1. GENERAL

1.1 Section Includes

1.1.1 Fire extinguishers, supplied loose, or in dedicated cabinets.

1.2 References

1.2.1 CAN/ULC-S508-02 (R2013), Standard for the Rating and Testing of Fire Extinguishers.

1.2.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.2.3 National Fire Code of Canada.

1.2.4 National Fire Protection Association (NFPA)

.1 NFPA 10-2010, Standard for Portable Fire Extinguishers.

1.2.5 Ontario Fire Code.

1.3 Submittals

1.3.1 Provide submittals in accordance with Section 01 33 00.

1.3.2 Product Data:

.1 Submit manufacturer's printed product literature and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies WHMIS MSDS - Material Safety Data Sheets.

1.3.3 Provide shop drawings.

1.3.4 Quality control submittals: submit following in accordance with Division 01.

.1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, and cleaning procedures.

.2 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3, FIELD QUALITY CONTROL.

1.4 Closeout Submittals

1.4.1 Provide operation and maintenance data for incorporation into manual.

1.5 Delivery, Storage, and Handling

.1 Packing, shipping, handling and unloading:

.2 Deliver, store and handle materials in accordance with Division 01.

1.5.2 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Division 01.

2. PRODUCTS

2.1 Multipurpose Dry Chemical Extinguishers – Type FE-1

2.1.1 Stored pressure rechargeable type with hose and shut-off nozzle.

2.1.2 ULC labelled for A, B and C class protection, red enamel finish.

2.1.3 Size 2.25 kg (5 lb)

2.1.4 Acceptable Manufacturers

.1 National Fire Equipment Limited – ABC.

.2 Flag Fire Equipment Limited – ABC.

.3 SAVA AMEREX Multi Purpose Dry Chemical.

.4 Wilson & Cousins.

2.2 Extinguisher Cabinets

2.2.1 Semi-recessed fire extinguisher cabinet constructed of 22 ga. (0.76mm) steel tub and 16 ga. (1.57mm) steel door & trim with 1” (25mm) return frame

2.2.2 A full length semi-concealed piano hinge and flush stainless steel door latch.

2.2.3 Entire cabinet finished in baked enamel paint and glazed with 3/16” (5mm) clear glass.

2.3 **Identification**

2.3.1 Include bilingual tag or label attached to extinguishers in accordance with recommendations of NFPA 10.

2.3.2 Attach tag or label to extinguishers, indicating month and year of installation. Provide space for service dates.

3. EXECUTION

3.1 **Manufacturer's Instructions**

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

3.2 **Manufacturer's Field Services**

3.2.1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.3 **Installation**

3.3.1 Provide in accordance with NFPA 10, CAN/ULC-S508, and authority having jurisdiction.

3.3.2 Confirm locations with local building or fire department prior to installation.

3.3.3 Provide fire extinguisher at each exit door way and as indicated on drawings.

3.3.4 Maximum travel distance to extinguisher shall be 22 metres (75 feet).

3.3.5 Install or mount extinguishers in cabinets or on brackets as indicated.

3.3.6 Provide fire extinguishers in all fire hose cabinets.

3.3.7 Provide fire extinguishers in all electrical, mechanical, communication, pump, boiler, sprinkler, emergency generator, fuel tank and elevator and control equipment rooms.

3.4 **Identification**

3.4.1 Identify extinguishers in accordance with recommendations of NFPA 10 and CAN/ULC-S508.

3.4.2 Attach tag or label to extinguishers, indicating month and year of installation. Provide space for service dates.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Supply all labour, tools, services and equipment, and provide all materials and equipment required to complete work in accordance with this Division of the Specification, and as indicated on the drawings.

1.2 References

1.2.1 ASTM International Inc.

.1 ASTM B32-08, Standard Specification for Solder Metal.

.2 ASTM B306-09, Standard Specification for Copper Drainage Tube (DWV).

.3 ASTM C564-09a, Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

1.2.2 Canadian Standards Association (CSA International).

.1 CAN/CSA-B70-06, Cast Iron Soil Pipe, Fittings and Means of Joining.

.2 CAN/CSA-B125.3-05, Plumbing Fittings.

.3 CAN/CSA-B45 Series-02(R2008), Plumbing Fixtures.

.4 CSA-B125.3-11, Plumbing Fittings.

.5 CAN/CSA-B651-94(R2010), Accessible Design for the Built Environment.

1.3 Quality Assurance

1.3.1 Perform all work in accordance with applicable and listed codes and standards, and authorities having jurisdiction. Comply with the requirements of latest edition of codes and standards available at the time of execution of work, including Ontario Building Code.

1.3.2 Welding Materials and Procedures: Conform to ASME Standards and applicable provincial labour regulations.

1.3.3 Identify pipe with marking including size, ASTM material classification, ASTM specification, and water pressure rating.

1.4 Delivery, Storage, and Handling

1.4.1 Handle and to manufacture's written instructions.

1.4.2 Accept valves on site in shipping containers with labelling in place. Inspect for damage.

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

1.4.4 Protect piping systems from entry of foreign materials by temporary covers.

1.5 Environmental Requirements

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

1.6 Quality Assurance

1.6.1 Perform all work in accordance with applicable and listed Codes and Standards, and Authorities Having Jurisdiction. Comply with the requirements of latest edition of Codes and Standards available at the time of execution of work.

1.6.2 All copper water tubing for use in the plumbing system shall be certified for compliance with the ASTM B88-83 Standard as specified in the Plumbing Code, Ontario Reg. 815/84.

1.7 Codes and Regulations

1.7.1 Conform to Ontario Water Resources Act, Regulation No. 736 respecting Plumbing, as revised to date; Canadian Plumbing Code and regulations of City, Local, Provincial or Territorial Authorities having jurisdiction. The most severe requirements of these authorities shall apply.

1.7.2 All copper water tubing for use in the plumbing system shall be certified for compliance with the ASTM B88-83 Standard as specified in the Plumbing Code, Ontario Reg. 815/84.

1.8 **Quality of Work**

1.8.1 Work shall be executed by plumbers holding certificates of competency. Rough-in, install and connect fixtures and equipment in exact conformity with their respective manufacturer's details and fit with individual shut-offs. Lay or hang lines to approved falls, and arrange so that any or all systems may be completely drained. Conceal roughing-in, except where otherwise specifically allowed, and project supply lines through walls.

1.9 **Submittals for Review**

1.9.1 Section 01 33 00.

1.9.2 Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

1.10 **Submittals**

1.10.1 Submittals: in accordance with Section 01 33 00.

1.10.2 Shop drawings; submit drawings stamped and signed for review by Consultant.

1.10.3 Shop drawings to show:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

1.10.4 Shop drawings and product data accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves.

.4 Manufacturer to certify current model production.

.5 Certification of compliance to applicable codes.

1.10.5 In addition to transmittal letter referred to in Section 01 33 00, use MCAC "Shop Drawing Submittal Title Sheet". Identify section and paragraph number.

1.11 **Closeout Submittals**

1.11.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00.

1.11.2 Operation and maintenance manual approved by, and final copies deposited with, Owner’s Representative before final inspection.

1.11.3 Operation data to include:

.1 Control schematics for systems including environmental controls.

.2 Description of systems and their controls.

.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for systems and component.

.5 Description of actions to be taken in event of equipment failure.

.6 Valves schedule and flow diagram.

.7 Colour coding chart.

1.11.4 Maintenance data to include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

1.11.5 Performance data to include:

.1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified.

.4 Testing, adjusting and balancing reports as specified in Section 23 05 93 - Testing, Adjusting and Balancing for HVAC.

1.11.6 Approvals:

.1 Submit 2 copies of draft Operation and Maintenance Manual to Owner’s Representative for approval. Submission of individual data will not be accepted unless directed by Owner’s Representative.

.2 Make changes as required and re-submit as directed by Owner's Representative.

1.11.7 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

1.11.8 Site records:

.1 Owner's Representative will provide 1 set of reproducible mechanical drawings or AutoCAD files. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.

.3 Use different colour for each service.

.4 Make available for reference purposes and inspection.

1.11.9 As-built drawings:

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.

.2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit to Owner's Representative for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.6 Submit copies of as-built drawings for inclusion in final TAB report.

1.12 **Regulatory Requirements**

1.12.1 Perform Work to local Municipal By-Laws and Regulations.

1.12.2 Provide CSA approved backflow prevention device, reduced pressure assembly type.

1.13 **Quality Assurance**

1.13.1 Quality Assurance: in accordance with Section 01 40 00.

1.13.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 00.

1.14 **Delivery, Storage, and Handling**

1.14.1 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 00.

2. PRODUCTS

2.1 **Materials**

2.1.1 All materials used on this project shall be new and CSA approved unless noted otherwise.

2.2 **Firestopping**

2.2.1 In accordance with Section 07 84 00.

2.2.2 General Purpose Fire Stopping Sealant:

.1 Manufacturers:

.1 Tremco.

.2 Substitutions: Refer to Section 01 25 00.

.2 Water based, nonslumping, premixed sealant with intumescent properties, rated for 3 hours per ASTM E814 and UL 1479.

3. EXECUTION

3.1 Painting, Repairs, and Restoration

3.1.1 Do painting in accordance with Section 09 90 00.

3.1.2 Prime and touch up marred finished paintwork to match original.

3.1.3 Restore to new condition, finishes which have been damaged.

3.2 Cleaning

3.2.1 Clean interior and exterior of all systems including strainers.

3.3 Field Quality Control

3.3.1 Site Tests: conduct following tests in accordance with Section 01 40 00 and submit report as described in PART 1 - SUBMITTALS.

.1 Perform tests as specified in other sections of this specification.

3.3.2 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.

3.4 Demonstration

3.4.1 Owner’s Representative will use equipment and systems for test purposes prior to acceptance. Contractor to supply labour, material, and instruments required for testing.

3.4.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

3.4.3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

3.4.4 Instruction duration time requirements as specified in appropriate sections.

3.4.5 Owner’s Representative may record these demonstrations on video tape for future reference.

3.5 Protection

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

3.6 Examination

3.6.1 Verify existing conditions before starting work.

3.7 Installation

3.7.1 Comply with manufacturer’s requirements.

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

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

3.7.4 Group piping whenever practical at common elevations.

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

3.7.6 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings.

3.7.7 Provide access where valves and fittings are not exposed.

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

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

3.7.10 Sleeve pipes passing through partitions, walls and floors.

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

3.8 **Connections for Owner Supplied Equipment**

3.8.1 Complete connections of mechanical services for all Owner Supplied equipment for water piping, drains, vents, compressed air piping, intake and discharge vents.

3.8.2 Carry out all connections as per manufacturer's installation instructions.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Plumbing demolition.

1.1.2 Cutting and patching.

2. PRODUCTS

2.1 Materials and Equipment

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

3. EXECUTION

3.1 Work in Existing Facilities

3.1.1 Refer to Demolition Notes on Mechanical Drawings and Section 02 41 19.

3.1.2 All work in the existing building, other than minor works required to permit construction of the new Work, is to be performed in such a manner as to not disrupt the building operations.

3.1.3 All systems are to be kept in full operation during normal building hours.

3.1.4 Note that any noise generating works that disrupt the building operation shall be co-ordinated accordingly and carried out after/before normal operating hours.

3.2 Examination

3.2.1 THE DRAWINGS ARE INTENDED TO INDICATE THE GENERAL SCOPE OF WORK AND DO NOT SHOW EVERY PIPE, OR PIECE OF EQUIPMENT THAT MUST BE REMOVED. THE CONTRACTOR SHALL VISIT THE SITE AND VERIFY CONDITIONS PRIOR TO SUBMITTING A BID.

3.2.2 Where walls, ceilings, etc., are shown as being removed on general drawings, the Contractor shall remove all mechanical equipment, devices, piping, fixtures, systems, etc., from the removed area.

3.2.3 Where ceilings, walls, partitions, etc., are temporarily removed and replaced by others, This Contractor shall remove, store, and replace equipment, devices, pipes, systems, etc.

3.2.4 Verify that abandoned utilities serve only abandoned equipment or facilities. Extend services to facilities or equipment that shall remain in operation following demolition.

3.2.5 Coordinate work with all other Contractors and the Owner. Schedule removal of equipment to avoid conflicts.

3.2.6 This Contractor shall verify all existing equipment sizes and capacities where equipment is scheduled to be replaced or modified, prior to ordering new equipment.

3.2.7 Bid submittal shall mean the Contractor has visited the project site and verified existing conditions and scope of work.

3.3 Preparation

3.3.1 Disconnect plumbing systems in walls, floors, and ceilings scheduled for removal.

3.3.2 Provide temporary connections to maintain existing systems in service during construction. When work must be performed on operating equipment, use personnel experienced in such operations.

3.3.3 Existing plumbing system:

.1 Maintain service to all plumbing fixtures until new piping is installed.

.2 Obtain permission from Owner at least 48 hours before shutting down system for any reason. Make changeover to new piping with minimum outage.

3.4 Demolition and Extension of Existing Work

3.4.1 Demolish and extend existing plumbing work under provisions of Division 02, and this section.

3.4.2 Remove, relocate, and extend existing installations to accommodate new construction.

3.4.3 Remove abandoned piping to source of supply and/or main lines.

3.4.4 Remove abandoned pipes, including abandoned pipes above accessible ceilings. Cut pipes above ceilings, below floors and behind walls. Cap remaining lines. Repair building construction to match original. Remove all clamps, hangers, supports, etc. associated with pipe removal.

3.4.5 Disconnect and remove mechanical devices and equipment serving equipment that has been removed.

3.4.6 Repair adjacent construction and finishes damaged during demolition and extension work.

3.4.7 Maintain access to existing mechanical installations which remain. Modify installation or provide access panels as appropriate.

3.4.8 Extend existing installations using materials and methods compatible with existing installations, or as specified.

3.4.9 Remove unused sections of domestic water piping back to mains and cap. Capped pipe shall be less than 600 mm (2 feet) from main to prevent "dead legs".

3.4.10 Temporarily cap all openings to the sanitary and vent system to prevent odour from entering the work area and building.

3.5 **Cutting and Patching**

3.5.1 This Contractor is responsible for all penetrations of existing construction required to complete the work of this project.

3.5.2 Penetrations in existing construction should be reviewed carefully prior to proceeding with any work.

3.5.3 Penetrations shall be neat and clean with smooth and/or finished edges. Core drill where possible for clean opening.

3.5.4 Repair existing construction as required after penetration is complete to restore to original condition. Use similar materials and match adjacent construction unless otherwise noted or agreed to by the Consultant prior to start of work.

3.5.5 This Contractor is responsible for all costs incurred in repair, relocations, or replacement of any cables, conduits, or other services if damaged without proper investigation.

3.6 **Cleaning and Repair**

3.6.1 Clean and repair existing materials and equipment which remain or are to be reused.

3.6.2 Clean all systems adjacent to project which are affected by the dust and debris caused by this construction.

3.6.3 PLUMBING ITEMS REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL DISPOSE OF MATERIAL THE OWNER DOES NOT WANT TO REUSE OR RETAIN FOR MAINTENANCE PURPOSES.

3.7 **Waste Processing**

3.7.1 Turn over designated equipment to the Owner.

3.7.2 Dispose of unwanted materials and equipment.

3.8 **Installation**

3.8.1 Install relocated materials and equipment under the provisions of Division 01.

END OF SECTION

1. GENERAL

1.1 Related Requirements

1.1.1 Section 22 42 00 – Commercial Plumbing Fixtures: mixing valves for plumbing fixtures.

1.2 References

1.2.1 CAN/CSA B 64.

1.3 Closeout Submittals

1.3.1 To Section 01 78 00: Operation and maintenance data.

1.3.2 Project Record Documents: Record actual locations of valves.

1.4 Extra Stock Materials

1.4.1 Provide two repacking kits for each size valve.

1.5 Quality Assurance

1.5.1 Valves: Manufacturer's name and pressure rating marked on valve body.

2. PRODUCTS

2.1 Flow Control Valves

2.1.1 Manufacturer: Armstrong

2.1.2 Other acceptable manufacturers offering equivalent products.

.1 Substitutions: Refer to Section 01 25 00.

2.1.3 Construction: Class 125, Brass or bronze body with union on inlet [and outlet], temperature and pressure test plug on inlet and outlet

2.1.4 Calibration: Control flow within 5 percent of selected rating, over operating pressure range of 10 times minimum pressure required for control, maximum minimum pressure 3.5 psi.

2.2 Ball Valves

2.2.1 Manufacturer: Watts

2.2.2 Other acceptable manufacturers offering equivalent products.

.1 Substitutions: Refer to Section 01 25 00.

2.2.3 Construction, 4 inches and Smaller: MSS SP-110, Class 150, 400 psi CWP, bronze, two piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle.

2.3 Valves

2.3.1 Gate, ball, globe and check valves, except as hereinafter specified, shall be suitable for 1380 kPa water pressure and, up to and including 38 mm size, shall be all brass. Valves of larger sizes shall have iron bodies and bronze trim. Valves shall be of one manufacture and shall open counter clockwise.

2.3.2 Gate and globe valves shall have deep stuffing box with bronze following ring. Globe valves shall have renewable composition disc. Gate valves shall have double wedge disc. Valves shall be rising stem type unless otherwise specified.

2.3.3 Turn over to the Owner on completion of construction 6 handles to fit loose key valves, lock shield valves and plug clocks.

2.3.4 Valves on branch piping supplying plumbing fixtures from mains and risers shall be ball valves set behind access doors. Unless otherwise shown, branch connections to a single and\or groups of fixtures shall be run at ceiling and down fed to said fixtures to enable shut-off valves to be located above ceilings and be accessible (through access door) from room or floor area involved.

2.3.5 Valves on copper pipe, up to and including 50 mm size, shall be brass solder joint ball valves (full size) for 1033 kPa (150 psi) water pressure.

2.3.6 Check valves, up to and including 50 mm size, shall be swing type with brass disc.

2.3.7 Gate, ball and check valves, provided under this Division of Specification, shall be of one manufacture.

2.3.8 Valves, unless otherwise specified, shall be as follows and as manufactured by:
- .1 Jenkins Canada Inc.
- .2 Toyo Valve Co. Ltd.
- .3 Kitz Newman.
- .4 Hattersley.

2.3.9 Ball Valves
- .1 on copper pipe up to 50 mm
  - .1 Jenkins 902 202J
  - .2 Crane 9322 F9222
  - .3 Toyo 5044
  - .4 Kitz 59
  - .5 MAS B-4

2.3.10 Check Valves up to 75 mm
- .1 Jenkins 4092
- .2 Crane 1342
- .3 Toyo 236.
- .4 Kitz 22

3. EXECUTION

3.1 Installation

3.1.1 Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

3.1.2 Locate valves for easy access and provide separate support where necessary.

3.1.3 Install valves in horizontal piping with stem at or above center of pipe.

3.1.4 Install valves in position to allow full stem movement.

3.1.5 Install swing check valves for proper direction of flow and in horizontal position with hinge pin level.

3.1.6 Install grooved end valves in accordance with the manufacturer's guidelines and recommendations. A representative shall provide on-site training for contractor's field personnel in the installation of grooved end valves. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

3.2 Adjusting

3.2.1 Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Tags.

1.1.2 Pipe Markers.

1.2 References

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

1.3 Submittals

1.3.1 Section 01 33 00: Submittals.

1.3.2 Submit list of wording, symbols, letter size, and colour coding for mechanical identification.

1.3.3 Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.

1.3.4 Product Data: Provide manufacturers catalogue literature for each product required.

1.3.5 Samples: Submit two labels, tags samples to Consultant for approval.

1.3.6 Manufacturer's Installation Instructions: Indicate special procedures, and installation.

1.4 Project Documentation

1.4.1 Section 01 77 00: Project Closeout.

1.4.2 Record actual locations of tagged valves.

2. PRODUCTS

2.1 Tags

2.1.1 Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background colour. Tag size minimum 1-1/2 inch diameter.

2.1.2 Chart: Typewritten letter size list in anodized aluminum frame.

2.1.3 Provide tags for all new manual and control valves.

2.2 Pipe Markers

2.2.1 Colour: Conform to ASME A13.1.

2.2.2 Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

2.2.3 Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.

2.2.4 Underground Plastic Pipe Markers: Bright coloured continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.2.5 Provide pipe identifications on all condenser water supply and return lines, domestic cold water lines, drainage/sanitary and waste lines, vent lines etc.

2.3 Ceiling Tacks

2.3.1 Description: Steel with 3/4 inch diameter colour coded head.

2.3.2 Colour code as follows:

.1 Green - Plumbing valves

3. EXECUTION

3.1 Preparation

3.1.1 Degrease and clean surfaces to receive adhesive for identification materials.

3.2 Installation

3.2.1 Install tags with corrosion resistant chain.

3.2.2 Install plastic pipe markers to manufacturer's instructions.

3.2.3 Install plastic tape pipe markers complete around pipe to manufacturer's instructions.

3.2.4 Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Domestic cold water (DCW), domestic hot water (DHW) piping.

1.2 References

1.2.1 ASME B31.9 – Building Services Piping.

1.3 Action Submittals

1.3.1 Section 01 33 00: Procedures for submittals.

1.3.2 Product Data: Provide data on pipe materials, pipe fittings, valves, and accessories. Provide manufacturers catalogue information. Indicate valve data and ratings.

1.4 Closeout Submittals

1.4.1 Section 01 78 00: Procedures for submittals.

1.4.2 Project Record Documents: Record actual locations of valves.

1.4.3 Section 01 78 00: Operation and maintenance data.

1.5 Quality Assurance

1.5.1 Perform Work to Province of Ontario and municipal standards. Maintain one copy on site.

1.5.2 Welding Materials and Procedures: Conform to ASME SEC IX and applicable provincial labour regulations.

1.5.3 Welders Certification: To ASME.

1.5.4 Identify pipe with marking including size, ASTM material classification.

1.6 Regulatory Requirements

1.6.1 Perform Work to Ontario Plumbing Code.

1.7 Delivery, Storage, and Handling

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

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

1.7.3 Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.8 Environmental Requirements

1.8.1 Section 01 61 00: Environmental conditions affecting products on site.

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

1.9 Extra Stock Materials

1.9.1 Provide two repacking kits for each size valve.

2. PRODUCTS

2.1 Water Piping

2.1.1 Copper Tubing: ASTM B88, Type L hard drawn, silver brazing alloy solder for fittings.

2.2 Water Piping, Above Grade

2.2.1 Copper TubingASTM B88, Type K. hard drawn.

.1 Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.

.2 Joints: ASTM B32, solder, Grade 95TA.

2.2.2 Copper Tubing: ASTM B88, Type K, hard drawn.

.1 Fittings: Cast iron, coated.

.2 Joints: Grooved mechanical couplings.

2.2.3 Steel Pipe: ASTM A53 Schedule 40, hot-dipped galvanized.

.1 Fittings: Cast iron.
.2 Joints: Grooved mechanical couplings.
.3 Electrogalvanized is not acceptable.

2.2.4 CPVC Pipe: ASTM D2846, ASTM F441, or ASTM F442.
.1 Fittings: ASTM D2846, ASTM F437, ASTM F438, ASTM F439, or ASTM F441, CPVC.
.2 Joints: ASTM D2846, solvent weld with ASTM F493 solvent cement.

2.2.5 PVC Pipe: ASTM D1785 or ASTM D2241.
.1 Fittings: ASTM D2665, PVC.
.2 Joints: ASTM D2846, solvent weld with ASTM F493 solvent cement.

2.2.6 PB Pipe: ASTM D3309.
.1 Fittings: ASTM F845, or copper.
.2 Joints: Mechanical with copper compression rings.

2.2.7 Polyethylene/Aluminum Composition Tubing: ASTM F1281 or ASTM 1282.
.1 Fittings and Joints: Brass compression type.

2.3 **Flanges, Unions, and Couplings**

2.3.1 Pipe Size 3 inches and under:
.1 Ferrous pipe: Class 150 malleable iron threaded unions.
.2 Copper tube and pipe: Class 150 bronze unions with soldered joints.

2.3.2 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.

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

2.3.4 Unburied domestic cold water piping inside the building up to and including 100 mm size and domestic hot water piping on all sizes shall be Type "L" hard drawn copper tubing with cast bronze or wrought copper solder type fittings. Do not connect copper piping directly to ferrous material including tanks or piping. When making such connections use unions or flange connections, similar to Epco Di-Electric pipe fittings. Extruded brass fittings will not be accepted.

3. EXECUTION

3.1 **Examination**

3.1.1 Verify existing conditions before starting work.

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

3.2 **Preparation**

3.2.1 Ream pipe and tube ends. Remove burrs.

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

3.2.3 Prepare piping connections to equipment with flanges or unions.

3.3 **Cold Water Distribution**

3.3.1 Extend cold water piping as indicated, and connect to fixtures requiring cold water.

3.4 **Hot Water Distribution**

3.4.1 Extend hot water piping as indicated, and connect to fixtures requiring hot water connection throughout the building.

3.5 **Installation**

3.5.1 Install to manufacturer's instructions.

3.5.2 Provide non-conducting dielectric connections wherever jointing dissimilar metals.

3.5.3 Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.
3.5.4 Install piping to maintain headroom, conserve space, and not interfere with use of space.
3.5.5 Group piping whenever practical at common elevations.
3.5.6 Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Refer to Section 22 05 16.
3.5.7 Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 22 07 00.
3.5.8 Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with Section 08 31 00.
3.5.9 Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
3.5.10 Provide support for utility meters to requirements of utility companies.
3.5.11 Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting. Refer to Section 09 91 00.
3.5.12 Install valves with stems upright or horizontal, not inverted.
3.5.13 Pipe vents from gas pressure reducing valves to outdoors and terminate in weather proof hood.
3.5.14 Install water piping to ASME B31.9.

3.6 Application

3.6.1 Install unions downstream of valves and at equipment or apparatus connections.
3.6.2 Install brass male adapters each side of valves in copper piped system. Solder adapters to pipe.
3.6.3 Install ball valves for shut-off and to isolate equipment, part of systems, or vertical risers.

3.7 Service Connections

3.7.1 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.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete Plumbing and Drainage systems as shown, as specified and as otherwise required. Complete systems shall be left ready for continuous and efficient satisfactory operation.

1.2 Reference Standards

1.2.1 Conform to Ontario Water Resources Act, Regulation No. 736 respecting Plumbing, as revised to date; Canadian Plumbing Code and regulations of City, Local, Provincial or Territorial Authorities having jurisdiction. The most severe requirements of these authorities shall apply.

1.2.2 All copper water tubing for use in the plumbing system shall be certified for compliance with the ASTM B88-83 Standard as specified in the Plumbing Code, Ontario Reg. 815/84.

1.3 Quality Assurance

1.3.1 Work shall be executed by plumbers holding certificates of competency. Rough-in, install and connect fixtures and equipment in exact conformity with their respective manufacturer's details and fit with individual shut-offs. Lay or hang lines to approved falls, and arrange so that any or all systems may be completely drained. Conceal roughing-in, except where otherwise specifically allowed, and project supply lines through walls.

2. PRODUCTS

2.1 Sanitary Drain and Vent Piping

2.1.1 Above ground sanitary drainage piping and fittings, including main vent piping, shall be PVC SDR 35 with XFR coating.

2.2 Vent Piping

2.2.1 Vent piping up to and including 50 mm shall be DWV copper. Vent piping 75 mm and over shall be DWV copper, or mechanical joint class 4000 cast iron.

2.3 Pipe and Fittings

2.3.1 Underground drainage pipe and fittings (75 mm and larger) from 1.5 m outside building wall to street sewer unless otherwise noted, shall be as follows:

.1 Sanitary drain (buried) shall be cast iron or PVC (SDR 35).

2.3.2 Buried drainage piping including fittings, inside building and to 1.5 m outside building, shall be Class 4000 cast iron bell and spigot or plain and pattern, factory coated with Anthes asphaltum coating. Cast iron drainage piping shall be in accordance with CSA B70-1974 Standard Specification. Drainage piping may be PVC or ABS for piping 75mm and larger.

2.3.3 Unburied drainage pipe and fittings, inside the building, unless otherwise noted, including main vent piping, shall be Class 4000 cast iron factory coated with Anthes asphaltum coating or type DWV hard drawn copper with drainage cast bronze or wrought solder type fittings. Piping that is less than 75 mm shall be DWV copper.

2.3.4 Do not use hubs, straight crosses, double T's or double TY's in any soil or waste pipe below any fixture. Do not use branch fittings other than a full "Y" or "Y" and an eighth bend, on any soil or waste pipe running in an horizontal direction. Do not use quarter bends placed on their sides. Do not use inverted joints below any fixture. Drainage fittings shall be equal in quality and wall thickness to piping to which they are attached.

2.3.5 Branch vents shall be standard weight hot-dipped galvanized steel pipe with standard weight hot-dipped galvanized malleable iron screwed fittings or type DWV hard drawn copper with cast bronze or wrought copper solder type fittings. Vapour vents shall be type "K" copper with wrought copper fittings.

2.3.6 PVC drainage piping shall not be used in return air plenums.

3. EXECUTION

3.1 Sanitary Drainage Piping Installation

3.1.1 Connect the new storm and sanitary services to the property line as shown. Coordinate location with the local Public Utility. Cost of street service connection is included in the Cash Allowances.

3.1.2 General Arrangement of drain piping is shown. Provide a complete system of underground drainage and site surface drainage as shown.

3.1.3 Connect weeping tile to storm drainage piping to the approval of the local plumbing inspection department.

3.1.4 Check proposed lines of excavation work for underground drains before trenching is commenced.

3.2 Piping System Installation

3.2.1 The general runs of mains, risers, runouts and connection details of piping systems are shown. Mains, risers, and runouts shall be furred in or installed above ceilings except in Mechanical Equipment Room, service corridors, and pipe shafts with no furred down ceilings, where they shall be exposed. Examine the Architectural Drawings and Room Finish Schedules to determine the exact areas with no furred ceilings. In these areas, keep piping as high as possible.

3.2.2 Anchor, guide and laterally support vertical and horizontal runs of piping as required to support its weight and absorb thrust. Provide anchors and pipe supports in an approved manner. Adequately guide domestic hot water and hot water recirculation risers at each floor level to prevent "snaking". Provide expansion compensators on storm pipe where offset from roof drains is less than 1.2 m.

3.2.3 Install approved type vacuum breakers and backflow preventers on equipment, hose bibbs and fixture connections as required by local codes, as shown, or as required for the proper functioning of the equipment.

3.2.4 Where hot and cold water supply pipes connect to a combination supply fitting with a shut-off valve on its discharge, or the combination supply fitting is equipped with manual or thermostatic mixing valve, equip each hot and cold water supply pipe with a composition disc swing check valve ahead of the supply fitting.

END OF SECTION

1. GENERAL

1.1 Section Includes
1.1.1 Sink and faucet

1.2 Related Requirements
1.2.1 Section 06 22 00 – Millwork.
1.2.2 Section 22 10 00 – Plumbing Piping.

1.3 References
1.3.1 ASME A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public Use.
1.3.2 ASME A112.18.1 - Plumbing Fixture Fittings.
1.3.3 CSA-B45 Series, Plumbing fixtures.
1.3.4 CSA-B125 Plumbing fittings.

1.4 Action Submittals
1.4.1 Section 01 33 00: Procedures for submittals.
1.4.2 Product Data: Provide catalogue illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.
1.4.3 Samples: Submit two sink supply fittings.

1.5 Informational Submittals
1.5.1 Section 01 33 00: Procedures for submittals.
1.5.2 Manufacturer's Instructions: Indicate installation methods and procedures.

1.6 Closeout Submittals
1.6.1 Section 01 78 00: Procedures for submittals.
1.6.2 Maintenance Data: Include fixture trim exploded view and replacement parts lists.
1.6.3 Warranty: Submit manufacturer warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.7 Quality Assurance
1.7.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years experience.

1.8 Regulatory Requirements
1.8.1 Products Requiring Electrical Connection: Listed and classified by [Underwriters Laboratories Inc.,] [testing firm acceptable to the authority having jurisdiction] as suitable for the purpose specified and indicated.

1.9 Delivery, Storage, and Handling
1.9.1 Section 01 61 00: Transport, handle, store, and protect products.
1.9.2 Accept fixtures on site in factory packaging. Inspect for damage.
1.9.3 Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

2. PRODUCTS

2.1 Plumbing Fixtures
2.1.1 Completely connect up plumbing fixtures. Protect surface of plumbing fixtures from damage before, during and after their installation and until Work is completed and accepted. Do not use plumbing fixtures for storage of tools or materials nor as a support or platform. Take every precaution during period of construction to avoid damage to fixtures and fittings. Clean fixtures, and trim immediately prior to building being taken over by Owner.
2.1.2 Fixtures and trim shall be CSA approved, in accordance with B-45 1973 Specifications. Finished surfaces shall be clear, smooth and bright, and guaranteed not to graze, discolour or

scale. Completely install fixtures and connect to drain, vent, hot and cold water supply piping, to approval of authorities.

2.1.3 Provide necessary plates, brackets or wall carriers, cleats and supports for rigidly securing fixtures in place. Accurately lay-out roughing-in. Offsets will not be accepted.

2.1.4 Visible parts of trimmings of fixtures including faucets, escutcheons, wastes, strainers, traps, shower heads, supplies and stops, shall be heavily chrome plated.

2.1.5 Provide a wheel handle or screw driver stop valve on hot and cold water supply to every fixture on job, in addition to valves or faucets on fixture itself.

2.1.6 Shop drawing shall show illustrations, dimension drawings, and detail descriptions of fixtures and trim.

2.1.7 Acceptable manufacturers:

.1 Fixtures and trim
- .1 Frank Commercial
- .2 American Standard Products (Canada) Ltd.
- .3 Crane

.2 Stainless Steel Sinks
- .1 Fran Commercial
- .2 American Standard products (Canada) Ltd.
- .3 Kindred.
- .4 Architectural Metals.

.3 Trim
- .1 Zurn
- .2 Moen
- .3 Symmons
- .4 Delta.

2.1.8 Provide fixtures complete with necessary trim, including traps, faucets, supplies, stops, strainers and escutcheons.

2.1.9 Water supply faucets, swing or fixed spouts shall be fitted with aerators unless otherwise specified.

2.2 **Lavatories and Sinks**

2.2.1 Barrier Free Countertop Mount Sink S-1

.1 Basin:
- .1 Franke Commercial #ALBS4606P-1/3 Single Bowl Countertop Mount Sink, 3 holes, 8" (203 mm) center, 460 mm (18-1/8") wide x 478 mm (18-13/16") long x 152 mm (6") high deep, counter mounted, backledge, grade 18-10 18 GA. (1.2 mm) type 304 stainless steel, self-rimming, satin finish rim and bowls, mounting kit provided, fully undercoated to reduce condensation and resonance, factory applied rim seal, 3-1/2" (89 mm) crumb cup waste assembly with 1-1/2" (38 mm) tailpiece.
- .2 Equals: American Standard.

.2 Faucet:
- .1 Chicago Faucets #430-ABCP Single Handle Faucet, chrome plated, center hole only, ECAST construction lead free (equal or less than 0.25%) ECAST brass construction, volume control and Hot Water Limit Stop cartridge, 5.7 LPM (1.5 GPM) pressure compensating Laminar Flow (non-aerating) outlet, 241 mm (9-1/2") projection rigid cast brass spout, single metal lever handle.
- .2 Equals: American Standard.

.3 Lawler #TMM-1070, Below Deck Mechanical Water Mixing Valve, bronze body, temperature adjusting dial, 10 mm (3/8") inlets and outlet compression fittings, high temperature thermostatic limit stop, shut-off with automatic reset when temperature exceeds 120 ºF (48.8 ºC), integral checks, offer temperature range from full cold through 46 °C (114.8 °F). Provide tee, adaptors and flex. Copper tubing to suit installation. Provide tempered water to hot side of faucet.

