP intercom system. Master Intercom N-8500MS with 32-character LCD display and Q-N-8540WP Outdoor Door Station. These devices are Power Over Ethernet (“POE”) and connect directly to the building LAN via POE network switch. Include YC-280 wall mount bracket for Master station and either flush mount back box model YC-150 or surface mount back box YS-13A depending on application.

.2 Valcom

.1 **Valcom model** VIP-172AL IP DoorPhone/Intercom: The VIP-172AL IP Talkback Door phone/Intercom allows communication to Valcom FXS units (VIP-811, -812, -814) and SIP Based telephone systems via an IP-based network. PBX, FXO Port w/VIP-811, POTS telephone set w/VIP-811, Valcom M Cast Page Group, SIP – enabled telephone system, RJ-45 for network connection, 1 Form C relay, Power over Ethernet (PoE) 802.3af compatible.

2.11 CREDENTIAL AND CREDENTIAL READING EQUIPMENT

.1 Multi-Technology iCLASS Reader

.1 Card Readers: *Provide* multi-technology HID® multiCLASS SE® proximity card readers where shown on the Drawings and/or where required by the *Contract*. Card Readers shall be rated for indoor and outdoor use, have multicolour LED with beeper for operator status indications and will operate on 5-16 V DC. *Provide* thin line mullion style readers where required to match door frame configuration.

.2 HID Corporation, HID® multiCLASS SE® proximity card reader RP15/RP40/RPK40, configured to work with all Regional credentials.

.2 Proximity Card

.1 Proximity Cards used by the *Region* are HID Corporation ProxCard II, HU-1326LSSSV (i.e., 120 kHz, 26 bit).

.2 The *Contractor* is not required to supply proximity cards to the *Region* unless otherwise indicated.

.3 Long Range Card Reader

.1 Long range proximity card reader, typical read range 3 to 5 metres

.2 HID® Proximity MaxiProx® 5375.

.3 Nedap 9215689 TRANSIT Ultimate. To be utilized for motorized entrance gates at the following facilities (to be identified in the *York Region* design drawings) with the prior approval from the *Region*:

.1 Transit Bus Storage Facilities

.2 Roads and Traffic Operation Yards

.4 Long Range Proximity Tag

.1 Long range proximity card, 860 – 960 MHz proximity active vehicle tag.

.2 HID Corporation, SIO Enabled UHF/iCLASS Smart Card.

.3 Nedap 9882650 Window Button R/O. To be utilized for motorized entrance gates at the following facilities (to be identified in the *York Region* design drawings) with the prior approval from the *Region*:

.1 Transit Bus Storage Facilities

.2 Roads and Traffic Operation Yards

2.12 MISCELLANEOUS SECURITY DEVICES

.1 Door Contacts

.1 Magnetic door contacts.

.2 1” recessed steel door approved door contact as shown in the list in section 2.7 List of Approved Security Equipment. Overhead door contact as shown in the list section 2.7 List of

Approved Security Equipment to be installed off the ground. Alternative solution might be required based on door type, mounting requirements, and environment.

.3 Explosion Proof door contacts or Intrinsically Safe devices as shown in the list in section 2.7 List of Approved Security Equipment to be used in Class 1, Div.1 and Div.2 classified areas.

.4 DPDT door contacts shall be used at facilities with Intrusion Detection integration requirements.

.2 Rechargeable Lead-Acid Batteries

.1 12V 7Ah Sealed Lead Acid Battery

.2 Ultratech, Honeywell, Detection Systems, Bosch-Canada, or approved equivalent.

.3 Exit Devices / Panic Bars

.1 Push pad exit device, dull chrome finish, UL Listed Von Duprin Panic Hardware FVSR SA163 (N), tested in accordance to ANSI A156.3, 1989, Grade 1.

.2 Von Duprin 99K-NL Series Panic Exit Devices, or approved equivalent.

.4 Electric Door Strikes

.1 Heavy duty, stainless steel construction, 3000 lbs static strength, UL 1034, ANSI/BHMA Grade 1, 0.25 Amps @ 24 VDC.

.2 HES 1006 Series Electric Strike or approved equivalent.

.3 HES 9600 Series Electric Strike, or approved equivalent.

.5 Electrical Power Transfer

.1 Transfer of electrical power from door frame to the edge of a swinging door; two (2) 18 AWG wiring, 24VDC, 2A continuous, 16A maximum surge.

.2 Von Duprin EPT-2, or approved equivalent.

.6 Control Transformers

.1 120V input, 16V output, 40VA, 60 Hz, single phase rating, copper conductors, dry type.

.2 Transformers shall be designed, constructed and rated in accordance with UL, CSA and NEMA standards.

.3 All transformers for each project shall be from the same manufacturer.

.4 ATC Frost Magnetic Inc., 1640, or approved equivalent.

.7 Request to Exit Sensors

.1 Wall mount high impact ABS plastic enclosure, alarm output: form “C” contact, single or double door use, adjustable to 60 s, UL Listed.

.2 Honeywell Model IS310

.8 Push Buttons

.1 Exit Push Button

.1 Wall mount brushed stainless steel plate enclosure, momentary switch output, SPDT 10A @ 125/250 VAC, UL Listed.

.2 Tyco Security Products - Kantech PB-EXIT, or approved equivalent.

.2 Arming Push Button

.1 RCI R991RBPTD9 Wall mount brushed stainless steel plate enclosure, push button with pneumatic time delay (adjustable 0-45 seconds), blank red button.

.9 Glass Break Detectors

.1 Shall **d**etect breakage of plate, tempered, layered, laminated and wired glass types, complete with automatic environment test circuitry, detection range of 9 met**re**s, alarm contact 50mA @ 24VDC, UL Listed.

.2 Honeywell FlexGuard FG-1625F, or approved equivalent.

.10 Motion Detectors

.1 Wall mount motion monitor with temperature compensation, high impact ABS plastic enclosure, alarm output: form “C” contact, 125 mA @ 28 VDC, tamper and trouble output contacts, UL Listed.

.2 Detection Systems DS940Q**.**

.3 Optex DX40**.**

.4 Approved equivalent.

.11 Audio Annunciator

.1 Wall mount, 24 VDC, 100 dB @ 10’, UL Listed.

.2 Toxalert Inc. HORN/REM RH-24 VDC, or approved equivalent.

.12 Uninterruptible Power Supply

.1 APC Back-UPS Pro to power all security, access control and wireless network solution. Model to be used is Antigen-presenting cell (“APC”) Pro BR1500G or approved equivalent.

.2 The UPS must reside on a dedicated AC circuit fed from an emergency power panel wherever possible.

2.13 DIGITAL VIDEO MANAGEMENT SYSTEM

.1 Digital Video Management System (DVMS)

.1 Lenel Milestone XProtect® Expert Digital Video Management System. The Digital Video Management System (DVMS) shall be designed and developed in conformity with the following standards:

.1 ISO 9001 (2015) Quality management systems

.2 ISO/IEC 15504 Measurement Framework for Process Capability and CMMI Level 3 or higher (Capability Maturity Model Integration) (SPICE 2.0 Software Process Improvement and Capability dEtermination)

.3 SEI CMM Level 3 or higher (American Software Engineering Institute - Capability Maturity Model)

.2 The Digital Video Management System shall include:

.1 Database Server(s)

.2 Application Server(s)

.3 Local recording Networked Camera Server(s) with appropriate software and databases as required

.4 Operator Workstations (dedicated to the DVMS)

.5 Network connected cameras and/or network connected video encoders

.6 Continuous Recording capability for a minimum of thirty (30) days at 30 frames per second (note: see more on the attached camera configuration parameters)

.3 The Digital Video Management System ("DVMS") shall be capable of supporting unlimited number of cameras.

.1 As a minimum, the system must support all the latest Axis network cameras, encoders and camera streamers.

.4 The following DVMS equipment must be used:

.1 Camera Streamers / Video Encoders:

.1 AXIS Communications

.2 PTZ Network Cameras:

.1 AXIS Communications Q6075-E

.3 Fixed Indoor Dome Cameras:

.1 AXIS Communications P3375-LV

.4 Fixed Outdoor Dome Cameras:

.1 AXIS Communications P3375-LVE

.5 Fixed 360 Indoor/Outdoor Camera:

.1 AXIS Communications P3717-PLE

.5 Use the latest generation of the equipment mentioned in this paragraph. The contractor must ensure that all equipment which is being supplied will be compatible with the existing and previously installed components. If any modifications or upgrades are required, these changes must be included in the project budget and identified in the proposal.

.6 The DVMS shall support at least the industry-standard Motion JPEG, MPEG-4, H.264, and H.265 as well as Axis's Zipstream technology encoding formats.

.7 The DVMS system shall be fully integrated with the Lenel OnGuard version currently in use by *York Region* and be fully compatible with all announced Versions of OnGuard at the time of installation. Lenel OnGuard will be used as the primary user interface.

.2 Network and Video Cabling

.1 A Local Area Network (LAN) shall be provided for communication between the system elements. All interfaces to the LAN shall be a minimum of 1000BaseTX Ethernet. The LAN may use additional technologies within the backbone for greater speed or distance. Acceptable types are:

.1 FDDI (Fibre Distributed Data Interface)

.2 1000BaseSX or 1000BaseLX Gigabit Ethernet (fibre)

.3 Asynchronous Transfer Mode (ATM)

.4 1000BASE-TX

.2 The LAN shall use standard network cables. Acceptable cable types are:

.1 Optical Fibre

.2 Category 6 or greater Unshielded Twisted Pair (UTP)

.3 The LAN shall be logically and/or physically separate from any existing LAN infrastructure. Interconnection to other LANs shall **only** be through one of the following:

.1 A router

.2 A Layer 3 capable network switch

.3 As an additional VLAN to the existing LAN equipment. Where required to interconnect VLANs, a router or Layer 3 capable switch shall be provided by the contractor.

.4 Network video cables shall not be run back to the Camera Server individually. All communications with the Camera Server shall be via the LAN. Each network camera or video streamer shall have a single network interface which is to be used for video and also Pan/Tilt/Zoom communications.

.5 Supply a complete and working Closed-Circuit Television System (CCTV) System and Digital Video Management System (DVMS).

2.14 CONDUITS, FITTINGS AND ACCESSORIES

.1 Conduit, Fastenings and Fittings

.1 Comply with the latest proclaimed version of the OESC**.**

.2 Rigid PVC conduit: Conduit, including elbows and fitting, Schedule 40 wall thickness, solvent weld connections, by IPEX Inc., Carlon or approved equivalent.

.3 Rigid PVC conduit connectors: Adapter type with threaded male portion, by IPEX Inc., Carlon or approved equivalent.

.4 Conduit straps for rigid steel and PVC conduit: Malleable iron, hot-dip galvanized, single hole type for conduits up to 50 mm, two-hole type for conduits larger than 50 mm.

.5 Beam clamps: Hot dip galvanized steel designed to clamp onto both sides of the flange. Cat. #S997BC-HG (100-230 mm flange) by Sasco Tube & Roll Forming Inc., Cat. #S999BC-HA (175-430 mm flange) by Sasco Tube & Roll Forming Inc., or type CS91 by Construt Inc. or approved equivalent.

.6 Expansion couplings: With ground straps or clamps. Type XJ by Cooper Crouse-Hinds Canada or approved equivalent.

.7 Swivel couplings: Threaded, one piece, by Elliot Electrical Manufacturing Co. Running threads are not acceptable or approved equivalent.