.4 McGuire #LFH170BV, Faucet Supplies, chrome plated finish polished brass, commercial duty 1/4 turn ball valve angle stops, 13 mm (1/2") I.D. Inlet x 127 mm

(5") horizontal extension tubes, combination V.P. Loose key handles, escutcheon and flexible copper risers.

.5 McGuire #8912CB P-Trap, heavy cast brass adjustable body, with slip nut, 38 mm (1-1/2") size, box flange and seamless tubular wall bend.

3. EXECUTION

3.1 Examination

3.1.1 Section 01 73 00: Verification of existing conditions before starting work.

3.1.2 Verify that walls and floor finishes are prepared and ready for installation of fixtures.

3.1.3 Verify that electric power is available and of the correct characteristics.

3.1.4 Confirm that millwork is constructed with adequate provision for the installation of counter top lavatories and sinks.

3.2 Preparation

3.2.1 Rough-in fixture piping connections to minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.2.2 Plumbing Fixture Installation Heights:

.1 Confirm all mounting heights with the Architect prior to roughing-in. Generally, heights for wall hung components are indicated on the drawings. Refer to Architectural drawings for counter mounted fixture heights.

.2 [Mount Urinals at low level and high (standard) level in Elementary Schools].

3.3 Installation

3.3.1 Install each fixture with trap, easily removable for servicing and cleaning.

3.3.2 Provide chrome plated rigid or flexible supplies to fixtures with [loose key stops, reducers, and escutcheons].

3.3.3 Install components level and plumb.

3.3.4 Install and secure fixtures in place with wall supports

3.3.5 Seal fixtures to wall and floor surfaces with sealant as specified in Section 07 92 00, colour to match fixture.

3.3.6 Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

3.4 Interface With Other Work

3.4.1 Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation.

3.5 Adjusting

3.5.1 Section 01 73 00: Adjusting installed work.

3.5.2 Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 Cleaning

3.6.1 Section 01 74 00: Cleaning installed work.

3.6.2 Clean plumbing fixtures and equipment.

3.7 Protection

3.7.1 Section 01 73 00: Protecting installed work.

3.7.2 Do not permit use of fixtures.

END OF SECTION

1. GENERAL

1.1 Submittals

1.1.1 Submittals: in accordance with Section 01 33 00.

1.1.2 Shop drawings; submit drawings stamped and signed for approval by Owner's Representative.

1.1.3 Shop drawings to show:

.1 Mounting arrangements.

.2 Operating and maintenance clearances.

1.1.4 Shop drawings and product data accompanied by:

.1 Detailed drawings of bases, supports, and anchor bolts.

.2 Acoustical sound power data, where applicable.

.3 Points of operation on performance curves.

.4 Manufacturer to certify current model production.

.5 Certification of compliance to applicable codes.

1.1.5 Closeout Submittals:

.1 Provide operation and maintenance data for incorporation into manual specified in Section 01 78 00.

.2 Operation and maintenance manual approved by, and final copies deposited with, Owner's Representative before final inspection.

.3 Operation data to include:

.1 Control schematics for systems including environmental controls (temperature and humidity).

.2 Description of systems and their controls.

.3 Description of operation of systems at various loads together with reset schedules and seasonal variances.

.4 Operation instruction for systems and component.

.5 Description of actions to be taken in event of equipment failure.

.4 Maintenance data to include:

.1 Servicing, maintenance, operation and trouble-shooting instructions for each item of equipment.

.2 Data to include schedules of tasks, frequency, tools required and task time.

.5 Performance data to include:

.1 Equipment manufacturer's performance datasheets with point of operation as left after commissioning is complete.

.2 Equipment performance verification test results.

.3 Special performance data as specified.

.4 Testing, adjusting and balancing reports as specified in Section 23 05 93.

.6 Approvals:

.1 Submit 2 copies of draft Operation and Maintenance Manual to Owner's Representative for approval. Submission of individual data will not be accepted unless directed by Owner's Representative.

.2 Make changes as required and re-submit as directed by Owner's Representative.

.7 Additional data:

.1 Prepare and insert into operation and maintenance manual additional data when need for it becomes apparent during specified demonstrations and instructions.

.8 Site records:

.1 Owner's Representative will provide 1 set of reproducible mechanical drawings or AutoCAD files. Provide sets of white prints as required for each phase of work. Mark changes as work progresses and as changes occur. Include changes to existing mechanical systems, control systems and low voltage control wiring.

.2 Transfer information weekly to reproducibles, revising reproducibles to show work as actually installed.

.3 Use different colour for each service.

.4 Make available for reference purposes and inspection.

.9 As-built drawings:

.1 Prior to start of Testing, Adjusting and Balancing for HVAC, finalize production of as-built drawings.

.2 Identify each drawing in lower right hand corner in letters at least 12 mm high as follows: - "AS BUILT DRAWINGS: THIS DRAWING HAS BEEN REVISED TO SHOW MECHANICAL SYSTEMS AS INSTALLED" (Signature of Contractor) (Date).

.3 Submit to Owner's Representative for approval and make corrections as directed.

.4 Perform testing, adjusting and balancing for HVAC using as-built drawings.

.5 Submit completed reproducible as-built drawings with Operating and Maintenance Manuals.

.10 Submit copies of as-built drawings for inclusion in final TAB report.

1.2 **Quality Assurance**

1.2.1 Quality Assurance: in accordance with Section 01 40 00.

1.2.2 Health and Safety Requirements: do construction occupational health and safety in accordance with Section 01 35 00.

1.3 **Maintenance**

1.3.1 Furnish spare parts in accordance with Section 01 78 00 as follows:

.1 One filter cartridge or set of filter media for each filter or filter bank in addition to final operating set.

1.3.2 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01 78 00.

1.4 **Delivery, Storage, and Handling**

1.4.1 Waste Management and Disposal:

.1 Construction/Demolition Waste Management and Disposal: separate waste materials for reuse and recycling in accordance with Section 01 74 00.

2. PRODUCTS

2.1 **Materials**

2.1.1 All materials used on this project shall be new and CSA approved unless noted otherwise.

3. EXECUTION

3.1 **Painting, Repairs, and Restoration**

3.1.1 Do painting in accordance with Section 09 90 00.

3.1.2 Prime and touch up marred finished paintwork to match original.

3.1.3 Restore to new condition, finishes which have been damaged.

3.2 **Cleaning**

3.2.1 Clean interior and exterior of all systems. Protect open ends of ducts, diffusers, grilles and registers during construction to prevent ingress of dust and dirt into interior of ducts. If dust or dirt is detected prior to startup, vacuum interior of all ducts and air handling units. Prior to vacuuming use video camera to record condition of ductwork. Also use video camera to record condition of ducts after cleaning.

3.3 **Field Quality Control**

3.3.1 Site Tests: conduct following tests in accordance with Section 01 40 00 and submit report as described in PART 1 - SUBMITTALS.

.1 Submit tests as specified in other sections of this specification.

3.3.2 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.

3.4 **Demonstration**

3.4.1 Owner's Representative will use equipment and systems for test purposes prior to acceptance. Contractor to supply labour, material, and instruments required for testing.

3.4.2 Supply tools, equipment and personnel to demonstrate and instruct operating and maintenance personnel in operating, controlling, adjusting, trouble-shooting and servicing of all systems and equipment during regular work hours, prior to acceptance.

3.4.3 Use operation and maintenance manual, as-built drawings, and audio visual aids as part of instruction materials.

3.4.4 Instruction duration time requirements as specified in appropriate sections.

3.4.5 Owner's Representative may record these demonstrations on video tape for future reference.

3.5 **Protection**

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

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 HVAC demolition.

1.1.2 Cutting and patching.

2. PRODUCTS

2.1 Materials and Equipment

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

3. EXECUTION

3.1 Work in Existing Facilities

3.1.1 Refer to Demolition Notes on Mechanical Drawings.

3.1.2 All work in the existing building, other than minor works required to permit construction of the new Work, is to be performed in such a manner as to not disrupt the building operations.

3.1.3 All systems are to be kept in full operation during normal building hours.

3.1.4 Note that any noise generating works that disrupt the building operation shall be co-ordinated accordingly and carried out after/before normal operating hours.

3.2 Examination

3.2.1 THE DRAWINGS ARE INTENDED TO INDICATE THE GENERAL SCOPE OF WORK AND DO NOT SHOW EVERY PIPE, DUCT, OR PIECE OF EQUIPMENT THAT MUST BE REMOVED. THE CONTRACTOR SHALL VISIT THE SITE AND VERIFY CONDITIONS PRIOR TO SUBMITTING A BID.

3.2.2 Where walls, ceilings, etc., are shown as being removed on general drawings, the Contractor shall remove all mechanical equipment, devices, piping, fixtures, systems, etc., from the removed area.

3.2.3 Where ceilings, walls, partitions, etc., are temporarily removed and replaced by others, This Contractor shall remove, store, and replace equipment, devices, pipes, ducts, systems, etc.

3.2.4 Verify that abandoned utilities serve only abandoned equipment or facilities. Extend services to facilities or equipment that shall remain in operation following demolition.

3.2.5 Coordinate work with all other Contractors and the Owner. Schedule removal of equipment to avoid conflicts.

3.2.6 This Contractor shall verify all existing equipment sizes and capacities where equipment is scheduled to be replaced or modified, prior to ordering new equipment.

3.2.7 Bid submittal shall mean the Contractor has visited the project site and verified existing conditions and scope of work.

3.3 Preparation

3.3.1 Disconnect mechanical systems in walls, floors, and ceilings scheduled for removal.

3.3.2 Provide temporary connections to maintain existing systems in service during construction. When work must be performed on operating equipment, use personnel experienced in such operations.

3.3.3 Existing Heating System: Maintain existing perimeter heating system in service.

3.4 Demolition and Extension of Existing HVAC Work

3.4.1 Demolish and extend existing mechanical work under provisions of Division 02, and this Section.

3.4.2 Remove, relocate, and extend existing installations to accommodate new construction.

3.4.3 Remove abandoned ducts and piping to source of supply and/or main lines.

3.4.4 Remove exposed abandoned pipes and ducts, including abandoned pipes and ducts above accessible ceilings. Cut ducts flush with walls and floors, cap duct that remains, and patch

surfaces. Cut pipes above ceilings, below floors and behind walls. Cap remaining lines. Repair building construction to match original. Remove all clamps, hangers, supports, etc. associated with pipe and duct removal.

3.4.5 Disconnect and remove mechanical devices and equipment serving equipment that has been removed.

3.4.6 Repair adjacent construction and finishes damaged during demolition and extension work.

3.4.7 Maintain access to existing mechanical installations which remain. Modify installation or provide access panels as appropriate.

3.4.8 Remove unused sections of supply and return air ductwork back to mains. Patch opening with sheet metal and seal airtight. Patch existing insulation to match existing. Where existing ductwork is to be capped and reused, locate the end cap within 150 mm (6 inch) of the last branch. End caps shall be 75 mm (3 inch) pressure class and seal class "A".

3.4.9 Extend existing installations using materials and methods compatible with existing installations, or as specified.

3.5 **Cutting and Patching**

3.5.1 This Contractor is responsible for all penetrations of existing construction required to complete the work of this project.

3.5.2 Penetrations in existing construction should be reviewed carefully prior to proceeding with any work.

3.5.3 Penetrations shall be neat and clean with smooth and/or finished edges. Core drill where possible for clean opening.

3.5.4 Repair existing construction as required after penetration is complete to restore to original condition. Use similar materials and match adjacent construction unless otherwise noted or agreed to by the Architect/Engineer prior to start of work.

3.6 **Cleaning and Repair**

3.6.1 Clean and repair existing ductwork materials and equipment which remain or are to be reused.

3.6.2 Clean all systems adjacent to project which are affected by the dust and debris caused by this construction.

3.6.3 MECHANICAL ITEMS REMOVED AND NOT RELOCATED REMAIN THE PROPERTY OF THE OWNER. CONTRACTOR SHALL PLACE ITEMS RETAINED BY THE OWNER IN A LOCATION COORDINATED WITH THE OWNER. THE CONTRACTOR SHALL DISPOSE OF MATERIAL THE OWNER DOES NOT WANT TO REUSE OR RETAIN FOR MAINTENANCE PURPOSES.

1. **Waste Processing**

1.1.1 Turn over designated equipment to the Owner.

1.1.2 Dispose of unwanted materials and equipment.

1.2 **Installation**

1.2.1 Install relocated materials and equipment under the provisions of Division 01.

1.3 **Special Requirements**

1.3.1 Install temporary filter media over outside air intakes which are within 100 feet of the limits of construction or as noted on the drawings. This Contractor shall complete any cleaning required for existing systems which are affected by construction dust and debris.

1.3.2 Review locations of all new penetrations in existing floor slabs or walls. Determine construction type and review for possible interferences. Bring all concerns to the attention of the Consultant before proceeding.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Pipe and equipment hangers and supports.

1.1.2 Sleeves and seals.

1.2 References

1.2.1 ASME B31.5 – Refrigeration Piping and Heat Transfer Components

1.2.2 ASTM F708 – Design and Installation of Rigid Pipe Hangers

1.2.3 MSS SP-58 – Pipe Hangers and Supports – Materials, Design and Manufacture

1.2.4 MSS SP-69 – Pipe Hangers and Supports – Selection and Application

1.2.5 MSS SP-89 – Pipe Hangers and Supports – Fabrication and Installation Practices

1.3 Submittals

1.3.1 Shop Drawings and product data in form of manufacturer's catalogue literature showing:

.1 Upper attachment.

.2 Middle attachment.

.3 Pipe attachment.

.4 Sway braces.

.5 Inserts.

1.3.2 Shop Drawings: Indicate system layout with location and detail of hangers.

1.3.3 Product Data: Provide manufacturers catalogue data including load capacity.

1.3.4 Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers.

1.3.5 Manufacturer's Installation Instructions: Indicate special procedures and assembly of components.

1.4 Regulatory Requirements

1.4.1 Conform to MSS SP58, MSS SP69, MSS SP89 and other applicable codes for support of piping.

2. PRODUCTS

2.1 General

2.1.1 Fabricate hangers, supports and sway braces in accordance with latest edition of ANSI B31.1 and MSS SP-69.

2.2 Pipe Hangers and Supports

2.2.1 Manufacturers:

.1 Anvil International

.2 Other acceptable manufacturers offering equivalent products.

.1 Crane.

.2 Adsco.

2.2.2 Hangers for Pipe Sizes 15 mm to 40 mm diameter, adjustable swivel, split ring.

2.2.3 Hangers for Pipe Sizes 50 mm and Over: Carbon steel, adjustable, clevis.

2.2.4 Wall Support for Pipe Sizes to 75 mm diameter: Cast iron hook.

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

2.3 Accessories

2.3.1 Hanger Rods: Hot-dipped galvanized steel threaded both ends, threaded one end, or continuous threaded.

2.3.2 Electrogalvanized will not be accepted.

2.4 Sleeves

2.4.1 Sleeves for pipes through non-fire rated floors: 18 gauge hot-dipped galvanized steel.

2.4.2 Sleeves for pipes through non-fire rated beams, walls, footings, and potentially wet floors: Steel pipe or 18 gauge hot-dipped galvanized steel.

2.4.3 Sleeves for pipes through fire rated and fire resistive floors and walls, and fire proofing: Prefabricated fire rated sleeves including seals, ULC listed.

2.4.4 Fire-stopping Insulation: Glass fibre type, non-combustible.

2.4.5 Sealant: Acrylic.

2.5 **Upper Attachments**

2.5.1 Concrete - New Construction:

.1 Inserts for cast-in-place concrete:

.1 For single or double pipe runs up to and including 300 mm (12 inch) diameter, use hot-dipped galvanized wedge to MSS SP-69, type 18. ULC listed for pipe NPS 3/4 through NPS 8.

.2 For pipe runs with three or more pipes use multiple inserts, spaced to suit the smallest pipe in group.

.2 Carbon steel plate with clevis for surface mount:

.1 Malleable iron socket and expansion case and bolt.

.2 Minimum two expansion cases and bolts for each hanger.

2.5.2 Existing Concrete:

.1 Provide any additional supports required from existing concrete construction for any piping or equipment by drilling same and installing expansion anchors.

.2 Do not install in uncured concrete.

2.5.3 Existing Concrete - Vibration Applications:

.1 Provide any additional supports required from existing concrete construction for any equipment subject to vibration by drilling same and installing chemical epoxy adhesive threaded rod anchors.

.2 Do not install in uncured concrete.

.3 Do not use explosive drive pins in any Section of Work without obtaining prior approval.

2.5.4 Steel Beam (Bottom Flange):

.1 Cold piping NPS 2 and under:

.1 Malleable iron C clamp to MSS SP-69, type 19 and 23, ULC listed.

.2 Cold piping NPS 2 1/2 to 12, and hot piping to NPS 12:

.1 Carbon or forged steel beam clamp to MSS SP-69, type 28 or 29, with weldless eye nut; ULC listed.

.3 All piping NPS 14 to NPS 24:

.1 Carbon steel welded beam attachment to MSS SP-69, type 22, ULC listed.

2.5.5 Steel Beam (Top):

.1 Cold piping NPS 2 and under:

.1 Malleable iron "top of beam" C clamp to MSS SP-69, Type 19, ULC listed.

.2 Cold piping NPS 2 1/2 to 8, and hot piping to NPS 8:

.1 Steel jaw, hook rod with nut, spring washer and plain washer, ULC listed.

2.5.6 Steel Joist:

.1 Cold and hot piping to NPS 12:

.1 Steel washer plate with double locking nuts.

2.5.7 Steel Channel or Angle (Bottom):

.1 Cold piping NPS 2 and under:

.1 Malleable iron C clamp to MSS SP-69, type 23, ULC listed.

.2 Cold piping NPS 2 1/2 to 8, and hot piping to NPS 8:

.1 Universal channel clamp, ULC listed.

2.5.8 Steel Channel or Angle (Top):

.1 Cold piping NPS 2 and under:

.1 Malleable iron "top of beam" clamp to MSS SP-69, type 19, ULC listed.

.2 Cold piping NPS 2 1/2 to NPS 8, and hot piping to NPS 8:

.1 Steel jaw, hook rod with nut, spring washer and plain washer, ULC listed.

2.6 **Middle Attachment (Rod)**

2.6.1 Carbon steel threaded rod black hot-dipped galvanized for mechanical rooms finish.

2.7 **Pipe Attachment**

2.7.1 Hot or cold suspended piping, including conduits, where horizontal movement is 25 mm (1 in) or less and middle attachment (rod) is longer than 300 mm (12 inches):

.1 For steel or cast iron, use adjustable clevis to MSS SP-69, type 1, ULC listed.

.2 For copper to 6 inch nominal size, use adjustable clevis; carbon steel, copper plated.

2.7.2 Suspended hot piping, steel or copper, with horizontal movement in excess of 25 mm (1 in) hot steel piping with middle attachment (rod) 300 mm (12 in) or less:

.1 Pipe roller to MSS SP-69, type 43.

2.7.3 Bottom supported hot piping, steel and copper:

.1 Pipe roller stand (adjustable) to MSS SP-69, type 46.

3. EXECUTION

3.1 **Installation**

3.1.1 Install to manufacturer's instructions.

3.2 **Hanger Spacing**

3.2.1 Use spacing and middle attachment (rod) diameter as shown in table below:

Pipe Size NPS	Rod Diameter	Maximum Spacing (Steel)	Maximum Spacing (Copper)	Maximum Spacing (PVC and CPVC)
1/2 copper	10 mm (3/8 in)	--	1.5 m (5')	--
1/2	10 mm (3/8 in)	1.8 m (6')	1.5 m (5')	1.0 m (3')
3/4	10 mm (3/8 in)	1.8 m (6')	1.5 m (5')	1.0 m (3')
1	10 mm (3/8 in)	1.8 m (6')	1.8 m (6')	1.0 m (3')
1 1/4	10 mm (3/8")	1.8 m (6')	1.8 m (6')	1.1 m (3.5')
1 1/2	10 mm (3/8 in)	2.7 m (9')	2.4 m (8')	1.1 m (3.5')
2	10 mm (3/8 in)	3.0 m (10')	2.7 m (9')	1.2 m (4')
2 1/2	10 mm (3/8 in)	3.6 m (11')	3.0 m (10')	1.2 m (4')
3	10 mm (3/8 in)	3.8 m (12')	3.0 m (10')	1.5 m (5')
4	16 mm (5/8 in)	4.2 m (14')	3.6 m (12')	1.5 m (5')

3.2.2 Flexible Joint Roll Groove Pipe:

.1 Spacing and middle attachment (rod) diameter as shown in table with not less than one hanger between joints.

.2 Anchors and guides located to maintain piping true to line and grade.

3.2.3 Hanger Installation:

.1 Supply and deliver inserts to site in ample time to be built into work. Set and correctly locate inserts for pipes and equipment hangers.

.2 Support from bottom or top of structural members. Where structural bearing does not exist or inserts are not in suitable locations, provide supplementary steel members.

.3 Offset hanger so that rod is vertical in operating position.

.4 Provide hanger within 300 mm (12 inches) of each horizontal elbow and tee.

.5 Adjust hangers to equalize load.

3.3 **Pipe Hangers and Supports**

3.3.1 Install hangers to provide minimum 15 mm (0.6 inches) space between finished covering and adjacent work.

3.3.2 Place hangers within 300 mm (12 inches) of each horizontal elbow.

3.3.3 Use hangers with 40 mm (1.5 inches) minimum vertical adjustment.

3.3.4 Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

3.3.5 Where several pipes can be installed in parallel and at same elevation, provide multiple or trapeze hangers.
3.3.6 Provide copper plated hangers and supports for copper piping.
3.3.7 Design hangers for pipe movement without disengagement of supported pipe.
3.3.8 Prime coat exposed steel hangers and supports.

3.4 **Equipment Supports**
3.4.1 Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.
3.4.2 Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 **Sleeves**
3.5.1 Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.
3.5.2 Where piping penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing, fire stopping insulation and caulk as required. Provide close fitting metal collar or escutcheon covers at both sides of penetration.
3.5.3 Install chrome plated steel escutcheons at finished surfaces.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Nameplates.
1.1.2 Tags.
1.1.3 Pipe Markers.

1.2 References

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

1.3 Submittals

1.3.1 Section 01 33 00: Submittals.
1.3.2 Submit list of wording, symbols, letter size, and colour coding for mechanical identification.
1.3.3 Submit valve chart and schedule, including valve tag number, location, function, and valve manufacturer's name and model number.
1.3.4 Product Data: Provide manufacturers catalogue literature for each product required.
1.3.5 Samples: Submit two labels, tags samples to Engineer for approval.

1.4 Manufacturer's Installation Instructions: Indicate special procedures, and installation. Record Documentation

1.4.1 Section 01 77 00: Project Closeout.
1.4.2 Record actual locations of tagged valves.

2. PRODUCTS

2.1 Nameplates

2.1.1 Description: Laminated three-layer plastic with engraved black letters on light contrasting background colour. Provide nameplates for Fuel Oil Pump Package, AC units, heat pump, etc.

2.2 Tags

2.2.1 Plastic Tags: Laminated three-layer plastic with engraved black letters on light contrasting background colour. Tag size minimum 1-1/2 inch diameter.
2.2.2 Chart: Typewritten letter size list in anodized aluminum frame.
2.2.3 Provide tags for all new manual and control valves.

2.3 Pipe Markers

2.3.1 Colour: Conform to ASME A13.1.
2.3.2 Plastic Pipe Markers: Factory fabricated, flexible, semi- rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.
2.3.3 Plastic Tape Pipe Markers: Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings.
2.3.4 Underground Plastic Pipe Markers: Bright coloured continuously printed plastic ribbon tape, minimum 6 inches wide by 4 mil thick, manufactured for direct burial service.
2.3.5 Provide pipe identifications on all condenser water supply and return lines, domestic cold water lines, drainage/sanitary and waste lines, vent lines etc.

2.4 Ceiling Tacks

2.4.1 Description: Steel with 3/4 inch diameter colour coded head.
2.4.2 Colour code as follows:
.1 Yellow - HVAC equipment
.2 Red - Fire dampers/smoke dampers
.3 Green - Plumbing valves

.4 Blue - Heating/cooling valves

3. EXECUTION

3.1 Preparation

3.1.1 Degrease and clean surfaces to receive adhesive for identification materials.

3.2 Installation

3.2.1 Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.

3.2.2 Install tags with corrosion resistant chain.

3.2.3 Install plastic pipe markers to manufacturer's instructions.

3.2.4 Install plastic tape pipe markers complete around pipe to manufacturer's instructions.

3.2.5 Install underground plastic pipe markers 6 to 8 inches below finished grade, directly above buried pipe.

3.2.6 Identify air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Small devices, such as in-line pumps, may be identified with tags.

3.2.7 Identify control panels and major control components outside panels with plastic nameplates.

3.2.8 Identify thermostats relating to terminal boxes or valves with nameplates.

3.2.9 Identify valves in main and branch piping with tags.

3.2.10 Identify air terminal units and radiator valves with numbered tags.

3.2.11 Tag automatic controls, instruments, and relays. Key to control schematic.

3.2.12 Identify piping, concealed or exposed, plastic tape pipe markers. Use tags on piping 3/4 inch diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 6 m (20 feet) on straight runs including risers and drops, adjacent to each valve and Tee, at each side of penetration of structure or enclosure, and at each obstruction.

3.2.13 Identify ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

3.2.14 Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Testing, adjustment, and balancing of air systems.
1.1.2 Measurement of final operating condition of HVAC systems.
1.1.3 Sound measurement of equipment operating conditions.

1.2 References

1.2.1 AABC - National Standards for Total System Balance.
1.2.2 ADC - Test Code for Grilles, Registers, and Diffusers.
1.2.3 NEBB - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
1.2.4 SMACNA - HVAC Systems Testing, Adjusting, and Balancing.

1.3 Sequencing

1.3.1 Sequence work to commence after completion of systems and schedule completion of work before Substantial Completion of Project.

1.4 Submittals

1.4.1 Submit to Section 01 33 00.
1.4.2 Submit name of adjusting and balancing to Owner for approval within 30 days after award of Contract.
1.4.3 Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
1.4.4 Prior to commencing work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.
1.4.5 Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Consultant and for inclusion in operating and maintenance manuals.
1.4.6 Provide reports in soft cover, letter size, 3-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
1.4.7 Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.
1.4.8 Test Reports: Indicate data on NEBB forms.

1.5 Quality Assurance

1.5.1 Perform total system balance to ASHRAE 111 and NEBB Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.
1.5.2 Testing Agencies: Company specializing in the testing, adjusting, and balancing of systems specified in this Section with minimum five years' documented experience.

2. PRODUCTS – NOT USED

3. EXECUTION

3.1 Examination

3.1.1 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 Fire and volume dampers are in place and open.
.7 Air coil fins are cleaned and combed.
.8 Access doors are closed and duct end caps are in place.
.9 Air outlets are installed and connected.
.10 Duct system leakage is minimized.

3.1.2 Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.

3.1.3 Beginning of work means acceptance of existing conditions.

3.2 Preparation

3.2.1 Provide instruments required for testing, adjusting, and balancing operations.

3.2.2 Provide additional balancing devices as required.

3.3 Installation Tolerances

3.3.1 Air Handling Systems: Adjust to within plus or minus 5 per cent of design for supply systems and plus or minus 10 per cent of design for return and exhaust systems.

3.3.2 Air Outlets and Inlets: Adjust total to within plus 5 per cent and minus 5 per cent of design to space. Adjust outlets and inlets in space to within plus or minus 10 per cent of design.

3.4 Adjusting

3.4.1 Ensure recorded data represents actual measured or observed conditions.

3.4.2 Permanently mark settings of dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

3.4.3 After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.

3.4.4 Leave systems in proper working order, closing access doors, and restoring thermostats to specified settings.

3.4.5 At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Owner.

3.4.6 Check and adjust systems approximately six months after final acceptance, and submit report.

3.5 Air System Procedure

3.5.1 Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities.

3.5.2 Make air quantity measurements in ducts by pitot tube traverse of entire cross sectional area of duct.

3.5.3 Measure air quantities at air inlets and outlets.

3.5.4 Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.

3.5.5 Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.

3.5.6 Vary branch air quantities by damper regulation.

3.5.7 Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

3.5.8 Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 per cent loading of filters.

3.5.9 Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

3.6 Air Balancing and Testing

3.6.1 Provide the services of an independent firm, acceptable to the Owner to undertake the work as follows:

.1 Submit names of air balancing companies and obtain approval from the Owner prior to commencing of work.

.2 Provide personnel for the purpose of reviewing working drawings, making site visits, preparing reports and taking responsibility for ensuring all air supply, exhaust, return and transfer distribution systems operate in accordance with specified requirements with tolerance of plus or minus 10 per cent.

.3 Review and check working drawings to ensure that modifications, if required, are implemented prior to the execution of the work.

.4 Provide inspections during the course of construction and issue reports making whatever recommendations are necessary in the interest of ensuring good air balance.

.5 When the work is adequately completed, inspect, check and test all air systems. Also co-operate with controls systems.

.6 After inspection and tests, identify all required sheaves, belts, adjustments, and ductwork modifications etc.

.7 After deficient items have been rectified retest and issue a final report and certificate covering the following:

.1 Specified (a total of all outlets) and achieved total air quantities for new packaged rooftop units with supporting schematic diagrams showing test points.

.2 Specified and achieved individual air quantities per outlet, and terminal units, with supporting schematic diagrams showing test points.

.3 Nameplate and actual motor loading in amperes at actual voltage and installed overload heater size and manufacturer for new packaged units and new fan powered terminal units.

.4 Specified and actual fan total static pressures with breakdown showing inlet and discharge pressures for terminal units, and packaged units.

.5 Set minimum primary airflow for terminal units to 20 per cent.

.6 Noise and vibration - ensure that there is no excessive air and equipment noise and vibration transmitted into the occupied spaces. The desired noise level within the occupied space is NC25.

.8 Unless noted otherwise, initially adjust the fresh air dampers for AC units to 20 per cent open.

.9 Review the operation of complete air handling systems after a month and after 12 months in operation, and make necessary adjustment to the air supply systems, including through the ducts, diffusers, and grilles, and ensure that systems are properly balanced to provide optimum operating efficiency and comfort level.

3.7 **Schedules**

3.7.1 Equipment requiring testing, adjusting and balancing:

.1 Existing VAV boxes.

.2 New By-pass boxes.

.3 Air Inlets and Outlets.

3.7.2 Report Forms:

.1 Title Page:

.1 Name of Testing, Adjusting, and Balancing Owner.

.2 Address of Testing, Adjusting, and Balancing Owner.

.3 Telephone number of Testing, Adjusting, and Balancing Owner.

.4 Project Name.

.5 Project Location.

.6 Project Engineer.

.7 Project Contractor.

.8 Report Date.

.2 Summary Comments:

.1 Design Versus Final Performance.

.2 Notable Characteristics of System.

.3 Description of Systems Operation Sequence.
.4 Nomenclature Used Throughout Report.
.5 Test Conditions.

.3 Instrument List:
.1 Instrument.
.2 Manufacturer.
.3 Model Number.
.4 Serial Number.
.5 Range.
.6 Calibration Date.

.4 Electric Motors:
.1 Manufacturer.
.2 Model/Frame.
.3 HP/BHP.
.4 Phase, Voltage, Amperage; Nameplate, Actual, No Load.
.5 RPM.
.6 Service Factor.
.7 Starter Size, Rating, Heater Elements.
.8 Sheave Make/Size/Bore.

.5 Air Distribution Test Sheet:
.1 Air Terminal Number.
.2 Room Number/Location.
.3 Terminal Type.
.4 Terminal Size.
.5 Area Factor.
.6 Design Velocity.
.7 Design Air Flow.
.8 Test (Final) Velocity.
.9 Test (Final) Air Flow.
.10 Per cent of Design Air Flow.

.6 Sound Level Report:
.1 Location.
.2 Octave Bands – Equipment Off.
.3 Octave Bands - Equipment On.

3.8 Mechanical System Performance and Acceptance Tests

3.8.1 Prior to the operating tests specified hereinafter, forward to the Consultant a letter stating that the mechanical systems are complete in all respects, have been checked and tested, and are ready for start-up. When the letter has been received, the Consultant will visit the site for the purpose of witnessing a performance test of the heating, ventilation and air conditioning systems.

3.8.2 Include for all required labour for the performance tests and any adjustments required due to the results of the tests, and ensure that competent and qualified equipment manufacturer's representatives are present during such tests.

3.8.3 When the heating, ventilation and air conditioning systems are ready for acceptance, but before acceptance of same, subject the entire system to a continuous run for the length of time required for the purpose of demonstrating that all apparatus, materials, and systems are in perfect working order, that all controls and operating services are properly adjusted, that all units are heating and/or cooling properly, and that the systems provide uniform temperatures inside the building regardless of the outside temperatures or conditions. Make the tests under the direction of the Consultant, and if the system is not in proper operating condition, the Owner reserves the right, if all defects are not properly rectified, to employ other parties to make the necessary alterations and put the systems in proper working order, at this Contractor's expense.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Duct work insulation.
1.1.2 Duct Liner.
1.1.3 Insulation jackets.

1.2 Related Requirements

1.2.1 Section 09 91 00 – Painting.
1.2.2 Section 23 31 00 – HVAC Ducts and Casings.
1.2.3 Section 23 33 00 – Air Duct Accessories.

1.3 References

1.3.1 ASTM B209 – Aluminum and Aluminum-Alloy Sheet and Plate.
1.3.2 ASTM C518 – Steady-State Thermal Transmission Properties by Means of the Heat Flow Metre Apparatus.
1.3.3 ASTM C553 – Standard Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
1.3.4 ASTM C612 – Standard Specification for Mineral Fibre Block and Board Thermal Insulation.
1.3.5 ASTM C921 – Properties of Jacketing Materials for Thermal Insulation.
1.3.6 ASTM C1071 – Fibrous Glass Duct Lining Insulation(Thermal Sound Absorbing Material).
1.3.7 ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
1.3.8 ASTM E96 – Water Vapour Transmission of Materials.
1.3.9 ASTM E162 – Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.
1.3.10 ASTM G21 – Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
1.3.11 NAIMA National Insulation Standards.
1.3.12 NFPA 255 – Standard Method of Test of Surface Burning Characteristics of Building Materials.
1.3.13 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
1.3.14 UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.

1.4 Scope

1.4.1 The work covered by this specification consists of furnishing all labor, equipment, materials and accessories, and performing all operations required, for correct fabrication and installation of commercial air duct systems of sheet metal lined with fibrous glass duct liner, in accordance with applicable project drawings and specifications, subject to terms and conditions of the contract:

.1 All air duct systems operating at internal air velocities not exceeding rated duct liner limitations and internal air temperature not exceeding 250 F (121 C) nor below 40 F (4 C).
.2 Duct liner products shall conform to the requirements of ASTM C1071.
.3 The manufacturer's product identification shall appear on the air stream surface.
.4 Duct liner adhesive shall conform to the requirements of ASTM C916.
.5 The finished duct system shall meet the requirements of NFPA 90A and 90B including:
    .1 It shall be rated for maximum operating temperature of 250 F (121 C) per ASTM C411.
    .2 It shall have a flame spread index not greater than 25 and a smoke developed index not greater than 50 per NFPA 255 (ASTM E84).
    .3 It shall have a potential heat value not greater than 3500 Btu/lb (8141 kJ/kg) per NFPA 259.

.4 It shall have no microbial growth when tested per ASTM C 1338, ASTM G 21-96 (fungus test) and ASTM G 22-96 (bacteria test).

.5 Marking on the airstream surface of the duct liner shall provide evidence of compliance.

1.4.2 Dimensions shown on the plans are finished inside dimensions.

1.4.3 Fabrication and installation shall conform to manufacturer's recommendations and to the requirements of the latest edition of North American Insulation Manufacturers Association Fibrous Glass Duct Liner Standard (hereinafter referred to as NAIMA FGDLS) or of Sheet Metal and Air Conditioning Contractors National Association HVAC Duct Construction Standards - Metal and Flexible (hereinafter referred to as SMACNA HVAC DCS).

1.4.4 Furnish all labor, materials, tools, and equipment for the installation of sound control lagging material where shown on the contract drawings or as required.

1.5 **Action Submittals**

1.5.1 Product Data: Provide product description, thermal characteristics, sound control characteristics list of materials and thickness for each service, and locations.

1.6 **Informational Submittals**

1.6.1 Manufacturer's Instructions: Indicate installation procedures which ensure acceptable workmanship and installation standards will be achieved.

1.7 **Quality Assurance**

1.7.1 Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years' experience.

1.7.2 Applicator Qualifications: Company specializing in performing the work of this section with minimum three years' experience.

1.7.3 The sound control lagging material shall be produced by a manufacturer having a minimum of five years' experience in furnishing similar noise control lagging material for pipe and duct.

1.7.4 Submittals shall include test reports from independent laboratories meeting the following minimum criteria. Products not meeting these minimum test standards will not be accepted.

.1 Insertion Loss when tested as a duct wrap over 51mm (2") fiber glass board (per ASTM E1222-90):

Frequency, Hz	125	250	500	1000	2000	4000	STC
KNM-100ALQ	2	10	16	27	35	34	33

.2 Insertion Loss when tested as a duct wrap directly over duct (ASTM E1222-90):

Frequency, Hz	125	250	500	1000	2000	4000	STC
KNM-100ALQ	3	6	7	18	24	27	28

.3

.4 Sound Transmission Loss when tested as a free-hanging barrier (ASTM E90-90):

Frequency, Hz	125	250	500	1000	2000	4000	STC
KNM-100ALQ	13	16	24	33	43	49	28

1.8 **Regulatory Requirements**

1.8.1 Materials: Flame spread/smoke developed rating of 25/50 to NFPA 255.

1.9 **Delivery, Storage, and Handling**

1.9.1 Accept materials on site in original factory packaging, labelled with manufacturer's identification, including product density and thickness.

1.9.2 Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping before and during installation. Replace wet, contaminated material.

1.9.3 Deliver all materials and/or fabricated, insulated duct sections and fittings to the job site and store in a safe, dry place.

1.10 **Environmental Requirements**

1.10.1 Maintain ambient temperatures and conditions required by manufacturers of adhesives, mastics, and insulation cements.

1.10.2 Maintain temperature during and after installation for minimum period of 24 hours.

2. PRODUCTS

2.1 Glass Fibre, Flexible

2.1.1 Manufacturer: Roxul

2.1.2 Other manufacturers offering equivalent products will be acceptable.

2.1.3 Insulation: ASTM C553; flexible, noncombustible blanket, 1" thick.

.1 Value : ASTM C518, 0.3 at 75 degrees F.

.2 Maximum service temperature: 250 degrees F.

2.1.4 Vapour Barrier Jacket:

.1 Kraft paper with glass fibre yarn and bonded to aluminized film 0.0032 inch vinyl.

.2 Secure with pressure sensitive tape.

2.2 Glass Fibre, Rigid

2.2.1 Manufacturer: Johns Manville

2.2.2 Other manufacturers offering equivalent products will be acceptable.

2.2.3 Insulation: ASTM C612; rigid, noncombustible blanket.

.1 'K' value: ASTM C518, 0.24 at 75 degrees F.

.2 Maximum service temperature: 250 degrees F.

.3 Density: 3.0 lb/cu ft.

2.2.4 Vapour Barrier Jacket:

.1 Kraft paper with glass fibre yarn and bonded to aluminized film 0.0032 inch vinyl.

2.3 Duct liner insulation

2.3.1 Insulate all supply ducts, return ducts, and related fittings with duct liner meeting the requirements of ASTM C1071 as follows:

.1 Type I - Flat, in roll form, in thicknesses of 1/2" to 2" (13mm to 51mm) in 1/2"(13mm) increments. R-value at 1/2" = 2.2, R-value at 1" = 4.2, R-value at 1.5" = 6.3, and Rvalue at 2" = 8.0. The duct liner shall have an airstream surface treatment.

.2 Type II - Flat, in sheet form, in thicknesses of 1", 1-1/2", and 2" (25mm, 38mm, and 51mm). R-value at 1" = 4.3, R-value at 1.5" = 6.3, and R-value at 2" = 8.7 The duct liner shall have an airstream surface treatment.

2.3.2 Acoustical Performance At 1/2" NRC = 0.55, at 1" NRC = 0.70, at 1.5" NRC = 0.85, at 2.0" NRC = 0.95

2.3.3 Air stream surface of duct liners should have a protective coating applied to a flexible glass mat that includes an FDA-registered anti-microbial agent.

2.4 Acoustic Duct Wrap/Lagging Material

2.4.1 The barrier shall be constructed of a 3-mm (0.12") thick mass loaded, limp vinyl sheet bonded to a thin layer of reinforced aluminum foil on one side. The barrier shall have a nominal density of 4.9-kg/m2 (1.0-psf) and shall have a minimum STC rating of 28. The barrier shall exhibit minimum flammability ratings of 0.0-seconds for flame-out and after-glow, and 5-mm (0.2") for char length when tested in accordance with Federal Test Std. No. 191-5903. The barrier shall have a minimum thermal conductivity (K) value of 0.29 and a rated service temperature range of -40°C (-40°F) to 105°C (220°F). When tested for Surface Burning Characteristics per ASTM E84, the barrier will have a Flame Spread Index of no more than 10 and a Smoke Development Index of no more than 40.

2.4.2 The decoupling layer shall be a combination of 25-mm (1.0") fiber glass batting, non-woven porous scrim-coated glass cloth, quilted together in a matrix of 100-mm (4.0") diamond stitch pattern which encapsulates the glass fibers.

2.4.3 The composite material shall be fabricated to include a nominal 152-mm (6") wide barrier overlap tab extending beyond the quilted fiber glass to facilitate a leak-tight seal around field joints. Nominal barrier width 1372-mm (54"), nominal fiber glass batt decoupler width 1219-mm (48").

2.4.4 Sound control lagging material shall be Kinetics Noise Control, Inc. Model KNM-100ALQ.

2.5 **Jackets**

2.5.1 Canvas Jacket: ULC listed, or to match base building.

3. EXECUTION

3.1 **Examination**

3.1.1 Verify existing conditions before starting work.

3.1.2 Verify that duct work has been tested before applying insulation materials.

3.1.3 Verify that surfaces are clean, foreign material removed, and dry.

3.1.4 Verify that the duct liner product may be installed in accordance with project drawings, operating performance parameters and limitations, and provisions of NAIMA FGDLS or SMACNA HVAC DCS.

3.1.5 Upon completion of installation of lined duct and before HVAC system start-up, visually inspect the ductwork and verify that duct liner has been correctly installed. Confirm that the duct system is free from construction debris.

3.2 **Installation**

3.2.1 Install to NAIMA National Insulation Standards.

3.2.2 Insulation of Straight Ducts and Fittings

.1 Cover completely with duct liner all portions of duct designated to receive duct liner. Neatly butt all joints. Install duct liner with the labeled or printed surface exposed to the air stream.

.2 Adhere duct liner to sheet metal with 90% (min.) coverage of adhesive complying with requirements of ASTM C916.

.3 Coat all transverse edges not receiving sheet metal nosing. Longitudinal joints in duct liner should occur at the corners of ducts. However, duct size and standard duct liner product dimensions may make exposed longitudinal joints necessary. In such cases, coat exposed joints with adhesive designed for duct liner application. Adhesive should meet the requirements of ASTM C916. Additionally secure such joints with mechanical fasteners in accordance with NAIMA FGDLS as if they were transverse joints.

.4 Additionally secure duct liner with mechanical fasteners, either weld secured or impact-driven. Mechanical fasteners shall not compress the insulation more than 1/8" (3 mm) based on nominal insulation thickness, and shall be installed perpendicular to the duct surface. Spacing of mechanical fasteners with respect to interior duct dimensions shall be in accordance with NAIMA FGDLS or SMACNA HVAC DCS. Fastener heads or washers shall have a minimum area of 0.75 in^2 ($480mm^2$) with beveled or cupped edges.

.5 Securely install metal nosings (either channel or zee profile) over transverse liner edges facing the airstream at fan discharge and at any point where lined duct is preceded by unlined duct. In addition, where air velocities exceed 4,000 FPM (20.3 m/sec), install metal nosing on upstream edges of lined duct sections.

.6 Fold duct liner in roll form and compress in the corners of rectangular duct sections, or cut and fit to assure a lapped, compressed corner joint.

.7 Cut and fit duct liner in sheet form to assure tight, overlapped corner joints. Install so top pieces of rigid duct liner are supported at the edges by the side pieces.

3.2.3 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.

3.2.4 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.

3.2.5 The correct installation of the sound control lagging material is critical in order to achieve the desired noise reduction. Sound control lagging material shall be cut to length, wrapped around the outside of the pipe or duct, and fastened with mechanical fasteners or bands. Tape and adhesive can be used in conjunction with mechanical fasteners or bands. All sound control lagging materials must be installed per the manufacturer's installation guidelines.

3.3 Commissioning

3.3.1 After the lined duct system is completely installed and ready for service, conduct a final inspection of the entire system. This inspection should include, at minimum, the following steps:

.1 Check all registers, grilles, and diffusers to ensure that they are clean and free from construction debris.

.2 Check all filters in accordance with their manufacturers' instructions. Use specified grade of filters at all times system is operating.

.3 Cover supply openings with filter media prior to system start-up to catch any loose material that may remain inside the ductwork.

.4 Turn the HVAC system on and allow it to run until steady state operation is reached.

.5 Remove the temporary filter media from supply openings and, along with it, any loose material blown downstream and caught by the filter media.

.6 Check to ensure that air delivery performance meets all requirements and complies with SMACNA leakage specifications.

3.4 Safety Precautions

3.4.1 Conduct all job site operations in compliance with applicable provisions of the Occupational Safety and Health Act, NAIMA's Health and Safety Partnership Program (HSPP) and all local safety and health codes and regulations that may apply to the work. Consult manufacturer's Material Safety Data Sheet (MSDS) when appropriate.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Commissioning of all building HVAC systems and component including:

- .1 Testing and adjustment.
- .2 Demonstration and training.
- .3 Instructions of all procedures for Owner's personnel.
- .4 Updating as-built data.
- .5 Co-ordination of Operation and Maintenance material.

1.1.2 Provide labour and material to conduct the commissioning process as outlined in this specification section, including the hiring of an Independent Testing Contractor (ITC) as detailed below.

- .1 The Independent Testing Contractor (ITC) shall provide the scope described in the CxA's Cx Plan for the MCA. Retain services of an independent Mechanical Commissioning Agent (MCA) with demonstrated minimum 10 years of experience in commissioning of mechanical systems and equipment such as those required on this project. MCA shall prepare final Installation/Start Up or Pre-functional Checklists, Performance Verification or Functional/Dynamic Forms and Performance Verification or Functional Test Procedures; execute the Cx; document the Cx; plan and deliver portions of training and execute the seasonal/deferred testing.

1.1.3 Provisions of this section shall apply to all sections of Division 23.

1.2 Related Requirements

1.2.1 Testing and commissioning are called for throughout the individual specifications. This does not relieve this trade from providing all testing and commissioning necessary to ensure that systems and equipment operate as required and that they interface with other systems and equipment as required.

1.3 Commissioning Process Allocation (For Progress Draw Purposes Only)

1.3.1 The commissioning process shall be allocated a value equal to 5 per cent of the contract. The HVAC Contractor may draw from this allocation as the commissioning process is completed.

1.3.2 The HVAC Contractor shall submit all test and verification forms. The Consultant will use these forms to calculate percentage complete.

1.3.3 The HVAC Contractor may claim up to 3 per cent of the contract from this allocation leading up to performance testing. The remaining 2 per cent shall not be paid out until the performance testing, O&M manuals, and training have been completed satisfactorily.

1.4 Definitions

1.4.1 Cx – Commissioning.

1.4.2 Commissioning Authority

- .1 The Commissioning Authority (CxA), also referred to as the Commissioning Consultant, shall be hired by The Owner.
- .2 The CxA responsibilities shall include:
  - .1 Preparing the commissioning plan
  - .2 Co-ordinating with the contractor to schedule tests
  - .3 Preparing a test form manual
  - .4 Witnessing selected tests
  - .5 Receiving all test forms
  - .6 Co-ordinating the contractors training
  - .7 Chair the commissioning meetings
- .3 The HVAC Contractor shall co-operate with the CxA and prepare a preliminary test form manual to be used by the ITC in preparation of their Cx plan and reports.

.4 The HVAC Contractor shall provide assistance to the CxA and have personnel available during the performance testing procedure. Each electrical system shall be tested in the operational mode.

1.5 **Submittals**

1.5.1 Conform to Section 01 33 00 for requirements for shop drawings and record drawings.

1.5.2 The HVAC contractor shall be responsible for ensuring all activities are properly documented in this manual and co-ordinated through the General Contractor.

1.5.3 As-built drawings and data books must be available two weeks prior to commissioning for review and use by the consultant and Commissioning Team prior to the start of the commissioning activities.

1.6 **Quality Assurance**

1.6.1 Provide qualified trades persons, certified testing agencies, factory trained and approved by the Commissioning Team Leader.

1.6.2 Submit the names of all personnel to be used during the Commissioning activities.

1.7 **Warranty**

1.7.1 Equipment and system warranties shall not begin until the system demonstration and turnover has been conducted successfully and accepted by the Owner.

1.7.2 The HVAC Contractor shall fill out the warranty form listing the equipment and systems and the start and finishing dates for warranty.

1.7.3 Refer to Division 01 and Section 23 05 00 for the requirements during the warranty period.

2. PRODUCTS

2.1 **Equipment**

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

3. EXECUTION

3.1 **The Commissioning Process**

3.1.1 The purpose of the commissioning process is to fully test all building systems including architectural, mechanical and electrical components and operating procedures by challenging these systems to realistic operation conditions.

3.1.2 The commissioning process consists of:

.1 Shop Drawings and Record Drawings
.2 Installation inspection and equipment verification
.3 Independent testing contractor
.4 Testing of equipment and systems
.5 Commissioning meetings
.6 Operating and maintenance manuals
.7 Operating training
.8 Commissioning Agent testing
.9 Systems Demonstration and turnover
.10 Testing forms
.11 Warranties
.12 Tasks and processes as described in the CxA's Cx Plan

3.2 **Preparation**

3.2.1 Provide test instruments required for all activities as defined in the commissioning documents.

3.2.2 Verify all systems are in compliance with the requirements of the commissioning documents prior to the pre-commissioning check out operation.

3.2.3 Confirm all scheduled activities have identified personnel available.

3.2.4 Where systems or equipment do not operate as required, make the necessary corrections or modifications, re-test and re-commission.

3.3 **System Description**

3.3.1 Perform all start-up operations, control adjustment, trouble shooting, servicing and maintenance of each item of equipment as defined in the commissioning documentation.

3.3.2 Owner will provide list of personnel to receive instructions and will co-ordinate their attendance at agreed upon times.

3.3.3 Prepare and insert additional data in the operations and maintenance manuals and update as-built drawings when need for additional data becomes apparent during the commissioning exercise.

3.3.4 Where instruction is specified in the commissioning manual, instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.

3.3.5 Conduct presentation on Owner's premises. Owner will provide space.

3.4 **Commissioning**

3.4.1 Commission the components of the HVAC system using the ASHRAE Guideline 1.1 - HVAC & R Technical Requirements for the Commissioning Process.

3.4.2 Refer to the project commissioning plan prepared by the CxA. The contractor shall comply with the requirements of the specifications and the CxA's Commissioning Plan.

3.4.3 Commissioning activities for the HVAC systems must have available up to date as-built drawing information and accurate Operations and Maintenance Manuals. These documents shall be a major part of this activity.

3.4.4 Contractor shall be responsible to update all documentation with information and any changes duly noted during the Commissioning exercise.

3.4.5 Contractor shall arrange for all outside suppliers, equipment manufacturers, test agencies and others as identified in the commissioning sections of this specification. The cost associated with this requirement shall be included as part of the tender price.

3.5 **Final Report**

3.5.1 This trade shall assemble all testing data and commissioning reports and submit them to the General Contractor for submission for review by the CxA with accepted version to the Owner.

3.5.2 Each form shall bear signature of recorder, and that of supervisor of reporting organizer.

3.6 **Schedule of Activities**

3.6.1 Commissioning activities shall be conducted based on pre-established schedule with all members of the commissioning team.

3.6.2 Refer to Cx Plan for the required meetings held through the contract duration to introduce the parties of the commissioning team, establish the schedules and deadlines for the various activities and review the Commissioning Manual.

3.6.3 Adhering to the established schedule is very important as the co-ordination and scheduling of the participants will be difficult to alter once this is established. Close co-ordination of this schedule is important.

3.6.4 In the event project cannot be commissioned in the allotted time slot, the contractor shall pay for all costs associated with assembling the Commissioning Team at a later date. If the contractor has not performed his duties to reach commissioning stage as outlined earlier, he will incur all expenses of other trades and the Commissioning Team due to his non-compliance.

3.7 **Installation Inspection and Equipment Verification**

3.7.1 The HVAC Contractor shall co-ordinate with the Mechanical Consultant who will inspect the HVAC installation.

3.7.2 The HVAC Contractor shall complete the equipment verification forms for each piece of equipment. The forms shall be included in the operating and maintenance manual. The equipment data shall include:
- .1 Manufacturers name, address and telephone number,
- .2 Distributors name, address and telephone number,
- .3 Make, model number and serial number,
- .4 Set points,

3.8 Independent Testing Contractor

3.8.1 The Independent Testing Contractor (ITC) shall be hired by the contractor and shall issue reports to the Mechanical Consultant.

3.9 Testing of Equipment and Systems

3.9.1 The HVAC Contractor shall be responsible for all tests detailed in this Section, and those tests required by a manufacturer as part of their installation requirements.

3.9.2 The HVAC Contractor shall schedule all tests which shall be witnessed by the Mechanical Consultant or the Commissioning Consultant. The contractor shall complete and sign the testing forms.

3.9.3 The HVAC Contractor shall conduct tests on the following equipment as a minimum. Refer to the individual specification sections for test procedures.
- .1 Section 23 09 00 – Instrumentation and Control for HVAC.

3.10 Commissioning Meetings and Reporting

3.10.1 The HVAC Contractor shall include the schedule for all tests in the construction schedule.

3.10.2 The Commissioning meetings shall occur during the regular construction meetings. The testing schedules and the results of all tests shall be reviewed.

3.10.3 All testing forms and reports associated with the HVAC systems shall be directed to the Mechanical Consultant, with copies to the Architect, Commissioning Consultant, and the Owner.

3.10.4 The forms and reports to be issued shall include:
- .1 Shop drawings, issued and accepted
- .2 Equipment verification forms
- .3 Testing forms
- .4 Reports resulting from tests
- .5 Testing schedule
- .6 Minutes of commissioning meetings
- .7 Manufacturers' Certificates
- .8 The Contractor shall provide the submittals called for by the CxA's Commissioning Plan.

3.11 Operating and Maintenance Manual

3.11.1 Conform to the specification section for the requirements of the O&M manuals.

3.12 Demonstration and Training

3.12.1 Conform to section for requirements for instructions to the Building Owner for each system and equipment.

3.12.2 The training shall be provided by qualified technicians or electricians and shall be conducted in a classroom and at the equipment or system.

3.12.3 The training sessions shall be scheduled and co-ordinated by the Commissioning Consultant.

3.12.4 The Contractor shall provide professional audio/visual services and shall video tape Cx training sessions.
- .1 Training videos shall be provided in digital media format determined by Owner.

3.12.5 Each training session shall be structured to cover:
- .1 The operating and maintenance manual.
- .2 Operating procedures.

.3 Maintenance procedures.
.4 Troubleshooting procedures.
.5 Spare parts.

3.12.6 Submit a course outline to the Mechanical Consultant before training commences. Provide course documentation for up to eight people.

3.12.7 Training shall be provided for systems listed in the CxA's Cx Plan.

3.12.8 The HVAC Contractor shall conduct a walkthrough of the installation. During the walkthrough the HVAC Contractor shall:
.1 Identify equipment
.2 Identify control panels
.3 Identify starters and disconnects
.4 Review the HVAC controls

3.13 HVAC System Demonstration and Turnover

3.13.1 The system demonstration and turnover to The Owner shall occur when:
.1 The installation is complete.
.2 The acceptance test conducted by the Mechanical Consultant has been completed successfully.
.3 Training has been completed.
.4 Equipment Operating and Maintenance Manuals have been accepted.
.5 System operating manuals have been accepted.
.6 Shop-drawings have been updated.
.7 As-built drawings have been completed.
.8 The commissioning process has been completed successfully and system operation accepted by the Mechanical Consultant and Commissioning Consultant.

3.13.2 The systems demonstration shall be conducted by the HVAC Contractor and manufacturers. The demonstration shall cover a physical demonstration of equipment installation and operation.

3.14 Testing Forms

3.14.1 The HVAC Contractor and manufacturers shall fill out the forms listed in this section or provide other forms. The forms must be approved by the Mechanical Consultant and the Owner before they are used.

END OF SECTION

1. GENERAL

1.1 Products Furnished but Not Installed under This Section

1.1.1 Control Dampers.

1.2 Description

1.2.1 Provide a stand-alone dual fan temperature control panel with all accessories, programming and start-up necessary to deliver an operable system to the owner.

1.2.2 Provide a complete system including:

- .1 Control Panel Including:
  - .1 Controller(s).
  - .2 Status and Alarm Lights on Front of Panel.
- .2 Transfer air damper.
- .3 Temperature sensors.
- .4 Programming.
- .5 Site Testing/Verification.
- .6 Operator Training (2 hour).

1.2.3 Provide electrical installation of the controller and all associated devices. All wiring in mechanical room to be in EMT conduit

1.2.4 Provide all power for controls.

1.2.5 Provide all line and load side wiring for the variable frequency drive.

1.2.6 Variable Frequency Drive

- .1 Conforms to the following codes:
  - .1 UL 508C
  - .2 CE
  - .3 NEC
  - .4 Canadian Underwriters Laboratory
  - .5 ISO 9001

1.3 Warranty

1.3.1 Warrant labour and materials for specified control system free from defects for a period of two years after final acceptance. Control system failures during warranty period shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner. Respond during normal business hours within 24 hours of Owner's warranty service request.

1.3.2 All components, parts, and assemblies shall be guaranteed against defects in material and workmanship for a period of two years after acceptance.

2. PRODUCTS

2.1 Manufacturers

2.1.1 The system is designed around HTS Controls (416.661.3400).

2.1.2 Alternate manufacturers are:

- .1 E.H. Price
- .2 Johnson Controls.
- .3 Honeywell.
- .4 TAC Controls.

2.2 Materials

2.2.1 Use new products the manufacturer is currently manufacturing and selling for use in new installations. Do not use this installation as a product test site unless explicitly approved in writing by Owner. Spare parts shall be available for at least five years after completion of this contract.

2.3 **Communication**

2.3.1 Each controller shall have a communication port for temporary connection to a laptop computer or other operator interface. Connection shall support memory downloads and other commissioning and troubleshooting operations.

2.4 **Controllers**

2.4.1 BACnet.

.1 Application Specific Controllers (ASCs). Each ASC shall conform to BACnet Application Specific Controller (B-ASC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-ASC in the BACnet Testing Laboratories (BTL) Product Listing.

2.4.2 Communication

.1 Service Port. Each controller shall provide a service communication port for connection to a Portable Operator's Terminal. Connection shall be extended to space temperature sensor ports where shown on

2.4.3 Environment. Controller hardware shall be suitable for anticipated ambient conditions.

.1 Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at -29°C to 60°C (-20°F to 140°F).

.2 Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).

2.4.4 Memory.

.1 Controller memory shall support operating system, database, and programming requirements.

.2 Each BC and AAC shall retain BIOS and application programming for at least 72 hours in the event of power loss.

2.4.5 Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).

2.4.6 Transformer. ASC power supply shall be fused or current limiting and shall be rated at a minimum of 125% of ASC power consumption.

2.5 **Auxiliary Control Devices**

2.5.1 Control Dampers

.1 Frames shall be 4" (101.6mm) deep x 1" (25.4 mm) and no less than .080" (2.03mm) in thickness, mill finish extruded aluminum (6063-T5) with mounting flanges on both sides of frame. Frame to be assembled using plated steel mounting fasteners.

.2 Blades to be extruded aluminum (6063-T5) mill finish air-foil profiles.

.3 Blade seals shall be of extruded EPDM. Frame seals shall be extruded silicone. Seals are to be secured in an integral slot within the aluminum extrusions. Blade and frame seals are to be mechanically fastened to eliminate shrinkage and movement over the life of the damper. Adhesive or clip-on type blade seals shall not be approved.

.4 Maintenance-free bearings are to be composed of a Celcon inner bearing fixed to a 7/16" (11.11 mm) aluminum hexagon blade pivot pin, rotating within a polycarbonate outer bearing inserted into the frame. There shall be no metal-to-metal or metal-to-plastic contact.

.5 Adjustable 7/16" (11.11 mm) hexagonal drive rod, U-bolt fastener and retaining nuts shall be hexagonal, corrosion-resistant, zinc-plated steel to provide positive connection to blades and linkage.

.6 Linkage hardware shall be installed in the frame side. All linkage crank arm and rod hardware parts shall be constructed of mill finished aluminum, complete with corrosion resistant, zinc-plated trunnions and cup-point trunnion screws for a slip-proof grip.

.7 Dampers are to be designed for operation in temperatures ranging between -40°F (-40°C) and 212°F (100°C).
.8 Leakage shall not exceed 3 cfm/ft² (15.2 l/s/m²) against 1" (0.25 kPa) w.g. differential static pressure.
.9 Dampers shall be made to size required without blanking off free area.
.10 Dampers shall be available with either opposed blade action or parallel blade action.
.11 Dampers shall be available in two mounting types: i.e., "Installed in Duct" or "Flanged to Duct".
.12 Installation of dampers must be in accordance with TAMCO's current installation guidelines, provided with each damper shipment. (Note that all technical information available on TAMCO's web site at www.tamcodampers.com supersedes and takes precedence over all information contained within the printed catalog.)
.13 Intermediate or tubular steel structural support is required to resist applied pressure loads for dampers that consist of two or more sections in both height and width. (See TAMCO Aluminum Damper Installation Guidelines.)
.14 Acceptable product shall be TAMCO Series 1000 Air-Foil Control Damper, as manufactured by T. A. Morrison & Co., Inc.

2.5.2 Control Actuators.
.1 Provide direct coupled spring electronic actuators.
.2 Size for torque required for damper seal at load conditions.
.3 Actuator to connect to damper shaft through a V shaped assembly.
.4 Provide spring return fail safe mechanism. Spring return actuators to be capable of both clockwise and counter clockwise fail safe operation.
.5 Proportional actuators will accept a 0-10VDC signal and provide a 2-10VDC position feedback signal.
.6 Actuators to be UL, CE or CSA approved.
.7 Acceptable products shall be Belimo, Johnson Controls, Honeywell, Siemens.

2.5.3 Temperature Sensors.
.1 Type. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.
.2 Space Temperature Sensors. Provide decorative wall stat with LCD, buttons for setpoint adjustment and communication port.

2.5.4 Relays.
.1 Control Relays. Control relays shall be plug-in type, UL listed, and shall have dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.

2.5.5 Current Switches.
.1 Current-operated switches shall be self-powered, solid-state with adjustable trip current. Select switches to match application current and DDC system output requirements.

2.5.6 Control Panels
.1 Provide NEMA 1 finished control panel.
.2 Provide lights as shown on schematic.

3. EXECUTION

3.1 General Installation

3.1.1 Install all equipment, accessories, conduit and interconnecting wiring in a neat manner by a skilled and qualified work person using the latest standard of practice for the industry.
3.1.2 Unless otherwise specified meet manufacturer's latest printed instructions for materials, planned maintenance and installation methods.
3.1.3 Notify consultant in writing of any conflict between these specifications and manufacturer's instructions.

3.1.4 All equipment installed shall be mechanically stable and, as necessary, fixed to wall or floor. Anti-vibration mounts to be provided, if required, for the proper isolation of equipment.

3.1.5 Install equipment to allow for easy maintenance access. Ensure equipment does not interfere in any way with access to adjacent equipment and personal traffic in the surrounding space.

3.1.6 Install all electrical wiring in conformance with the requirements of the local electrical authority, Provincial Building Code and, unless otherwise indicated, the specifications of Division 26 Electrical.

3.1.7 Install low voltage wiring in accordance with the control manufacturer's recommendations. Run all wiring in a protective conduit in areas where exposed or where required to meet with applicable codes. Plenum rated (FT6) type cables may be used in accordance with applicable codes, in concealed, accessible locations such as ceiling spaces and wall cavities.

3.2 **Installation of Controlled Devices and Sensors**

3.2.1 Install all equipment in accordance with manufacturer's published instructions.

3.2.2 Supply equipment to be installed by other divisions in accordance with their work schedule.

3.2.3 Coordinate final location of all sensors with consultant's field representative prior to installation.

3.2.4 Sensor assemblies and elements must be readily accessible.

3.2.5 Locate all sensing elements to correctly sense measured variable. Isolate elements from vibrations and temperatures which could affect measurement.

3.2.6 All damper actuators shall be rigidly mounted and supplied with heavy duty linkage consisting of a crankarm, pushrod and swivel balljoint to connect to the damper shaft. Secure linkages in such a manner as to prevent slipping under normal operating torque.

3.3 **Programming**

3.3.1 Program, set up and tune all control loops during initial start-up of the systems.

3.4 **Field Tests and Inspections**

3.4.1 Controls contractor requests completion acceptance in writing and advises owner's authorized representative of situations that prevent a complete testing of overall system performance.

3.4.2 Return to the site to perform additional tests and/or adjustments, if required, to prove system performance during the warranty period.

3.5 **Training**

3.5.1 Provide 2 hour of training for the Owner at the completion of the project.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Metal duct work.

1.2 Related Requirements

1.2.1 Section 23 33 00 – Air Duct Accessories.

1.2.2 Section 23 05 93 - Testing, Adjusting, and Balancing for HVAC.

1.3 References

1.3.1 ASTM A90/A90M - Weight (Mass) of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.

1.3.2 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.3.3 NFPA 90B - Installation of Warm Air Heating and Air-Conditioning Systems.

1.3.4 SMACNA - HVAC Air Duct Leakage Test Manual.

1.3.5 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.3.6 UL 181 - Factory-Made Air Ducts and Connectors.

1.4 Submittals

1.4.1 In accordance with Section 01 33 00.

1.4.2 Product Data: Provide data for duct materials, duct liner, duct connectors.

1.4.3 Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

1.5 Record Documentation

1.5.1 Refer to Section 01 77 00, and Section 23 05 93.

1.5.2 Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 Quality Assurance

1.6.1 Perform Work to SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.6.2 Maintain one copy of document on site.

1.7 Regulatory Requirements

1.7.1 Construct duct work to SMACNA and all applicable NFPA standards.

1.8 Environmental Requirements

1.8.1 Do not install duct sealants when temperatures are less than those recommended by sealant manufacturers.

1.8.2 Maintain temperatures during and after installation of duct sealants.

2. PRODUCTS

2.1 Manufactured Duct Work and Fittings

2.1.1 Manufactured to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

2.1.2 Sealant: Non-hardening, water resistant, fire resistive, compatible with mating materials; liquid used alone or with tape, or heavy mastic.

2.1.3 Hanger Rod: ASTM A36; steel, hot-dipped galvanized; threaded both ends, threaded one end, or continuously threaded.

2.2 Galvanized Steel Ducts

2.2.1 ASTM A653 galvanized steel sheet, lock-forming quality, having G60 zinc coating to ASTM A90.

2.3 **Flexible Ducts**

2.3.1 Flexible ducts manufactured from a continuous strip of spirally wound 3003 corrugated aluminum, mechanically interlocked to produce an air-tight and leak proof triple seam.

2.3.2 Basis of Design: Commercial (Bare) True Flex – Model TF by Peppertree Air Solutions Inc.

2.3.3 Ratings and Classifications:

.1 ULC-S110 listed as Class 1 air duct connector

.2 Flame Spread Rating of not over 25.

.3 Smoke Developed Rating of not over 50.

.4 Pressure Rating: 1000 Pa (4 inches WG) positive and 175 Pa (0.5 inches WG) negative.

.5 Maximum Velocity: 20.3 m/sec 4000 fpm.

.6 Temperature Range: -28 to 79 degrees C (-20 to 175 degrees F).

2.3.4 Install as one continuous piece.

2.3.5 Maximum length not to exceed 1.5 m (5 feet).

3. EXECUTION

3.1 **Substitution Limitations**

3.1.1 No variation of duct configuration or sizes permitted except by written permission from Consultant. Size round ducts installed in place of rectangular ducts to ASHRAE table of equivalent rectangular and round ducts.

3.2 **Duct Work Fabrication**

3.2.1 Fabricate and support to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated. Provide duct material, gauges, reinforcing, and sealing for operating pressures indicated.

3.2.2 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.

3.2.3 Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

3.2.4 Fabricate continuously welded round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints: minimum 100 mm (4 inch) cemented slip joint, brazed or electric welded. Prime coat welded joints.

3.2.5 Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

3.3 **Installation**

3.3.1 Install to manufacturer's instructions.

3.3.2 Install and seal ducts to SMACNA HVAC Duct Construction Standards - Metal and Flexible.

3.3.3 Duct sizes are inside clear dimensions. For lined ducts, maintain sizes inside lining.

3.3.4 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.

3.3.5 Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

3.3.6 Use double nuts and lock washers on threaded rod supports.

3.3.7 Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

3.3.8 During construction provide temporary closures of metal or taped polyethylene on open duct work to prevent construction dust from entering duct work system.

3.4 **Cleaning**

3.4.1 Clean work in accordance with Section 01 74 00.

3.4.2 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.

3.4.3 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.

3.5 **Field Tests and Inspections**

3.5.1 Air Balancing in accordance with Section 23 05 93.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Dampers:
- .1 Volume control dampers.

1.1.2 Duct access doors.

1.1.3 Duct test holes.

1.1.4 Flexible duct connections.

1.2 Related Requirements

1.2.1 Section 23 31 00 – HVAC Ducts and Casings.

1.2.2 Section 23 37 00 – Air Outlets and Inlets.

1.3 References

1.3.1 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

1.3.2 NFPA 92A - Smoke-Control Systems.

1.3.3 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.3.4 UL 33 - Heat Responsive Links for Fire-Protection Service.

1.3.5 ULC S112 - Fire Dampers.

1.3.6 AMCA 210 – Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

1.4 Submittals

1.4.1 Refer to Section 01 33 00.

1.4.2 Shop Drawings: Indicate for shop fabricated assemblies including volume control dampers, duct access doors and duct test holes.

1.4.3 Product Data: Provide for shop fabricated assemblies including volume control dampers, duct access doors, duct test holes and hardware used. Include electrical characteristics and connection requirements.

1.4.4 Manufacturer's Installation Instructions: Indicate for fire dampers and combination fire and smoke dampers.

1.5 Record Documentation

1.5.1 Refer to Section 01 78 00.

1.5.2 Record actual locations of access doors.

1.6 Regulatory Requirements

1.6.1 Products Requiring Electrical Connection: Listed and classified by Canadian Standards Association, or testing firm acceptable to the Authority Having Jurisdiction as suitable for the purpose specified and indicated.

1.7 Delivery, Storage, and Handling

1.7.1 Refer to Section 01 61 00.

1.7.2 Protect dampers from damage to operating linkages and blades.

2. PRODUCTS

2.1 Duct Access Doors

2.1.1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

2.1.2 Fabrication: Rigid and close-fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated duct work, install minimum 25 mm (one inch) thick insulation with sheet metal cover.
- .1 Less Than 300 mm (12 inches) Square: Secure with sash locks.
- .2 Up to 450 mm (18 inches) Square: Provide two hinges and two sash locks.
- .3 Up to 600 mm by 1200 mm (24 inches by 48 inches): Three hinges and two compression latches with outside and inside handles.