.8 Conduit spacers: Malleable iron, sized to suite conduit size, by O-Z/Gedney Co., or 1300 Series by Thomas & Betts Ltd or approved equivalent.

.9 Conduit seals and fittings for hazardous locations: Suitable for applications in designated area, by Crouse-hinds, Pyle-National of Canada Inc., Killark Electrical Manufacturing Co., Appleton Electric Ltd., O-Z/Gedney Co., or approved equivalent

.10 Hazardous area seal filling compound: As recommended by seal manufacturer.

.11 Pull cords: 6 mm polypropylene or nylon material. Pro-pull rope by Ideal Industries Inc. or approved equivalent

.12 Bituminous backpaint: In accordance with CAN/CGSB-1.108.

.13 Conduits and all junction boxes shall be colour coded to identify the nature of the cabling which is contained within. Where it is not practical to paint the entire conduit, pull box or junction box, e.g., PVC devices, suitable coloured markings shall be applied and visible from a distance, e.g., boxes on the ceiling shall be visible from the ground.

.2 *York Region* Convention for Conduit Colours:

Sequence No.	Voltage	Colour
1	High Voltage (In Excess Of 750 V):	Brown
2	347/600 V:	Sand
3	120/208 V:	Grey
4	Emergency Power:	Associated Voltage Colour
5	Fire Alarm & Fire phone:	Red
6	Security/Intrusion/Surveillance:	Green
7	Low Voltage Switching:	Black
8	Annunciator Cabinets:	Black
9	Data/Telephone Cabinets:	Blue
10	Telephone Backboards:	Grey
11	Television:	White
12	Public Address/Intercom:	Purple

2.15 CABLING, CONDUCTORS AND MISCELLANEOUS ACCESSORIES

.1 The construction of all conduits and associated components shall comply with the requirements of the Ontario Electrical Safety Code (OESC) and with other requirements as stated below and in the *Contract Documents*. This compliance requirement applies even if the conduit is not being used for electrical applications.

.2 All new communications conduits are limited to a fill capacity of 30% of the cross-sectional area. The industry practice and Codes allow for 40% fill but new conduits shall allow for a future expansion in cable occupancy to 40% fill. Where existing conduits are being reused by addition of new cables the conduits may not exceed 40% fill upon completion of the construction.

.3 All cabling, wiring and conductors shall comply with the requirements set forth below and, as applicable, are also subject to the specifications as defined in the OESC including the fire rating FT-4 or FT-6 and CSA or equivalent certification.

.4 Wiring and Miscellaneous Accessories

.1 *Provide* all RS-232, RS-485, Optical Fibre and Ethernet cabling, and Fibre and Ethernet jacks as required for a complete network, as applicable.

.2 Direct burial cable for all outdoor applications.

.5 Cabling

.1 RS-485 Cables

.1 Belden EIA Industrial RS-485.

.2 Conductors: Twisted pair, each conductor No. 22 AWG stranded copper.

.1 Pairs: 2.

.2 Shield: Aluminum-polyester and 90% copper tinned braid.

.3 Jacket: Black UV resistant PVC.

.4 Electrical Characteristics at 20°C

.1 Capacitance: 36.1 pF/m

.2 Impedance: 120 ohms

.3 Propagation Velocity: 78%

.5 Belden Datalene Insulated 3107A.

.2 Lenel hardware wiring shall follow the wiring guide below:

Purpose	Cable type	Gauge	Cond.	Description	Belden number
RS-485, 4-wire	Non-plenum	24	2P	Overall shield	9842
RS-485, 4-wire	Plenum	24	2P	Overall shield	88102
RS-232	Non-plenum	24	5	Overall shield	9610
	Plenum	24	6	Overall shield	83506
Reader drops	Non-plenum	22	6/8	Overall shield	5504FE/ 5506FE
	Non-plenum	22	6	Overall shield	5504FE, 9536
	Plenum	22	6/8	Overall shield	6504FE/6506FE
12 VDC power	Non-plenum	18	2	Overall shield	5300FE, 8760
	Plenum	18	2	Overall shield	6300FE, 88760

.3 CAT6 Cables

.1 Conform with the following plenum rated Ethernet 1000BASE-TX TIA/EIA 568-B.2-1 Category 6 cable:

.1 CSA Certified for trays and risers.

.2 Conductors: Unshielded twisted pair, #23 AWG solid copper.

.3 Pairs: 4

.4 Jacket: Purple Flamearrest, CSA FT4/FT6 rating.

.5 Certification/Testing to at least Category 6 in accordance with the current TIA/ISO Channel Standards.

.6 Belden Inc. #2400 or approved equivalent.

.4 Instrumentation Cables (4-20mA)

.1 Belden Inc. #8760 or approved equivalent.

.1 #18 AWG.

.2 16-stranded copper.

.3 Beldfoil aluminium polyester shield.

.4 Twisted shielded pair.

.5 Bare #20AWG copper drain wire.

.6 Wiring Accessories

.1 Wire and cable markers: Printable, self-laminating, self-adhesive markers, white background, black lettering on white background, vinyl plastic or polyester film suitable to environment. Wire marker to be sleeved with clear heat shrink tubing.

.2 Terminal blocks: 600 V, 25 A minimum rating, modular, 35 mm DIN rail mounted, provision for circuit number labelling, individually removable, sized to accommodate conductor size and circuit current.

.1 SAK Series by Weidmuller Ltd.,

.2 UK Series by Phoenix Terminal Blocks Ltd.,

.3 WK Series by Wieland Electric Inc.,

.4 ABB Entrelec or

.5 Approved equivalent.

.3 Field wiring terminations: Where screw-type terminal blocks are provided, supply insulated fork tongue terminals.

.1 Sta-Kon by Thomas & Betts Ltd.,

.2 Scotchlok by 3M Canada Inc or

.3 Approved equivalent.

.4 Moisture and waterproofing: In wet locations, with Liquid Tape by Ideal Industries Canada Corp. or approved equivalent.

.5 Cables ties: Nylon, one-piece, self-locking type, by

.1 Thomas & Betts Ltd.,

.2 Burndy Inc.,

.3 Wieland Electric Inc or

.4 Approved equivalent.

.6 Electrical insulating tape: Scotch 33 by 3M Canada Inc or approved equivalent.

.7 Cable grips: To accommodate type and geometry of cable supported, single weave, variable mesh design, by:

.1 Thomas and Betts Ltd.,

.2 Crouse Hinds,

.3 Woodhead Canada Ltd or

.4 Approved equivalent.

.8 Cable pulling lubricant shall be compatible with cable covering and not to cause damage or corrosion to conduits or ducts. Yellow77 or Clear-Glide by Ideal Industries Canada Corp. or approved equivalent.

.9 Input 120 VAC power to all security related and access control panels must be provided at each location identified in the design drawings and must be dedicated and separated from any other loads.

.10 Where conduits may be accessible to “rodents”, or if gas seepage is a risk, steps should be taken to block such rodents from entering and damaging cable insulation. The contractor shall ensure that the proposed products do not prejudice the cables which are installed in the conduits (or ducts). Possible products include:

.1 Polywater Conduit/Duct Seal,

.2 3M Scotchcast Duct Sealing Kit,

.3 Filoseal + HD Duct Sealing Kit or

.4 Approved equivalent.

.11 Wherever conduits or cables are installed through fire rated elements the contractor is responsible to repair any damage to the impregnability of the wall in conformity with the Code requirements.

.7 Communications Line Extenders

.1 When communications lines are subject to interference from electrical noise, as for example, when using travelling lines intended for power transmission to elevator cars or lines passing through elevator mechanical rooms, precautions are needed to avoid the introduction of erroneous data.

.2 Products provided by Cypress Integration Solutions have been proven to allow Wiegand signals to maintain their integrity under onerous conditions and are to be used for the *Region* under such circumstances.

.3 The recommended device is the Suprex RS-485, Single Reader Extender SPX-1300. 2 modules are required, one at the computer end and one in the elevator and both will require power.

2.16 DOOR HARDWARE

.1 Keys and Cylinders

.1 All doors are to be equipped as outlined in the Security Device Summary document which is associated with the current project. The final configuration will require that the construction (temporary) lock cylinder cores will be replaced with Medeco M^3 IC cores. Where specific locks are not defined, doors should initially be equipped with:

.1 Sargent,

.2 Assa Abloy or

.3 Corbin locksets.

.2 All interior pedestrian exit doors (not overhead doors) shall be equipped with either a “push paddle” or a “panic crash bar” exit device. Such devices shall be installed at a standard height.

.3 *York Region* does not have a registered keyway or a dedicated locksmith.

.4 During the construction phase, the *Contractor* shall supply temporary cylinders keyed to any convenient, secure combination. The *Region* shall be given five copies of the keys providing access to the area under construction for emergency and security patrol use.

.5 There is no general policy regarding provision of grandmaster or sub master keying of locks and the *Contractor* shall comply with the requirements as defined in the *Contract Documents*.

.6 Upon completion of the construction, three passkeys shall be provided for each door on which a final lock cylinder has been installed and the combination of each shall be recorded by the *Contract* Administrator.

.7 The final lock cylinders or cylinder core shall be installed only after the final commissioning has been successfully completed.

.8 Details of the locksmith providing the cylinders and keys as described in this section shall be furnished to the *Region* as part of the required As-Built Documentation.

.2 Electromagnetic Locks

.1 As is stated elsewhere electromagnets may be used on *York Region* projects where specified. Such installations require permits and integration with the Fire Alarm system.

.2 The Hold Force Sensor should be wired to the door controller if the controlled allows for an auxiliary connection to this sensor or may be wired in series with the door contact so that in either case the Intrusion Detection System will report that the door is improperly closed.

.3 Note that in the event that the power to the magnet fails and the door remains closed, the HFS will report the door as being “forced”.

.4 It is recommended that the electromagnet should be installed with the factory installed door position indicators and LED status indicator.

.5 The *Contractor* shall reinforce the door and, as required the door frame, to ensure that neither will distort sufficiently to allow the door to open because of a mechanical misalignment.

.6 The Pre-Approved Electromagnetic Lock is:

.1 RCI (Dormakaba) Model 8310 (single door) and Model 8320 (double door) with auto sensing 24 / 12 V DC and LED Status indicator.

.2 Brushed Aluminum by default but optional finishes are available.

.3 Optional Door Status Senor (DSS), i.e., Door Contact.

.4 Optional Security Condition Sensor (SCS), i.e., Bond Sensor.

2.17 UNIVERSAL WASHROOM

.1 The security *Contractor* is to ensure that the emergency button alarms are reporting to the access control system. Monitoring of the washroom alarm will be implemented both locally, i.e., by the *Region*, and also by an off-site, 3rd party monitoring station.

.2 Available Washroom Kit

.1 The approved hardware required to implement the Universal Washroom in compliance with the OBC is:

.1 Camden Door Control equipment package CX-WEC10, “Universal Emergency Call System Kit” which includes: Emergency Button, LED Annunciator with sounder, Dome Light (various colours) with sounder and sign.

PART 3- EXECUTION

3.1 ELECTRICAL INSTALLATION

.1 The Electrical work required under this contract shall conform to the requirements of the OESC and meet with the approval of the ESA.

.2 Electricians working on the site shall adhere to the requisite safety procedures and Best Practices required to protect themselves from any risks arising from potential Arc Flash sources.

.3 Electricians shall not work on “hot circuits” without special permission from the *Region*.