.4 Larger Sizes: Provide an additional hinge.

2.1.3 Access doors with sheet metal screw fasteners are not acceptable.

2.1.4 Manufacturers:

.1 Ruskin.

.2 Nailor.

.3 Ductmate Industries.

.4 Equivalent approved by Engineer.

2.2 **Duct Test Holes**

2.2.1 Temporary Test Holes: Cut or drill in ducts as required. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

2.2.2 Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Provide extended neck fittings to clear insulation.

2.3 **Flexible Duct Connections**

2.3.1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

2.3.2 Connector: Fabric crimped into metal edging strip.

.1 Fabric: ULC listed fire-retardant neoprene coated woven glass fibre fabric to NFPA 90A, minimum density 1.0 kg/sq m.

.2 Net Fabric Width: Approximately 150 mm wide.

.3 Metal: 75 mm wide, 0.6 mm thick galvanized steel.

2.3.3 Leaded Vinyl Sheet: Minimum 14 mm thick, 4.2 kg/sq m, 10 dB attenuation in 10 to 10,000 Hz range.

2.4 **Volume Control Dampers**

2.4.1 Fabricate to SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated.

2.4.2 Splitter Dampers:

.1 Material: Same gauge as duct to 600 mm size in either direction, and two gauges heavier for sizes over 600 mm.

.2 Blade: Fabricate of double thickness sheet metal to streamline shape, secured with continuous hinge or rod.

.3 Operator: Minimum 6 mm diameter rod in self-aligning, universal joint action, flanged bushing with set screw.

2.4.3 Butterfly Dampers

.1 Butterfly dampers shall be constructed of 16 gauge steel. Sizes up to 300 mm wide and 760 mm long shall be of standard louvre blade construction. Larger size ducts use standard size multi-blade louvre dampers with a minimum of 150 mm blade.

2.4.4 Manual Dampers

.1 Manual dampers shall be lockable in place with damper quadrant. Damper rod end to be marked indicating blade position.

3. EXECUTION

3.1 **Preparation**

3.1.1 Verify that electric power is available and of the correct characteristics.

3.2 **Installation**

3.2.1 Install accessories to manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.

3.2.2 Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and elsewhere as indicated. Provide for cleaning kitchen exhaust duct work to NFPA 96. Provide minimum 200 mm by 200 mm size for hand access, 450 mm by 450 mm size for shoulder access, and

as indicated. Provide 100 mm by 100 mm for balancing dampers only. Review locations prior to fabrication.

3.2.3 Provide duct test holes where indicated and required for testing and balancing purposes.

3.2.4 Provide flexible connections immediately adjacent to equipment in ducts associated with fans and motorized equipment, and supported by vibration isolators.

3.2.5 Use splitter dampers only where indicated.

3.2.6 Provide balancing dampers on systems where indicated.

3.2.7 Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Inline centrifugal exhaust fan.

1.1.2 Fan Accessories.

1.2 Related Requirements

1.2.1 Section 23 31 00 – HVAC Ducts and Casings.

1.2.2 Section 23 33 00 – Air Duct Accessories.

1.3 References

1.3.1 AMCA 99 - Standards Handbook.

1.3.2 AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

1.3.3 AMCA 300 - Reverberant Room Method for Sound Testing of Fans.

1.3.4 AMCA 301 - Method of Calculating Fan Sound Ratings from Laboratory Test Data.

1.3.5 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.

1.3.6 NFPA 90A and NFPA 90B – Requirement for Flame Spread and Smoke Generation

1.4 Submittals

1.4.1 Product Data: Provide data on exhaust fans and accessories including fan curves with specified operating point clearly plotted, sound power levels for both fan inlet and outlet at rated capacity, and electrical characteristics and connection requirements.

1.4.2 Manufacturer's Installation Instructions.

1.5 Closeout Submittals

1.5.1 Maintenance Data: Include instructions for lubrication, motor and drive replacement, spare parts list, and wiring diagrams.

1.6 Delivery, Storage, and Handling

1.6.1 Transport, handle, store, and protect products.

1.6.2 Protect motors, shafts, and bearings from weather and construction dust.

1.7 Environmental Requirements

1.7.1 Do not operate fans for any purpose until ductwork is clean, filters in place, bearings lubricated, and fan has been test run under observation.

2. PRODUCTS

2.1 Inline Exhaust Fan [EF-1]

2.1.1 Manufacturers:

.1 Loren Cook Company of Springfield, Missouri.

.2 Greenheck.

.3 Carnes.

.4 Penn Ventilator.

.5 Substitutions: Equivalent must be approved by Engineer.

2.1.2 The exhaust fan shall be duct mounted, direct driven centrifugal square inline type as per Fan Schedule.

2.1.3 The fan shall be manufactured at an ISO 9001 certified facility.

2.1.4 The fan shall be listed by Underwriters Laboratories (UL 705) and UL listed for Canada (cUL705).

2.1.5 The fan shall bear the AMCA certified ratings seal for sound and air performance.

2.1.6 The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18 gauge galvanized steel with integral duct collars. Bolted access doors shall be provided on three sides, sealed with closed cell neoprene gasketing. Housing shall be pre-drilled to accommodate universal mounting feet for vertical or horizontal installation.

Unit shall bear an engraved aluminum nameplate. Nameplate shall indicate design CFM and static pressure. Unit shall be shipped in ISTA certified transit tested packaging.

2.1.7 The wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA standard 204-05, balance quality and vibration levels for fans.

2.1.8 Motor shall be an electronically commutated motor rated for continuous duty and furnished either with internally mounted potentiometer speed controller or with leads for connection to 0-10 VDC external controller.

2.1.9 The motor shall be mounted on vibration isolators.

2.1.10 Fan shall be model SQN-D as manufactured by Loren Cook Company of Springfield, Missouri. (Basis of design)

3. EXECUTION

3.1 Installation

3.1.1 Install to manufacturer's instructions.

3.1.2 Install fans with resilient mountings and flexible electrical leads.

3.1.3 Install flexible connections between fan inlet and discharge ductwork. Ensure metal bands of connectors are parallel with minimum 25 mm flex between ductwork and fan while running.

3.1.4 Provide safety screen where inlet or outlet is exposed.

3.1.5 Provide backdraft dampers on discharge of exhaust fans and as indicated.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Constant-Air-Volume terminal units: “bypass boxes”.

1.2 Submittals

1.2.1 Submit manufacturer's data sheets with equipment model numbers, performance and design data, outline dimensions, enclosure details, support and connection arrangements and electrical power requirements where applicable.

1.3 References

1.3.1 ARI Standard 880 Standard for Air Terminals

1.3.2 ARI Standard 885 Standard for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets.

1.3.3 ASHRAE Standard 180 Methods of Testing for Rating Ducted Air Terminal Units

2. PRODUCTS

2.1 General

2.1.1 Selection of units to meet air quantities shown to be based on;

- .1 maximum Inlet Air Pressure; 750 Pa (3 in wg),
- .2 minimum Inlet Air Pressure; 75 Pa (0.3 in wg),
- .3 maximum room NC sound pressure level (2 x 10^{-4} microbar reference) at maximum inlet pressure to be less than 40 at discharge and 42 radiated for box with attenuator mounted exposed (without ceiling).

2.1.2 Where sizes, model numbers and unit types are indicated, selections are taken from E.H. Price catalogue.

2.1.3 Standard of Acceptance

- .1 E.H. Price
- .2 Titus
- .3 Nailor Industries.
- .4 Carnes

2.2 Terminal Boxes

2.2.1 Construction:

- .1 pressure independent type with pneumatic velocity sensor, damper assembly, factory calibrated controller and actuator with adjustable minimum stop
- .2 damper arranged "normally open" for morning warm-up.
- .3 controller capable of maintaining air quantity within ±5% of set value, between zero and stipulated rated air flow,
- .4 sound level below specified values when operating from minimum to maximum inlet static pressure.

2.2.2 Silencer/attenuator:

- .1 on box discharge, acoustically treated open end or multiple outlet attenuator 900mm (30 in) long on boxes up to Size 10 and 1.5m (5 ft) long on boxes Size 12 and larger
- .2 acoustic lining - fibreglass:
  - .1 20mm (13/16 in) thick, 64kg/m^3 (4 lb/sq ft) density, rigid fibreglass with fire resistive reinforced aluminum foil-scrim-kraft (FSK) facing,
  - .2 flame spread rating not to exceed 25, smoke development rating not to exceed 50,
  - .3 fastened to interior sheet metal surface with 100% coverage of adhesive, and fasteners at 1 pin per 0.2m^2 (2 sq ft) but not less than 1 row on each duct side.
  - .4 edges concealed by metal nosings at inlet and discharge, with notch and tuck fabrication and seams protected by Z strips
    - .1 Standard of Acceptance
      - .1 Steri-Liner

.3 acoustic lining - elastomeric:
- .1 spray coated, flexible, closed cell elastomeric insulation in sheet form, with self adhering backing
- .2 flame spread rating not to exceed 25, smoke development rating not to exceed 50,
- .3 fastened to interior sheet metal surface with 100% coverage of adhesive, and fasteners at 1 pin per 0.2m^2 (2 sq ft) but not less than 1 row on each duct side.
  - .1 Standard of Acceptance
    - .1 Armacell AP Armaflex SA

.4 duct liner fasteners:
- .1 2.0 mm (1/16 in) diameter pins,
- .2 length selected to suit thickness of insulation,
- .3 32 mm (1¼ in) square Nylon retaining clips.

2.3 **Controllers**

2.3.1 Direct Digital Controllers (DDC), if applicable, including actuators to be supplied by B.A.S. Equipment Controllers, and factory mounted by Terminal Box Manufacturer. Costs associated with receiving, storage, installation and calibration to be included by Terminal Box Manufacturer.

2.3.2 Air flow sensor to be provided by Terminal Box Manufacturer.

2.3.3 120 VAC to 24 VAC transformer for DDC controller to be supplied by B.A.S. Equipment Controllers, and factory installed by the Terminal Box Manufacturer.

3. EXECUTION

3.1 **Box Installation**

3.1.1 Support terminal boxes from building structure with angles, hangers and supplementary steel before installation of piping and connecting ductwork.

3.2 **Ductwork Connections**

3.2.1 Connect inlet ductwork with spiral flat seam round duct of same diameter as terminal box inlet

3.2.2 Support outlet ductwork independent from box.

3.2.3 Seal openings in box and attenuator for reheat coil and connections, control, and power wiring.

3.3 **Electrical Connections**

3.3.1 Electrical Division 26 will provided 120 Volt, single phase power supply with a junction box for each group of terminal boxes with maximum of 12 terminal box controls fed from one junction box. For fan powered terminal boxes Electrical Division 26 will provided 120 Volt, single phase power supply for fan motors and controls at a junction box adjacent each fan powered terminal box.

3.3.2 Extend power supply from these junction boxes and connect to terminal units.

3.4 **Leakage Testing**

3.4.1 Terminal boxes and attenuators to be included in ductwork leakage testing.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Devices used to supply or remove air from a space or building.

.1 Diffusers, Registers, and Grilles.

1.2 Related Requirements

1.2.1 Section 23 31 00 – HVAC Ducts and Casings.

1.3 References

1.3.1 NFPA 90A - Installation of Air Conditioning and Ventilating Systems.
1.3.2 NFPA 92A - Smoke-Control Systems.
1.3.3 SMACNA - HVAC Duct Construction Standards - Metal and Flexible.
1.3.4 UL 33 - Heat Responsive Links for Fire-Protection Service.
1.3.5 UL 555 - Fire Dampers.
1.3.6 AMCA 210 – Laboratory Methods of Testing Fans for Aerodynamic Performance Rating.

1.4 Submittals

1.4.1 Refer to Section 01 33 00.

1.5 Closeout Submittals

1.5.1 Refer to Section 01 78 00.

1.6 Delivery, Storage, and Handling

1.6.1 Refer to Section 01 61 00.
1.6.2 Protect dampers from damage to operating linkages and blades.

2. PRODUCTS

2.1 Diffusers, Registers, and Grilles

2.1.1 Manufacturers:

.1 E.H. Price
.2 Carnes.
.3 Nailor.
.4 Substitutions: Equivalent must be approved by Engineer.

2.1.2 Accessories

.1 Provide all grilles, registers, and diffusers complete with accessories as detailed on the drawings.
.2 For t-bar lay in ceilings the grilles, registers, and diffusers shall lay into t-bar system and no flange shall extend beyond flange of T-Bar.
.3 See schedule on drawings for manufacturer and model.

3. EXECUTION

3.1 Installation

3.1.1 Install accessories to manufacturer's instructions, NFPA 90A, and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.
3.1.2 Install devices in accordance with manufacturer’s recommendations and related sections.
3.1.3 Provide balancing dampers on duct take-off to diffusers, grilles, and registers, regardless of whether dampers are specified as part of the diffuser, grille, or register assembly.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Common requirements for electrical work.

1.1.2 Mounting heights for electrical equipment and devices.

1.2 Related Requirements

1.2.1 Provisions of this section apply to all sections of Division 26, Division 27, Division 28.

1.2.2 Document 00 64 01 – Request Form for Electronic Files.

1.2.3 Section 07 84 00 – Firestopping.

1.2.4 Section 08 31 00 – Access Doors and Panels.

1.2.5 Section 09 91 00 – Painting.

1.2.6 This section is to be read in conjunction with Division 00 documents, and Division 01 specification sections, which take precedence as described in CCDC 2-2008.

.1 General Conditions.

.2 Supplementary General Conditions.

.3 General Requirements.

1.3 Intent

1.3.1 Include all material, labour, equipment, and plant construction as necessary to make a complete installation as shown and specified hereinafter.

1.3.2 Leave complete systems ready for continuous and efficient satisfactory operation.

1.3.3 Discipline and Trade Jurisdiction

.1 In accordance with CCDC 2-2008 GC 1.1.7: Neither the organization of the Specifications nor the arrangement of Drawings shall control the Contractor in dividing the work among Subcontractors and Suppliers.

.2 MasterFormat's organizational structure used in a project manual does not imply how the work is assigned to various design disciplines, trades, or subcontractors. MasterFormat is not intended to determine which particular elements of the project manual are prepared by a particular discipline. Similarly, it is not intended to determine what particular work required by the project manual is the responsibility of a particular trade. A particular discipline or trade is likely to be responsible for subjects from multiple Divisions, as well as from multiple Subgroups.

1.4 Drawings and Specifications

1.4.1 The drawings and specifications are complementary each to the other and what is called for by one to be binding as if called for by both. Should any discrepancy appear between the drawings and specifications, which leaves the Contractor in doubt as to the true intent and meaning of plans and specifications, a ruling is to be obtained from the Consultant in writing before submitting Bid. If this is not done, the maximum, the most expensive alternate or option will be provided in base tender bid.

1.4.2 All drawings and all Divisions of these specifications shall be considered as a whole, and work of this Division shown anywhere therein shall be furnished under this Division.

1.4.3 Drawings are diagrammatic and indicate the general arrangement of equipment and pathways. Most direct routing of conductors and wiring is not assured. Exact requirements are governed by architectural, structural, and mechanical conditions of the job. Consult all other drawings in preparation of the bid. Extra lengths of wiring or addition of pull and junction boxes, etc. necessitated by such conditions are to be included in the bid. Check all information and report and apparent discrepancies before submitting the bid.

1.4.4 Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pathways so as to best fit the layout of the job.

1.4.5 Scaling off the drawings will not be sufficient or accurate for determining these locations. Where job conditions require reasonable changes in indicated arrangement and locations, such changes shall be made at no additional cost to the Owner.

1.4.6 Because of the scale of the drawings, certain basic items, such as junction boxes, pull boxes, conduit fittings, etc. may not be shown, but where such items are required by other sections

of the specifications of where there are required for proper installation of the work, such items are to be furnished and installed.

1.4.7 Before ordering any conduit, cable tray, conductors, wireways, raceway bus duct, fittings, etc., verify all pertinent dimensions at the job site and be responsible for their accuracy.

1.4.8 If obvious ambiguities or omissions are noticed when tendering refer same to the Consultant for a ruling and obtain the ruling in writing in the form of an Addendum. Claims for extras for ambiguities or omission of items brought to the attention of the Consultant after the award of a contract which, due to the nature of the ambiguity or omission, should have been brought to the attention of the Consultant during the tendering period, will not be allowed.

1.4.9 The drawings are performance drawings, diagrammatic, and show locations for apparatus and materials. The drawings are intended to convey the scope of work and do not intend to show Architectural and Structural details. The locations shown are approximate, and may be altered, when approved by the Consultant, to meet requirements of the material and/or apparatus, other equipment and systems being installed, and of the building. Do not scale drawings.

1.4.10 Provide any fitting, offset, transformation, etc., required to suit architectural and structural details but not shown.

1.5 Work Restrictions

1.5.1 Refer to Section 01 14 00.

1.5.2 Existing buildings:

.1 Examine the existing building, the site and surrounding areas and by fully informed as to the conditions and limitations under which the work has to be executed. Claims for additional costs will not be entertained with respect to conditions which could reasonably been ascertained by an inspection prior to Tender closing.

.2 All work in the existing building, other than minor works required to permit construction of the new addition, is to be performed in such a manner as to not disrupt the building operations.

.3 All systems are to be kept in full operation during normal building hours.

.4 Note that any noise generating works that disrupt the building operation shall be coordinated accordingly and carried out after/before normal operating hours.

.5 Cut, modify, or extend as necessary or as directed by the Consultant, the existing material or equipment to be reused or relocated to suit work under this contract.

.6 Existing materials and equipment which are to be used in new work shall be repaired and refinished as necessary. Provide additional new materials and components as required to facilitate reinstallation of such existing materials and equipment.

.7 Co-ordinate with the Owner, and refer to General Conditions.

.8 Do work in existing areas to best suit available space and not interfere with or obstruct use of existing facilities.

.9 Where disruptions of existing services are required, coordinate shut down with the Owner’s operating staff and do the work at a time and in a manner mutually acceptable. Carefully schedule disruptions to keep “down time” to a minimum.

1.5.3 Do all cutting, patching and making good to leave in a finished condition and to make the several parts of the Work come together properly. Co-ordinate work to keep cutting and patching to a minimum.

1.5.4 Quality of workmanship and materials used in patching, making good and refinishing of existing construction and/or compartments shall be of a standard equal to that specified for new construction and if not specified, equal to or exceeding that of original existing work.

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

1.6 Substitution Procedures

1.6.1 Refer to Section 01 25 00 and General Provisions of the Contract.

1.6.2 Additionally, "Approved Equal" shall be defined as an alternate approved by the Consultant.

1.6.3 If during the tender bid process, the bidding contractor wishes to substitute the specified equipment for an "Approved Equal", the bidding contractor must submit shop drawings to the Consultant before the tender close for approval. If no substitution request is made, the as-specified equipment is that to be provided.

1.6.4 Where several manufacturers' names are given, the first named manufacturer constitutes the basis for job design and establishes the equipment quality required to be used in this contract.

1.6.5 This contractor, at his option, may use equipment as manufactured by the other manufacturers if listed. This contractor is responsible to ensure that all items submitted by these other manufacturers meets are requirements of the drawings and specification and fits in the allocated space. The final determination of a product being equivalent is to be determined by the Consultant when a catalog number is not listed, or listed in part.

1.6.6 Any material, article or equipment of other unnamed manufacturers which will adequately perform the services and duties imposed by the design and is of a quality equal to or better than the material, article or equipment identified by the drawings and specifications may be used if approval is secured in writing from the Consultant as described in the General Provisions of the Contract for Submittals. The Contractor bears full responsibility for the unnamed manufacturers' equipment adequately meeting the intent of the design. The Owner or the Consultant may reject manufacture at time of shop drawing submittal.

1.7 Contract Modification Procedures

1.7.1 When submitting quotations in response to changes in the contract, quotations for electrical work are to include a breakdown of all material, including material unit rates, and labour units as indicated in the NECA Manual of Labor Units (MLU).

1.8 Coordination

1.8.1 Refer to Section 01 31 00.

1.8.2 Coordinate work with other trades to avoid conflict and to provide correct rough-in and connection for equipment furnished under other trades that require electrical connection. Inform Contractors of other trades of the required access to and clearances around electrical equipment to maintain serviceability and code compliance.

1.8.3 Verify equipment dimensions and requirements with provision specified under this Section. Check actual job conditions before fabricating work. Report necessary changes in time to prevent needless work. Changes or additions subject to additional compensation, which are made without written authorization and an agreed price, shall be at Contractor's risk and expense.

1.8.4 Read specifications and drawings of other trades and conform with their requirements before proceeding with any work specified in this Division related to other trades. Co-operate with all other trades on the job, so that all equipment can be satisfactorily installed, and so that no delay is caused to any other trades.

1.8.5 Coordinate utility service outages with the owner. Obtain permission from Owner at least 24 hours before partially or completely disabling system. Minimize outage duration.

1.8.6 [Existing Fire Alarm System: Maintain existing system in service. Disable system only to make switch overs and connections. Notify Owner at least 24 hours before partially or completely disabling system. Minimize outage duration.]

1.8.7 Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

1.8.8 Co-ordinate work with all trades to ensure a proper and complete installation. Notify all trades concerned of the requirement for openings, sleeves, insets and other hardware necessary for the installation and, where work is to be integrated with the work of other trades or is to be installed in close proximity with the work of other trades, carefully co-ordinate the work prior to installation.

1.8.9 Working Detail Drawings

.1 The contractor is to prepare working detail drawings supplementary to the contract drawings, when deemed necessary by the Consultant, for all areas where a multiplicity of materials and or apparatus occur, or where the work due to architectural and

structural considerations involves special study and treatment. Such drawings may be prepared jointly by all trades affected, or by the one trade most affected with due regard for and approval of the other trades, all as the Consultant will direct in each instance. Such drawings must be reviewed by the Consultant before the affected work is installed.

.2 Carry out all alterations in the arrangement of work which has been installed without proper study and approval, even if in accordance with the contract documents, in order to make such work come within the finished lines of walls, floors and ceilings, or to allow the installation of other work, without additional cost. In addition, make any alterations necessary in other work required by such alterations, without additional cost.

1.9 **Submittal Procedures**

1.9.1 Refer to Section 01 33 00.

1.9.2 Before delivery to site of any item of equipment, submit shop drawings complete with all data, pre-checked and stamped accordingly, for review by the Consultant. Indicate project name on each brochure or sheet, make reference to the number and title of the appropriate specification section, type identifier such panelboard ID or luminaire type as indicated on appropriate schedule, and provide adequate space to accommodate the Consultant's review stamp(s).

1.9.3 Verify field measurements and affected adjacent Work are coordinated, including passageway clearances for movement of equipment into location.

1.9.4 Submit shop drawings to the Consultant in electronic (PDF) format, as coordinated after award of contract. Where submittals are derived from digital originals, do not print and rescan documents; submittals made as such will be immediately rejected.

1.9.5 Submit a schedule of shop drawings within one week after award of contract. Group submittals by specification division as appropriate.

1.9.6 Shop Drawings

.1 Submit for review, properly identified shop drawings showing in detail the design and construction of all equipment and materials as requested in sections of the specification governed by this Section.

.2 Obtain and comply with the manufacturer's installation instructions.

.3 Endorse each shop drawing copy "CERTIFIED TO BE IN ACCORDANCE WITH ALL REQUIREMENTS", stamp each copy with your company name, date each copy with the submittal date, and sign each copy. Shop drawings which are received and are not endorsed, dated and signed will be returned for re-submittal.

.4 The Consultant will stamp shop drawings as follows:

.1 Reviewed ( )
.2 Reviewed as Modified ( )
.3 Revise and Re-Submit ( )
.4 Not Reviewed ( )

.5 If "REVIEWED" is checked-off, the shop drawing is satisfactory. If "REVIEWED AS MODIFIED" is checked-off, the shop drawing is satisfactory subject to requirements of remarks put on shop drawing copies. If "REVISE AND RE-SUBMIT" is checked-off, the shop drawing is entirely unsatisfactory and must be revised in accordance with comments written on shop drawing copies and resubmitted. If "NOT REVIEWED" is checked-off, the shop drawing is in error of submission, not applicable for this project.

.6 This review by the Consultant is for the sole purpose of ascertaining conformance with the general design concept. This review shall not mean that the Consultant approved the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor, and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the contract documents. Be responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation, and for co-

ordination of the work as well as compliance with codes and inspection authorities such as CSA, etc.

1.10 **Safety Requirements**

1.10.1 Refer to Section 01 35 29.

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

1.11 **Regulatory Requirements**

1.11.1 Refer to Section 01 41 00.

1.11.2 Codes and Standards

.1 Ontario Electrical Safety Code c/w Bulletins and Amendments.

.2 Ontario Building Code and its referenced standards.

.3 Applicable CSA and ULC Standards.

.4 [All work shall be in accordance with Owner's Design Guidelines.]

1.11.3 Permits and Fees

.1 Obtain and pay for all permits and fees required for the execution and inspection of the electrical work and pay all charges incidental to such permits. Submit to Electrical Inspection Department and Supply authority necessary number of drawings and specifications for examination and approval prior to commencement of work. Arrange and pay for any special inspection of equipment specified if and when required.

.2 Apply, pay and obtain all permits as required for the electrical work.

.3 Upon substantial completion of your work, supply and turn over to the Consultant all required inspection certificates from governing authorities to certify that the work as installed conforms to the rules and regulations of the governing authorities.

1.11.4 Patents

.1 Pay all royalties and licence fees, and defend all suits or claims for infringement of any patent rights, and save the Owner, Architect, Project Manager and Consultants harmless of loss or annoyance on account of suit, or claims of any kind for violation or infringement of any letters patent or patent rights, by this Subcontractor or anyone directly or indirectly employed by him or by reason of the use by him or them of any part, machine, manufacture or composition of matter on the work, in violation or infringement or such letters patent or rights.

1.12 **References**

1.12.1 Canadian Standards Association

.1 CSA-C22.1-12, Canadian Electrical Code, Part 1 (22nd Edition), Safety Standard for Electrical Installations.

.2 CAN3-C235-83(R2006), Preferred Voltage Levels for AC Systems, 0 to 50 000 V.

.3 Do underground systems in accordance with CSA C22.3 No.7-06, Underground Systems, except where specified otherwise.

.4 Ontario Electrical Safety Code, 25th Edition / 2012.

1.12.2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.1 EEMAC 2Y-1-1958, Light Gray Colour for Indoor Switch Gear.

1.12.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

1.12.4 Ontario Electrical Safety Code, 25th Edition / 2012, and all bulletins.

1.12.5 Hydro requirements and local applicable codes and regulations.

1.12.6 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.

1.13 **Definitions**

1.13.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.14 **Quality Assurance**

1.14.1 Refer to Section 01 43 00.

1.14.2 The specifications contained herein are set forth as the minimum acceptable requirements. This does not relieve the Contractor from executing other quality assurance measures to obtain a complete operating system within the scope of this project.

1.14.3 Ensure that all workmanship, all materials employed, all required equipment and the manner and method of installation conforms to accepted construction and engineering practices, and that each piece of equipment is in satisfactory working condition to satisfactorily perform its functional operation.

1.14.4 Provide quality assurance tests and operational check on all components of the electrical distribution system, all lighting fixtures, and communication systems.

1.14.5 Only first class workmanship will be accepted, not only in regards to durability, efficiency and safety, but also in regards to neatness of detail. Present a neat and clean appearance on completion to the satisfaction of the Consultant. Any unsatisfactory workmanship will be replaced at no extra cost.

1.14.6 Conform to the best practices applicable to this type of work. Install all equipment and systems in accordance with the manufacturer's recommendations, but consistent with the General Requirements of this specification. Electrical Contractor will be held responsible for all damage to the work of his own or any other trade, resulting from the execution of his work. Store all electrical equipment and materials in dry locations.

1.14.7 Provide foreman in charge of this work at all times.

1.14.8 The contractor shall be fully liable to provide and maintain in force during the life of this Contract, such insurance, including Public Liability Insurance, Product Liability Insurance, Auto Liability Insurance, Worker’s Compensation, and Employer’s Liability Insurance.

1.14.9 Governing Federal, Provincial and Municipal codes and regulations will be considered minimum standards for the work and where these are at variance with the drawings and specification, the more stringent ruling will apply.

1.14.10 Where any code, regulation, bylaw, or standard is quoted it shall mean the current edition including all revisions or amendments at the time of the tender.

1.14.11 In case of conflict, the codes and regulations take precedence over the Contract Documents. In no instance reduce the standard or scope of work or intent established by the drawings and specifications by applying any of the codes referred to herein.

1.15 **Quality Control**

1.15.1 Refer to Section 01 45 00.

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

1.16 **Temporary Utilities**

1.16.1 Refer to Section 01 51 00.

1.16.2 Do not use any of the permanent facility systems during construction except as may be specified, or unless written approval is obtained from the Consultant.

1.16.3 The use of permanent facilities for temporary construction service will not affect in any way the commencement day of the warranty period.

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

1.17 **Temporary Facilities and Controls**

1.17.1 Refer to Section 01 56 00.

1.17.2 Prior to start of each work period in occupied area, install temporary protection to prevent damage to any personal property or furnishing. Coordinate with Owner’s representative if any furniture must be relocated to facilitate work.

1.17.3 [Submit temporary protection plan to Owner’s Representative for approval prior to use.]

1.17.4 Take necessary steps to ensure that required firefighting apparatus is accessible at all times. Flammable materials shall be kept in suitable places outside the building.

1.18 **Product Requirements**

1.18.1 Refer to Section 01 61 00.

1.18.2 The design, manufacture and testing of electrical equipment and materials shall conform to or exceed the latest applicable CSA, IEEE, and ANSI standards.

1.18.3 All materials must be new and be ULC or CSA listed. Any materials not covered by the aforementioned listing standards shall be tested and approved by an independent testing laboratory, Technical inspection Services, or other government agency.

1.18.4 Materials and equipment are specifically described and named in this Specification in order to establish a standard of material and workmanship.

1.18.5 Materials required for performance of work shall be new and the best of their respective kinds and of uniform pattern throughout work.

1.18.6 Materials shall be of Canadian manufacture where obtainable. Materials of foreign manufacture, unless specified, shall be approved before being used.

1.18.7 Equipment items shall be standard products of approved manufacture. Identical units of equipment shall be of same manufacture. In any unit of equipment, identical component parts shall be of same manufacture, but the various component parts comprising the unit need not be of one manufacture.

1.18.8 Chemical and physical properties of materials and design performance characteristics and methods of construction and installation of items of equipment, specified herein, shall be in accordance with latest issue of applicable Standards or Authorities when such are either mentioned herein, or have jurisdiction over such materials or items of equipment.

1.18.9 Materials shall bear approval labels as required by Code and/or Inspection Authorities.

1.18.10 Install materials in strict accordance with manufacturer's recommendations.

1.18.11 Include items of material and equipment not specifically noted on Drawings or mentioned in Specification but which are necessary to make a complete and operating installation.

1.18.12 Remove materials, condemned as not approved for use, from job site and deliver and install suitable approved materials in their place.

1.18.13 Unless otherwise noted, equipment and material specifications in Sections of the Specification governed by this Section are based on products of a manufacturer selected by the Consultant for the purpose of setting a standard of quality, size, performance, capacity, appearance and serviceability.

1.18.14 In most instances the names of acceptable manufacturers are also stated for materials and equipment, and you may base your tender price on equipment and materials produced by either the specified manufacturer or a manufacturer listed as acceptable.

1.18.15 For any items of equipment, material, or for any system where acceptable manufacturers are not stated, you must provide only the equipment, material or system specified.

1.18.16 If materials or equipment manufactured and/or supplied by a manufacturer named as acceptable are used in lieu of products of the manufacturer specified, be responsible for ensuring that the substituted material or equipment is equivalent in size, performance and operating characteristics to the specified materials or equipment, and it shall be understood that all costs for larger starters, additional space, larger power feeders, and changes to associated or adjacent work required as a result of providing materials and equipment named as acceptable in lieu of the specified product will be borne by Contractor.

1.18.17 In addition to the manufacturers specified or named as acceptable, the Contractor may propose alternative manufacturers of equipment and/or apparatus to the Consultant for acceptance, listing in each case a corresponding credit for each alternative proposed, however, the tender price must be based on apparatus or materials specified or named as acceptable. Certify in writing to the Consultant that the alternative meets all space, power, design, and all other required of the specified or equivalent material or apparatus. In addition, it shall be understood that all costs for larger starters, space, power feeders, and changes to associated equipment, mechanical and/or electrical, required by acceptance of proposed alternatives, will be borne by the party making the proposal. Alternative equipment requiring

greater than specified energy requirements or unduly limiting service space requirements will not be accepted.

1.18.18 Where a manufacturer is not listed for a particular product, it will be deemed to mean that the contractor will provide the specified manufacturer's product.

1.19 **Examination and Preparation**

1.19.1 Refer to Section 01 71 00.

1.19.2 Examine the existing equipment, the site and surrounding areas and be fully informed as to the conditions and limitations under which the work has to be executed. Claims for additional costs will not be entertained with respect to conditions which could reasonably have been ascertained by an inspection prior to Tender closing.

1.19.3 Examine work upon which your work depends. Report in writing defects in such work. Application of your work shall be deemed acceptance of work upon which your work depends.

1.19.4 Drawings are, in part, diagrammatic and are intended to convey scope of work and indicate general and approximate location, arrangement and sizes of equipment, piping, and similar items. Obtain more accurate information about locations, arrangement and sizes from study and coordination of drawings, including shop drawings and manufacturers' literature and become familiar with conditions and spaces affecting these matters before proceeding with work.

1.19.5 Where job conditions require reasonable changes in indicated locations and arrangements, make such changes with approval of the Consultant at no additional cost to the Owner. Similarly, where existing conditions interfere with new installation and require relocation, such relocation is included in work.

1.20 **Cutting and Patching**

1.20.1 Refer to Section 01 73 00.

1.20.2 The Electrical Contractor will be responsible for all cutting and patching required for the electrical installation. Structural members are not to be cut without the consent of the Consultant.

1.20.3 All cutting and patching required under Division 26, Division 27, and Division 28 shall be in accordance with Division 01. Layout such work for approval before undertaking same.

1.20.4 Cutting shall be kept to an absolute minimum and performed in a neat and workmanlike manner using the proper tools and equipment. Caution shall be exercised in all cutting and procedures to ensure that concealed services are not affected. Do not cut if in doubt. Request Consultant's presence to determine if concealed services exist.

1.20.5 Assume responsibility for prompt installation of Work in advance of concrete pouring or similar Work. Should any cutting or repairing of finished/unfinished Work be required because such installation was not done, employ the particular trade, whose Work is involved, to do such cutting and patching. Pay for any resulting costs. Layout such Work for approval before undertaking same.

1.21 **Cleaning and Waste Management**

1.21.1 Refer to Section 01 74 00.

1.21.2 The Contractor and associated sub trades, at all times during construction, to keep the site free of all debris, boxes, packing, etc., resulting from work of this trade. At the completion of this work, the electrical installation is to be left in a clean and finished condition to the satisfaction of the Consultant.

1.21.3 Clean and repair existing materials and equipment which remain or are to be reused.

1.21.4 Luminaires to be reinstalled: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts.

1.21.5 Assume responsibility for removing tools and waste materials on completion of Work, and leave Work in clean and perfect condition.

1.22 **Starting and Adjusting**

1.22.1 Refer to Section 01 75 00.

1.22.2 Conduct acceptance tests to demonstrate that the equipment and systems actually meet the specified requirements. Tests may be conducted as soon as conditions permit, and consequently make all changes, adjustments, or replacements required as the preliminary tests may indicate prior to the final tests. Tests shall be as specified in various sections of this Division. Carry out tests in the presence of the Consultant. Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project. The Electrical Contractor shall be in charge of the plant during tests. He shall assume responsibility for damages in the event of injury to the personnel, building, equipment, and shall bear all costs for liability, repairs, and restoration in this connection. Submit test results.