3.2 INSTALLATION – WIRES AND CABLES

.1 *Provide* wires of number and gauge (including corresponding raceways) as required, with sufficient space for conductors as indicated in the Drawings. *Provide* adequate wiring for the actual equipment which is being installed. There is no requirement to make allowance for future expansion by using oversized conductors or excess numbers of conductors. As noted, conduits shall have spare capacity.

.2 *Provide* wire and cable according to the drawings and security system requirements. This includes consideration of wire types (related to environmental criteria) colours, conductor types, jacketing, conductor type and gauge.

.3 Pull cable into ducts, conduits and cable trays in accordance with cable manufacturer’s recommendations. Use specialised cable grips suitable for cable type, or pulling eyes fastened directly onto cable conductors.

.4 Limit pulling tension and minimum bending radii to those recommended by manufacturer. Also observe that the conduits which are being used must adhere to the Code limitations regarding numbers of bends, lengths of pulls and provision of pull boxes.

.5 Prevent damage to cable jackets by utilizing adequate amount of approved lubricant when pulling cables through ducts and conduits.

.6 Support cables in manholes and utility tunnels on cable trays or cable racks.

.7 Arrange cables in parallel rows on cable trays. Maintain cable spacing by fastening cables, with Velcro, a minimum of every 2000 mm on straight horizontal runs and to each rung at bends, including two rungs of adjoining straight sections. Fasten cables on vertical tray runs every 1000 mm. Limit the number of cables in each bundle of cables in accordance with best practices.

.8 Connect cables to electrical boxes and equipment enclosures located in outdoor, wet or sprinklered areas with watertight cable connectors.

.9 *Provide* cable grips for vertical and horizontal (catenary) cable suspension installations to reduce cable tension at connectors and at cable bends. *Provide* supporting messenger cables in accordance with best practices.

.10 Install through wiring in junction boxes and pull boxes having no connection within the box. Leave a minimum of 300 mm (12 ins) of slack inside box or follow best practices in accordance with the type of cable and the location.

.11 Facilitate making of splices and connections by leaving sufficient slack length of each conductor at panel boards, outlet boxes and other devices. Typically, the conductors should allow for 3 m (10 ft) of spare cable during the cable pulling process prior to the termination and dressing of each cable.

.12 Where suitable, e.g., outdoor or below ground, seal the conduits after completing the cable installation to mitigate the risk of rodent damage to the cable jackets. The sealant being used shall be designated for this purpose and shall be approved by the *Region*.

.13 Install instrumentation/system (low voltage) conductive signal wires in separate raceways from power and control wiring as is required by Code.

.14 Identify each cable by attaching a cable marker at each end, in all intermediate manholes, junction boxes and pull boxes. (See section 3.9 Labelling Requirements.

.15 Install cables so as to conserve headroom in exposed locations and to minimize the amount of interference in spaces through which they pass.

.16 Where exposed, install raceways, conduits and cables parallel or perpendicular to building lines and group neatly.

.17 Maintain the integrity of all fire separations by sealing around all cables, trays or conduits where they pass through such fire separations. Generally, this includes all floors, ceilings and concrete or masonry walls. Fire stopping may be performed with approved materials meeting the NFPA requirements or by means of manufactured systems which may more readily permit later additions. In all cases the resulting installation must meet or exceed that of the existing barrier.

.18 As far as is practicable, all feeder wiring shall be continuous from origin to panel termination without installing splices in intermediate pull boxes or splicing chambers. Sufficient slack (typically 3 m or 10 ft) shall be left at the termination point to make proper connections to the equipment. Any splices must be in accordance with the requirements of the Code and best practices. The communication cables may have specific length restrictions and splices or intermediate connections are generally not permitted. All splices or junctions must be readily accessible, i.e., must be visible and accessible subsequent to completion of the project.

3.3 INSTALLATION – ALL SECURITY SYSTEM DEVICES

.1 Supply, install, configure, test, and commission all the access control system and intrusion detection system components, communications equipment and all system components to ensure the functionality of complete security system and network. The contractor shall identify and report all pre-existing or related construction defects which will affect the progress of the *Work* to the *Region* and the *Consultant* before commencing construction.

.2 The Drawings included with the project *Specifications* have been developed on a conceptual basis. The *Contractor* is responsible for providing/verifying the quantities and part numbers contained in these documents which are based on the pre-approved products as listed in the above-mentioned Appendices. The *Contractor* shall also itemise all additional components, cables, etc. which are required to complete the *Work* as defined in the *Specifications* and on the Drawings. The *Contractor* shall also itemise the Bill of Materials in a logical, per building, per floor, and per area manner. The detailed design shall be done by the *Contractor* who shall verify the part numbers and quantities which are required. The contractor shall include any recommended spare parts as may be appropriate. In particular, the contractor shall also identify any compatibility issues, should these exist, between the existing installation and the proposed new equipment.

.3 Please refer to the drawings provided with the *Contract Documents* which identify the project requirements, the security device summary document, the *Specifications* and the Appendices for the specific security, locksmithing requirements and any other needs related to this project.

.4 A minimum quantity of 20% of inputs and 20% of relay outputs are to remain available for use in all systems which are being affected by the project unless otherwise stated. Unless otherwise noted in the *Contract* Drawings and *Documents*, the total quantity of inputs and outputs in the security system shall be less than 80% full, leaving a minimum of 20% capacity available for future use.

.5 All of the security system hardware and devices and additional nodes, as may be identified during the detailed design, are to be housed in NEMA 2 (IP11), NEMA 3 (IP54), or NEMA 4 (IP66) rated enclosures as listed in section 2.7 List of Approved Security Equipment or approved equivalent to suit the application. All enclosures are to be wall mounted and located as shown on the drawings. The *Region* will review and, as appropriate, approve the recommendations proposed by the *Contractor*.

.6 The enclosure sizes shall be sufficient to ensure ease of maintenance, adequate ventilation, and space for the elsewhere defined potential for 20% expansion.

.7 Where cabinets are exposed to the environment (see section 2.3 Environmental Requirements), the *Contractor* is responsible for ensuring that the cabinet incorporates sufficient ventilation to ensure that the temperature inside the cabinet remains within acceptable tolerances, even when considering direct sunlight or winter storms. Such ventilation may require heaters, fans or air conditioning along with suitable thermostats. While some equipment to be housed in such cabinets may, for example, be rated for operation to -20°C, the condensation which occurs at temperatures below 5°C is of itself damaging and is therefore to be avoided. The *Contractor* shall *Provide* suitable calculations and design information to justify the solution which is being proposed for such cabinets.

.8 Equipment location and other mounting locations may be modified with prior approval from the *Region*.

.9 The pre-approved Power Supplies are listed in “List of Approved Security Equipment” and shall be installed with a back plate. Only the approved power distribution modules are to be used for the system design.

.10 Enclosure and Power Supply solutions are to be presented to the *Region* for approval.

.11 All control panels, where applicable, are to be equipped with local battery backup power. Control panel batteries are to consist of 12V, 7Ah sealed lead acid batteries. Batteries shall be labelled with the installation contractor name and the date when initially installed and this information is to be updated when the batteries are replaced (see Section 1.4.22).

.12 All equipment is to be installed according to the manufacturer’s recommendations and the *Region* shall be informed whenever such recommendations are not being followed. The *Region* shall receive an explanation or justification when such conditions occur and direct the *Contractor* accordingly. If any instances are identified by the *Region* where the manufacturer’s recommendations have been disregarded, corrective measures may be required by the *Region*. Any such modifications shall be at the *Contractor*’s costs.

.13 All security system control panel enclosures must include:

.1 Tamper switches on the cabinet door(s);

.2 UPS back up (as may be required by the *Region*);

.3 Key operated lock on the cabinet door(s);

.4 Battery backup;

.5 Switched LED light inside panel to facilitate maintenance (as may be required);

.6 Clear and approved label on the outside;

.7 Internally stored configuration documentation etc;

.8 A dedicated network jack for maintenance purposes; and

.9 A dedicated 120VAC power circuit.

.14 The *Contractor* shall supply all necessary wiring, termination equipment/devices and other necessary miscellaneous components which are not specified in the *Contract Documents* but which are necessary to implement a fully functional access control, intrusion detection and security system as well as mechanical/electromechanical key locking system. Details for lock placement, function and keying can be found in the associated Security Device Summary document. The door lock override key shall be the Medeco Intelligent Key Systems – M3 & X4 CLIQ (see also 2.16 Door Hardware).

.15 All cables and wires shall be CSA or equivalent approved and have a flame test rating equal to, or greater than, that required by the local building or fire code where it is being used, including the OBC and OESC and be clearly marked with the seal of approval by the testing agency.

.16 End of Line (EOL) supervision shall be used on all sensor connections monitoring door status or other conditions. End of line resistor packs shall always be installed at the remote end of the detection line and not at the control panel. The *Contractor* shall install resistor packs using either one resistor (2 state monitoring) or using two resistors to *Provide* 4 state monitoring. Resistance values are determined by the manufacturer of the equipment which is being used and the *Region* will define where and how such supervision implementation is to be installed. Both of these "supervision" configurations will alert the intrusion detection system when the connection wires are cut or short circuited and signal a "tamper trouble" status.

.17 All cable runs should, where possible, be installed using a continuous, splice free cable run.

.18 If splices are required, the splices shall be made in CSA or other approved junction boxes utilizing DIN rail-mounted terminal blocks. Splice box locations shall be marked on the wiring diagram and included in as-built documentation. All splice locations shall be clearly marked in accordance with the requirements identified in section 3.9 Labelling Requirements and shown on the drawings.

.19 Wiring lists shall be permanently affixed inside all cabinets where splices, or control components are installed.

.20 Security wiring should not be run in parallel within 30 cms (12") of 110 VAC or higher voltage electrical wiring or conduit.

.21 All wiring shall adhere to applicable local, Provincial and Federal Codes and industry Best Practices shall be followed (also see 1.6 Applicable Standards for a partial list).

.22 The location of equipment shown on the Drawings may be revised during construction prior to its installation and the *Contractor* shall not be entitled to any additional costs for the relocation of equipment if the new location is within 10 metres (33 ft) of the original location.

.23 The contractor shall *Provide* unit costing for each item in the *Contract Documents* which shall apply for all quantity changes of increase or decrease within +/- 5% of the quantities specified in the original documents. If the change exceeds this limit, then the job shall be repriced.

.24 Install transformers complete with mounting brackets and hardware in positions in accordance with the manufacturer's instructions and where approved by the *Region*.

.25 The *Contractor* shall *Provide* all necessary lugs and mounting equipment which are not already provided with transformers and which are not individually specified.

.26 For the Regional Water and Wastewater facilities, the Control Panel relay outputs are to be wired to a local facility field controller so as to *Provide* security system discrete dry contact inputs to the SCADA system. Inputs which are to be wired in a fail-safe mode include:

.1 Intrusion Alarm

.2 Security System Armed

.3 Security System Disarmed

.4 Spare

.27 Communications between all of the distributed security devices and the *York* Regional Security servers shall use TCP/IP. The internal communication between the security devices and the prime security system interface port will use a protocol determined by the equipment manufacturer and, as long as it is does not involve the *Region*'s networks, does not need to be documented or approved by ITS. Configuration and activation of switch/hub ports on networking equipment maintained by the *Region*'s Information Technology Services Group ("ITS") is to be co-ordinated by the *Region*. The *Contractor* shall *Provide* one (1) week advance notification to the *Region*'s ITS Group for configuration of network ports.

.28 IP addresses shall be provided by the *Region*'s ITS department on request.

.29 If local IT Network infrastructure linking from the remote site to the Regional security servers is not present, Wireless network equipment shall be used. *York Region* ITS will supply the pre-configured Wireless Modem and network switch as well as the installation guidelines, (see Section 1.8 “Network TCP/IP Coordination”).

.30 The Network switch which is being used to communicate between a remote location and the security server shall be housed within the security system enclosure at the remote location. Both the modem and the switch should be powered from UPS power supplies.

.31 All replaced or surplus equipment is to be delivered to the *Region* upon completion of this *Contract* for possible re-use.

.32 Where magnetic locking devices are to be used, and where permitted by Federal, Provincial, Local Municipal or Town/City Codes, all necessary permits, engineered drawings and fire alarm interconnection shall be completed by the *Contractor*. Modification of the fire alarm system, signage and security systems, as may be required, shall be performed by the Fire Alarm System contractor of record for that location and by the *Contractor* as appropriate.

.33 Pre-Approved magnetic locks are shown in the section 2.16 Door Hardware. Such locks shall be Plate Magnet style locks with a minimum of 1200 lbf (540 kgs) holding force. In addition, they shall have indicator LED’s showing if they are closed or open and have integral Hold Force Sensors (HFS) (Bond Sensors) and Door Contacts.

.34 Where electro-magnets are being installed for a double door entrance, the magnetic lock shall be equipped with 2 electromagnets and 2 “plates” enclosed in a single housing. Door status monitoring may interpret the 2 doors as a single “opening”.

.35 The installation of the electromagnet may depend on the direction of “emergency egress” and wherever possible must be on the secure side of the door opening to reduce the risk of malicious attacks.

.36 The final inspection regarding permit approval of the magnetic lock inspection shall be coordinated by the *Contractor* and shall take place in the presence of the *Region*’s *Project* Coordinator. Presence of other required participants shall be coordinated by the *Contractor*.

.37 All manufacturers’ requirements and electrical Code requirements for grounding and bonding, including the requirements of the OESC and OBC, shall be followed. For larger projects there shall be 2 independent grounds, the power system ground and the telecommunications ground. Ground wires, ground lugs, grounding bolts and ground bars shall all be made of copper or bronze.

.38 Concealed magnetic door contacts are to be installed on all exterior access doors and interior doors, as identified on the Device Summary Chart as well as on the *Contract* drawing.

.39 Electric door strikes are to be installed on all doors which are identified within the Device Summary Chart as well as the *Contract* drawings. The electric strike shall be fire rated where these doors are a part of a fire separation. The strikes shall be configured to fail secure, i.e., when there is no applied power, the door shall be locked. Door key cylinders and locks shall be installed in every such door to allow key override of door strikes in all doors equipped with electric strikes. A message will be generated by the security system noting that the door has been “forced” when the door is opened using an “override” key.

.40 The *Contractor* shall install snubbing diodes in all security devices incorporating electro-magnetic devices to minimize the induced reverse voltage which occurs when such devices are deactivated. Such diodes shall, for example, be installed close to all electric strikes and electro magnetic locks to maximise protection.

.41 Installation of all electric strikes shall incorporate use of an “in-line power controller” to reduce the voltage supplied to the electric strike after the initial voltage surge activates the device. This device must be rated for the electric strike which is being installed and is intended to protect strikes which remain powered for long durations, such as an office entrance which may be opened by a schedule at 9:00 am and then powered until the office closes at end of the day. This is to be installed on all strikes to facilitate future applications of any door. The *Contractor* shall certify the use of such “in-line power controllers” so that the *Region* may exploit the doubling of the factory warranty period on such installations.

.42 The *Contractor* shall label all enclosures containing security equipment identifying the nature of the equipment and the addresses of the enclosed nodes. All networked equipment is to be labelled with the corresponding IP information. Main alarm outputs and relays shall be labelled accordingly. All alarm points, card readers and other system components shall be labelled in accordance with the door numbering and description syntax. All labelling shall be consistent on site, in the as-built documentation and in the software. Labels shall be weather/environment resistant type (see 3.9 Labelling Requirements).

.43 The contractor shall post warranty/contact information on the inside of the main control enclosure for each facility. Where possible this information should identify contact information which is operational 24/7.

.44 Dedicated security system alarm outputs shall be provided for all Environmental Services facilities and connected to the SCADA control panel so as to *Provide* integrated monitoring of intrusion detection alarm and arming status (see Section 3.2.26). The SCADA system accepts only dry form C relay contacts, i.e., NO and NC contacts. Integration with the *Region*’s SCADA system must be coordinated with the *Region*, 2 weeks in advance of the integration so as to have a representative from Environmental Services scheduled to be present and assist with the integration. All work undertaken in chemical rooms (chlorine, ammonia rooms) at Environmental Water and Wastewater facilities must also be coordinated with the *Region* in advance to have a representative from Environmental Services scheduled to be present.

.45 The *Contractor* is responsible for programming and testing of the intrusion reporting component if it is to be monitored by a 3rd party Central Station. The *Contractor* is to coordinate with the central monitoring station for configuration and testing of the system for all relevant signals. The intrusion reporting system at the *Region*’s sites shall be equipped with both Wireless and IP-Wired communication modules. The *Contractor* shall supply, install, configure, test and commission a compatible cellular communication module(s) complete with an active SIM card and an application appropriate antenna, i.e., the contractor shall enroll the security system as a subscriber. This antenna is to be installed on the inside or outside of the building so as to ensure a consistent and reliable signal and shall be in accordance with the requirements of applicable laws, including municipal, Provincial and Federal legislation and regulations. The contractor shall coordinate the subscription with the *Region* and establish the appropriate response plan for each of the alarm points. If there is an existing contract with a local monitoring service, the *Contractor* shall modify the existing contract to allow for the added service.

.46 The *Contractor* shall ensure that the cellular service and the monitoring service are so configured that the billing and other communications from the carrier are routed as requested by the *Region*.

.47 All Alarms shall be the only notifications communicated to the 3rd Party Monitoring Service. No pre-alarms (as are associated with the Door Held Open alarms) shall be communicated to the 3rd Party Monitoring service.

.48 The *Contractor* shall configure a routine test alarm transmission to the 3rd Party Monitoring Service which shall be set up to independently confirm the operation of both the wireless and the

IP communications links during the silent night hours e.g., 2:00 am and 2:15 am every 24 hours unless otherwise instructed.

.49 The *Contractor* shall work with the *Region* to confirm the:

.1 Unique and unambiguous naming of all the alarm points;

.2 Name and contact information of three contacts for each alarm point; and

.3 A suitable Response plan for each alarm point.

.1 The *Contractor* shall ensure that the response plan and contact information is confirmed with the 3rd Party Monitoring Service and shall test the system response by tripping each of the alarm points in turn and validating the 3rd Party Monitoring Service logs with those recorded by the Central Operations Audit Trail log in conjunction with the *Region*'s representative.

3.4 INSTALLATION – ENTERPRISE SOFTWARE INTEGRATION

.1 Integrate or modify the configuration for the facility which being modified into the *Region*'s existing Enterprise software database.

.2 The *Contractor* shall co-ordinate the *Work* to incorporate the facility into the existing Enterprise system with the *Region*.

.3 This work shall be completed a minimum of 15 *Working Day*s prior to the date of *Substantial Performance of the Work*. The *Contractor* shall coordinate this integration effort with the *Region*'s Security and Life Safety Coordinator at 1-877-464-9675 ext. 76900 unless informed otherwise.

3.5 OPERATION - GENERAL

.1 Operation of the new security system is to function similarly to existing systems installed at other Regional facilities of a similar type. The *Contractor* shall confirm all security system functions and operation with the *Region* of *York* Security and Life Safety Coordinator at 1-877-464-9675 ext.76900 prior to undertaking any programming unless otherwise informed.

.2 Overview: A general overview of the intended operation of the system is as follows:

.1 The system shall allow for the monitoring of intrusion detection alarms inside the system alarm monitoring module, in addition to giving command and control of supported intrusion detection devices. Once alarms are brought in to the system, they shall be stored in the system Audit Trail log.

.2 All system events either designated as alarm conditions or not designated as alarm conditions shall be stored in the system Audit Trail log.

.3 Each door shall be programmed to generate "Door Forced" and "Door Held Open" alarms. These alarms shall have a user-definable, independent time delay which if not otherwise specified should be:

.1 Time to trigger a "door held open" pre-alarm is 45 seconds;

.2 Additional time for a "door held open" alarm is 10 seconds; and

.3 Time to trigger "door forced "alarm is immediate.

.4 Request to exit ("RTE") motion sensors are to be installed on the interior of all perimeter exit doors which are equipped with door contacts in order to prevent false "forced entry" alarms caused by egress of personnel even when the security system is armed. RTE's (motion sensors) are to be configured to only shunt egress detection for 45 seconds unless otherwise specified. RTEs shall not be configured to release the electric strike. These RTE's shall be aimed carefully so that that the sensor is not triggered by individuals or activities not related to exiting through the door, such as by individuals using a stairwell or a coffee machine close to the exit door. The RTE described here will require a different configuration if the door is locked by an electro magnet.

.5 Where access control and intrusion detection systems are installed on doors which also have automatic operators (also referred to as handicapped door operators), there are a number of special requirements. In order to achieve these added functions, there needs to be a door interface relay / sequence board which can integrate and schedule operation of the inputs and outputs in a way that the security system cannot. This device is normally installed in the ceiling above the handicapped door. This device integrates some of the functions identified below and introduces delays as may be required to ensure that the door lock and the handicapped operator function in sequence and not simultaneously. The usual sequence of operations is as follows.

.1 The card reader on the insecure side of the door is always active.

.2 The insecure side handicapped paddle is normally inactive.

.3 The door is normally closed and locked unless there is a schedule during which the lock is disengaged.

.4 The secure side handicapped paddle is normally active and there is also an RTE device (typically a motion sensor)

.5 When entering the secure space from the insecure side:

.6 The user will swipe a valid card on the reader which will enable the insecure side handicapped paddle and unlock the door. Those who are capable of doing so may open the door manually and enter through the door which will automatically close and relock behind that person. Mobility challenged individuals may press the handicapped paddle which will activate the handicapped operator by activating the REN (Request to Enter) on the access control system. Once the operator completes its cycle and closes the door the insecure side handicapped paddle will be inactive and the door will relock.

.7 When leaving the secure space and going to the insecure side:

.8 The user will approach the door thereby activating the RTE device, thereby unlocking the door. The door can be opened by pulling on the handle or by pressing the handicapped paddle to activate the door operator. Once the operator completes its cycle and closes the door the secure side handicapped paddle will be active and the door will relock.

.6 The security system shall automatically upload/download information to/from the control panels while the control panels are in communication with the host server application. A data download/upload may also be initiated manually by a technician should this be required. This transfer of data may consist of either controller database information or alarms and events.

.7 Data transfer shall not interfere with normal daily operations. The local system shall be capable of working for at least 24 hours or 5,000 events written to local logs without communications to the central system. Alarms will sound locally and they and the events will be recorded locally when such downloads/uploads are unavailable. Should the local storage capacity be exceeded the oldest records will be overwritten. Once the downloads/uploads resume, these records will be transferred and will then appear in the Central Audit Trail log.

.3 Authentication to the security System shall be via programmed Access Levels, e.g., all users will have only the access levels which are predicted to be relevant to their responsibilities, and these may relate to only one site for a local responsibility such as a librarian, or to many sites for an ITS trainer. When new sites are brought on-line, existing access levels may need to be augmented or new ones may need to be approved. Such access levels can be further customised by using schedules to allow for the accesses to be limited by time of day or day of week, thereby providing more control and greater security.