1.22.3 Make tests of equipment and wiring at times requested.

1.22.4 Tests shall include meggered insulation values, voltage and current readings to determine balance of panels and feeders under full load, and operation of each piece of equipment for correct operation.

1.22.5 Supply meters, materials and personnel as required to carry out these tests.

1.22.6 Test electrical work to standards and function of Specification and applicable codes in an approved manner. Replace defective equipment and wiring with new material and leave entire system in complete first class operating condition.

1.22.7 Connect single phase loads so that there is the least possible unbalance of the supply phases.

1.22.8 Submit all test results in report format.

1.22.9 Trial Usage

.1 The Consultant reserves the right to use any system, piece of equipment, device, or material for such reasonable lengths of time and at such times as may be required to make a complete and thorough test of the same, or for the purpose of learning operational procedures, before the final completion and acceptance of the work. Such tests shall not be construed as evidence of acceptance of the work, and it is agreed and understood that no claim for damage will be made for injury or breakage to any part or parts of the above due to the aforementioned tests, where such injuries or breakage are caused by a weakness or inaccuracy of parts, or by defective materials or workmanship of any kind. Supply all labour and equipment required for such tests.

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

1.23 **Closeout Procedures**

1.23.1 Refer to Section 01 77 00.

1.23.2 The Consultant will carry out inspections and prepare deficiency list for action by the Contractor, during and on completion of project.

1.23.3 Furnish a Certificate of Acceptance from Inspection Department on completion of work.

1.24 **Closeout Submittals**

1.24.1 Refer to Section 01 78 00.

1.24.2 Project Record Documents

.1 Extra sets of white prints will be provided on which to make, as the job progresses, all approved changes and deviations from the original drawings. Complete Record Drawings accurately marked up in red ink must be submitted for approval before the contract is considered to be completed.

.2 Changes and deviations include those made by addenda, change orders, and supplemental instructions, and changes and deviations to be marked on the white print record drawings indicated on supplemental drawings issued with addenda, change orders, and supplemental instructions. Maintain the "as-built" white prints at the site for periodic inspection by the Consultant throughout the duration of the work.

.3 Upon substantial completion of the work, obtain a set of reproducible white prints of the drawings and neatly amend the print in accordance with the marked-up white prints to produce a true "as-built" set of drawings.

.4 As-built drawings are to indicate all circuiting as installed and all distribution junction box locations as well as conduit routes.

.5 Trace routing of existing panelboard feeders for all panelboards and indicate on as-built drawings.

.6 As-Built AutoCAD Drawings

.1 Submit completed Document 00 64 01 to the Consultant, and remit payment as indicated for release of Consultant's AutoCAD files.

.2 Transfer the information from the "as-built" white prints to the files, and submit to the Consultant for review.

.3 Employ a competent computer draftsperson to indicate changes on the electronic set of record drawings. Provide drawings in Adobe Acrobat 6.0, and AutoCAD release 2010.

.4 Submit three (3) CD's of as-built drawings in AutoCAD format, one with each O&M manual.

.5 Provide three (3) sets of full size as-built drawings in hard copy format, one with each O&M manual.

.7 As-built Single Line Diagram:

.1 Provide in Main Electrical Room one wall mounted copy of as-built Single Line Diagram on 1/4 inch foam board.

.2 As-built Single Line Diagram to indicate manufacturer name and catalogue numbers of as-installed products.

1.24.3 Operations and Maintenance (O&M) Data

.1 Submit two complete sets of Operation and Maintenance instruction manuals in hard copy, and one in electronic format. Include in each copy of the manual:

.1 Verification certificates for installation of life safety systems by the manufacturer's representative.

.2 A copy of "reviewed" shop drawings.

.3 Complete explanation of operating principles and sequences.

.4 Recommended maintenance practices and precautions.

.5 Complete wiring and connection diagrams.

.6 Certificates of guarantees.

.2 Ensure that operating and maintenance instructions are specific and apply to the model and types of equipment provided.

1.24.4 Warranties

.1 Submit a written guarantee to the Owner for two years from the date of acceptance. This guarantee shall bind the contractor to correct, replace or repair promptly any defective equipment workmanship without cost to the Owner.

.2 All equipment, materials and workmanship shall be unconditionally guaranteed for a minimum period of two years from the date of acceptance.

.3 Provide warranty certificates, wherever given or required, in excess of the normal warranty period showing the name of the firm giving the warranty, dated and acknowledged, on specific equipment and systems.

.4 Warranties for temperature controls and building automation systems will start on the date of verification of acceptance by the Consultant.

.5 Include these certificates with the maintenance and operating manuals in the appropriate sections.

1.25 **Demonstration and Training**

1.25.1 Refer to Section 01 79 00.

1.25.2 In the presence of the Owner, demonstrate the proper operation of all systems.

1.25.3 Instruct the Owner's designated representatives in all aspects of the operation and maintenance of systems and equipment listed in the trade sections governed by this Section. Obtain in writing from the Consultant a list of the Owner's representatives qualified to receive instructions.

1.25.4 Arrange for and pay for the services of qualified service technicians and other manufacturer's representatives required for instruction of specialized portions of the installation.

2. PRODUCTS – NOT USED

3. EXECUTION

3.1 Demolition

3.1.1 Refer to Division 02 and Section 26 05 05.

3.1.2 Remove all electrical equipment and devices on redundant structures. Make safe all circuits, and provide continuity of remaining circuits.

3.1.3 To make safe: Withdraw redundant wiring and remove unwanted conduit/wiring and accessories. Position breakers to OFF position and update panel schedules.

3.1.4 Make safe any redundant mechanical devices as shown on mechanical drawings.

3.1.5 Maintain continuity of existing services for other circuits/devices serving areas outside the Work area. Provide additional wiring/conduits/boxes etc. to suit existing services to be maintained and also implement new Work as detailed.

3.1.6 Allow for this work in Tender Price.

3.1.7 Turn over designated equipment to the Owner. Dispose of unwanted materials and equipment.

3.2 Concrete Work

3.2.1 Refer to Division 03 – Concrete.

3.2.2 Provide all concrete work required for the electrical work. Reinstall surfacing as per architectural requirements.

3.2.3 Provide a 100 mm (4 inch) high concrete housekeeping pad for floor mounted electrical distribution equipment, such as the following:

.1 Transformers.
.2 Switchgear and switchboards.
.3 Distribution panelboards.
.4 Engine Generators.
.5 Uninterruptible Power Supplies and batteries.
.6 Transfer Switches.

3.3 Lintels

3.3.1 Refer to Division 04 – Masonry.

3.3.2 Lintels for openings in masonry shall conform with requirements of by-laws, and as approved by the Structural Engineer.

3.3.3 Pay all costs for lintels over openings, required solely by the electrical trades, not shown on architectural or structural drawings.

3.4 Metals

3.4.1 Refer to Division 05 – Metals.

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

3.5 Flashing and Sheet Metal

3.5.1 Refer to Section 07 60 00.

3.5.2 Flash all conduits and systems passing through roof or built into an outside wall, or a waterproof floor.

3.5.3 Provide copper flashing for sleeves passing through exterior walls or waterproof floors.

3.6 Firestopping

3.6.1 Provide firestopping in accordance with Section 07 84 00.

3.6.2 Ensure that fire ratings of floors and walls are maintained.

3.6.3 Provide ULC classified firestopping products by 3M or Hilti which have been tested in accordance with CAN4-S115.

3.6.4 Pack clearance spaces, fill all spaces between openings, pipes and ducts passing through fire separations and install firestopping systems in accordance with the appropriate ULC system number for the products and type of penetration.

3.6.5 Install firestopping systems using personnel trained or instructed by the product manufacturer.

3.7 **Access Doors**

3.7.1 Provide access doors in accordance with Section 08 31 00.

3.7.2 Group conduit work to ensure the minimum number of access doors is required.

3.7.3 Access doors are to be installed by the trade responsible for the particular type of construction in which the doors are required.

3.8 **Painting and Finishes**

3.8.1 Refer to Section 09 91 00.

3.8.2 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

3.8.3 Repair and finish factory finished equipment, damaged or scratched during installation, in an approved manner.

3.8.4 All structural steel including hangers, brackets, supports and other ferrous metals shall be shop or factory prime painted wherever practicable. Wherever structural steel including hangers, brackets, supports, and other ferrous metals cannot be shop or factory prime painted, wire brush to remove all traces of rust, clean of all traces of dirt, oil, and grease, and apply one coat of an approved rust inhibiting primer in accordance with CGSB-GB-40d, and leave ready to receive finish paint.

3.8.5 Primary and final painting for Work, other than items specified as factory primed or finished, will be performed as described in Division 09 – Finishes.

3.8.6 All electrical fittings, supports, hanger rods, pull boxes, channel frames, conduit racks, outlet boxes, brackets, clamps etc., to have galvanized finish or paint finish over corrosion-resistant primer.

3.8.7 All panelboards, motor starters etc., to be factory finished with baked on enamel. All enamel to be baked on gloss over corrosion resistant primer.

3.8.8 Touch up minor damage to finish on factory finished equipment. Items suffering major damage to finish shall be replaced at the direction of the Consultant.

3.8.9 Protect work so that finishes will not be damaged or marred during construction. Maintain the necessary protection until completion of the work.

3.8.10 Provide all exposed ferrous metal work on equipment with at least one factory prime coat, or paint one prime coat on job. Clean up or wire brush all equipment, etc., before painting.

3.8.11 For factory applied finishes, repaint or refinish surfaces damaged during shipment, erection or construction work.

3.9 **Location of Outlets**

3.9.1 Refer to Architectural drawings for dimensions denoting exact locations.

3.9.2 The Consultant reserves the right to change the location of outlets to within 3 m from the point indicated on the plans without extra charge providing the Contractor is advised before installation is made.

3.9.3 Location of lighting, convenience, telephone, power and communication outlets shall be subject to change, without extra cost to Owners, provided information is given prior to installation. No extra amount will be paid for extra labour and materials for relocating outlets up to 3000 mm from their original location nor will credits be anticipated where relocation up to 3000 mm reduces materials and labour. Other cases will be considered on their individual merits.

3.9.4 Coordinate location of boxes with latest architectural drawings and instructions to suit door swings, millwork, special equipment including appliances, printers, etc. prior to rough-in.

3.10 **Mounting Heights and Device Locations**

3.10.1 Refer to architectural drawings for exact location of electrical equipment and devices.

3.10.2 Architectural elevations take precedence over electrical elevations. If there are conflicts between architectural and electrical, adjust locations of electrical equipment at no additional cost to the owner.

3.10.3 Prior to roughing-in, the contractor is to mark locations of electrical equipment and devices for conflicts with architectural, studs, etc. If conflicts are noted, inform the consultant for a decision prior to commencing the rough-in.

3.10.4 Mounting heights of equipment and devices listed below is from finished floor to centreline of equipment, unless specified or indicated otherwise.

3.10.5 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

3.10.6 Install electrical equipment at following heights above finished floor (AFF). Dimensions are to centre of device unless indicated otherwise.

.1 Power door operator push buttons: 1000 mm.

.2 HVAC thermostats and manual HVAC controls: 1200 mm.

.3 Local switches, and manual lighting control devices:

.1 1100 mm.

.2 Locate on lock side of door.

.4 System furniture service fittings: to suit furniture layout.

.5 Wall receptacles:

.1 General: min. 400 mm AFF.

.1 Above top of counters: 175 mm.

.2 Above top of continuous baseboard heater, or mechanical heating/radiation units: 75 mm to bottom of device.

.3 In fan rooms, mechanical rooms, and electrical rooms: 1100 mm.

.2 Outlets in raceways or millwork to be located as per Architectural details.

.3 Door bell pushbuttons: 1100 mm.

.4 Panelboards: as indicated in Section 26 24 16.

.5 Emergency lighting remote heads: 300 mm below finished ceiling, or 2400 mm AFF for exposed areas or areas with ceiling height above 2750 mm (9 feet).

.6 Communications:

.1 Typical communication outlets (voice and data): 400 mm.

.2 Communications outlets for wall mounted telephones, intercom, or similar: 1100 mm.

.3 Television outlets: 200 mm below finished ceiling.

.4 Wall mounted public address speakers: 2100 mm.

.5 Clocks: 2100 mm.

.7 Access control card readers and keypads: 900 mm.

.8 Fire alarm manual pull stations: 1200 mm.

.9 Wall mounted fire alarm audible devices, including bells or horns:

.1 2300 mm to the top of the device in areas of ceiling height 2450 mm or greater.

.2 150 mm below the finished ceiling for ceiling heights less than 2450 mm, measured to the top of the device.

.10 Wall mounted fire alarm visible signal devices, including strobes: 2300 mm.

.11 Fire Alarm emergency telephones: 1400 mm.

3.11 **Manufacturer's Instructions**

3.11.1 Where the specifications call for an installation to be made in accordance with Manufacturer's recommendations, a copy of such recommendations shall be at all times be kept on the job site and be available to the Owner's Representative.

3.11.2 Follow manufacturer's instructions where they cover points now specifically indicated on the drawings and specifications. If they are in conflict with the drawings and specifications obtain clarification from the Consultant before starting work.

3.12 **Tests and Acceptance**

3.12.1 The operation of the equipment and electrical system does not constitute an acceptance of the work by the Owner. The final acceptance is to be made after the Contractor has adjusted his

equipment and demonstrated that it fulfills the requirements of the drawings and the specifications.

3.12.2 Testing of all systems shall be performed in the presence of the Owner's designated representative. The contractor shall give 72 hours advance notice to the Owner before beginning the tests.

3.12.3 Upon completion of the installation, the Contractor shall furnish certificates of approval from all authorities having jurisdiction, as applicable. Contractor shall demonstrate that work is complete and in perfect operating condition, with raceway and conduit systems properly grounded, wiring free from grounds, shorts, and that the entire installation is free for any physical defects.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Work in existing facilities.

1.1.2 Electrical demolition.

1.2 Related Requirements

1.2.1 Section 02 41 19 – Selective Demolition.

1.3 Scheduling

1.3.1 Refer to Section 01 14 00, and Section 01 73 00.

1.3.2 All work in the existing building, other than minor works required to permit construction of the new Work, is to be performed in such a manner as to not disrupt the building operations.

1.3.3 All systems are to be kept in full operation during normal building hours.

1.3.4 Coordinate any noise generating works that disrupt the building operation to be carried out after/before normal operating hours.

2. PRODUCTS

2.1 Materials

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

3. EXECUTION

3.1 Examination

3.1.1 Verification of Conditions

.1 Verify field measurements and circuiting arrangements are as shown on Drawings.

.2 Verify that abandoned wiring and equipment serve only abandoned facilities.

.3 Demolition drawings are based on casual field observation. Report discrepancies to the Consultant before disturbing existing installation.

.4 Beginning of demolition means installer accepts existing conditions.

3.1.2 Tracing Existing Electrical Circuits

.1 Trace all circuits in the area of work listed as existing, and verify existing conditions prior to any modifications as indicated.

.2 Where drawings indicate “connect to existing circuit”, use a spare breaker, where available. Otherwise, verify existing load with a meter and advise the Consultant if the additional load will cause a circuit to trip.

.3 Where provided panelboard schedules indicate "Existing Circuit" or similar, provide the correct description for the circuit. Existing Circuit will not be acceptable in the final panelboard schedules submitted as part of closeout submittals.

3.1.3 Existing Cabling in Return Air Plenums

.1 In ceilings being used as a return air-plenum, Contractor to review existing low-voltage cabling uncovered as part of the work.

.2 Immediately notify the Consultant if any cables identified are not plenum rated (i.e. CMP, or FT6 rated).

3.2 Preparation

3.2.1 Coordinate utility service outages with utility company.

3.2.2 Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

3.2.3 Existing electrical service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switch overs and connections. Obtain permission from Owner at least 24 hours before partially or completely disabling

system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.2.4 Existing Telephone System: Maintain existing system in service. Notify Owner at least 24 hours before partially or completely disabling system. Minimize outage duration. Make temporary connections to maintain service in areas adjacent to work area.

3.2.5 Existing Fire Alarm System: Maintain existing system in service. Minimize outage duration. Provide fire watch as required. Make temporary connections to maintain service in areas adjacent to work area.

3.3 **Demolition / Removal**

3.3.1 Disconnect electrical systems in walls, floors, and ceilings scheduled for removal.

3.3.2 Demolish and extend existing electrical work to Section 02 41 19, and this Section.

3.3.3 Remove, relocate, and extend existing installations to accommodate new construction.

3.3.4 Remove abandoned wiring to source of supply.

3.3.5 When relocating or removing equipment, should any circuits be abandoned, the conductors to these circuits must be removed or properly terminated as detailed in Ontario Electrical Safety Code (OESC) bulletin 12-25-1, or latest revision.

3.3.6 Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.

3.3.7 Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets which are not removed.

3.3.8 Disconnect and remove abandoned panelboards and distribution equipment.

3.3.9 Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

3.3.10 Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.

3.3.11 Repair adjacent construction and finishes damaged during demolition and extension work.

3.3.12 Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.3.13 Maintain continuity of existing services for other circuits/devices serving areas outside the Work area. Provide additional wiring/conduits/boxes etc. to suit existing services to be maintained and also implement new Work as detailed.

3.4 **Restoration**

3.4.1 Install relocated materials and equipment under the provisions of Division 01.

3.5 **Cleaning**

3.5.1 Clean and repair existing materials and equipment which remain or are to be reused.

3.5.2 Luminaires: Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts, and broken electrical parts.

3.5.3 Waste Management

.1 Turn over designated equipment to the Owner.

.2 Dispose of unwanted materials and equipment.

3.6 **Protection**

3.6.1 Maintain access to existing electrical installations which remain active. Modify installation or provide access panels as appropriate.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Building wire and cable.
- .1 Armoured cable.
- .2 Metal clad cable.
- .3 Wiring connectors and connections.

1.1.2 Permitted voltage drop for feeder and branch circuits.

1.2 References

1.2.1 CSA C22.1 - Canadian Electrical Code, Part I, Safety Standard for Electrical Installations
1.2.2 Ontario Electrical Safety Code
1.2.3 CSA C22.2 No. 0.3 - Test Methods for Electrical Wires and Cables.
1.2.4 CSA C22.2 No. 48-M90 (R2000) - Non-metallic Sheathed Cable.
1.2.5 CSA C22.2 No. 51 Armoured Cables.
1.2.6 CSA C22.2 No. 52-96 (R2000) - Underground Service-Entrance Cables.
1.2.7 CAN/CSA C22.2 No. 65-03 (CSA/UL/ANCE) – Wire Connectors.
1.2.8 CSA C22.2 No. 75-03 (CSA/UL/ANCE) - Thermoplastic-Insulated Wires and Cables.
1.2.9 CSA C22.2 No. 123 Aluminum Sheathed Cables.
1.2.10 CSA C22.2 No. 131 Type TECK 90 Cable.
1.2.11 NECA (National Electrical Contractors Association) - Standard of Installation.
1.2.12 NETA (International Electrical Testing Association) - ATS-2003 - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
1.2.13 CAN/ULC-S139-12 – Standard Method of Fire Test for Evaluation of Integrity of Electrical Power, Data and Optical Fibre Cables.

1.3 Coordination

1.3.1 Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

1.4 Qualifications

1.4.1 Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years' experience.

1.5 Regulatory Requirements

1.5.1 Conform to CSA C22.1.
1.5.2 Provide products listed and classified by CSA (Canadian Standards Association) as suitable for the purpose specified and indicated.

1.6 Site Conditions

1.6.1 Verify that field measurements are as indicated.
1.6.2 Conductor sizes are based on copper unless indicated as aluminum or "AL".
1.6.3 Wire and cable routing indicated is approximate unless dimensioned.

2. PRODUCTS

2.1 Manufacturers

2.1.1 BICC Phillips.
2.1.2 General Cable.
2.1.3 Nexans.
2.1.4 Prysmian.
2.1.5 Southwire.

2.2 Building Wire

2.2.1 RW90:

.1 Single copper conductor.
.2 Minimum #12 AWG for branch circuit wiring.
.3 Minimum #14 AWG for 120V control wiring.
.4 Chemically cross-linked polyethylene insulation.
.5 Rated for 90 degrees C, 600V
.6 Suitable for handling to minus 40 degrees C.
.7 For interior installations in conduit.

2.2.2 RWU90:
.1 Single copper conductor.
.2 Minimum 12 AWG for branch circuit wiring.
.3 Minimum 14 AWG for 120 V control wiring.
.4 Chemically cross-linked polyethylene insulation.
.5 Rated for 90 degrees C, 600 V
.6 Suitable for handling to minus 4 degrees C.
.7 For exterior installations in conduit.

2.2.3 T90 Nylon:
.1 Single copper conductor.
.2 Thin wall PVC insulation with nylon covering.
.3 Rated for 90 degrees C, 600V.
.4 May be used up to size 10 AWG for interior installations.
.5 Base conduit fill on RW90 cable diameters.

2.3 **Armoured Cable**

2.3.1 Description: Type AC.
2.3.2 Two, three or four copper conductors rated RW90, 1000 V.
2.3.3 Bare copper ground wire.
2.3.4 Insulation Voltage Rating: 600 volts.
2.3.5 Insulation Temperature Rating: 90 degrees C (194 degrees F).
2.3.6 Insulation Material: Thermoplastic.
2.3.7 Runs to be limited to fixture drops and in walls, maximum exposed run 1.5 m.
2.3.8 Do not daisy chain (leap frog) luminaires with armoured cable.

2.4 **Mineral Insulated (MI) Cables**

2.4.1 Pentair Pyrotenax 1850 series with 2 hour fire rating to ULC S139 and to meet Ontario Building Code Rule 3.2.7.10.
2.4.2 Alternates such as “Lifeline” installed in conduit may only be considered if listed by ULC under ULC Category Code ‘FHJRC’ after October 2014.

2.1 Acceptable alternate: VITALink MC Brand Type MC, manufactured by Marmon Wire & Cable Inc. (listed by ULC under ULC category code ‘FHJRC’, dated 19 May 2015).

2.2 **TECK90 Cable**

2.2.1 Single, three, or four conductors as indicated on drawings.
2.2.2 Cable to CAN/CSA-C22.2 No. 131.
2.2.3 Conductors:
.1 Grounding conductor: copper.
.2 Circuit conductors: copper, size as indicated.
2.2.4 Insulation: Cross-linked polyethylene (XLPE), type RW90, rating: 600 V.
2.2.5 Inner jacket: polyvinyl chloride.
2.2.6 Armour: interlocking aluminum.
2.2.7 Overall covering: thermoplastic.
2.2.8 Fastenings:
.1 One-hole steel straps to secure surface cables 50 mm diameter and smaller. Two-hole steel straps for cables larger than 50 mm diameter.
.2 Channel type supports for two or more cables at 1500 mm centres.
.3 Threaded rods: 6 mm diameter to support suspended channels.

2.2.9 Connectors: Watertight, approved for TECK cable.

2.3 **Wiring Termination**

2.3.1 Lugs, terminals, or screws used for termination of wiring to be suitable for copper conductors. Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring. Maintain phase sequence and colour coding throughout.

2.3.2 Splice wire, up to and including No. 6 gauge, with nylon insulated expandable spring type connectors.

.1 Thomas & Betts – Marr Max Series

2.3.3 Splice large conductors using compression type connections insulated with heat shrink sleeves.

.1 Thomas & Betts – 5400 Series lugs & heat shrink type #s series

2.4 **Conductors, Wires, and Cables**

2.4.1 Indoor wiring installed in conduit, unless otherwise noted: 600 volt "RW90 XLPE".

2.4.2 Wiring in channel back of fluorescent lighting fixtures: 600 volt type GTF or TEW.

2.4.3 Lighting and power branch circuit wiring:

.1 Copper, minimum No. 12 gauge.

.2 Home runs to lighting and receptacle panels, which exceed 22 m (75 feet) in length: minimum No. 10 gauge.

2.4.4 Size wires for 2 per cent maximum voltage drop to farthest outlet on a maximum 80 per cent loaded circuit.

2.4.5 Outdoor wiring: “RWU90 XLPE”.

2.4.6 Conductors shall be colour coded. Conductors No. 10 gauge and smaller shall have colour impregnated into insulation at time of manufacture. Conductors size No. 8 gauge and larger may be colour coded with adhesive colour coding tape but only black insulated conductors shall be employed in this case, except for neutrals which shall be white wherever possible.

2.4.7 Colour coding as follows:

.1 Phase "A" - Red

.2 Phase "B" - Black

.3 Phase "C" - Blue

.4 Control - Orange

.5 Ground - Green

.6 Neutral - White

2.4.8 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.

3. EXECUTION

3.1 **Examination**

3.1.1 Voltage Drop

.1 Ensure voltage drop in power and control conductors is in accordance with the requirements of the Electrical Code.

.2 Size conductors accordingly when sizes are not identified.

.1 Feeder conductors: maximum voltage drop of 2 per cent.

.2 Branch circuit conductors: maximum voltage drop of 3 per cent.

3.1.2 Verify that mechanical work likely to damage wire and cable has been completed.

3.1.3 Verify that raceway installation is complete and supported.

3.2 **Preparation**

3.2.1 Completely and thoroughly swab raceway before installing wire.

3.3 **Installation**

3.3.1 Route wire and cable as required to meet project conditions.

3.3.2 Install cable to CSA C22.1.

3.3.3 Conduit and cable supports

.1 All wiring to be installed in EMT at all exposed areas and in partitions unless otherwise specified.

.2 All mechanical equipment to be connected with liquid tight flexible conduit.

.3 Support cables above accessible ceiling, using spring metal clips to support cables from structure. Do not rest cable on ceiling panels.

3.3.4 Conductors

.1 Provide separate neutral for each circuit. Common neutrals not permitted.

.2 Use solid conductor for feeders and branch circuits 10 AWG and smaller.

.3 Use stranded conductors for control circuits.

.4 Use conductor not smaller than 12 AWG for power and lighting circuits.

.5 Use conductor not smaller than 16 AWG for control circuits.

.6 Armoured cable (commonly referred to as BX) is only to be used for light fixture connections and limited to maximum 1830 mm in length.

.7 Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 25 m.

3.3.5 Pulling conductors

.1 Pull all conductors into raceway at same time.

.2 Use suitable wire pulling lubricant for building wire 4 AWG and larger.

.3 Neatly train and lace wiring inside boxes, equipment, and panelboards.

.4 Protect exposed cable from damage.

3.3.6 Connectors

.1 Use suitable cable fittings and connectors.

.2 Clean conductor surfaces before installing lugs and connectors.

.3 Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

.4 Use split bolt connectors for copper conductor splices and taps 6 AWG and larger. Tape uninsulated conductors and connector with electrical tape to 150 per cent of insulation rating of conductor.

.5 Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.

.6 Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

3.4 **Identification**

3.4.1 Identify and colour code wire and cable to Section 26 05 53. Identify each conductor with its circuit number or other designation indicated.

3.4.2 Where colour-coded tape is utilized, apply a minimum of 50 mm (2 inches) at terminations, junction and pull boxes and conduit fittings. Do not paint conductors under any condition.

3.4.3 Utilize colour coding on bussing in panels and, switchgear, disconnects, and metering cabinets to match conductor colour coding.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Grounding electrodes and conductors.
1.1.2 Equipment grounding conductors.
1.1.3 Bonding.
1.1.4 The terms “connect” and “bond” are used interchangeably in this Specification and have the same meaning.

1.2 References

1.2.1 Canadian Standards Association
.1 CSA C22.1 - Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.
.2 CSA C22.2 No.0.4 - Bonding of Electrical Equipment.
.3 CSA C22.2 No. 41 - Grounding and Bonding Equipment.
1.2.2 Ontario Electrical Safety Code.
1.2.3 ANSI/TIA/EIA J-STD-607-A - Commercial Building Grounding (Earthing) and Bonding Requirements for Telecommunications.
1.2.4 Institute of Electrical and Electronics Engineers, Inc.: IEEE 81-1983 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System.

1.3 Performance Requirements

1.3.1 Grounding System Resistance: 5 ohms.
1.3.2 Provide all equipment grounding as required regardless of whether it has been shown on drawings or called for in this specification. Arrange grounds so that under normal operating conditions no injurious amount of current will flow in any grounding conductor.

1.4 Action Submittals

1.4.1 Product Data: Provide for grounding electrodes and connections.

1.5 Informational Submittals

1.5.1 Test Reports: Indicate overall resistance to ground and resistance of each electrode.
1.5.2 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 Closeout Submittals

1.6.1 Project Record Documents: Record actual locations of components and grounding electrodes.
1.6.2 Certificate of Compliance: Indicate approval of installation by authority having jurisdiction.

1.7 Qualifications

1.7.1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum three years’ experience.

1.8 Regulatory Requirements

1.8.1 Products: Listed and classified testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

2. PRODUCTS

2.1 Manufacturers

2.1.1 B-Line by Eaton.
2.1.2 Hubbell (Burndy).

2.1.3 Panduit.
2.1.4 Thomas & Betts.

2.2 **Grounding and Bonding Conductors**

2.2.1 Electrical grounding conductors shall be UL 83 insulated stranded copper, except that sizes #10 AWG and smaller shall be solid copper. Insulation colour shall be continuous green for all equipment grounding conductors.

2.2.2 Bonding conductors shall be ASTM B8 bare stranded copper, except that sizes #10 AWG and smaller shall be ASTM B1 solid bare copper wire.

2.3 **Splices and Termination Components**

2.3.1 Components shall meet or exceed CSA C22.2 No 41, and be clearly marked with the manufacturer, catalog number, and permitted conductor size(s).

2.4 **Ground Connections**

2.4.1 Above Grade:

.1 Bonding Jumpers: compression type connectors, using zinc-plated fasteners and external tooth lockwashers.

.2 Ground Busbars: Two-hole compression type lugs using tin-plated copper or copper alloy bolts and nuts.

2.5 **Ground Terminal Blocks**

2.5.1 At any equipment mounting location (e.g. backboards and hinged cover enclosures) where rack-type ground bars cannot be mounted, provide screw lug-type terminal blocks.

2.6 **Splice Case Ground Accessories**

2.6.1 Splice case grounding and bonding accessories shall be supplied by the splice case manufacturer when available. Otherwise, use 6 AWG insulated ground wire with shield bonding connectors.

2.7 **Mechanical Connectors**

2.7.1 Material: Bronze.

3. **EXECUTION**

3.1 **Installation**

3.1.1 General

.1 Ground in accordance with the Ontario Electrical Safety Code, as shown on drawings, and as hereinafter specified.

.2 System Grounding:

.1 Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and at the related transformers.

.2 Separately derived systems (transformers downstream from the service entrance): Ground the secondary neutral.

.3 Equipment Grounding: Metallic structures (including ductwork and building steel), enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits shall be bonded and grounded.

.4 Ground electrical equipment and wiring in accordance with Ontario Electrical Safety Code and Local Inspection Authority's Rules and Regulations.

.5 Install grounding conductors, outside Electric Rooms and Electrical Closets in conduit and conceal where possible. Make connections to water mains, all metallic piping systems, neutral and equipment with brass, copper or bronze bolts and connectors or weld using Cadweld or Thermoweld processes.

.6 Provide grounding conductors, sized as per Code, and connect to grounding bus or water main wherever non-raceways are installed.

3.1.2 Provide grounding electrode conductor and connect to reinforcing steel in foundation footing. Bond steel together.

3.1.3 Provide bonding to meet Regulatory Requirements.

3.1.4 Bond together metal siding not attached to grounded structure; bond to ground.

3.1.5 Install ground grid under access floors indicated.

3.1.6 Bond together each metallic raceway, pipe, duct and other metal object entering space under access floors. Bond to underfloor ground grid. Use #6 AWG bare copper conductor.

3.1.7 Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

3.1.8 Ground Resistance

.1 Grounding system resistance to ground not to exceed 5 ohms. Make necessary modifications or additions to the grounding electrode system for compliance without additional cost to the Owner. Final tests shall assure that this requirement is met.

.2 Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized and shall be made in normally dry conditions not less than 48 hours after the last rainfall. Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together below grade. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

.3 Services at power company interface points shall comply with the power company ground resistance requirements.

3.1.9 Inaccessible Grounding Connections

.1 Make grounding connections, which are buried or otherwise normally inaccessible (except connections for which periodic testing access is required) by exothermic weld.

3.1.10 Secondary Equipment and Circuits

.1 Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.

.2 Metallic Piping, Building Steel, and Supplemental Electrode(s):

.1 Provide a grounding electrode conductor sized per code between the service equipment ground bus and all metallic water and gas pipe systems, building steel, and supplemental or made electrodes. Jumper insulating joints in the metallic piping. All connections to electrodes shall be made with fittings that conform to CSA C22.2 No 41.

.2 Provide a supplemental ground electrode and bond to the grounding electrode system.

.3 Conduit Systems:

.1 Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.

.2 Non-metallic conduit systems shall contain an equipment grounding conductor, except that non-metallic feeder conduits which carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment need not contain an equipment grounding conductor.

.3 Conduit containing only a grounding conductor, and which is provided for mechanical protection of the conductor, shall be bonded to that conductor at the entrance and exit from the conduit.

.4 Feeders and Branch Circuits: Install equipment grounding conductors with all feeders and power and lighting branch circuits.

.5 Boxes, Cabinets, Enclosures, and Panelboards:

.1 Bond the equipment grounding conductor to each pull box, junction box, outlet box, device box, cabinets, and other enclosures through which the

conductor passes (except for special grounding systems for intensive care units and other critical units shown).

.2 Provide lugs in each box and enclosure for equipment grounding conductor termination.

.3 Provide ground bars in panelboards, bolted to the housing, with sufficient lugs to terminate the equipment grounding conductors.

.6 Receptacles shall not be grounded through their mounting screws. Ground with a jumper from the receptacle green ground terminal to the device box ground screw and the branch circuit equipment grounding conductor.

.7 Raised Floors: Provide bonding of all raised floor components.

3.1.11 Corrosion Inhibitors

.1 When making ground and ground bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.1.12 Conductive Piping

.1 Bond all conductive piping systems, interior and exterior, to the building to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.2 **Field Quality Control**

3.2.1 Perform inspections and tests listed in NETA ATS, Section 7.13.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Conduit and equipment supports.
1.1.2 Anchors and fasteners.

1.2 References

1.2.1 CSA C22.1 - Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.
1.2.2 Ontario Electrical Safety Code.
1.2.3 CECA - Canadian Electrical Contractors Association.

1.3 Closeout Submittals

1.3.1 Submit the following in the Operation and Maintenance Manual for products used over the course of the project:
- .1 Product Data: Provide manufacturer's catalogue data for fastening systems.
- .2 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.4 Regulatory Requirements

1.4.1 Provide products listed and classified by Canadian Standards as suitable for purpose specified and shown.

2. PRODUCTS

2.1 Manufacturers

2.1.1 B-line by Eaton.
2.1.2 Burndy Canada Ltd. (Hubbell).
2.1.3 Erico Caddy.
2.1.4 E. Myatt & Co. Inc.
2.1.5 Hilti Canada.
2.1.6 Thomas & Betts.
2.1.7 Unistrut.
2.1.8 Alternates as considered by the Consultant.

2.2 General

2.2.1 All supporting devices, strut channel, threaded rod, anchors, etc. to be used shall be of the “hot dipped” galvanized type. Electrogalvanized components will not be accepted.
2.2.2 Materials and Finishes: Provide adequate corrosion resistance.
2.2.3 Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
2.2.4 Anchors and Fasteners:
- .1 Concrete Structural Elements: Use expansion anchor sand preset inserts.
- .2 Steel Structural Elements: Use beam clamps and welded fasteners.
- .3 Concrete Surfaces: Use self-drilling anchors and expansion anchors.
- .4 Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.
- .5 Solid Masonry Walls: Use expansion anchors and preset inserts.
- .6 Sheet Metal: Use sheet metal screws.
- .7 Wood Elements: Use wood screws.

2.3 Anchors and Hangers

2.3.1 Hangers for electrical conduit shall be galvanized after fabrication.
2.3.2 Perforated strapping: not permitted.

2.4 **Inserts**

2.4.1 Use only factory-made threaded or toggle type.

2.4.2 Where inserts cannot be placed, use factory-made expansion shields for light weights, where approved by the Consultant.

2.4.3 Do not use powder-activated tools except with the written permission of the Consultant.

2.5 **Sleeves**

2.5.1 Through interior walls, use standard weight steel pipes, conduit, or 18 gauge galvanized steel. Cut flush with finished surfaces. Check room finish schedules.

2.5.2 Through exterior walls above grade, floors, and roof use standard weight steel pipes, machine cut, flush with finished surface inside and to suit flashing outside.

2.5.3 Through exterior walls below grade, water-proofed floors, and other water-proof walls, use heavy weight cast iron pipes, machine cut. Extend sleeves 100 mm (4 inches) above finished floors, and cut flush with underside of floor.

2.6 **Steel Channel**

2.6.1 Description: Painted steel.

2.7 **Supports**

2.7.1 Steel supports in wet or dry locations to be galvanized after fabrication.

2.7.2 Where galvanized members are bolted together use cadmium plated bolts.

2.7.3 For hanger rods use minimum 10 mm (3/8 inch) diameter steel threaded rod. Use clevis type attachment.

2.7.4 Provide minimum 100 mm (4 inch) high concrete bases for all floor mounted equipment.

2.8 **Supports and Bases**

2.8.1 Submit proposed method of attachment of hangers and beam clamps, to cellular steel deck for approval before proceeding with Work.

2.8.2 Supply and erect special structural Work required for the installation of electrical equipment. Provide anchor bolts and other fastenings unless noted otherwise. Mount equipment required to be suspended above floor level, where details are not shown, on a frame or platform bracketed from the wall or suspended from the ceiling. Carry supports to either the ceiling or the floor, or both as required, at locations where, because wall thickness is inadequate, it is not permitted to use such brackets.

2.8.3 Electrical panels, switches or other electrical equipment shall be complete with suitable bases or mounting brackets.

2.8.4 Provide channel or other metal supports where necessary, to adequately support lighting fixtures. Do not use wood unless wood forms part of the building structure.

2.8.5 Support hangers, in general, from inserts in concrete construction or from building structural steel beams, using beam clamps. Provide additional angle or channel steel members, required between beams for supporting conduits and cables.

2.8.6 Provide any additional supports required from existing concrete construction for any piping or equipment, by drilling same and installing expansion bolt cinch anchors.

2.8.7 Do not use explosive drive pins in any section of Work without obtaining prior approval.

2.9 **Threaded Rod Covers**

2.9.1 Protect cable from abrasion caused by contact with threaded rod.

2.9.2 To meet UL 94V-0 specifications.

2.9.3 Colour: Black.

2.9.4 Example product: Panduit TRC18FR-X20Y.

3. EXECUTION

3.1 **Installation**

3.1.1 Obtain permission from Consultant before drilling or cutting structural members.

3.1.2 Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

3.1.3 Install surface-mounted cabinets and panelboards with minimum of four anchors.

3.1.4 In wet and damp locations use steel channel supports to stand cabinets and panelboards 25 mm (1 inch) off wall.

3.1.5 Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

3.1.6 Where threaded rod is exposed in data centre, provide threaded rod cover.

3.1.7 Provide inserts, sleeves, equipment supports and hangers, sealing of sleeves and openings, as required for all electrical work. Ensure that the load onto structures does not exceed the maximum loading per square metre as shown on Structural Drawings or as directed by the Consultant.

3.1.8 Provide insets, holes, anchor bolts and sleeves in time when walls, floors, and roof are erected.

3.1.9 Provide sleeves at each place where electrical devices pass through a wall, floor or roof.

3.1.10 Size sleeves to provide 13 mm (1/2 inches) clearance all round.

3.1.11 Sleeves are not required in interior walls and dry area floors where conduit is installed ahead of floor construction.

3.1.12 Seal all openings and sleeves after installation of equipment:

.1 With an approved material to maintain fire rating where sleeves and openings pass through fire separations and floors.

.2 With an approved material to maintain fire rating for sleeves and openings provided for future equipment.

3.1.13 Provide all flashing and waterproofing for sleeves through roof and exterior walls to the requirements of Division 07.

3.1.14 Place insets only in structural members and not in the finishing material.

3.1.15 Secure all supports and hangers to the structure unless noted otherwise.

3.1.16 Suspend hanger rods from approved concrete inserts and from beam clamps. Obtain Consultant's approval before welding to steel structural members.

3.1.17 Secure supports to precast concrete members to inserts originally cast into the members or by rods passing between the members and connected to a steel plate bearing.

3.1.18 Sealing of Sleeves and Openings to Maintain Fire Rating

.1 Use Dow-Corning #3-6548 'Silicone RTV' foam, Thomas & Betts "Flamesafe' firestopsystem, Electrovert 'Flameseal" firestop putty, or approved equal materials installed in accordance with the manufacturer's specifications and recommendations.

.2 Submit data sheets for review prior to installation.

3.1.19 Supports

.1 All conduits, panels, etc. to be securely and adequately supported.

.2 Where more than three conduits run together, conduit racks to be used.

.3 Single runs of conduit to be supported by galvanized conduit straps or ring bolt type hangers. Tie wire or perforated metal strap hangers will NOT be accepted.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Metal conduit.
1.1.2 Flexible metal conduit.
1.1.3 Liquid tight flexible metal conduit.
1.1.4 Electrical metallic tubing.
1.1.5 Fittings and conduit bodies.

1.2 References

1.2.1 Canadian Standards Association
.1 CSA C22.1 – Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.
.2 Ontario Electrical Safety Code.
.3 CAN/CSA-C22.2 No. 18 – Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
.4 CSA C22.2 No. 45 – Rigid Metal Conduit.
.5 CSA C22.2 No. 45.1 – Rigid Metal Conduit - Steel.
.6 CSA C22.2 No. 56 – Flexible Metal Conduit and Liquid - Tight Flexible Metal Conduit.
.7 CSA C22.2 No. 83.1 – Electrical Metallic Tubing - Steel.
.8 CSA C22.2 No. 211.1 – Rigid Types EB1 and DB2/ES2 PVC Conduit.
.9 CSA C22.2 No.211.2 – Rigid PVC (Unplasticized) Conduit.
.10 CSA C22.2 No. 211.3 – Reinforced Thermosetting Resin Conduit (RTRC) on Fittings.
.11 CSA C22.2 No. 227.1 – Electrical Nonmetallic Tubing.
.12 CSA C22.2 No. 227.2.1 – Liquid-Tight Flexible Nonmetallic Conduit.

1.3 Project Record Documents

1.3.1 Accurately record actual routing of conduits larger than 51 mm.
1.3.2 Accurately record actual routing of all conduits installed below grade, regardless of size, including whether direct buried or installed in concrete duct bank.

1.4 Regulatory Requirements

1.4.1 Provide products listed and classified by CSA (Canadian Standards Association) as suitable for purpose specified and shown.

1.5 Delivery, Storage, and Handling

1.5.1 Accept conduit on site. Inspect for damage.
1.5.2 Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.6 Project Conditions

1.6.1 Verify that field measurements are as shown on drawings.
1.6.2 Verify routing and termination locations of conduit prior to rough-in.
1.6.3 Conduit routing is shown on drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

2. PRODUCTS

2.1 Manufacturers

2.1.1 Where products are listed in this section based on a single manufacturer, the equivalent product from the following manufacturers is acceptable:
.1 Appleton.
.2 Columbia-MBF.
.3 Crouse-Hinds by Eaton.

.4 Hubbell.
.5 Thomas & Betts Ltd.

2.2 **Conduit Requirements**
2.2.1 Minimum size: 21 mm (3/4 inch) unless otherwise specified.
2.2.2 Outdoor locations, above grade: use rigid steel.
2.2.3 Wet and damp locations: use rigid and non-metallic tubing.
2.2.4 Dry locations:
.1 Concealed: Use electrical metallic tubing
.2 Exposed: Use electrical metallic tubing.

2.3 **Metal Conduit**
2.3.1 Rigid Steel Conduit: C22.2 No. 45.1.
2.3.2 Rigid Aluminum Conduit: C22.2 No. 45.
2.3.3 Intermediate Metal Conduit (IMC): Rigid steel.
2.3.4 Fittings and Conduit Bodies: Material to match conduit.

2.4 **Flexible Metal Conduit**
2.4.1 Description: Interlocked steel construction.
2.4.2 Fittings: CSA C22.2 No. 56.

2.5 **Liquid Tight Flexible Metal Conduit**
2.5.1 Description: Interlocked steel aluminum construction with PVC jacket.
2.5.2 Fittings: CSA C22.2 No. 56.

2.6 **Electrical Metallic Tubing (EMT)**
2.6.1 Description: CSA C22.2 No. 83.1; galvanized tubing.
2.6.2 Fittings and Conduit Bodies: CSA C22.2 No. 83.1; steel type.

2.7 **Electrical Nonmetallic Tubing (ENT)**
2.7.1 Not permitted.

2.8 **Conduit, Fittings, and Accessories**
2.8.1 Conduit accessories, conduits and fittings conforming to CSA Standard C22.2 No. 18-1972.
2.8.2 Rigid conduit bushings:
.1 Thomas & Betts Ltd. - Series 5031.
2.8.3 EMT Connectors:
.1 Thomas & Betts Ltd. - Steel City TC 121E Series.
2.8.4 Ground Bushings:
.1 Thomas & Betts – Blackjack or 1220 Series.
2.8.5 Flexible conduit connectors:
.1 Thomas & Betts Ltd. - Series 3110.
.2 EMT couplings: steel concrete tight to match connectors.
2.8.6 Terminate rigid conduit entering boxes or enclosures with nylon insulated steel threaded bushings.
.1 Thomas & Betts – 8125 Series.
2.8.7 Terminate EMT entering boxes or enclosures with nylon insulated steel concrete tight connectors.
2.8.8 Terminate flexible conduit entering boxes or enclosures with nylon insulated steel connectors.
.1 Thomas & Betts – 5332 Series.

3. EXECUTION

3.1 **Installation**
3.1.1 Install conduit to CSA C22.1.

3.1.2 Arrangement and supports
- .1 Arrange supports to prevent misalignment during wiring installation.
- .2 Arrange conduit to maintain headroom and present neat appearance.
- .3 Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- .4 Group related conduits; support using conduit rack.
- .5 Construct rack using steel channel; provide space on each for 25 per cent additional conduits.
- .6 Fasten conduit supports to building structure and surfaces to Section 26 05 29.
- .7 Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports
- .8 Do not attach conduit to ceiling support wires.
- .9 Route exposed conduit parallel and perpendicular to walls.
- .10 Route conduit installed above accessible ceilings parallel and perpendicular to walls.
- .11 Route conduit in and under slab from point-to-point.
- .12 Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- .13 Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.

3.1.3 Clearances
- .1 Maintain adequate clearance between conduit and piping.
- .2 Maintain 300 mm (12 inch) clearance between conduit and surfaces with temperatures exceeding 40 degrees C.

3.1.4 Conduit bends
- .1 Install no more than equivalent of three 90 degree bends between boxes.
  - .1 Use conduit bodies to make sharp changes in direction, as around beams.
  - .2 Use hydraulic one-shot bender to fabricate bends in metal conduit larger than 50 mm size.

3.1.5 Install wall entrance seals where conduits pass through exterior walls below grade.

3.1.6 Provide expansion coupling in conduit runs at building expansion joints and in long runs subject to thermal expansion, all in accordance with manufacturer recommendations.

3.1.7 Cut conduit square using saw or pipe cutter; de-burr cut ends.

3.1.8 Bring conduit to shoulder of fittings; fasten securely.

3.1.9 Use suitable caps to protect installed conduit against entrance of dirt and moisture.

3.1.10 Use conduit hubs or sealing locknuts to fasten conduit and to cast boxes.

3.1.11 Provide suitable pull string in each empty conduit except sleeves and nipples.

3.1.12 Ground and bond conduit to Section 26 05 26.

3.1.13 Identify conduit to Section 26 05 53.

3.1.14 Wiring Methods
- .1 Install wiring in conduit unless otherwise specified.
- .2 Install wiring and conduit work in a concealed manner. Surface conduit work is not permitted unless specifically noted.
- .3 Use thin wall conduit, up to and including 53 mm (2 inch) conduit size, for branch circuit and feeder wiring in ceilings, furred spaces, and in hollow walls and partitions. Use rigid galvanized steel conduit for wiring in poured concrete, where exposed, and for conduit 65 mm or larger. Use rigid PVC conduit for wiring in slabs on grade and wiring below grade.
- .4 Aluminium conduit may be used, in lieu of rigid steel conduit, in clean and dry locations, but shall not be used in poured concrete, or for signal and intercommunication systems wiring.
- .5 Flexible conduit and armoured cable will be accepted for a maximum length of 1500 mm for final connection to lighting fixtures. Do not connect from fixture to fixture.

.6 Conduit manufacturer's touch-up enamel shall be used to repair all scratches and gouges on epoxy-coated conduit.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Wall and ceiling outlet boxes.

1.1.2 Pull and junction boxes.

1.2 Related Requirements

1.2.1 Section 26 09 23 – Lighting Control Devices.

1.2.2 Section 26 27 26 – Wiring Devices: Wall plates in finished areas, floor box service fittings, fire-rated poke-through fittings, and access floor boxes.

1.3 References

1.3.1 CSA C22.1 - Canadian Electrical Code, Part I, Safety Standard for Electrical Installations

1.3.2 Ontario Electrical Safety Code.

1.3.3 CAN/CSA-C22.2 No. 18 - Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.

1.3.4 CSA C22.2 No. 18.1 (CSA/UL/ANCE) - Metallic Outlet Boxes.

1.3.5 CSA C22.2 No. 40 - Cutout, Junction and Pull Boxes.

1.3.6 CAN/CSA-C22.2 No. 85 - Rigid PVC Boxes and Fittings.

1.4 Closeout Submittals

1.4.1 Record actual locations and mounting heights of outlet, pull, and junction boxes on project record documents.

1.5 Regulatory Requirements

1.5.1 Provide products listed and classified by CSA (Canadian Standards Association) as suitable for the purpose specified and indicated.

2. PRODUCTS

2.1 Outlet Boxes

2.1.1 Sheet Metal Outlet Boxes: CSA C22.2 No. 18, galvanized steel.

.1 Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 13 mm male fixture studs where required.

.2 Concrete Ceiling Boxes: Concrete type.

2.1.2 Non-metallic Outlet Boxes: CSA C22.2 No. 18.

2.1.3 Cast Boxes: CSA C22.2 No. 18, Type FD, aluminum. Provide gasketed cover by box manufacturer. Provide threaded hubs.

2.1.4 Wall Plates for Finished Areas: As specified in Section 26 27 26.

2.2 Pull Boxes and Junction Boxes

2.2.1 Sheet Metal Boxes: CSA C22.2 No. 18, galvanized steel.

2.2.2 Surface Mounted Cast Metal Box: CSA C22.2 No. 18, Type 4; flat-flanged, surface mounted junction box:

.1 Material: Cast aluminum.

.2 Cover: Provide with ground flange, neoprene gasket, and stainless steel cover screws.

2.3 Outlet Boxes

2.3.1 Conform to CSA C22.2 No. 18.

2.3.2 Ceiling boxes: 103 mm (4 inch) octagon or square, complete with fittings, where required to support fixtures.

2.3.3 Switch and receptacle boxes:

.1 103 mm (4 inch) square with plaster ring, where flush mounted in plaster walls.

.2 Iberville 1104 series box, or equal, where flush mounted in wood or drywall, with stud fasteners as required.

.3 Masonry boxes in masonry walls.

2.3.4 Where boxes are surface mounted in unfinished areas they shall be FS conduits.

2.3.5 Standard outlet boxes manufactured from code gauge galvanized steel.
2.3.6 Provide a suitable outlet box for each light, switch, receptacle or other outlet, approved for the particular area it is to be installed.
2.3.7 Support outlet boxes independently of conduit and cable.
2.3.8 Locate outlet boxes, mounted in hung ceiling space, so they do not obstruct or interfere with the removal of lay-in ceiling tiles.
2.3.9 Offset outlet boxes, shown back to back in partitions, horizontally a minimum 150 mm (6 inch) to minimize noise transmission between adjacent rooms.
2.3.10 Use gang boxes at locations where more than one device, of the same system only, is to be mounted. Utilize separate boxes for each system.
2.3.11 Use tile wall covers where 103 mm (4 inch) square outlet boxes are installed in exposed concrete or cinder block in finished areas.
2.3.12 Provide flush mount boxes, panels, cabinets and electrical devices, which are installed in finished areas, with suitable flush trims and doors or covers, unless specifically noted otherwise.
2.3.13 Provide pre-formed polyethylene vapour barriers for all boxes located in walls with internal vapour barriers.

3. EXECUTION

3.1 Examination

3.1.1 Verify locations of floor boxes prior to rough-in.

3.2 Installation

3.2.1 Install boxes to CSA C22.1.
3.2.2 Install in locations as shown on drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.
3.2.3 Set wall mounted boxes at elevations to accommodate mounting heights indicated.
3.2.4 Electrical boxes are shown on drawings in approximate locations unless dimensioned. Adjust box location up to 3 m (10 feet) if required to accommodate intended purpose.
3.2.5 Orient boxes to accommodate wiring devices oriented as specified in Section 26 27 26.
3.2.6 Maintain headroom and present neat mechanical appearance.
3.2.7 Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.
3.2.8 Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 150 mm (6 inch) from ceiling access panel or from removable recessed luminaire.
3.2.9 Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods.
3.2.10 Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
3.2.11 Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.
3.2.12 Align adjacent wall mounted outlet boxes for switches, thermostats, and similar devices.
3.2.13 Use flush mounting outlet box in finished areas.
3.2.14 Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.
3.2.15 Do not install flush mounting box back-to-back in walls; provide minimum 150 mm separation. Provide minimum 600 mm separation in acoustic rated walls.
3.2.16 Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.
3.2.17 Use stamped steel bridges to fasten flush mounting outlet box between studs.
3.2.18 Install flush mounting box without damaging wall insulation or reducing its effectiveness.
3.2.19 Use adjustable steel channel fasteners for hung ceiling outlet box.
3.2.20 Do not fasten boxes to ceiling support wires.
3.2.21 Support boxes independently of conduit.
3.2.22 Use gang box where more than one device is mounted together. Do not use sectional box.
3.2.23 Use gang box with plaster ring for single device outlets.
3.2.24 Use cast outlet box in exterior locations exposed to the weather.

3.2.25 Use cast outlet box in wet locations.
3.2.26 Set floor boxes level.
3.2.27 Large pull boxes: Use hinged enclosure in interior dry locations, surface-mounted cast metal box in other locations.

3.3 **Adjusting**
3.3.1 Adjust floor box flush with finish flooring material.
3.3.2 Adjust flush-mounting outlets to make front flush with finished wall material.
3.3.3 Install knockout closures in unused box openings.

3.4 **Cleaning**
3.4.1 Clean interior of boxes to remove dust, debris, and other material.
3.4.2 Clean exposed surfaces and restore finish.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Metal Raceway is an enclosed pathway used for surface distribution of branch circuit electrical wiring, and cabling for voice, data, multi-media, low voltage, and optical fiber. Raceway is typically installed in existing building structures, or after construction is complete. A complete raceway system includes raceway, covers, mounting hardware, various fittings, and outlet boxes installed at specific locations. Specific codes and standards apply to electrical wires and telecommunications cables that are deployed within metal raceway. Compliance to codes and standards is required for installation, grounding and bonding, and cable deployment.

1.2 Related Requirements

1.2.1 Section 26 05 33.13 – Conduit for Electrical Systems.
1.2.2 Section 26 05 33.16 – Boxes for Electrical Systems.

1.3 Quality Assurance

1.3.1 Product free from defects in material or workmanship.
1.3.2 Materials and work specified in this document shall comply with, and are not limited to the codes, standards, and regulations listed below.
.1 CSA C22.1 - Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.
.2 National Electrical Manufacturer's Association (NEMA)
.1 ANSI/NEMA WD-6-2002: Wiring Devices – Dimensional Requirements
.2 NEMA 250-2003: Enclosures for Electrical Equipment.
1.3.3 Performance Requirements:
.1 Metal raceway and fittings UL Listed and CSA certified.

1.4 Submittals

1.4.1 Product Data Sheet.
1.4.2 Manufacturer's Instructions.
1.4.3 Product Catalog Literature.
1.4.4 Product Drawings.

1.5 Warranty

1.5.1 Product is warranted free of defects in material or workmanship.
1.5.2 Product is warranted to perform the intended function within design limits.

2. PRODUCTS

2.1 Manufacturers

2.1.1 Wiremold Legrand.
2.1.2 Hubbell.
2.1.3 Thomas & Betts Canada.

2.2 Surface Mounted Raceway, General

2.2.1 The raceway and all system components must be UL Listed and exhibit non-flammable self-extinguishing characteristics tested to comparable specifications of UL94V-0. The raceway base and cover shall be manufactured by rigid compound, available in ivory or white colours, and allow for field painting.

2.3 Metal Raceway

2.3.1 Metal raceway shall be a one-piece design with base and cover, factory assembled, with mounting hardware and instructions included.

2.3.2 Metal raceway, cover, surface boxes, shall be a formed steel construction with a thickness of 0.040", and zinc plated. Related fittings shall be galvanized on all surfaces.
2.3.3 Metal raceway, cover, and related fittings shall have an Ivory color powder coat paint finish on all external surfaces.
2.3.4 Have tools available for field cutting and bending.
2.3.5 Assembly and disassembly of raceway base, cover, and fittings requiring no special tools.
2.3.6 Available fittings including couplings, internal and external elbows, tees, entrance fittings, conduit adapters and bushings.
2.3.7 Available fittings including internal, external and flat elbows, and tee fitting, with a 1 ½" radius to accommodate communications UTP and fiber cabling minimum bend radius requirements.
2.3.8 Installed fittings designed to overlap the raceway to cover exposed or uneven edges from field cutting.

2.4 **Device Boxes**
2.4.1 Compatible device boxes shall have a removable knockout portion to permit metal raceway entry and exit.
2.4.2 Device boxes available in standard NEMA single- and double-gang, and multiple gang up to six-gang. Device box depth shall range from 1.125" to 2.75".
2.4.3 Device boxes shall have a single seam construction with rounded corners to eliminate sharp edges.
2.4.4 Assembled device box front face design to permit flush mounting of standard wall plates to minimize perimeter profile exposure.
2.4.5 Device boxes shall have threaded standoff posts attached to the base, to facilitate mounting of covers with short screws for ease of alignment during installation.

3. EXECUTION

3.1 **Preparation**
3.1.1 Submit layout drawings of the raceway system for reviewed prior to installation.
3.1.2 Installation of metal raceway in wet areas is not permitted.
3.1.3 Manufacturer's instructions for installing raceway and fittings shall be followed by the installer.
3.1.4 All wall surfaces, or other permanent structures to which raceway is mounted shall be finished complete.

3.2 **Installation**
3.2.1 Mount base and cover together to wall or structure using the appropriate fasteners and clips, per manufacturer's instructions.
3.2.2 Securely support raceway in intervals not exceeding 3 m (10 feet) or per manufacturer's instructions.
3.2.3 Install fittings and device boxes in the specified locations, per manufacturer's instructions and per contract drawing specifications.
3.2.4 Completed raceway installation shall be mechanically continuous and connected to all electrical outlets, device boxes, and enclosures with no gaps or exposed cuts.
3.2.5 Provide insulated ground wire for power raceways per OESC requirements. Raceway shall not be used as the primary ground path.
3.2.6 Prior to wire and cable installation, the raceway system shall be installed complete, including insulating bushings, adapters, fittings, outlets, boxes, and enclosures. Unused raceway openings shall be closed.
3.2.7 Make wiring connections with the proper approved insulated wire connectors or lugs. Exposed conductors at harness wiring junctions are not permitted regardless of connection method.
3.2.8 Provide a physical barrier in raceway and boxes to separate power and communication wiring.

3.2.9 Install covers on raceway, boxes and fittings after wiring is complete, or if wire and cable installation is to be done at a later date.

3.3 **Field Quality Control**

3.3.1 Verify layout of system to contract drawings.

3.3.2 Raceway system shall be free of dents, scratches, bare metal edges, and exposed uneven cuts.

3.3.3 Securely fasten all outlets, boxes, and enclosures walls or permanent structures.

3.3.4 Verify that all wiring junctions or connections have no exposed conductors prior to energizing the circuits.

3.3.5 Verify that all bonding locations are code and standards compliant.

3.3.6 Verify that power and communications wiring are separated by a physical barrier in raceway and boxes.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Nameplates and labels.
1.1.2 Wire and cable markers.
1.1.3 Conduit markers.
1.1.4 Receptacle labels.
1.1.5 Signage.

1.2 Related Requirements

1.2.1 Section 27 05 53 – Identification for Communications Systems.

1.3 Submittals

1.3.1 Product Data: Provide catalogue data for nameplates, labels, and markers.
1.3.2 Provide shop drawings of nameplates for Consultant's review prior to fabrication (scale 1:1)
1.3.3 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation and installation of Product.

1.4 Regulatory Requirements

1.4.1 Provide products listed and classified by CSA (Canadian Standards Association) as suitable for the purpose specified and indicated.

2. PRODUCTS

2.1 Nameplates and Labels

2.1.1 Nameplates:
- .1 Engraved three-layer laminated plastic, letters on contrasting background.
- .2 Colours to match existing building system, where applicable. If no building system exists, use the following:
  - .1 347/600 Volt System: White text on Blue Background.
  - .2 230/400 Volt System: White text on Blue Background.
  - .3 120/208 Volt System: Black text on White Background.
  - .4 Fire Detection System: White text on Red Background.
  - .5 Emergency Lighting System: Red text on White Background.
  - .6 LV Systems: White text on Green Background.
  - .7 120/208 Volt Uninterruptable Power Supply (UPS): White text on Orange Background.
- .3 Confirm colours with Engineer prior to ordering nameplates.

2.1.2 Equipment Nameplates to indicate:
- .1 Equipment/Panelboard ID
- .2 Ampacity.
- .3 Voltage
- .4 Number of Phases
- .5 Number of wires in system
- .6 Interrupting Capacity
- .7 Size, number of poles, Panelboard ID, and circuit number of upstream overcurrent protection device.
  - .1 Location of upstream device if not in the same room.

2.1.3 Locations:
- .1 Distribution panelboards, and individual distribution panelboard branch breakers.
- .2 Receptacle panelboards.
- .3 Each electrical distribution and control equipment enclosure.
- .4 Uninterruptible Power Supply.

.5 Mechanical Equipment.
.6 UPS Receptacles.
.7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
.8 Terminal cabinets, junction boxes, and pull boxes: indicate system and voltage.
.9 Transformers: indicate capacity, primary and secondary voltages.

2.1.4 Letter Size:
.1 Use 3 mm letters for identifying individual equipment and loads.
.2 Use 6 mm letters for identifying grouped equipment and loads.

2.1.5 Labels:
.1 Mechanically fastened with sheet metal screws, with 5 mm white letters on black background.
.2 White letters on red background for UPS and equipment, and devices downstream of UPS.
.3 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
.4 Wording on nameplates and labels to be approved by the Engineer prior to manufacture.
.5 Allow for minimum of twenty-five (25) letters per nameplate and label.
.6 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
.7 Terminal cabinets and pull boxes: indicate system and voltage.

2.2 Wiring Identification

2.2.1 Identify wiring with permanent indelible identifying markings, numbered, on both ends of phase conductors of feeders and branch circuit wiring.
2.2.2 Maintain phase sequence and colour coding throughout.
2.2.3 Colour coding: to CSA C22.1.
2.2.4 Use colour coded wires in communication cables, matched throughout system.

2.3 Wire Markers

2.3.1 Description: tape, split sleeve, or tubing type wire markers.
2.3.2 Locations: Each conductor at panelboard gutters, pull boxes, outlet and junction boxes and each load connection.
2.3.3 Legend:
.1 Power and Lighting Circuits: Branch circuit or feeder number indicated on drawings.
.2 Control Circuits: Control wire number indicated on shop drawings.

2.4 Conduit Markers

2.4.1 Colour code conduits, boxes and metallic sheathed cables.
2.4.2 Location: Provide markers for each conduit longer than 2 m.
2.4.3 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
2.4.4 Colours to match equipment nameplate background colour:
.1 347/600 Volt System: Blue.
.2 230/400 Volt System: Blue.
.3 120/208 Volt System: Black.
.4 Fire Alarm System: Red.
.5 Emergency Lighting System: Red/White.
.6 LV Systems (EPO, Remote Monitoring, Generator Control, Communications): Green.
.7 120/208 Volt Uninterruptable Power Supply (UPS): Orange
2.4.5 Confirm colours with Engineer prior to commencing rough-in.

2.5 **Branch Breaker Labels**

2.5.1 General:

.1 Legibly identify every circuit and circuit modification as to its clear, evident, and specific purpose or use. Include sufficient detail to allow each circuit to be distinguished from all others.

.2 Label spare positions that contain unused overcurrent devices or switches.

.3 Do not describe any circuit in a manner that depends on transient conditions of occupancy.

2.5.2 Switchboards, distribution panelboards, enclosed breakers, and disconnect switches:

.1 Locate identification at each switch.

.2 Branch breaker nameplates on switchboards, distribution panelboards and switchboards, and generator load breakers to indicate:

.1 Locate identification at each switch on a switchboard.

.2 Identification of downstream equipment fed from the breaker. Location of downstream device if not in the same room.

.3 Breaker size and number of poles.

.4 Interrupting Capacity.

.5 Circuit number (where applicable).

.6 Do not describe any circuit in a manner that depends on transient conditions of occupancy.

2.5.3 Lighting and Receptacle Panelboards:

.1 Provide a circuit directory that is located on the face or inside of the panel door.

.2 Do not describe any circuit in a manner that depends on transient conditions of occupancy.

2.6 **Receptacle Labels**

2.6.1 Label all receptacles with the panelboard ID and circuit number.

2.6.2 Use receptacle labels by electronic labeller Brother P-Touch, model PT-20/25, Dymo-Tape or approved equal.

2.6.3 Location: On receptacle wall plate.

3. EXECUTION

3.1 **Equipment Nameplates from Manufacturers**

3.1.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.1.2 Manufacturers' nameplates and CSA labels are to be visible and legible after equipment is installed. Provide warning signs, as specified, or to meet requirements of Inspection Department, Health and Safety, and the Consultant.

3.1.3 Label power outlets with circuit identification on visible portion of faceplate or surface mounted outlet box.

3.2 **Conduit Identification**

3.2.1 Locate labels as follows:

.1 At every end of every conduit, duct or cable run, adjacent to item of equipment serviced.

.2 On each exposed conduit, duct or cable passing through a wall, partition or floor (one on each side of such wall partition or floor).

.3 At intervals of 50'-0" along every exposed conduit, duct or cable run exceeding 50'-0" in length.

.4 At every access point on concealed conduit duct or cable.

3.2.2 Place labels so as to be visible from 5'-0" above adjacent floor platform.

3.3 **Preparation**

3.3.1 Degrease and clean surfaces to receive nameplates and labels.

3.4 **Application**

3.4.1 Confirm colours prior to start of work.

3.4.2 Install nameplate and label parallel to equipment lines.

3.4.3 Secure nameplate to equipment front using adhesive.

3.4.4 Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.

3.4.5 Identify conduit using field painting.

3.4.6 Paint coloured band on each conduit longer than 2 m.

3.4.7 Paint bands 6 m on centre.

3.5 **Labelling**

3.5.1 Colour code wiring consistently throughout the installation and generally match colour coding of internal wiring of pre-wired components.

3.5.2 Label wiring with point name using Thomas & Betts 12 character polestar metalized labels with 3 rows of characters per label, or equal by Brady. Label to occur as a minimum at both ends and at pull boxes of the wiring run.

3.5.3 Identify all pull boxes, junction boxes, etc. (installed as part of this project or used by this project) with the exact use of the box. Indelible felt pen marker is acceptable.

3.5.4 Label light control items with point name using Thomas & Betts 12 character label, or equal by Brady. Label to be black lettering on clear backing.

3.5.5 Label relays and controllers inside panels using Thomas & Betts 12 character label, or equal by Brady.

3.5.6 Provide red, 13 mm (1/2 inch) diameter, sticker on emergency light fixture frame. Include circuit number on sticker with thin permanent black mark pen.

3.6 **Labels and Signs**

3.6.1 Manufacturers' nameplates and CSA labels are to be visible and legible after equipment is installed. Provide warning signs, as specified, or to meet requirements of Inspection Department, Health and Safety, and the Consultant.

3.6.2 Label power outlets with circuit identification on visible portion of faceplate or surface mounted outlet box.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Electrical connections to equipment specified in other sections.

1.2 Related Requirements

1.2.1 Division 08 – Openings.
1.2.2 Division 11 – Equipment.
1.2.3 Division 22 – Plumbing.
1.2.4 Division 23 – Heating, Ventilating, and Air Conditioning.

1.3 References

1.3.1 NEMA WD 1 - General Colour Requirements for Wiring Devices.
1.3.2 NEMA WD 6 - Wiring Devices - Dimensional Requirements.

1.4 Coordination

1.4.1 Obtain and review shop drawings, product data, and manufacturer's instructions for equipment provided under other sections.
1.4.2 Determine connection locations and requirements.
1.4.3 Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.
1.4.4 Sequence electrical connections to coordinate with start-up schedule for equipment.

1.5 Submittals

1.5.1 Submit to Section 01 33 00.
1.5.2 Product Data: Provide wiring device manufacturer's catalogue information showing dimensions, configurations, and construction.
1.5.3 Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.6 Regulatory Requirements

1.6.1 Provide products listed and classified by testing firm acceptable to authority having jurisdiction as suitable for purpose specified and shown.

2. PRODUCTS

2.1 Common Motor Requirements

2.1.1 Motors up to and including 1/3 HP, shall be 1 phase, 60 Hz, 120 volts.
2.1.2 Motors 1/2 HP and above shall be 3 phase, 60 Hz, 575 volts or 208 volts.

2.2 Cords and Caps

2.2.1 Attachment Plug Construction: Conform to NEMA WD 1.
2.2.2 Configuration: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
2.2.3 Cord Construction: NFPA 70, Type SJO multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
2.2.4 Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

3. EXECUTION

3.1 Wiring of Equipment Provided Under Other Divisions

3.1.1 Use the following procedure with regard to wiring of motors and equipment provided under other Divisions.

3.1.2 The following equipment shall be responsibility of the trade supplying the equipment unless otherwise noted, in accordance with the requirements laid out in the individual section, or this division:
- .1 Motors.
- .2 Starters.
- .3 Variable Frequency Drives.
- .4 Motor Control Centres.
- .5 Control wiring.

3.1.3 In every instance, install starter, motor control centre, variable frequency drivers (VFD), etc. and wire to line side of the starter, the Motor Control Centre, or VFD. Extend wiring from starter, motor control centre or VFD to motor as indicated.

3.1.4 Provide all wiring for starters and VFD's from supply to starter to VFD and to motor. Coordinate requirements with the appropriate trade.

3.1.5 Provide 500 mm of liquid tight flexible metal conduit for final connection to motor. Provide disconnect switches where required by code, and as indicated on the drawings.

3.1.6 Where individual starters and controls are grouped together provide a panel for mounting this equipment. Provide a feeder, main fused disconnect and a splitter of adequate size and capacity and wire to line side of the starters on this panel and from starters to motors.