.4 Proximity Card Reader and combination “Proximity Card Reader and Arming Button” shall function as a method of disarming and arming the security system respectively.

.5 When a valid card is presented to the Card Reader on the insecure side of the door, the system of which that reader is a part will disarm immediately and temporarily unlock the door. The door does not need to be opened and even if the door is not opened the system will remain disarmed and the lock will relock after the timer expires.

.6 The security system shall only Arm if there are no open contacts, open areas, or alarms in the system. Troubles will generally not inhibit Arming of the system, e.g., a low battery voltage causes a trouble signal which will not prevent arming of the system. When the system is “secure”, i.e., “ready to arm” (as shown on the keypad), swiping the card at the Card reader on the secure side of the door and then pressing the arming button which incorporates a 45 second delay and will result in the system commencing a countdown timer, which will be set to 1 minute unless otherwise specified. During this “Exit Delay” the keypad display will beep slowly and display “Exit Delay in Progress”. When the “Exit Delay” is complete, the sounder will become silent and the “Ready to Arm” indication will be replaced with the “armed” LED status indicator at the keypad will be illuminated on the keypad.

.7 Upon presentation of proximity card with the correct Access Level, i.e., a valid access card, to a card reader, the security system shall activate the unlocking mechanism on the corresponding door, allowing that door to be opened. As noted above this will happen when the security system area is armed or not.

.8 Upon authorized entry through a door (Access Granted) the system shall automatically disarm the security system area related to that door if it was previously armed. “Security System Disarmed” status shall be indicated as an input to the access control and intrusion system.

.9 Prior to exiting from a facility, personnel shall arm the security system by presenting their card to the secure side “Arming” card reader and then pushing the adjacent push button (Arming Button). This sequence of events will initiate arming of the security system. “Security System Armed” input shall be signalled to field controller. The system shall only Arm if there are no alarms or “open contacts” in the system.

.10 The use of a manual, “override” key entry to an armed facility, (or any other means of opening the door except for the use of an approved access card) shall cause “Intrusion Alarm” input to be signalled to the access control system and to the intrusion detection system.

.11 Upon a forced entry to the facility, “Intrusion Alarm” input will be signalled to the local access control system and the intrusion detection system. The Central System maintains “Security System Armed” input signal to the access control system and intrusion detection system.

3.6 SECURITY WIRING FIELD QUALITY CONTROL

.1 Sensor and other signal wiring should be tested for continuity of each conductor using ohmmeter or DC buzzer. Resistance values shall not exceed 5 ohms. Megger or 120 Volt filament lamp testing is not acceptable.

.2 Carry out functional tests with the *Region*'s Representative to confirm field wiring, interconnections, and device functionality.

.3 Depending upon the magnitude and the complexity of the system, the *Contractor* may elect to divide the security system into logical sections, and activate one section at a time so as to sequentially verify the operation of each selected section.

.4 Upon completion of the sectional tests, the *Contractor* shall undertake testing of the integrated system comprised of all the sections.

.5 The *Contractor* shall verify operation of the complete system for operational sequencing.

.6 For local testing, each device/sensor should be tested and marked off one by one until all devices/sensors are tested. Each sensor shall be verified to the intended zone.

.7 Submit one copy of all signed and dated test results to the *Consultant*. This shall only be done after any aberrations uncovered during the testing have been rectified.

3.7 NETWORK WIRING FIELD QUALITY CONTROL

.1 The network cabling requires certification in order to achieve full acceptance by both the *Region* and the Manufacturer.

.2 The *Region* requires that the performance of the entire LAN infrastructure be certified to Category 6e performance which shall include at least the following parameters as defined in the ANSI/TIA/EIA-568-B.1 and other compatible standards by using a calibrated tester.

.3 Cable installers will generally *Provide* these results for each cable link in tabular and graphical format which should be generated by the test equipment. These results will automatically flag those measurements which do not meet the performance standards which were selected, e.g., Category 5, Category 5e Category 6, Category 6e etc.

.1 Wire map

.2 Propagation delay

.3 Delay Skew

.4 Cable Length

.5 Insertion Loss

.6 Return Loss

.7 Near-End Crosstalk (NEXT)

.8 Power Sum NEXT (PSNEXT)

.9 The Equal-Level Far-End Crosstalk (ELFEXT)

.10 Power Sum ELFEXT (PSELFEXT)

.11 Attenuation-to-Crosstalk ratio (ACR)

.12 Power sum ACR (PSACR)

.13 DC Loop Resistance

.4 Naturally for the entire network to perform satisfactorily the components forming part of the network must all be certified to the same standard. Patch cords in particular are generally purchased pre-manufactured and are not normally a part of the "link testing".

.5 The system inspection shall include inspection of the labelling, the cable dressing, the terminations, the testing, patch panels, the jacks and the type of the insulation which has been used. All of these items shall be accepted by the *Region* only if all components are certified to the same standard.

3.8 WIRING IDENTIFICATION

.1 Identify all wiring infrastructure including fibre optic cabling and conduits with wire markers in accordance with the requirements noted in 3.9 Labelling Requirements.

.2 Identify each conductor, including any spares, with a unique alphanumeric designation to facilitate troubleshooting and maintenance as identified by *Region* of *York* standards.

.3 Identify all controller wiring at terminal blocks and connection points with the controller terminal (I/O) address numbers.

3.9 LABELLING REQUIREMENTS

.1 Introduction

.1 This section describes the requirement for the *Contractor* to suitably identify and label all pieces of equipment.

.2 ANSI/TIA-606-C is the current version of the voluntary standard for administering telecommunications cabling infrastructure, released by the Telecommunications Industry Association (TIA) in July 2017. TIA-606-C builds on the guidelines already established in TIA-606-B, released in 2012, as well as includes some new additions and updates. This standard provides extensive guidelines to the proper use of labelling for environments such as that used at *York Region*.

.3 The primary objecting of the labelling is to ensure that all those charged with the responsibility of performing maintenance or repairs on the system at any time can uniquely and safely refer to each component of the system.

.4 The labelling shall always correspond with the terminology and format of the labels defined on the drawings. Labels shall always be applied to every serviceable or adjustable component of the system.

.5 Details related to the labelling should always be presented to *York Region* before being applied.

.6 Depending on the installation, there will be equipment cabinets, junction boxes, pull boxes, man holes, cameras, network components and other components which are installed to support the security system. Each of these "devices" must be labelled clearly and permanently, using the same nomenclature than has been documented in the system schematics.

.7 Typically, the preferred form of permanent labelling is engraved Lamacoid. The colours and the format of the label shall be approved by *York Region* and shall follow the guidance of this section. The selection of colours should be designed so that the engraved or printed labels exhibit good contrast and will not fade or deteriorate due to exposure to the environment in which they are installed, e.g., sunlight or de-icing chemicals.

.8 The labels, Lamacoid or flexible cable labels shall not, inherently or through their means of installation, induce damage or corrosion to the surface to which they are being attached.

.9 There will be situations where other means of labelling devices may be more suitable and such options should be reviewed with *York Region*.

.10 The labels shall be screwed to the cabinets or, at the discretion of *York Region*, may be attached to the cabinet using a suitable double-sided weatherproof tape. The surfaces to which the tape is to be applied shall be properly prepared if this approach is selected. All labels to be attached in this manner shall be in "landscape mode" and centred from left to right.

.11 In some situations, labels will need to be "hung" directly from a component, and this may be accomplished by means of a hole drilled into the label and the use of suitable stainless-steel aircraft cable made for this purpose.

.12 Further a suitable colour code which may be implemented on conduits with a colour band or in the labelling is recommended. (See section 2.14 Conduits, Fittings and Accessories)

.13 All labels shall be machine-generated. Handwritten labels are not acceptable.

.14 All cables and conductors shall be labelled at each end and at each pull box or hand-hole.

.15 All labelling shall be consistent on site, in the as-built documentation and in the software.

.16 Special care should be exercised and labels should be applied to *Provide* warnings related to special procedures when opening some "devices". For example, if there are multiple sources of power, potentially dangerous supervision of, or monitoring of, automated responses to "tampering" etc. notifications should be present to advise the service staff of such situations.

.17 The contractor shall post warranty/contact information on the inside of the main control enclosure for each facility as well as the commissioning date.

.2 Labelling Details

.1 Details with respect to the information to be included within the labels are provided below.

.2 Main alarm outputs and relays shall be labelled accordingly. All alarm points, card readers and other system components shall be labelled in accordance with the door numbering and description syntax.

.3 Enclosures

.1 Electrical cabinets shall be identified with at least:

.1 Voltage, type of power, power source (including as appropriate Circuit No);

.2 Purpose of the cabinet; and

.3 Name of the cabinet as shown on the drawings.

.2 Communications / Security cabinets shall be identified with at least:

.1 Type of Application, Signal source (including as appropriate Circuit / Port No);

.2 Purpose of the cabinet; and

.3 Name of the cabinet as shown on the drawings.

.3 Junction boxes shall be identified with at least:

.1 Nature of enclosure content, e.g., Data, CCTV, Power, etc

.2 If appropriate, Voltage, type of power, power source (including as appropriate Circuit No);

.3 Purpose of the cabinet; and

.4 Name of the cabinet as shown on the drawings.

.4 The *Contractor* shall label all enclosures containing security equipment indicating the nodes installed within.

.5 All Networked equipment is to be labelled with corresponding IP information.

.4 Conduits

.1 The following information is repeated here for the sake of convenience and also appears in Conduits, Fittings and Accessories.

.2 *York Region* uses the following Conduit colours:

Category No.	Voltage	Colour
.1	High Voltage (in excess of 750 V):	Brown
.2	347/600 V:	Sand
.3	120/208 V:	Grey
.4	Emergency Power:	Associated Voltage Colour
.5	Fire Alarm & Fire phone:	Red
.6	Security/Intrusion/Surveillance:	Green
.7	Low Voltage Switching:	Black
.8	Annunciator Cabinets:	Black
.9	Data/Telephone Cabinets:	Blue
.10	Telephone Backboards:	Grey
.11	Television:	White
.12	Public Address/Intercom:	Purple

.3 Cable Colours are not specified unless they are defined for a particular project.

.5 Cables

.1 Each end of every cable including the grounding system shall be labelled. Every cable shall also be identified at every pull box or other accessible location along the length of the run.

.2 These labels shall be of the “wraparound” variety, and as for all other labels shall be machine-generated.

.3 The labels shall be of suitable size to fit the cables to which they are applied i.e., there will generally be a requirement for multiple label sizes. The labels shall be PANDUIT PLL-33-Y3-5 labels or approved equivalent.

.4 The specific cable label types are designated based on diameters anticipated for a project. It is recognised that some of the cable diameters may be changed during project execution and for this, or other reasons, the *Contractor* shall ensure that the overall requirement to ensure that the clear part of the cable label protects the printed part of the cable label is always satisfied. This specification may demand alternative cable labels which shall be from the PANDUIT PLL product line or approved equivalent.

.5 The label shall be applied within 15 cm (6 ins) of the end of the cable and shall be located so that the cable may readily be identified.

.6 The printing shall be at least 12-point Arial font or approved equivalent.

.7 All labelling must be mechanically printed using a laser printer and follow the ANSI/EIA/TIA-606C guideline for colour codes. Hand written labels are not permitted. The following identifies the labelling convention.