3.1.7 Equipment, General
- .1 Ascertain exact locations of starters, motor control centres, motors, etc. from drawings and coordinate exact locations with the supplying trade.
- .2 Control wiring shall be the responsibility of the supplying trade.
  - .1 Control wiring shall be in accordance with Section 26 05 19.
  - .2 Control wiring shall be installed in conduit in accordance with Section 26 05 33.13.

3.1.8 Plumbing Equipment
- .1 Ascertain exact locations of starters, motor control centres, motors, infra-red plumbing fixture controls from Mechanical Drawings and coordinate exact locations with plumbing trade.
- .2 Provide branch circuit wiring and an outlet for each infra-red plumbing fixture control.
- .3 Control wiring shall be the responsibility of the plumbing trade, as described above.

3.1.9 HVAC Equipment
- .1 Ascertain exact locations of starters, motor control centres, motors, motorized dampers, VAV boxes, and heating control valves from HVAC drawings and coordinate exact locations with HVAC Division.
- .2 In the case of unit heaters, reheat coils and cabinet unit heaters, terminate wiring on terminals provided. Control wiring, thermostats, or other control devices shall be the responsibility of the HVAC trade, as described above.
- .3 Provide branch circuit wiring and an outlet for each motorized damper, variable air volume (VAV) box, or heating control valve. Control wiring shall be the responsibility of the HVAC trade, as described above.

3.2 **Examination**

3.2.1 Verify that equipment is ready for electrical connection, wiring, and energization.

3.3 **Electrical Connections**

3.3.1 Make electrical connections to equipment manufacturer's instructions.

3.3.2 Make conduit connections to equipment using flexible conduit. Use liquid-tight flexible conduit with watertight connectors in damp or wet locations.

3.3.3 Make wiring connections using wire and cable with insulation suitable for temperatures encountered in heat producing equipment.

3.3.4 Provide receptacle outlet where connection with attachment plug is indicated. Provide cord and cap where field-supplied attachment plug is indicated.

3.3.5 Provide suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.

3.3.6 Install disconnect switches, controllers, control stations, and control devices as indicated.
3.3.7 Modify equipment control wiring with terminal block jumpers as indicated.
3.3.8 Provide interconnecting conduit and wiring between devices and equipment where indicated.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Commissioning of all building electrical systems and component including:
- .1 Testing and adjustment.
- .2 Demonstration and training.
- .3 Instructions of all procedures for Owner's personnel.
- .4 Updating as-built data.
- .5 Co-ordination of Operation and Maintenance material.

1.1.2 Provide labour and material to conduct the commissioning process as outlined in this specification section, including the hiring of an Independent Testing Contractor (ITC) as detailed below.

1.1.3 Provisions of this section shall apply to all sections of Division 26, Division 27, and Division 28.

1.2 Related Requirements

1.2.1 Testing and commissioning are called for throughout the individual specifications. This does not relieve this trade from providing all testing and commissioning necessary to ensure that systems and equipment operate as required and that they interface with other systems and equipment as required.

1.2.2 Section 26 08 50 – Commissioning of Lighting: additional commissioning requirements for commissioning of lighting and lighting controls.

1.3 Commissioning Process Allocation

1.3.1 The commissioning process shall be allocated a value equal to 5 per cent of the contract. The Electrical Contractor may draw from this allocation as the commissioning process is completed.

1.3.2 The Electrical Contractor shall submit all test and verification forms. The Consultant will use these forms to calculate percentage complete.

1.3.3 The Electrical Contractor may claim up to 3 per cent of the contract from this allocation leading up to performance testing. The remaining 2 per cent shall not be paid out until the performance testing, O&M manuals, and training have been completed satisfactorily.

1.4 Definitions

1.4.1 Cx – Commissioning.

1.4.2 Commissioning Authority
- .1 The Commissioning Authority (CxA), also referred to as the Commissioning Consultant, shall be hired by The Owner.
- .2 The CxA responsibilities shall include:
  - .1 preparing the commissioning plan
  - .2 co-ordinating with the contractor to schedule tests
  - .3 preparing a test form manual
  - .4 witnessing selected tests
  - .5 receiving all test forms
  - .6 co-ordinating the contractors training
  - .7 chair the commissioning meetings
- .3 The Electrical Contractor shall co-operate with the CxA.
- .4 The Electrical Contractor shall provide assistance to the CxA and have personnel available during the performance testing procedure. Each electrical system shall be tested in the operational mode.

1.5 Submittals

1.5.1 Conform to Section 01 33 00 for requirements for shop drawings and record drawings.

1.5.2 A commissioning document shall be prepared by the CxA prior to conducting these activities for use by the Commissioning Team.

1.5.3 The electrical sub-contractor shall be responsible for ensuring all activities are properly documented in this manual and co-ordinated through the General Contractor.

1.5.4 As-built drawings and data books must be available two weeks prior to commissioning for review and use by the consultant and Commissioning Team prior to the start of the commissioning activities.

1.6 **Quality Assurance**

1.6.1 Provide qualified trades persons, certified testing agencies, factory trained and approved by the Commissioning Team Leader.

1.6.2 Submit the names of all personnel to be used during the Commissioning activities.

1.7 **Warranty**

1.7.1 Equipment and system warranties shall not begin until the system demonstration and turnover has been conducted successfully and accepted by the Owner.

1.7.2 The Electrical Contractor shall fill out the warranty form listing the equipment and systems and the start and finishing dates for warranty.

1.7.3 Refer to Division 01 and Section 26 05 00 for the requirements during the warranty period.

2. PRODUCTS

2.1 **Equipment**

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

3. EXECUTION

3.1 **The Commissioning Process**

3.1.1 The purpose of the commissioning process is to fully test all building systems including architectural, mechanical and electrical components and operating procedures by challenging these systems to realistic operation conditions.

3.1.2 The commissioning process consists of:

.1 Shop Drawings and Record Drawings
.2 Installation inspection and equipment verification
.3 Independent testing contractor
.4 Testing of equipment and systems
.5 Commissioning meetings
.6 Operating and maintenance manuals
.7 Operating training
.8 Commissioning Agent testing
.9 Systems Demonstration and turnover
.10 Testing forms
.11 Warranties

3.2 **Preparation**

3.2.1 Provide test instruments required for all activities as defined in the commissioning documents.

3.2.2 Verify all systems are in compliance with the requirements of the commissioning documents prior to the pre-commissioning check out operation.

3.2.3 Confirm all scheduled activities have identified personnel available.

3.2.4 Where systems or equipment do not operate as required, make the necessary corrections or modifications, re-test and re-commission.

3.3 **System Description**

3.3.1 Perform all start-up operations, control adjustment, trouble shooting, servicing and maintenance of each item of equipment as defined in the commissioning documentation.

3.3.2 Owner will provide list of personnel to receive instructions and will co-ordinate their attendance at agreed upon times.

3.3.3 Prepare and insert additional data in the operations and maintenance manuals and update as-built drawings when need for additional data becomes apparent during the commissioning exercise.

3.3.4 Where instruction is specified in the commissioning manual, instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.

3.3.5 Conduct presentation on Owner's premises. Owner will provide space.

3.4 **Commissioning**

3.4.1 Commission the components of the electrical system using the NETA Acceptance Testing Specifications.

3.4.2 Refer to the project commissioning plan prepared by the CxA.

3.4.3 Commissioning activities for the electrical systems must have available up to date as-built drawing information and accurate Operations and Maintenance Manuals. These documents shall be a major part of this activity.

3.4.4 Contractor shall be responsible to update all documentation with information and any changes duly noted during the Commissioning exercise.

3.4.5 Contractor shall arrange for all outside suppliers, equipment manufacturers, test agencies and others as identified in the commissioning sections of this specification. The cost associated with this requirement shall be included as part of the tender price.

3.5 **Final Report**

3.5.1 This trade shall assemble all testing data and commissioning reports and submit them to the General Contractor for submission to the Owner.

3.5.2 Each form shall bear signature of recorder, and that of supervisor of reporting organizer.

3.6 **Schedule of Activities**

3.6.1 Commissioning activities shall be conducted based on pre-established schedule with all members of the commissioning team.

3.6.2 In addition, there will be two meetings held through the contract duration to introduce the parties of the commissioning team, establish the schedules and deadlines for the various activities and review the Commissioning Manual.

3.6.3 Adhering to the established schedule is very important as the co-ordination and scheduling of the participants will be difficult to alter once this is established. Close co-ordination of this schedule is important.

3.6.4 In the event project cannot be commissioned in the allotted time slot, the contractor shall pay for all costs associated with assembling the Commissioning Team at a later date. If the contractor has not performed his duties to reach commissioning stage as outlined earlier, he will incur all expenses of other trades and the Commissioning Team due to his non-compliance.

3.7 **Installation Inspection and Equipment Verification**

3.7.1 The Electrical Contractor shall co-ordinate with the Electrical Consultant who will inspect the electrical installation.

3.7.2 The Electrical Contractor shall complete the equipment verification forms for each piece of equipment. The forms shall be included in the operating and maintenance manual. The equipment data shall include:

.1 Manufacturers name, address and telephone number

.2 Distributors name, address and telephone number

.3 Make, model number and serial number

.4 Voltage and current ratings

3.8 **Independent Testing Contractor**

3.8.1 The Independent Testing Contractor (ITC) shall be hired by the contractor and shall issue reports to the Electrical Consultant.

3.8.2 The ITC shall conduct load balancing measurements to verify load balancing performed in accordance with Section 26 05 00.

3.9 **Testing of Equipment and Systems**

3.9.1 The Electrical Contractor shall be responsible for all tests detailed in this Section, and those tests required by a manufacturer as part of their installation requirements.

3.9.2 The Electrical Contractor shall schedule all tests which shall be witnessed by the Electrical Consultant or the Commissioning Consultant. The contractor shall complete and sign the testing forms.

3.9.3 The Electrical Contractor shall conduct tests on the following equipment as a minimum. Refer to the individual specification sections for test procedures.

.1 Section 26 05 19 – Low-Voltage Electrical Power Conductors and Cables.

.2 Section 26 24 16 – Panelboards.

.3 Section 28 10 00 –Access Control.

3.9.4 When all testing has been completed and all mechanical and electrical systems are operational the contractor shall conduct system load balance measurements, infra-red test and harmonics tests.

3.10 **Commissioning Meetings and Reporting**

3.10.1 The Electrical Contractor shall include the schedule for all tests in the construction schedule.

3.10.2 The Commissioning meetings shall occur during the regular construction meetings. The testing schedules and the results of all tests shall be reviewed.

3.10.3 All testing forms and reports associated with the electrical systems shall be directed to the Electrical Consultant, with copies to the Architect, Commissioning Consultant, and the Owner.

3.10.4 The forms and reports to be issued shall include:

.1 Shop drawings, issued and accepted

.2 Equipment verification forms

.3 Testing forms

.4 Reports resulting from tests

.5 Testing schedule

.6 Minutes of commissioning meetings

.7 Manufacturers' Certificates

3.11 **Operating and Maintenance Manual**

3.11.1 Conform to the specification section for the requirements of the O&M manuals.

3.12 **Demonstration and Training**

3.12.1 Conform to section for requirements for instructions to the Building Owner for each system and equipment.

3.12.2 The training shall be provided by qualified technicians or electricians and shall be conducted in a classroom and at the equipment or system.

3.12.3 The training sessions shall be scheduled, co-ordinated and video taped by the Commissioning Consultant.

3.12.4 Each training session shall be structured to cover:

.1 The operating and maintenance manual.

.2 Operating procedures.

.3 Maintenance procedures.

.4 Troubleshooting procedures.

.5 Spare parts.

3.12.5 Submit a course outline to the Electrical Consultant before training commences. Provide course documentation for up to eight people.

3.12.6 The training session shall be scheduled and co-ordinated by the Commissioning Consultant. The Commissioning Consultant shall video tape the sessions.

3.12.7 Training shall be provided for the following systems:

.1 Electrical Systems including distribution and lighting: 8 hour minimum

3.12.8 The Electrical Contractor shall conduct a walkthrough of the installation. During the walkthrough the Electrical Contractor shall:

.1 Identify equipment
.2 Identify electrical panels
.3 Identify starters and disconnects
.4 Review the electrical power distribution
.5 Review the light power distribution
.6 Review the switchgear
.7 Review the general maintenance procedures

3.13 **The Electrical System Demonstration and Turnover**

3.13.1 The system demonstration and turnover to The Owner shall occur when:

.1 The installation is complete.
.2 The acceptance test conducted by the Electrical Consultant has been completed successfully.
.3 Training has been completed.
.4 Equipment Operating and Maintenance Manuals have been accepted.
.5 System operating manuals have been accepted.
.6 Shop-drawings have been updated.
.7 As-built drawings have been completed.
.8 The commissioning process has been completed successfully and system operation accepted by the Electrical Consultant and Commissioning Consultant.

3.13.2 The systems demonstration shall be conducted by the Electrical Contractor and manufacturers. The demonstration shall cover a physical demonstration of equipment installation and operation.

3.14 **Testing Forms**

3.14.1 The Electrical Contractor and manufacturers shall fill out the forms listed in this section or provide other forms. The forms must be approved by the Electrical Consultant and the Owner before they are used.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Common requirements for commissioning of all electric lighting, including interior, exterior, and emergency lighting.

1.1.2 The party responsible for the functional testing shall not be directly involved in either the design or construction of the project.

1.2 Related Requirements

1.2.1 Section 26 09 23 – Lighting Control Devices.

1.2.2 Section 26 51 19 – LED Interior Lighting.

1.2.3 Section 26 52 13.13 – Emergency Lighting.

1.3 References

1.3.1 ASHRAE

.1 ASHRAE Guideline 0-2005 – The Commissioning Process.

.2 ASHRAE 90.1-2010 – Energy Standard for Building Except Low-Rise Residential Buildings.

1.3.2 Illumination Engineering Society (IES)

.1 IES DG-29-11 – Design Guide for the Commissioning Process Applied to Lighting and Control Systems.

1.3.3 Ontario Building Code

.1 Supplementary Standard SB-10: Energy Efficiency Requirements.

1.4 Action Submittals

1.4.1 Refer to Section 01 33 00.

1.4.2 Submit sample commissioning forms.

1.5 Closeout Submittals

1.5.1 Section 01 33 00 and Section 01 78 00: Submittals for project closeout.

1.5.2 Submit commissioning reports.

.1 Submit a floor plan or spreadsheet table checklist that indicates each local lighting control device, occupancy sensors, daylighting controls, system component.

.2 Submit the system sequence of operation fully describing the equipment components and functionality, including set points and alarm functions.

.3 The detailed sequence of operation shall be provided regardless of the completeness and clarity of the sequences in the controls specification and/or drawings.

1.5.3 The functional testing party shall provide documentation certifying that the installed lighting controls meet or exceed all documented performance criteria.

2. PRODUCTS – NOT USED

3. EXECUTION

3.1 Commissioning

3.1.1 Sensor placement and orientation for all sensor types.

3.1.2 Occupancy sensor function, sensitivity, and time delays.

3.1.3 Daylight harvesting sensor calibration.

3.1.4 Automated shade operation.

3.1.5 Manual control placement and operation.

3.1.6 Automated control operation, including scheduled on/off functions and dimming trims and presets.

3.1.7 Override operation, access, and functionality.

3.1.8 Centralized control interfaces and operation.

3.1.9 Client education of operations.

3.1.10 Documentation archived to client.

3.2 **Functional Testing**

3.2.1 Lighting control devices and control systems shall be tested to ensure that control hardware and software are calibrated, adjusted, programmed, and in proper working condition in accordance with the construction documents and manufacturer's installation instructions.

3.2.2 When occupant sensors, time switches, programmable schedule controls, or photosensors are installed, at a minimum, the following procedures shall be performed:

.1 Confirm that the placement, sensitivity and time-out adjustments for occupant sensors yield acceptable performance, lights turn off only after space is vacated and do not turn on unless space is occupied.

.2 Confirm that time switches and programmable schedule controls are programmed to turn the lights off.

.3 Confirm that photosensor controls reduce electric lights levels based on the amount of usable daylight in the space as specified.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Occupancy and Vacancy sensors.
1.1.2 Power packs, and auxiliary relays, momentary switches.
1.1.3 Manual controls devices, including dimming switches and low voltage momentary switches.
1.1.4 Timer switches.
1.1.5 Daylight harvesting photo sensors.
1.1.6 Emergency lighting control units.

1.2 Products Installed But Not Supplied Under This Section

1.2.1 Line voltage manual control devices, as described in Section 26 27 26 – Wiring Devices.

1.3 Related Requirements

1.3.1 Section 26 08 50 – Commissioning of Lighting.
1.3.2 Section 26 27 26 – Wiring Devices.
1.3.3 Section 26 51 19 – LED Interior Lighting.

1.4 References

1.4.1 Canadian Standards Association (CSA) (www.csa.ca).
.1 CSA C22.1, Canadian Electrical Code, Part 1, Safety Standard for Electrical Installations.
.2 Ontario Electrical Safety Code.
.3 CSA C22.2 No. 14 Industrial Control Equipment
.4 CSA C22.2 No. 184 - Solid-State Lighting Controls
.5 CSA C22.2 No. 184.1 - Solid State Dimming Controls.
.6 CSA C22.2 No. 156 - Solid-State Speed Controls
.7 CSA C22.2 No. 42.1 - Cover Plates for Flush Mounted Wiring Devices
.8 CSA C22.2 No. 42 - General Use Receptacles
1.4.2 National Electrical Manufacturers Association (NEMA)
.1 WD1 (R2005) –- General Color Requirements for Wiring Devices.
.2 WD6 – Dimensional Specifications
1.4.3 Ontario Building Code.
1.4.4 UL 924 - Standard for Safety of Emergency Lighting and Power Equipment.

1.5 Submittals

1.5.1 In accordance with Section 01 33 00.
1.5.2 Product Data:
.1 Submit manufacturer's descriptive literature and product specifications for each product.
.2 Manufacturer's product drawings.
.3 Manufacturer's installation instructions

1.6 Quality Assurance

1.6.1 Manufacturer Qualifications: Products free of defects in material and workmanship.

1.7 Warranty

1.7.1 Product is warranted free of defects in material and workmanship.
1.7.2 Product is warranted to perform the intended function within design limits.

2. PRODUCTS

2.1 Manufacturers

2.1.1 Wattstopper (Basis of Design).
2.1.2 Eaton's Cooper Lighting Business.
2.1.3 Hubbell.

2.1.4 Lutron.
2.1.5 Sensorswitch.

2.2 **General Requirements of all Sensors and Power Packs**

2.2.1 Manufactured by an ISO 9002 certified manufacturing facility and shall have a defect rate of less than 1/3 of 1 per cent.
2.2.2 Five year warranty and CUL listed.
2.2.3 In the event of failure, provide a bypass manual "override on" feature on each sensor.
2.2.4 When bypass utilized, lighting to remain on constantly, or control is to be diverted to a wall switch until sensor is replaced. The override feature is to be designed for use by building maintenance personnel and not be readily achieved by building occupants.

2.3 **Occupancy and Vacancy Sensors**

2.3.1 General:
.1 Sensors using passive infrared, ultrasonic, microphonic, and multi-technology adaptive technology.
.2 Sensor timeouts configurable by system software.
.3 Electrical: Rating: 24 VDC input voltage, up to 40 mA current draw.
.4 Mechanical: Mounting: Sensors for mounting on ceilings and walls, including corners, must be available.
.5 Environmental:
.1 Operating Temperature Range: 0 degrees C to 40 degrees C
.2 Relative Humidity: 0 per cent to 95 per cent non-condensing.

2.3.2 Dual Technology Wall Switch Sensor, 24V
.1 Wattstopper DW-100-24-W series (Basis of Design).
.2 Sensor capable of detecting presence in the control area by detecting Doppler shifts in transmitted ultrasound and passive infrared heat changes.
.3 Utilize a dual sensing verification principle for coordination between ultrasonic and Passive Infrared (PIR) Technologies to reduce likelihood of false triggering.
.4 For best results, sensor shall feature a trigger mode where the end-user can choose which technology will activate the sensor from Off mode (initial), the type of detection that will reset the time delay (maintain), and the type of detection that will cause the sensor to be turned back on immediately after the lights are turned off due to lack of motion (re-trigger). Selection of technologies for initial, maintain, and re-trigger shall be done with DIP switches.
.5 Sensor shall have its trigger mode factory preset to allow for quick installation in most applications. In this default setting, both technologies must occur in order to initially activate lighting systems. Detection by either technology shall maintain the lighting on, and detection by either technology shall turn lights back on after lights were turned off for 5 seconds or less in automatic mode, and 30 seconds or less in manual mode.
.6 Robotic test method, as referred in the NEMA WD 7 Guide, shall be utilized for minor motion coverage verification.
.7 Ultrasonic sensing shall be volumetric in coverage with a frequency of 40 kHz. It shall utilize Advanced Signal Processing which automatically adjusts the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.
.8 The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall filter short wavelength IR, such as those emitted by the sun and other visible light sources. Face lens grooves in to avoid dust and residue build up which affects IR reception.
.9 Utilize zero crossing circuitry to reduce stress on relay, and therefore increase sensor life.
.10 Operate at 24 VDC and halfwave rectified and utilize a power pack or lighting control system input module to supply power.
.11 To blend in aesthetically, sensor protrusion not more than 3/8" from the wall and utilize colour-matched lens.

.12 To assure detection at desktop level uniformly across the space, sensor shall have a 28 segment, 2 level, Fresnel injection molded lens.
.13 Sensor shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds, set by DIP switch.
.14 To avoid false ON activations and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, to respond only to those signals caused by human motion.
.15 Coverage up to 1,000 sq. ft. for walking motion, with a field view of 180 degrees.
.16 Automatic-ON or manual-ON operation, adjustable with a DIP switch.
.17 Sensor shall have an adjustable time delay.
.18 Each sensing technology shall have an LED indicator that remains active at all times, in order to verify detection within the area to be controlled.
.19 Sensor shall have a service switch to allow end-users to operate the sensor in the unlikely event of a failure; set by a trim pot.
.20 Sensor shall have a built-in light level that features simple, one-step daylighting setup that works from 8 fc to 180 fc.
.21 The Dual Technology wall switch sensor shall be a completely self-contained control system that replaces a standard toggle switch

2.3.3 Dual Technology Ceiling Mounted Sensor, 24V
.1 Wattstopper DT-300 series (Basis of Design).
.2 The Dual Technology sensor shall be capable of detecting presence in the control area by detecting doppler shifts in transmitted ultrasound and passive infrared heat changes.
.3 Sensor shall utilize Dual Sensing Verification Principle for coordination between ultrasonic or microphonic and Passive Infrared (PIR) Technologies. Detection verification of both technologies must occur in order to activate lighting systems. Upon verification, detection by either technology shall keep the lighting on.
.4 Sensor shall have a retrigger feature in which detection by either technology shall retrigger the lighting system on within 5 seconds of being switched off.
.5 Sensors shall be ceiling mounted with a flat, unobtrusive appearance, and provide 360 degree coverage.
.6 Ultrasonic sensing shall be volumetric in coverage, with a frequency of 40 kHz. It shall utilize Advanced Signal Processing that automatically adjusts the detection threshold dynamically to compensate for changing levels of activity and airflow throughout a controlled space.
.7 To avoid false ON activations, and to provide immunity to RFI and EMI, Detection Signature Analysis shall be used to examine the frequency, duration, and amplitude of a signal, in order to respond only to those signals caused by human motion.
.8 The PIR technology shall utilize a temperature compensated, dual element sensor and a multi-element Fresnel lens. The lens shall be Poly IR4 material to offer superior performance in the infrared wavelengths and filter short wavelength IR, such as those emitted by the sun and other visible light sources. The lens shall have grooves facing in to avoid dust and residue build up which affects IR reception.
.9 Sensors shall operate at 24 VDC, and halfwave rectified, and utilize a 24 V power pack.
.10 Sensors shall feature a walk-through mode, where lights turn off 3 minutes after the area is initially occupied if no motion is detected after the first 30 seconds.
.11 The sensor shall have a built-in light level sensor that works from 10 fc to 300 fc.
.12 The sensors shall feature terminal style wiring.
.13 Each sensing technology shall have an LED indicator that remains active at all times in order to verify detection within the area to be controlled. The LED can be disabled for applications that require less sensor visibility.

2.4 **Special Purpose Occupancy Sensors**

2.4.1 Occupancy Sensors for High bay applications:

.1 For use in warehouses, distribution centers, and gymnasiums.
.2 Maximum 14 m (45 feet) mounting height.
.3 Surface-mount or end-mount model to suit application.
.4 180 degree and 360 degree coverage lenses available.
.5 Low-voltage, passive infrared (PIR) sensor.
.6 End-mount model to attach directly to industrial T5HO and T8 fixtures through an extended 13 mm (0.5 inch) chase nipple or junction box.
.7 Adjustable timeout for maximum energy savings.
.8 Basis of design: Lutron LUT-WSPSM24V-360-CPN6111 and similar.

2.5 **Power Packs**

2.5.1 General:
.1 Self-contained transformer and relay module.
.2 Internal relay controlling up to 20A for 120, 230, 277VAC or 347VAC ballast loads and 120VAC incandescent loads.
.3 Provide a 24 VDC, 150 mA output.
.4 Capable of parallel wiring without regard to AC phases on primary.
.5 Power pack can be used as a standalone, low voltage switch, or can be wired to sensor for auto control.
.6 Construction: high impact, UL rated plastic case
.7 Power pack shall be UL/CUL Listed, FCC Certified, UL 2043 plenum rated and meets ASHRAE 90.1 requirements
.8 Shall at minimum meet the following environmental specifications:
.1 Operating Temperature Range: 0 degrees C to 40 degrees C
.2 Relative Humidity: 0 per cent to 95 per cent non-condensing

2.5.2 Power Pack and Auxiliary Relay, 347 V
.1 Power Pack: Wattstopper B347D-P Series (Basis of Design)
.2 Auxiliary Relay: Wattstopper S347-E-P Series (Basis of Design)
.3 Power pack shall be a self-contained transformer and relay module measuring 45 mm by 70 mm by 38 mm (1.75 inch by 2.75 inch by 1.5 inch).
.4 For ease and speed of installation, power pack shall have 12 mm (1/2") snap-in nipple for 12 mm (1/2") knockouts and mounting on outside of enclosure.
.5 Power pack shall have dry contacts capable of switching 15 amp ballast @ 347 VAC, 60Hz.
.6 Power pack shall have primary voltage input of 347 VAC.
.7 Power pack shall provide a 24 VDC, 114 mA output, with the relay connected.
.8 Power pack shall be capable of parallel wiring without regard to AC phases on primary.
.9 Power pack can be used as a standalone, low voltage switch, or can be wired to sensor for auto control.
.10 Power pack shall have hold-ON and hold-OFF inputs for integration with lighting control panels, BMS and other building systems.
.11 Power pack shall have overcurrent protection if the low voltage current drawn exceeds 150 mA. In the event of an overcurrent, the low voltage output current shuts down and the LED will blink to indicate a fault condition.
.12 Power pack shall have an LED to indicate status of relay.
.13 Power pack shall utilize Zero Crossing Circuitry to protect from the effects of inrush current and increase product longevity.

2.6 **Decorator Low Voltage Momentary Switches**

2.6.1 Wattstopper DCC2 series (Basis of Design).
2.6.2 Switch intended for use with power packs and sensors requiring a momentary contact switch that provides on/off signals.
2.6.3 12 VAC/VDC, 24 V Rectified, 24 VAC/VDC
2.6.4 50 mA Max. Internal Contact rating
2.6.5 500 mΩ resistance when closed

2.6.6 Single pole, double throw with center position rest.

2.7 **Dimming Switches**

2.7.1 Direct control of dimming luminaires up to the luminaire manufacturer's specified rating.

2.7.2 Coordinate dimming signal configuration (2-wire phase cut, 3-wire, 4-wire 0-10V, or 4-wire DALI) with the fixture driver per Section 26 51 19, lighting fixture schedule, and related sections.

2.7.3 Compatible with related lighting control devices i.e. occupancy sensors.

2.7.4 Submit luminaire manufacturer's dimmer compatibility documentation to demonstrate compatibility and limits of dimming level.

2.7.5 Acceptable Manufacturers:

.1 Lutron NovaT* style dimmers.

.2 Equal by Cooper.

.3 Equal by Philips.

.4 Approved Equal.

2.8 **Timer Switches**

2.8.1 Digital time switch programmable to turn loads off after a preset time.

2.8.2 Capable of operating as an ON/OFF switch.

2.8.3 Five terminal, completely self-contained control system that replaces a standard toggle switch. Switching mechanism 30 V @ 1 A air gap relay.

2.8.4 24 VAC when used in conjunction with power packs. For small rooms, or small localized loads, line voltage is permitted.

2.8.5 No minimum load requirement.

2.8.6 Time scroll feature permitting manual overriding of the preset time-out period. Selecting time scroll UP shall allow time-out period to scroll up throughout the timer possibilities to the maximum. Time scroll DN (down) shall allow time-out period to scroll down to minimum.

2.8.7 Options available for user to enable:

.1 One second light flash warning at five minutes before the timer runs out and twice when the countdown reaches one minute (when used to control lighting loads).

.2 Beep warning sounding every five seconds once the time switch countdown reaches one minute.

2.8.8 Manual timer reset where pressing the ON/OFF switch for more than 2 seconds resets the timer to the programmed time-out period.

2.8.9 Liquid crystal display (LCD) that shows the timer's countdown.

2.8.10 Incorporates two pulsed, open collector NPN transistor outputs for external latching relay coil drives or lighting control panel inputs.

2.8.11 Fit behind a decorator style faceplate. Concealed calibration switch for setting time-out, time scroll, one second light flash, and beep warning to prevent tampering of adjustments and hardware.

2.8.12 Time-out period adjustable in increments of 5 minutes from 5 minutes to 1 hour, and in increments of 15 minutes from 1 hour to 12 hours.

2.8.13 Operate with power packs in order to control additional loads.

2.8.14 Utilize terminal style wiring.

2.8.15 For safety, in the event there is an open circuit in the low voltage line, automatically switch to OFF mode.

2.8.16 Warranty: 5 year warranty.

2.8.17 CUL listed.

2.8.18 Wattstopper TS-400 and TS-400-24 series (Basis of Design).

2.9 **Emergency Lighting Control Unit for 120 Volt Circuits**

2.9.1 Description:

.1 Sequence of Operation: activate emergency lighting in the event of loss of normal utility power, regardless of control status of the luminaire.

.2 Provide all required functionality to allow any standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.

2.9.2 Device shall be listed to UL 924 to meet the intent of Ontario Building Code for "fail-safe operation", and be approved for use in Canada.

2.9.3 Example Manufacturers

.1 Functional Devices Inc. ESR01P series.
.2 Douglas Lighting Controls WR-RIB2401B-EL.
.3 Philips Bodine BLCD-20B.
.4 Schneider Electric SLSERC1277.
.5 Wattstopper ELCU-200 series.
.6 Approved Equal.

2.9.4 Mounting: Able to fit in a standard junction box knockout.

2.9.5 Features:

.1 Senses local single circuit power failure.
.2 LED indication for emergency and normal power.
.3 Provides absolute fail-to-on emergency lighting.
.4 Emergency lights are controlled with normal lighting.
.5 Sequence of Operation: automatically switch emergency lighting on and off as normal lighting is switched. When normal power is not available, force and hold emergency lighting on regardless of the state of any external control device until normal power is restored.

2.9.6 Specifications:

.1 120 VAC; 60 Hz.
.2 Maximum Ballast Load: 10A @ 120 VAC.
.3 Housing: Fire rated V-0, 80 degrees C.
.4 Zero crossing circuitry to protect relay contacts from damaging effects of inrush current generated by switching electronic ballast loads.
.5 UL94 V-O plenum rated with compression wire terminals.
.6 UL, cUL listed Emergency Lighting and Equipment; five year warranty.

2.10 **Daylight Harvesting Photo Sensors**

2.10.1 General:

.1 Class 2, low voltage.
.2 Ambient light sensor designed to interface directly with the analog input of the Lighting Control System.
.3 Supply an analog signal to the Lighting Control System proportional to the light measured.
.4 Sensor output shall provide for zero or offset based signal.
.5 Capable of a fully adjustable response in the range between 0 and 10,000 foot candles with a +/- 1 per cent accuracy at 21 degrees C.
.6 Input: 10 VDC.
.7 Output: 0 VDC to 10 VDC.
.8 Flame retardant housing and meet UL 94 HB standards.
.9 Operating temperature: -10 degrees C to 60 degrees C.

2.10.2 Interior sensors: Fresnel lens, with a 60 degree cone of response. Range between 0 fc and 750 fc.

2.10.3 Exterior sensors: Complete with hood over the aperture to shield the sensor from direct sunlight. Outdoor sensor circuitry completely encased in an optically clear epoxy resin. Sensor range between 0 fc and 750 fc.

2.10.4 Atrium sensors: Translucent dome with a 180 degree field of view. Range from 2 fc to 2,500 fc.

2.10.5 Skylight sensors: Translucent dome with a 180 degree field of view. Range between 10 fc and 7,500 fc.

2.11 **Sequences of Operation**

2.11.1 Vacancy Sensor Operation: Manual On, Manual/Auto Off.

3. EXECUTION

3.1 Installation

3.1.1 In accordance with manufacturer's instructions.

3.1.2 Minimum 14 AWG from the circuit control hardware relays.

3.1.3 It shall be the contractor's responsibility to locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have 90 per cent to 100 per cent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room.

3.1.4 It is the contractor's responsibility to arrange a pre-installation meeting with manufacturer's factory authorized representative, at Owner's facility, to verify placement of sensors and installation criteria.

3.1.5 Proper judgement must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.

3.1.6 Install manual control devices and sensors in accordance with manufacturer's instructions for Vacancy Operation.

3.2 Training

3.2.1 Provide training in accordance with Section 01 79 00.

3.3 Commissioning

3.3.1 In accordance with Section 26 08 50.

3.3.2 Upon completion of the installation, the system shall be completely commissioned to verify all adjustments and sensor placement to ensure a trouble-free lighting control system.

3.3.3 Submit commissioning report to the Consultant and the commissioning authority for review.

3.3.4 Provide the Consultant and Commissioning Authority with ten working days written notice of the scheduled commissioning date.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Materials and components for dry type transformers up to 600 V primary, equipment identification and transformer installation.

1.2 References

1.2.1 ANSI/ASHRAE/IES Standard 90.1-2010 -- Energy Standard for Buildings Except Low-Rise Residential Buildings.

1.2.2 Canadian Standards Association (CSA):

.1 CSA C22.1-12 - Canadian Electrical Code, Part I (22nd Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (25th Edition / 2012).

.3 CAN/CSA C22.2 No. 47 - Air-Cooled Transformers (Dry Type).

.4 CSA C802.2-12 Minimum Efficiency Values for Dry-Type Transformers.

1.2.3 National Electrical Manufacturers Association (NEMA):

.1 NEMA ST-20 for Sound Level.

1.2.4 NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).

1.2.5 Ontario Building Code and its referenced standards.

1.3 Action Submittals

1.3.1 Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, power, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

1.4 Informational Submittals

1.4.1 Test Reports: Indicate loss data, efficiency at 25, 50, 75, and 100 per cent rated load, and sound level.

1.4.2 Submit manufacturer's installation instructions.

.1 Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements.

.2 Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.5 Closeout Submittals

1.5.1 Record actual locations of transformers in project record documents.

1.6 Regulatory Requirements

1.6.1 Products: Listed and classified by CSA (Canadian Standards Association).

1.6.2 Efficiency ratings:

.1 Meet or exceed the efficiency levels indicated in CSA C802.2-12, and ASHRAE 90.1-2010, Table 8.1.

1.7 Delivery, Storage, and Handling

1.7.1 Store and handle in strict compliance with manufacturer’s instructions and recommendations. Protect from potential damage from weather and construction operations.

1.7.2 Store so condensation will not form on or in the transformer housing and if necessary, apply temporary heat where required to obtain suitable service conditions. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

1.7.3 Handle to manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.7.4 Handle transformer using proper equipment for lifting and handling, use when necessary lifting eye and/or brackets provided for that purpose.