.6 Cable Labelling Conventions

.1 The labelling of cables shall clearly identify the application of the cables. This convention requires that cables be identified as follows:

.1 C for communications;

.2 F for fire related applications;

.3 H for “high”-voltage power (greater than 48V);

.4 L for “low”-voltage power (less than 48V);

.5 N for networking;

.6 S for signalling;

.7 T for transducer; and

.8 V for video cables.

.2 A typical cable label might, for example, be labelled as: “L0003-GAR001-064-ADMIN009-922”. Which would signify,

.1 Low Voltage Cable

.2 Number 0003 cable

.3 Cable is from location “GAR001”, “connection 064” to location “ADMIN009”, “connection 922”, i.e., source and destination must be uniquely specified.

.3 Such cable identifications shall be incorporated in the documentation.

.4 The *Contractor* shall obtain the *York Region*’s approval of any modification or extension to this convention.

.5 Main alarm outputs and relays shall be labelled accordingly. All alarm points, card readers and other system components shall be labelled in accordance with the door numbering and description syntax.

.7 Considerations Regarding ANSI / TIA-606-C:

.1 TIA-606-C is the latest update to the voluntary standard for administering telecommunications cabling infrastructure, released by the Telecommunications Industry Association (TIA) in July 2017. TIA-606-C builds on the guidelines already established in TIA-606-B, released in 2012, as well as includes some new additions and updates.

.8 How to Properly Identify Cables According to TIA-606-C

.1 Each of the following components must be clearly labelled with the appropriate identifiers:

.1 Pathways

.2 *Work* area outlets

.3 Patch panels

.4 Racks and cabinets

.5 Ports

.6 Grounding busbars

.7 Cabling

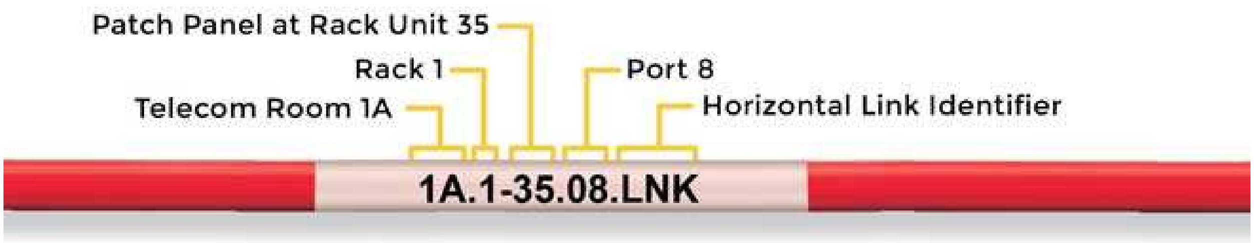
.8 Firestop locations

.9 Telecommunications space

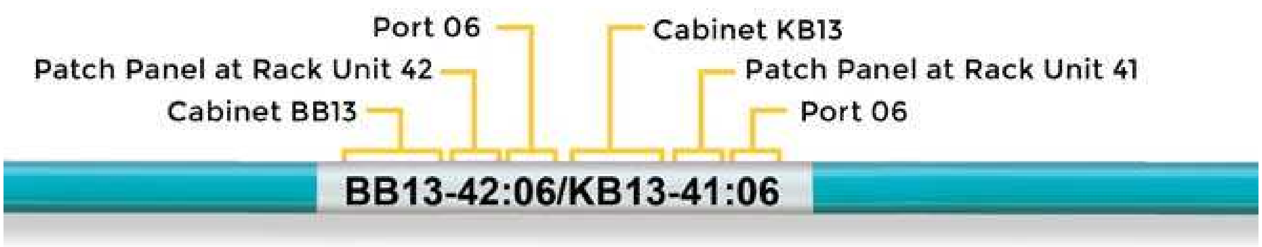
.10 Data center room grid

.9 Examples of TIA 606C Compliant Labelling (Brady Labels)

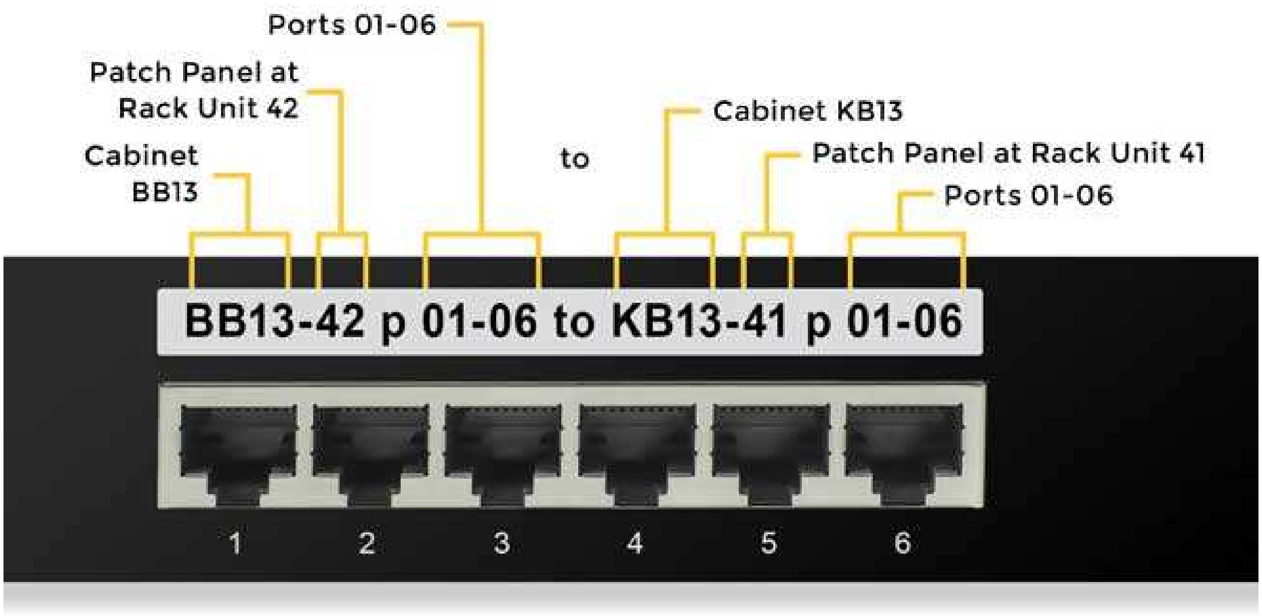
.1 LINK Identifier Not Terminated in the Same Space Label Example



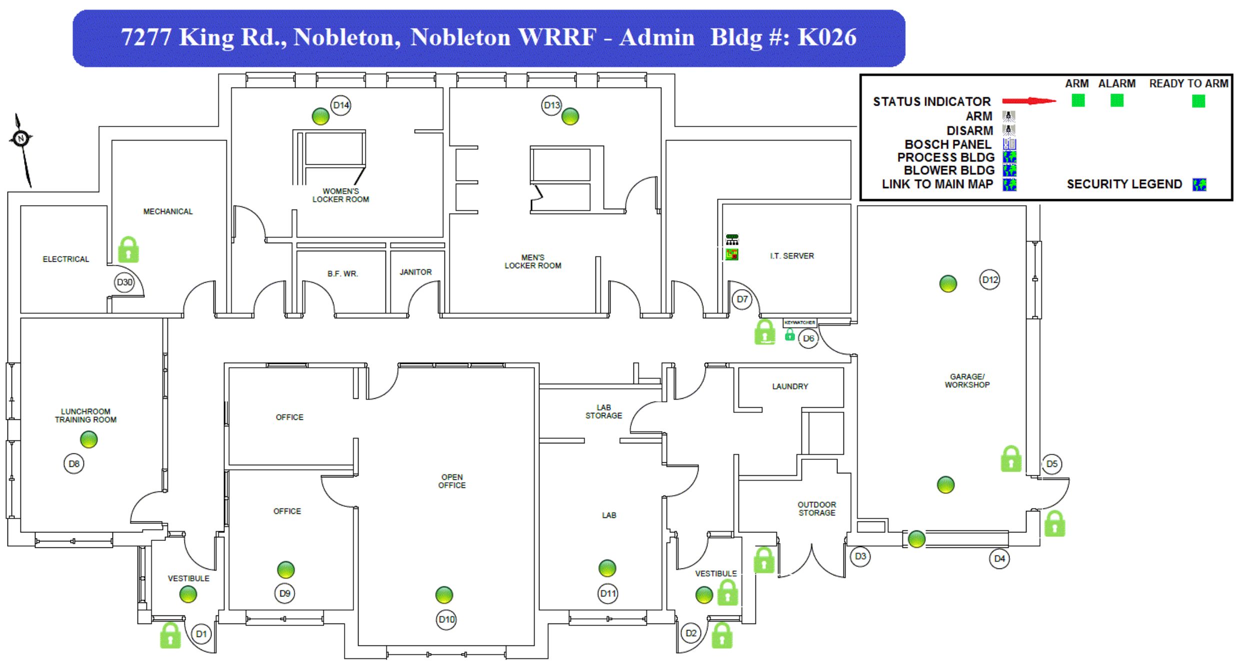
.2 LINK Identifier Terminated in Same Space Label Example



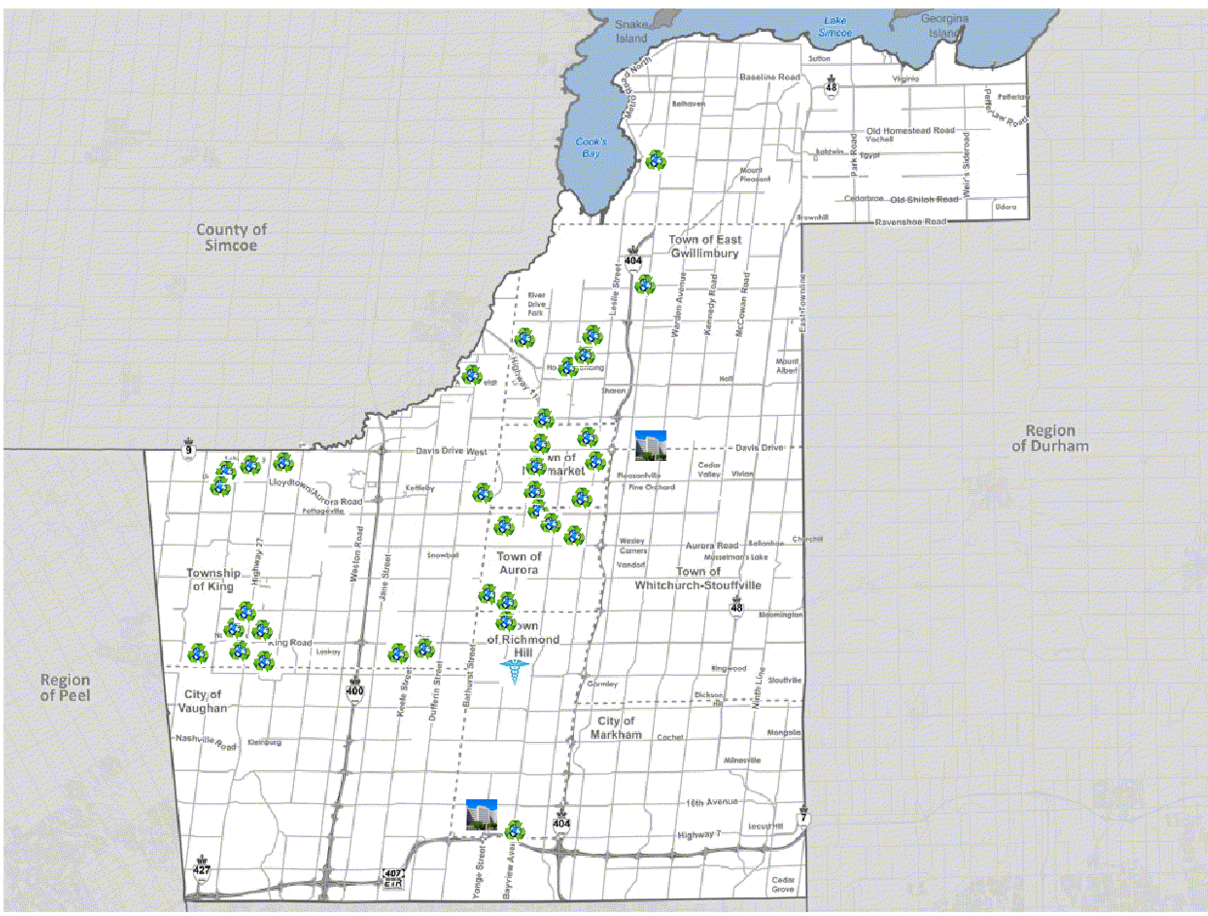
.3 Patch Panel Identification Label Example



3.10 SAMPLE GRAPHIC ALARM MAP, REGIONAL LAYOUT AND ICONS



Security Legend	
	Door Closed/Secure
	Door Forced Open
	Door Held Open
	Door Unlocked by Operator
	Door Locked by Operator
	Door Offline
	Door Contact Closed/Secure
	Door Contact Open
	Door Contact Offline
	Camera Online
	Camera Offline
	Link back to York Region Map



3.11 REGIONAL SECURITY SYSTEM NAMING CONVENTION STANDARDS

.1 All components and interconnections are to be identified by a unique name which shall be used on drawings, documentation and labels.

.2 These names are to be assigned in compliance with the following guidelines.

.3 Labels are to be attached in a manner which is durable, can be readily read and are in accordance with these guidelines and is further documented in 3.9 Labeling Requirements.

.4 A full list of the Sites and existing buildings can be provided on request. The *Contractor* is advised to obtain the latest listing to ensure that this contains any recent updates.

Site:

E005-B (Facility/Building Code) followed by address and/or building name

E = Municipality (example: East Gwillimbury)
005 = Building *Site* Sequential Number
B = Identifies site as an owned Building

Other options:
L = Leased Building
P = Property

System Controllers and Panels (Lenel LNL-2220, Bosch B9512G):

E005SS01 (LNL-2220)

E005SI01 (B9512G)

E005 = *Site* Number

S = Security controller

S = Intelligent System Controller (ISC)

I = Intrusion Alarm Panel (Bosch)

01 = ISC/Intrusion Panel Sequential Number

Door:

E005D001

E005 = *Site* Number

D = Card Reader/Door

001 = Matches Reader Port it is associated with.

3.12 *SITE* TESTING

.1 Following installation or modification of the security System at a facility, *Site* testing shall be performed by the *Contractor*. Testing is to be co-ordinated with the *Region*.

.2 Record test results in a log book and submit to the *Consultant* for reference and approval. Replace or repair circuits which do not meet requirements before submitting to the *Consultant*.

.3 The Facility is to be tested to confirm/demonstrate the proper operation of the System in accordance with a test plan approved by the *Consultant*.

.4 The *Region*'s representative is to be present for all final testing. The *Region*'s representative is to confirm that testing has been satisfactorily completed and that the system is ready for operational use as intended.

.5 All exterior facility access doors are to be tested for valid access control functions and intrusion detection operation while using test proximity card(s). The corresponding inputs to the SCADA system are also to be verified when they are present. The security system is to be tested with both valid and invalid proximity cards in online and offline operating modes. The testing shall ensure that both the mechanical and electronic aspects of the doors as well as any other special features function correctly. The various trouble options shall also be shown to work properly. Any malfunctions must be corrected prior to the *Region* accepting the system.

.6 Use of the “emergency” mechanical key override through all perimeter doors is to be tested by manually opening such doors. The key must readily *Provide* access without any action by the access control system but must also report the key operation as a “Door Forced” event. Corresponding inputs to the SCADA system are to be confirmed as may be appropriate.

.7 Since all arming is activated by use of a card and push button at one of the doors in each facility, there needs to be a careful verification of this function at each door which is equipped with this function. The testing shall ensure that any of the “faults” intended to inhibit the arming function do prevent the arming and that these situations are clearly identified on the keypad screens. Such faults include, door open, trouble events, inadequate credential access level, communications failure etc. The testing process requires comparison of the Audit Trail log with the local record maintained by the testing team.

.8 All event and alarm conditions are to be verified and logged to the system Audit Trail log. The activation of such alarms and associated events are to be logged using an accurate time source, e.g., a cell phone and then recorded. There are several different responses which should be initiated by this testing process and which therefore require testing:

  .1 A local response, e.g., siren at the door,

  .2 A facility wide response, e.g., an active icon on the alarm management screen in the facility,

  .3 A Regional central monitoring operation notification, e.g., an active icon on the alarm management screen; and

  .4 Notification to the 3rd Party, off site Monitoring Station.

.9 Upon completion of the on-site testing, the “test team” records shall be compared with the system Audit Trail log report and with the notification log which shall be obtained from the 3rd Party Monitoring Station. Any evidence of a malfunction in this auditing process needs to be corrected before the *Region* will accept the system.

.10 Following successful integration with the *Region*’s Security Server, “shift programming”, otherwise referred to as “access level adjustments” of the facility, if applicable, are to be coordinated through the *Region*’s Security and Security Systems Administrator who is available at 1-877-464-9675 ext.76900.

END OF SECTION

PART 1 – GENERAL

1.1 General Requirements

.1 Read and be governed by conditions of the Contract Documents, including sections of Division 01.

1.2 Reference Standards

.1 National Research Council Canada (NRC)
- .1 National Building Code of Canada 2015 (NBC).

.2 Treasury Board of Canada Secretariat (TBS), Occupational Safety and Health (OSH)
- .1 Fire Protection Standard-10.

.3 Underwriter's Laboratories of Canada (ULC)
- .1 CAN/ULC-S524-06, Standard for the Installation of Fire Alarm Systems.
- .2 CAN/ULC-S526-07, Visible Signal Devices for Fire Alarm Systems, Including Accessories.
- .3 CAN/ULC-S527-99, Standard for Control Units for Fire Alarm Systems.
- .4 CAN/ULC-S528-05, Manual Stations for Fire Alarm Systems, Including Accessories.
- .5 CAN/ULC-S529-09, Smoke Detectors for Fire Alarm Systems.
- .6 CAN/ULC-S530-91(R1999), Heat Actuated Fire Detectors for Fire Alarm Systems.
- .7 CAN/ULC-S531-02, Standard for Smoke Alarms.
- .8 CAN/ULC-S537-04, Standard for the Verification of Fire Alarm Systems.

1.3 Action And Informational Submittals

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

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for multiplex fire alarm system and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
- .1 Submit drawings.
- .2 Indicate on shop drawings:
  - .1 Detail assembly and internal wiring diagrams for control units. Consoles Auxiliary cabinets.
  - .2 Overall system riser wiring diagram identifying control equipment initiating zones signaling circuits; identifying terminations, terminal numbers, conductors and raceways.
  - .3 Details for devices.
  - .4 Details and performance specifications for control, annunciation and peripherals with item by item cross reference to specification for compliance.
  - .5 Step-by-step operating sequence, cross referenced to logic flow diagram.

.4 Sustainable Design Submittals:
  .1 Construction Waste Management:
    .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.4 Closeout Submittals

.1 Submit in accordance with Section 01 77 00 – Project Closeout.

.2 Operation and Maintenance Data: submit operation and maintenance data for fire alarm system for incorporation into manual.

.3 Include:
  .1 Instructions for complete fire alarm system to permit effective operation and maintenance.
  .2 Technical data - illustrated parts lists with parts catalogue numbers.
  .3 Copy of approved shop drawings with corrections completed and marks removed except review stamps.
  .4 List of recommended spare parts for system.

1.5 Maintenance Material Submittals

.1 Submit maintenance materials in accordance with Section 01 77 00 – Project Closeout.

1.6 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 materials from nicks, scratches, and blemishes.
  .3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 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 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 Description

.1 Fully supervised, microprocessor-based, fire alarm system, utilizing digital techniques for data control and digital, and multiplexing techniques for data transmission.

.2 System to carry out fire alarm and protection functions; including receiving alarm signals;

initiating general alarm; supervising components and wiring; actuating annunciators and auxiliary functions; initiating trouble signals and signaling to monitoring agency fire department.

.3 Zoned, non-coded single stage.

.4 Modular in design to allow for future expansion.

.5 Operation of system shall not require personnel with special computer skills.

.6 System to include:
   .1 Central Control Unit in separate enclosure with power supply, stand-by batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display, and program control/signaling.
   .2 Data Gathering Panels/Transponders with stand-alone capabilities.
   .3 Power supplies.
   .4 Initiating/input circuits.
   .5 Output circuits.
   .6 Auxiliary circuits.
   .7 Wiring.
   .8 Manual and automatic initiating devices.
   .9 Audible and visual signaling devices.
   .10 End-of-line resistors.
   .11 Local and Remote annunciators display.
   .12 Printer Event log memory chip.
   .13 Historic event recorder.
   .14 Y2K compliancy.

.7 Equipment and devices: ULC listed and labelled and supplied by single manufacturer.

.8 Power supply: to CAN/ULC-S524.

.9 Audible signal devices: to CAN/ULC-S524.

.10 Visual signal devices: to CAN/ULC-S526.

.11 Control unit: to CAN/ULC-S527.

.12 Manual pull stations: to CAN/ULC-S528.

.13 Thermal detectors: to CAN/ULC-S530.

.14 Smoke detectors: to CAN/ULC-S529.

.15 Smoke alarms: to CAN/ULC-S531.

.16 Regulatory Requirements:
   .1 To TBS Fire Protection Standard.
   .2 Subject to Fire Commissioner of Canada (FC) approval.
   .3 Subject to FC inspection for final acceptance.
   .4 System components: listed by ULC and comply with applicable provisions of NBC Local Provincial Building Code, and meet requirements of local authority having jurisdiction.

2.2 System Operation: Single Stage - Signals Only

.1 Actuation of any alarm initiating device to:
  .1 Cause electronic latch to lock-in alarm state at central control unit and data gathering panel/transponder.
  .2 Indicate zone of alarm at central control unit and remote annunciator display.
  .3 Cause audible signaling devices to sound continuously throughout building and at central control unit.
  .4 Transmit signal to fire department via central station.
  .5 Cause air conditioning and ventilation fans to shut down or to function to provide required control of smoke movement.
  .6 Cause fire doors and smoke control doors, if normally held open, to close automatically.

.2 Acknowledging alarm: indicated at central control unit.

.3 Ensure that it is possible to silence signals by "alarm silence" switch at control unit, after 60 seconds period of operation.

.4 Subsequent alarm, received after previous alarm has been silenced, to re-activate signals.

.5 Actuation of supervisory devices to:
  .1 Cause electronic latch to lock-in supervisory state at central control unit and data gathering panel/transponder.
  .2 Indicate respective supervisory zone at central control unit and at remote annunciator.
  .3 Cause audible signal at central control unit to sound.
  .4 Activate common supervisory sequence.

.6 Resetting alarm supervisory device not to return system indications/functions back to normal until control unit has been reset.

.7 Trouble on system to:
  .1 Indicate circuit in trouble at central control unit.
  .2 Activate "system trouble" indication, buzzer and common trouble sequence. Acknowledging trouble condition to silence audible indication; whereas visual indication to remain until trouble is cleared and system is back to normal.

.8 Trouble on system: suppressed during course of alarm.

.9 Trouble condition on any circuit in system not to initiate alarm conditions.

2.3 Control Panel

.1 Central control unit (CCU).
  .1 Suitable for DCLA communication style: to CAN/ULC-S524.
  .2 Features specified are minimum requirements for microprocessor-based system with digital data control and digital multiplexing techniques for data transmission.
  .3 Minimum capacity of 250 addressable monitoring and 250 addressable control/signal points. Points may be divided between 2 communication channels in distributed system, each channel operating independently of other. Faults on one communication channel not to affect operation of other channel.
  .4 System to provide for priority reporting levels, with fire alarm points assigned highest priority, supervisory and monitoring lower priority, and third priority for

troubles. Possible to assign control priorities to control points in system to guarantee operation or allow emergency override as required.

.5 Integral power supply, battery charger and standby batteries.

.6 Basic life safety software: retained in non volatile Erasable Programmable Read-Only-Memory (EPROM). Extra memory chips: easily field-installed. Random-Access-Memory (RAM) chips in panel to facilitate password-protected field editing of simple software functions (i.e. zone labels, priorities) and changing of system operation software.

.7 Circuitry to continuously monitor communications and data processing cycles of microprocessor. Upon failure, audible and visual trouble indication to activate.

.8 Support up to 2 RS-232-C I/O ports. CCU output: parallel ASCII with adjustable baud rates to allow interface of any commercially available printer, terminal or PC.

.9 Equipped with software routines to provide Event-Initiated-Programs (EIP); change is status of one or more monitor points, may be programmed to operate any or all of system's control points.

.10 Software and hardware to maintain time of day, day of week, day of month, month and year.

.11 Software to operate variable sensitivity addressable smoke detectors and annunciate their status and sensitivity settings at control panel.

2.4 Power Supplies

.1 120 V, 60 Hz as primary source of power for system.

.2 Voltage regulated, current limited distributed system power.

.3 Primary power failure or power loss (less than 102 V) will activate common trouble sequence.

.4 Interface with battery charger and battery to provide uninterruptible transfer of power to standby source during primary power failure or loss.

.5 During normal operating conditions fault in battery charging circuit, short or open in battery leads to activate common trouble sequence and standby power trouble indicator.

.6 Standby batteries: sealed, maintenance free.

.7 Continuous supervision of wiring for external initiating and alarm circuits to be maintained during power failure.

2.5 Initiating/Input Circuits

.1 Receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, heat detectors and water flow switches, wired in DCLA configuration to central control unit DGP's/transponders.

.2 Alarm receiving circuits (active and spare): compatible with smoke detectors and open contact devices.

.3 Actuation of alarm initiating device: cause system to operate as specified in "System Operation".

.4 Receiving circuits for supervisory, N/O devices. Devices: wired in DCLA configuration to central control unit DGP's/transponders.

.5 Actuation of supervisory initiating device: cause system to operate as specified in "System Operation".

2.6 Alarm Output Circuits

.1 Alarm output circuit: connected to signals, wired in class A configuration to central control unit DGP's/transponders.
  - .1 Signal circuits' operation to follow system programming; capable of sounding horns continuously at 20 spm. Each signal circuit: rated at 2 A, 24 VDC; fuse-protected from overloading/overcurrent.
  - .2 Manual alarm silence, automatic alarm silence and alarm silence inhibit to be provided by system's common control.

2.7 Auxiliary Circuits

.1 Auxiliary contacts for control functions.

.2 Actual status indication (positive feedback) from controlled device.

.3 Alarm and or supervisory trouble on system to cause operation of programmed auxiliary output circuits.

.4 Upon resetting system, auxiliary contacts to return to normal or to operate as pre-programmed.

.5 Fans: stagger-started upon system reset; timing circuit to separate starting of each fan or set of fans connected to auxiliary contact on system.
  - .1 Timing circuit: controlled by CCU.

.6 Auxiliary circuits: rated at 2 A, 24 Vdc or 120 Vac, fuse-protected.

2.8 Wiring

.1 Twisted copper conductors: rated 120 300 600 V.

.2 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.

.3 To signal circuits: 16 AWG minimum, and in accordance with manufacturer's requirements.

.4 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.

2.9 Manual Alarm Stations

.1 Manual alarm stations: pull lever, glass rod, wall mounted semi-flush surface type, non-coded single pole normally open contact for single stage and general alarm key switch for two stage system bilingual English French signage.

.2 Addressable manual pull station.
  - .1 Pull lever, break glass rod, surface semi-flush wall mounted type, single double action, single stage, electronics to communicate station's status to addressable module/transponder over 2 wires and to supply power to station. Station address to be set on station in field.

2.10 Automatic Alarm Initiating Devices

.1 Heat detectors, fixed temperature, non- restorable, rated 57 88 degrees C.

.2 Thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57 88 degrees C, rate of rise 8.3 degrees C per minute.

.3 Addressable thermal fire detectors, combination fixed temperature and rate of rise, non-restorable fixed temperature element, self-restoring rate of rise, fixed temperature 57 88 degrees C, rate of rise 8.3 degrees C per minute.
  .1 Electronics to communicate detector's status to addressable module/transponder.
  .2 Detector address to be set on detector base head in field.

.4 Smoke detector: ionization photo-electric type air duct type with sampling tubes with protective housing.
  .1 Twist-lock Plug-in type with fixed base.
  .2 Wire-in base assembly with integral red alarm LED, and terminals for remote relay alarm LED.

.5 Addressable smoke detector.
  .1 Photo-electric type.
  .2 Electronics to communicate detector's status to addressable module/transponder.
  .3 Detector address to be set on detector base head in field.

.6 Addressable variable-sensitivity smoke detectors.
  .1 Photo-electric type.
  .2 Electronics to communicate detector's status to addressable module/transponder.
  .3 Detector address to be set on detector base head in field.
  .4 Sensitivity settings: 3 7 settings, determined and operated by control panel. No shifting in detector sensitivity due to atmospheric conditions (dust, dirt) within certain parameters.
  .5 Ability to annunciate minimum of 2 levels of detector contamination automatically with trouble condition at control panel.

2.11 Audible Signal Devices

.1 Horns: 98 dB, weatherproof mounting, 24 V dc.

2.12 Visual Alarm Signal Devices

.1 Strobe type: flashing 24 V dc.

.2 Designed for surface mounting on ceiling or walls as indicated.

2.13 End-Of-Line Devices

.1 End-of-line devices to control supervisory current in alarm circuits and signaling circuits, sized to ensure correct supervisory current for each circuit. Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at main control panel and remotely as indicated.

2.14 Remote Annunciators

.1 LED and remote alphanumeric type, with designation cards to indicate zones.

.2 Display:
 .1 Alarms and troubles for alarm initiating circuits.
 .2 Supervisory alarms and troubles common supervisory alarm for supervisory initiating circuits.
 .3 Common system trouble.

.3 Trouble buzzer:
 .1 Acknowledging trouble at main panel to silence trouble buzzers in system.

.4 Supervised, with LED test button and alarm trouble acknowledge button.

.5 Minimum wiring configuration with main panel and other remote annunciators.

2.15 Graphic Display

.1 Provide Passive type display beside remote annunciator.

2.16 As-Built Riser Diagram

.1 Fire alarm system riser diagram: in glazed frame on black lamicoid sheet with beveled edges, white lettering and designations, minimum size 600 x 600 mm.

2.17 Ancillary Devices

.1 Remote relay unit to initiate fan shutdown.

2.18 Smoke Alarms and Carbon Monoxide Detectors

.1 Combination smoke/carbon monoxide alarm are not to be connected to the fire alarm system.

.2 120 Volt hardwired combination smoke/carbon monoxide alarms shall have photoelectric type detection. The unit shall be equipped with a solid state ‘Power On’ indicator, sensory test button, horn with output providing 85 dB at 3 meters. The unit shall have temporal patterns, visual and voice warnings. Complete with 10 year sealed lithium battery backup.

.3 Kidde Model P4010A CLEDSC0-2 or equivalent.

PART 3 - EXECUTION

3.1 Examination

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for fire alarm installation in accordance with manufacturer's written instructions.
 .1 Visually inspect substrate in presence of York Region Representative.
 .2 Inform York Region Representative 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 York Region Representative.

3.2 Installation

.1 Install systems in accordance with CAN/ULC-S524 and TB Fire Protection Standard.

.2 Install central control unit and connect to ac power supply, ac dc standby power.

.3 Install manual alarm stations and connect to alarm circuit wiring.

.4 Locate and install detectors and connect to alarm circuit wiring. Mount detectors more than 1 m from air outlets. Maintain at least 600 mm radius clear space on ceiling, below and around detectors. Locate duct type detectors in straight portions of ducts.

.5 Connect alarm circuits to main control panel.

.6 Install signal bells chimes horns and visual signal devices and connect to signaling circuits.

.7 Connect signaling circuits to main control panel.

.8 Install end-of-line devices at end of alarm and signaling circuits.

.9 Install remote annunciator panels and connect to annunciator circuit wiring.

.10 Install door releasing devices.

.11 Install remote relay units to control fan shut down.

.12 Sprinkler system: wire alarm and supervisory switches and connect to control panel.

.13 Room detection system.
  .1 Install detectors. Make necessary connections between room detection panel and main fire alarm panel.
  .2 Locate and install audible signals visual alarms.
  .3 Locate and install detectors under raised floor. Fasten to steel brackets approximately 300 mm above sub-floor level to clear cables and conduits.

.14 Connect fire suppression systems to control panel.

.15 Splices are not permitted.

.16 Provide necessary raceways, cable and wiring to make interconnections to terminal boxes, annunciator equipment and CCU, as required by equipment manufacturer.

.17 Ensure that wiring is free of opens, shorts or grounds, before system testing and handing over.

.18 Identify circuits and other related wiring at central control unit, annunciators, and terminal boxes.

3.3 Field Quality Control

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical and CAN/ULC-S537.

.2 Fire alarm system:
  .1 Test such device and alarm circuit to ensure manual stations, thermal and smoke detectors sprinkler system transmit alarm to control panel and actuate first stage alarm general alarm ancillary devices.
  .2 Check annunciator panels to ensure zones are shown correctly.
  .3 Simulate grounds and breaks on alarm and signaling circuits to ensure proper operation of systems.
  .4 Addressable circuits system style DCLA:
    .1 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals on each side of single open-circuit fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
    .2 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
  .5 Addressable circuits system style DCLB:
    .1 Test each conductor on all DCLB addressable links for capability of providing 3 or more subsequent alarm signals on line side of single open-circuit fault condition imposed near electrically most remote device on each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
    .2 Test each conductor on all DCLB addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near electrically most remote device on each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.

.3 Provide final PROM program re-burn for system York Region Representative incorporating program changes made during construction.

3.4 Cleaning

.1 Progress Cleaning:
  .1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
  .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
  .2 Place materials defined as hazardous or toxic waste in designated containers.

3.5 Protection

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by fire alarm system installation.

3.6 Closeout Activities

.1 Provide on-site lectures and demonstration by fire alarm equipment manufacturer to train operational personnel in use and maintenance of fire alarm system.

END OF SECTION