1.8 **Warranty**

1.8.1 The transformer shall carry a two year warranty from the time of substantial performance.

2. PRODUCTS

2.1 **General**

2.1.1 Transformers shall be standard general purpose dry type unless otherwise indicated on drawings as K-Rated or Harmonic Mitigation type.

2.1.2 Use transformers of one manufacturer throughout project and in accordance with CAN/CSA-C22.2 No.47 and CSA-C9.

2.1.3 Manufacturers:

.1 STI.
.2 Cutler Hammer.
.3 Delta Transformer.
.4 Hammond.
.5 Rex Power Magnetics.
.6 Siemens.
.7 Schneider Electric.
.8 Substitutions: permitted if approved by Consultant prior to Tender closing date.

2.2 **General Purpose Transformers**

2.2.1 NEMA ST-20, factory-assembled, air cooled low-inrush dry type transformer, ratings and voltages as indicated on drawings.

2.2.2 Single or three phase as indicated on drawings.

2.2.3 Type: AN/AA Ventilated self-cooled.

2.2.4 Copper windings.

2.2.5 Finish: Final coating to be ASA 61 Grey Epoxy Powder

2.2.6 T-connected transformers are not acceptable.

2.2.7 Isolate core and coil from enclosure using vibration-absorbing mounts.

2.2.8 Impedance: Standard.

2.3 **Primary Voltage**

2.3.1 600 volts delta, 3 phase;

2.3.2 480 volts delta, 3 phase.

2.4 **Secondary Voltage**

2.4.1 347/600 volts, 3 phase wye;

2.4.2 277/480 volts, 3 phase wye;

2.4.3 120/208 volts, 3 phase wye.

2.5 **Insulation system and average winding temperature rise for rated kVA as follows:**

2.5.1 1-15 kVA: Class 185 with 80 degrees C rise.

2.5.2 16-500 kVA: Class 220 with 80 degrees C rise.

2.5.3 Above 500 kVA: Class 220 with 80 degrees C rise.

2.6 **Case Temperature**

2.6.1 Do not exceed 35 degrees C rise above ambient at warmest point at full load.

2.7 **Winding Taps**

2.7.1 To NEMA ST-20.

2.7.2 Four full capacity 5 per cent adjustment taps, 2 at 2.5 per cent FCBN (full capacity below nominal) and 2 at 2.5 per cent FCAN (full capacity above nominal).

2.8 **Basic Impulse Level:**

2.8.1 10 kV BIL.

2.9 **Grounding**

2.9.1 Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

2.10 **Mounting**

2.10.1 1-15 kVA: suitable for wall mounting.

2.10.2 16-75 kVA: suitable for wall or floor, as shown.

2.10.3 Larger than 75 kVA: suitable for floor mounting.

2.11 **Coil Conductors**

2.11.1 Continuous windings with terminations brazed or welded.

2.12 **Enclosure**

2.12.1 NEMA ST-20, CSA, Type 2 ventilated, Sprinkler-proof. Provide lifting eyes or brackets.

2.13 **Sound Levels**

2.13.1 To NEMA ST-20 for transformers up to 300 kVA:

.1 Up to 9 kVA: 40 dB.

.2 10 – 50 kVA: 45 dB.

.3 51 – 150 kVA: 50 dB.

.4 151 – 300 kVA: 55 dB.

2.13.2 Sound levels 3 db less than NEMA ST-20 for transformers 301 kVA and greater.

.1 301 – 500 kVA: 57 dB.

.2 501 – 700 kVA: 59 dB.

.3 701 – 1000 kVA: 61 dB.

.4 Above 1000 kVA: 3 db less than NEMA ST-20.

2.14 **Nameplate**

2.14.1 Transformer shall have embossed aluminum or stainless steel nameplate indicating, but not restricted to the following:

.1 kVA rating.

.2 Voltage rating.

.3 Impedance.

.4 Type.

.5 Insulation class.

.6 Temperature rise.

.7 Connection diagram.

.8 Serial number.

2.15 **Equipment Identification**

2.15.1 Provide equipment identification in accordance with Section 26 05 53.

2.16 **Source Quality Control**

2.16.1 Production test each unit according to NEMA ST-20.

3. EXECUTION

3.1 **Installation**

3.1.1 Set transformer plumb and level.

3.1.2 Use flexible conduit, under the provisions of Section 26 05 33.13, 600 mm minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

3.1.3 Mount wall-mounted transformers using integral flanges or accessory brackets provided by the manufacturer.

3.1.4 Mount floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

3.1.5 Mount trapeze-mounted transformers as indicated.
3.1.6 Provide seismic restraints.
3.1.7 Provide grounding and bonding to Section 26 05 26.
3.1.8 Mount dry type transformers up to 75 kVA, as indicated.
3.1.9 Mount dry type transformers above 75 kVA on floor.
3.1.10 Ensure adequate clearance around transformer for ventilation.
3.1.11 Install transformers in level upright position.
3.1.12 Remove shipping supports only after transformer is installed and just before putting into service.
3.1.13 Loosen isolation pad bolts until no compression is visible.
3.1.14 Make primary and secondary connections in accordance with wiring diagram.
3.1.15 Energize transformers after installation is complete.

3.2 **Field Quality Control**
3.2.1 Section 01 43 00: Field Inspection, Testing, Adjusting.
3.2.2 Perform inspections and tests listed in NETA ATS, Section 7.2.

3.3 **Adjusting**
3.3.1 Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Power distribution panelboards – Circuit breaker type.

1.1.2 Lighting and Appliance Branch Circuit Panelboards.

1.2 Related Requirements

1.2.1 Section 26 28 16.02 – Molded Case Circuit Breakers.

1.2.2 Section 26 43 13 – Surge Protective Devices for Low-Voltage Electrical Power Circuits.

1.3 References

1.3.1 CSA C22.1-12 - Canadian Electrical Code, Part I (22nd Edition), Safety Standard for Electrical Installations

1.3.2 Ontario Electrical Safety Code (25th Edition / 2012)

1.3.3 CSA C22.2 No.29 - Panelboards and Enclosed Panelboards.

1.3.4 NEMA AB1 - Molded Case Circuit Breakers, Molded Case Switches, and Circuit - Breaker Enclosures.

1.3.5 NEMA ICS 2 - Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.

1.3.6 NEMA KS1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

1.3.7 NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).

1.3.8 The panelboards and circuit breakers referenced herein are designed and manufactured according to the latest revision of the following specifications.

.1 NEMA PB 1 - Panelboards

.2 NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

.3 NEMA AB 1 - Molded Case Circuit Breakers

.4 CSA C22.2 No. 29-M1989 - Panelboards and Enclosed Panelboards

.5 CSA C22.2 No. 5-M91 - Molded Case Circuit Breakers

1.4 Action Submittals

1.4.1 Submit in accordance with Section 01 33 00.

1.4.2 Shop drawings shall contain overall panelboard dimensions, interior mounting dimensions, and wiring gutter dimensions. The location of the main, branches, and solid neutral shall be clearly shown. In addition, the drawing shall illustrate one line diagrams with applicable voltage systems.

1.4.3 Shop drawings

.1 Indicate the following:

.1 Outline and support point dimensions

.2 Voltage

.3 Main bus ampacity

.4 Integrated short circuit ampere rating

.5 Circuit breaker arrangement, types and sizes.

.2 The following information shall be submitted to the Engineer:

.1 Breaker layout drawing with dimensions indicated and nameplate designation

.2 Component list

.3 Conduit entry/exit locations

.4 Assembly ratings including:

Short-circuit rating

Voltage

Continuous current

.5 Cable terminal sizes

.6 Product data sheets

.3 Where applicable, the following additional information shall be submitted to the Engineer:
.1 Key interlock scheme drawing and sequence of operations

1.4.4 Submittals for Construction
.1 The following information shall be submitted for record purposes:
.1 Installation information

1.5 **Closeout Submittals**

1.5.1 Refer to Section 01 78 00.

1.5.2 Record actual locations of panelboards and record actual circuiting arrangements in project record documents.

1.5.3 Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.5.4 Final as-built drawings and information shall incorporate all changes made during the manufacturing and installation process.

1.6 **Maintenance Material Submittals**

1.6.1 Manufacturer shall provide installation instructions and NEMA Standards Publication PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

1.6.2 Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

1.6.3 Provide two of each panelboard key.

1.6.4 Provide final panelboard schedules indicating panelboard data, phasing, breaker sizes, and loads served.

1.7 **Quality Assurance**

1.7.1 Regulatory Requirements
.1 Products: Listed and classified by CSA (Canadian Standards Association).

1.7.2 Qualifications
.1 Company specializing in manufacturing of panelboard products with a minimum of 20 years' experience.
.2 The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
.3 For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.
.4 The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Engineer, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

1.8 **Delivery, Storage, and Handling**

1.8.1 Inspect and report concealed damage to carrier within their required time period.

1.8.2 Handle carefully to avoid damage to panelboard internal components, enclosure, and finish.

1.8.3 Store in a clean, dry environment. Maintain factory packaging and, if required, provide an additional heavy canvas or heavy plastic cover to protect enclosure(s) from dirt, water, construction debris, and traffic.

1.8.4 Equipment shall be handled and stored in accordance with manufacturer's instructions. One copy of these instructions shall be included with the equipment at time of shipment.

1.9 **Manufacturer Warranty**

1.9.1 Warrant specified equipment to be free from defects in materials and workmanship for eighteen (18) months from the date of purchase.

2. PRODUCTS

2.1 General

2.1.1 Description: CSA C22.2 No.29, circuit breaker type.

2.2 Distribution Panelboards – Circuit Breaker Type

2.2.1 Manufacturers:
- .1 Square D by Schneider Electric, I-LINE Series.
- .2 Eaton Cutler-Hammer, PRL 3 and PRL4 Series.
- .3 Equal by Siemens.

2.2.2 The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Engineer ten days prior to bid date.

2.2.3 Panelboard Bus:
- .1 Copper, ratings as indicated.
- .2 Provide copper neutral bus for panelboards indicated for 4-wire systems.
- .3 Provide copper ground bus in each panelboard.

2.2.4 Short Circuit Ratings:
- .1 Panelboards rated 600 V shall have minimum integrated short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 65 000 amperes RMS symmetrical.
- .2 Distribution panelboards with bolt-on devices contained therein shall have interrupting ratings as specified herein or indicated on the drawings.
- .3 Panelboards shall be fully rated.
- .4 Where indicated, provide circuit breakers ULC listed for application at 100 per cent of their continuous ampere rating in their intended enclosure.

2.2.5 Minimum integrated short circuit rating: Panelboards rated 240 V shall have minimum integrated short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 10 000 amperes RMS symmetrical.

2.2.6 Molded Case Circuit Breakers: To Section 26 28 16.02.

2.2.7 Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.

2.2.8 Cabinet Front: Surface type, fastened hinge and latch, metal directory frame, finished in manufacturer's standard gray enamel.

2.2.9 Enclosures: CSA type 2 sprinklerproof complete with drip hood, or as noted.

2.2.10 Trims shall be equipped with a flush lock

2.2.11 Breaker positions labeled as “Spare” or “Space” shall constitute no less than 20 per cent of available breaker positions, whether indicated or not in panelboard schedules.

2.2.12 Each panel shall be complete with a directory which shall be mounted inside door in a metal frame with clear plastic cover and copy in each Data Book. Use final Room Numbers for directories.

2.3 Branch Circuit Panelboards

2.3.1 Manufacturers:
- .1 Square D by Schneider Electric, NQ or NQOD Series.
- .2 Eaton Cutler-Hammer, POW-R-LINE 1, POW-R-LINE 2, POW-R-LINE 3 Series.
- .3 Equal by Siemens.

2.3.2 Description: CSA C22.2 No.29, circuit breaker type, lighting and appliance branch circuit panelboard.

2.3.3 Panelboard Bus:
- .1 Copper, ratings as indicated.
- .2 Provide copper neutral bus in each panelboard.
- .3 Provide copper ground bus in each panelboard.
- .4 Provide insulated ground bus where scheduled.

2.3.4 Minimum Integrated Short Circuit Rating: 10 000 amperes RMS symmetrical for 240 volt panelboards, or as indicated.

2.3.5 Molded Case Circuit Breakers: NEMA AB 1, plug-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.

2.3.6 Current Limiting Molded Case Circuit Breakers where indicated: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.

2.3.7 Cabinet Front: Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.

2.3.8 Enclosure shall be CSA type 2 sprinklerproof complete with drip hood, or as noted.

2.3.9 Trims shall be equipped with a flush lock

2.3.10 Breaker positions labeled as “Spare” or “Space” shall constitute no less than 20 per cent of available breaker positions, whether indicated or not in panelboard schedules.

2.3.11 Panelboards: to CSA C22.2 No.29 and product of one manufacturer.

.1 Install circuit breakers in panelboards before shipment.

.2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.

2.3.12 Panelboards rated 240 Vac or less shall have short-circuit ratings as shown on the drawings or as herein scheduled, but not less than 10,000 amperes RMS symmetrical.

2.3.13 Bus and breakers rated for symmetrical interrupting capacity, as indicated.

2.3.14 Sequence phase bussing with odd numbered breakers on left and even on right, with each breaker identified by permanent number identification as to circuit number and phase.

2.3.15 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.

2.3.16 Two keys for each panelboard and key panelboards alike.

2.3.17 Copper bus with neutral of same ampere rating as mains.

2.3.18 Mains: suitable for bolt-on breakers.

2.3.19 Trim with concealed front bolts and hinges.

2.3.20 Trim and door finish: baked grey enamel.

2.3.21 The minimum short-circuit rating for branch circuit panelboards shall be as specified herein or as indicated on the drawings. Panelboards shall be fully rated.

2.3.22 Bolt-on type, heavy-duty, quick-make, quick-break, single- and multi-pole circuit breakers of the types specified herein, shall be provided for each circuit with toggle handles that indicate when unit has tripped.

2.3.23 Circuit breakers shall be thermal-magnetic type with common type handle for all multiple pole circuit breakers. Circuit breakers shall be minimum 100-ampere frame and through 100-ampere trip sizes shall take up the same pole spacing. Circuit breakers shall be ULC listed as type SWD for lighting circuits.

.1 Circuit breaker handle locks shall be provided for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.

2.3.24 Circuit breakers shall have a minimum interrupting rating of 10 000 amperes symmetrical at 240 volts, and 14 000 amperes symmetrical at 480 volts, unless otherwise noted on the drawings.

2.3.25 Each panel shall be complete with a directory which shall be mounted inside door in a metal frame with clear plastic cover and copy in each Data Book. Use final Room Numbers for directories.

2.3.26 Lighting and receptacle panels shall be surface or flush-mounting type, as shown.

2.3.27 Panels shall be dead front type in code gauge steel enclosures. All panels shall be sprinkler proof c/w drip hoods as required.

2.3.28 Panels shall have mains of voltage and capacity, and main and branch breakers, as shown on the drawings. Spaces shall include necessary bus work such that Owners, at a later date, need buy only the breakers.

2.3.29 Where panels exceed 42 circuits, use multi-section panel with main cross-over solid bus bars. Main bus capacity of each section shall be full size to match cross-over bus.

2.3.30 Breakers shall have bolted type connections. Multi-pole breakers shall be common trip type with a single handle, suitable for voltage applied and of same manufacture as single pole breakers.

2.3.31 Panels for 120/208 volt, 3-phase, 4-wire systems shall be complete with full size breakers.

2.3.32 Where shown on drawings or required by code, certain breakers shall include ground fault interrupter.

2.3.33 Provide lighting and receptacle panels, surface or flush-mounting type, as shown.

2.3.34 Provide locking bars on non-switched circuits where panels are used for switching lighting circuits.

2.3.35 Panels for non-linear loads shall be complete with lugs for double neutrals.

2.3.36 Panels shall be given a rust-resistant treatment to both tub and trim.

2.3.37 Flush panels shall have concealed hinges and flush type combination lock latch. Locks shall be chrome plated. Doors shall open minimum 135 degrees. Trims shall have fasteners concealed and shall be prime coated to receive room finish paint.

2.3.38 Surface mounted panels shall have manufacturer's standard surface door trim complete with lock and latch. Finish shall be grey.

2.3.39 Recessed panels shall have standard flush trims.

2.3.40 Co-ordinate panel finish with Room Finish Schedule.

2.4 Molded Case Circuit Breakers

2.4.1 Breakers: to Section 26 28 16.02.

2.4.2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.

2.4.3 Main breaker: separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

2.4.4 Lock-on devices for 10 per cent of 15 A to 30 A breakers installed as indicated. Turn over unused lock-on devices to Owner.

2.4.5 Lock-on devices for fire alarm, security, and sprinkler circuits.

2.4.6 Provide shunt trips, bell alarms, and auxiliary switches as shown on the contract drawings.

2.4.7 Provide breakers for externally mounted Surge Protective Devices in accordance with Section 26 43 13.

2.5 Construction

2.5.1 General:

.1 Interiors shall be completely factory assembled. They shall be designed such that switching and protective devices can be replaced without disturbing adjacent units and without removing the main bus connectors.

.2 Surface trims shall be same height and width as box. Flush trims shall overlap the box by 3/4 of an inch on all sides.

.3 A temporary directory card with a clear plastic cover shall be supplied and mounted on the inside of each door.

.4 All locks shall be keyed alike. Key same as existing.

2.5.2 Branch Circuit Panelboards:

.1 Trims for branch circuit panelboards shall be supplied with a hinged door over all circuit breaker handles. Doors in panelboard trims shall not uncover any live parts. Doors shall have a semi flush cylinder lock and catch assembly. Door-in-door trim shall be provided. Both hinged trim and trim door shall utilize three point latching. No tools shall be required to install or remove trim. Trim shall be equipped with a door-actuated trim locking tab. Equip locking tab with provision for a screw such that removal of trim requires a tool, at the owner’s option. Installation shall be tamper resistant with no exposed hardware on the panelboard trim.

2.5.3 Distribution Panelboards:

.1 Distribution panelboard trims shall cover all live parts. Switching device handles shall be accessible.

2.6 **Bus**

2.6.1 Main bus bars shall be copper sized in accordance with CSA standards to limit temperature rise on any current carrying part to a maximum of 65 degrees C above an ambient of 40 degrees C maximum.

2.6.2 A copper system ground bus shall be included in all panelboards.

2.6.3 Full-size (100 per cent rated) insulated copper neutral bars shall be included for panelboards shown with neutral. Bus bar taps for panels with single-pole branches shall be arranged for sequence phasing of the branch circuit devices. Neutral busing shall have a suitable lug for each outgoing feeder requiring a neutral connection. 200 per cent rated neutrals shall be supplied for panels designated on drawings with oversized neutral conductors.

2.7 **Equipment Identification**

2.7.1 Provide equipment identification in accordance with Section 26 05 53.

2.7.2 Nameplate for each panelboard size 4 engraved.

2.7.3 Nameplate for each branch circuit in distribution panelboards size 2 engraved.

2.7.4 Complete circuit directory with typewritten legend showing location and load of each circuit.

2.7.5 Provide an engraved nameplate for each panelboard section.

2.7.6 Provide copies of all circuit directories in Manuals.

3. EXECUTION

3.1 **Installation**

3.1.1 Install panelboards to CSA C22.1.

3.1.2 Install panelboards plumb.

3.1.3 Height: 1800 mm to top of panelboard; install panelboards taller than 1800 mm with bottom no more than 100 mm above floor.

3.1.4 Provide filler plates for unused spaces in panelboards.

3.1.5 Provide typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

3.1.6 Provide engraved plastic nameplates under the provisions of Section 26 05 53.

3.1.7 Ground and bond panelboard enclosure according to Section 26 05 26.

3.1.8 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.

3.1.9 Install surface mounted panelboards on fire rated plywood backboards in accordance with Section 06 10 00. Where practical, group panelboards on common backboard.

3.1.10 Connect loads to circuits.

3.1.11 Connect neutral conductors to common neutral bus with respective neutral identified.

3.1.12 Deliver five (5) duplicate keys for each panel lock to Owner.

3.1.13 Mount electrical panels, where possible, with top of trim at uniform height of 2000 mm.

3.1.14 Cap ends of conduits in accessible locations in ceiling spaces above panels, to allow for future wiring.

3.1.15 The Contractors shall install all equipment per the manufacturer’s recommendations and the contract drawings.

3.1.16 Install panelboards in accordance with manufacturer's written instructions, NEMA PB 1.1 and Electrical Code requirements.

3.1.17 After completion of wiring, type directory showing a clear description of each circuit being controlled from panel and place in metal frame inside door.

3.1.18 Provide revised directories for existing panels if revised.

3.1.19 Provide circuit breaker handle locks for all circuits that supply exit signs, emergency lights, energy management, and control system (EMCS) panels and fire alarm panels.

3.2 **Field Quality Control**

3.2.1 Perform inspections and tests listed in NETA ATS, Section 7.4 for switches, Section 7.5 for circuit breakers.

3.2.2 Inspect complete installation for physical damage, proper alignment, anchorage, and grounding.

3.2.3 Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads within 20 per cent of each other. Maintain proper phasing for multi-wire branch circuits.

3.2.4 Check tightness of bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written specifications.

3.3 **Adjusting**

3.3.1 Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other.

3.3.2 Maintain proper phasing for multi-wire branch circuits.

3.4 **Factory Testing**

3.4.1 The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.5 **Closeouts**

3.5.1 Provide three 27 mm empty conduits from top of lighting, receptacle, telephone, signal and communication panels recessed in walls, to ceiling space.

3.5.2 Include a copy of each panelboard schedule in the Operation and Maintenance manual.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Switches, receptacles, wiring devices, cover plates and their installation.

1.2 Related Requirements

1.2.1 Section 26 09 23 – Lighting Control Devices.

1.2.2 Section 26 27 26.33 – Surface Mounted On-Floor Raceway and Floor Boxes.

1.3 References

1.3.1 Canadian Standards Association

.1 CSA C22.1 - Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code.

.3 CSA-C22.2 No.42-99(R2004), General Use Receptacles, Attachment Plugs and Similar Devices.

.4 CAN/CSA-C22.2 No.42.1-00(R2004), Cover Plates for Flush-Mounted Wiring Devices (Bi-National standard, with UL 514D).

.5 CSA-C22.2 No.55-M1986 (R2003), Special Use Switches.

.6 CSA-C22.2 No.111-00(R2005), General-Use Snap Switches (Bi-national standard, with UL 20, twelfth edition).

1.3.2 International Electrotechnical Commission (IEC)

.1 IEC 60309 – Plugs, socket-outlets and couplers for industrial purposes.

1.4 Action Submittals

1.4.1 Submit shop drawings and product data in accordance with Section 01 33 00.

1.4.2 Product Data: Provide manufacturer's catalogue information showing dimensions, colours, and configurations.

1.5 Informational Submittals

1.5.1 Submit manufacturer's installation instructions.

1.6 Regulatory Requirements

1.6.1 Provide products listed and classified by CSA (Canadian Standards Association).

2. PRODUCTS

2.1 Manufacturers

2.1.1 Cooper Wiring Devices by Eaton.

2.1.2 Hubbell Bryant.

2.1.3 Pass & Seymour (Legrand).

2.2 Wall Switches

2.2.1 Single pole, double pole, three-way, four-way switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111.

2.2.2 Description: CSA-C22.2 No.111, Commercial Spec Grade, AC only general-use snap switch.

2.2.3 Local switches shall be 20 ampere, silent, brown coloured, AC type and CSA certified, specification grade. Provide switches rated to suit system voltage 120 V or 347 V.

2.2.4 Manually-operated general purpose AC switches with following features:

.1 Terminal holes approved for 10 AWG wire.

.2 Silver alloy contacts.

.3 Urea or melamine moulding for parts subject to carbon tracking.

.4 Suitable for back and side wiring.

2.2.5 Voltage: 120 volt or 347 volt, AC as indicated.

2.2.6 Current: 20 amperes.

2.2.7 Body and Handle: white plastic with toggle handle. Confirm finish colour prior to ordering.
2.2.8 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
2.2.9 Example Products (Decorator style):
.1 120 volt:
.1 Hubbell HBL2121 series.
.2 347 volt:
.1 Pass & Seymour 2601-347 series.
2.2.10 Example Products (Toggle style):
.1 120 volt:
.1 Hubbell HBL1221 (single pole).
.2 Hubbell HBL1222 (double pole).
.3 Hubbell HBL1223 (three-way).
.4 Hubbell HBL1224 (four-way).
.2 347 volt:
.1 Hubbell HBL18221 (single pole).
.2 Hubbell HBL18223 (three-way).
.3 Pass & Seymour PS372030I
2.2.11 Local switches and receptacles shall be of the same manufacturer throughout except where a specified item is not made by that manufacturer.

2.3 Receptacles

2.3.1 General
.1 Description: CSA C22.2 No.42, Commercial Spec Grade general use receptacles.
.2 Device Body: white plastic.
.3 Configuration: Type as specified and indicated.
.4 Convenience Receptacle: Type 5-15, 5-20 where indicated.
.5 GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.
.6 Data Room Receptacle Types: As indicated on drawings.
.7 Receptacles of one manufacturer throughout project.
2.3.2 Receptacles shall be white coloured, specification grade, unless noted otherwise.
2.3.3 Receptacles shall be as listed below:
.1 15 ampere, 120 volt, single phase grounded duplex receptacle shall be NEMA-U-ground type CSA Configuration 5-15R.
.2 20 ampere, 120 volt, single phase grounded duplex receptacle shall be NEMA-U-ground type CSA Configuration 5-20RA
.3 15 ampere, 120 volt, weatherproof receptacles shall be equal to those above but complete with gasketted cast plate and hinged covers.
2.3.4 Other types of receptacles shall be provided as shown on Drawings.
2.3.5 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA-C22.2 No.42 with following features:
.1 White urea moulded housing.
.2 Suitable for No. 10 AWG for back and side wiring.
.3 Break-off links for use as split receptacles.
.4 Eight back wired entrances, four side wiring screws.
.5 Triple wipe contacts and riveted grounding contacts.
2.3.6 Single receptacles CSA type 5-15 R, 125 V, 15 A, U ground with following features:
.1 White urea moulded housing.
.2 Suitable for No. 10 AWG for back and side wiring.
.3 Four back wired entrances, 2 side wiring screws.
2.3.7 Other receptacles with ampacity and voltage as indicated.
2.3.8 Example Products (Decorator style duplex 5-15R):
.1 Pass & Seymour 26252 Series.
.2 Hubbell HBL2152 Series.
2.3.9 Ground Fault Circuit Interrupter (GFCI or GFI) Receptacles

.1 Protected by a ground fault circuit interrupter of the Class A type.
.2 Any receptacle within 1.5 m of a sink must be GFCI protected.
.3 Any receptacle located outdoor must be GFCI protected.

2.3.10 Isolated Ground (IG) Receptacles:
.1 Marked as such (green triangle).
.2 Example Products:
.1 Hubbell IG2152 (15A duplex decorator style, orange faceplate).

2.3.11 Tamper Proof receptacles.
.1 Marked as such (for example "TR")
.2 To be used in the following spaces:
.1 Child care facilities and kindergarten classrooms.
.2 Dwelling unit receptacles.
.3 Example Products:
.1 Hubbell BR15WHITR (15A duplex decorator style).
.2 Hubbell BR20WHITR (20A duplex decorator style).

2.3.12 Wet Location and weatherproof devices:
.1 Receptacles and cover plates suitable for wet locations, cover plates to provide shielding with and without a plug inserted into the receptacle in accordance with OESC rule 26-702. Cover plates to be marked "Extra Duty".
.2 Receptacles shall be 20A rated, GFI.

2.4 Cover Plates

2.4.1 Cover plates for wiring devices to: CAN/CSA-C22.2 No.42.1.
2.4.2 Cover plates from one manufacturer throughout project.
2.4.3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
2.4.4 Stainless steel, vertically brushed, cover plates, thickness 2.5 mm for wiring devices mounted in flush-mounted outlet box.
2.4.5 Cast cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.
2.4.6 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.
2.4.7 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.
2.4.8 Decorative Cover Plate: Polycarbonate.
.1 Pass & Seymour TP26W Series
2.4.9 Switch, receptacle, telephone and other plates shall be stainless steel 18-8 chrome metal alloy, Type 302, non-metallic in finished areas and pressed steel in unfinished areas. Finish brush marks shall be run in a vertical direction.
2.4.10 Wet Location and weatherproof devices: receptacles and cover plates shall be suitable for wet locations, and provide shielding with and without a plug inserted into the receptacle in accordance with OESC rule 26-702.

2.5 Pendant Receptacles

2.5.1 Pendant cord mounted single receptacles complete with strain relief device.
2.5.2 Strain relief system: Hubbell Kellems Grips, or equal.

2.6 Special Wiring Devices

2.6.1 Pilot lights as indicated, with neon type 0.04 W, 125 V lamp and red plastic jewel flush type.

3. EXECUTION

3.1 Mounting Heights

3.1.1 In accordance with Section 26 05 00.

3.2 **Examination**

3.2.1 Verify that outlet boxes are installed at proper height.

3.2.2 Verify that wall openings are neatly cut and will be completely covered by wall plates.

3.2.3 Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.3 **Preparation**

3.3.1 Provide extension rings to bring outlet boxes flush with finished surface.

3.3.2 Clean debris from outlet boxes.

3.4 **Installation**

3.4.1 Install to CSA C22.1.

3.4.2 Install devices plumb and level.

3.4.3 Install switches with OFF position down.

3.4.4 Install wall dimmers to achieve full rating specified and indicated after de-rating for ganging as instructed by manufacturer.

3.4.5 Do not share neutral conductor on load side of dimmers.

3.4.6 Install receptacles with grounding pole on bottom.

3.4.7 Connect wiring device grounding terminal to outlet box with bonding jumper.

3.4.8 Install decorative plates on switch, receptacle, and blank outlets in finished areas.

3.4.9 Connect wiring devices by wrapping conductor around screw terminal.

3.4.10 Use jumbo size plates for outlets installed in masonry walls.

3.4.11 Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

3.4.12 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.

3.4.13 Receptacles:

.1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.

.2 Where split receptacle has one portion switched, mount vertically and switch upper portion.

.3 Connect receptacle grounding terminal to the outlet box with an insulated green ground strap.

.4 Receptacles for maintenance of HVAC and similar equipment located on rooftops

.1 Provide weatherproof GFI 5-20R receptacles on roof, installed at 750 mm (30 inches) above finished roof level, complete with wet location cover plate.

.2 Locate within 7500 mm (25 feet) of new HVAC equipment, and at least 1800 mm (6 feet) away from roof line.

.3 Refer to OESC 2012 rules 2-314, 26-702, and 26-704, and OESC bulletin 26-27-0.

3.4.14 Cover plates:

.1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.2 Install suitable common cover plates where wiring devices are grouped.

.3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

.4 Do not install plates until final painting of room or area is completed. Remove protective covering.

3.4.15 Circuit identification: in accordance with Section 26 05 53.

3.5 **Field Quality Control**

3.5.1 Inspect each wiring device for defects.

3.5.2 Operate each wall switch with circuit energized and verify proper operation.

3.5.3 Verify that each receptacle device is energized.

3.5.4 Test each receptacle device for proper polarity.

3.5.5 Test each GFCI receptacle device for proper operation.

3.6 **Adjusting**

3.6.1 Adjust devices and wall plates to be flush and level.

3.7 **Cleaning**

3.7.1 Clean exposed surfaces to remove splatters and restore finish.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Surface mounted raceways.

1.1.2 Floor boxes.

1.2 Related Requirements

1.2.1 Section 27 10 00 – Structured Cabling.

1.2.2 Section 27 41 16.01 – Tabletop Integrated Audio-Video System and Equipment.

1.3 Submittals

1.3.1 Submit under provisions of Section 01 33 00.

1.3.2 Product Data: Submit for surface raceways and floor boxes.

1.3.3 Shop Drawings: For the following electrical system components. Include plans, elevations, sections, details, and attachments to other work.

.1 Floor boxes.

1.3.4 Samples: Submit three 152 mm (6 inch) lengths of exposed type surface raceways with required color and finish. Show standard color ranges available.

1.4 Quality Assurance

1.4.1 Manufacturer Qualifications: Firms regularly engaged in manufacture of raceway systems, boxes and fittings of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 10 years. Provide raceways and boxes produced by a manufacturer listed in this section.

1.5 Delivery, Storage, and Handling

1.5.1 Deliver raceways and distribution systems in factory labeled packages.

1.5.2 Store and handle in strict compliance with manufacturer's written instructions and recommendations.

1.5.3 Protect from damage due to weather, excessive temperature, and construction operations.

2. PRODUCTS

2.1 Overfloor Wireway

2.1.1 Manufacturers:

.1 Basis of design: Legrand/Wiremold OFR series overfloor raceway.

.1 Base: 2.0 mm (0.080 inch) aluminum, Divided into four channels.

.1 Raceway cover: Cover: 1.0 mm (0.040 inch) steel. Durable black powder coat finish.

.2 Accessories including entrance end fitting.

.3 Alternate by Connectrac.

3. OVERFLOOR RACEWAY 4-GANG BOX

3.1.1 Legrand/Wiremold OFR48-4 series: Divided four-gang device box. Allows multiple services (power, communication, A/V) at a single point-of-use. Side facing device mounting provides low profile, with space for large cable bend radius. Accepts OFR Series device plates. Removable divider can be aligned with any of the raceway channels.

4. EXECUTION

4.1 Examination

4.1.1 Examine conditions under which raceways, boxes, distribution systems, accessories, and fittings are to be installed and substrate that will support raceways. Notify the Consultant in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

4.2 **Installation**

4.2.1 Strictly comply with manufacturer's installation instructions and recommendations and approved shop drawings. Coordinate installation with adjacent work to ensure proper clearances and to prevent electrical hazards.

.1 Mechanical security: Raceway systems shall be mechanically continuous and connected to all electrical outlets, boxes, device mounting brackets, and cabinets, in accordance with manufacturer's installation sheets.

.2 Electrical security: Metal raceway shall be electrically continuous and bonded in accordance with the National Electric Code for proper grounding.

.3 Accessories: Provide accessories as required for a complete installation, including insulated bushings and inserts where required by manufacturer.

.4 Unused Openings: Close unused raceway openings using manufacturer's recommended accessories.

4.3 **Cleaning**

4.3.1 Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer.

4.4 **Protection**

4.4.1 Protect raceways and boxes until acceptance.

END OF SECTION

1. GENERAL

1.1 Submittals

1.1.1 Provide submittals in accordance with Section 01 33 00.

1.1.2 Product Data:

.1 Provide fuse performance data characteristics for each fuse type and size above 200 amps. Performance data to include: average melting time-current characteristics.

1.1.3 Shop Drawings:

.1 Provide shop drawings in accordance with Section 01 33 00.

1.2 Delivery, Storage, and Handling

1.2.1 Ship fuses in original containers.

1.2.2 Do not ship fuses installed in switchboard.

1.2.3 Store fuses in original containers in storage cabinet.

1.2.4 Waste Management and Disposal:

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21.

1.3 Maintenance Materials

1.3.1 Provide maintenance materials in accordance with Section 01 78 00.

1.3.2 3 spare fuses of each type and size installed above 600 A.

1.3.3 6 spare fuses of each type and size installed up to and including 600 A.

2. PRODUCTS

2.1 Manufacturers

2.1.1 Bussman by Eaton.

2.1.2 GEC.

2.1.3 Littelfuse.

2.1.4 Mersen.

2.1.5 Substitutions are not permitted.

2.2 Fuses - General

2.2.1 Fuse type references L1, L2, J1, R1, etc. have been adopted for use in this specification.

2.2.2 Fuses: product of one manufacturer.

2.2.3 Fuses shall be sized as shown, time delay type, and of the same type throughout.

2.2.4 Fuses shall be CSA certified Class-J for 1-600A or Class-L for 650 Amps and above.

2.3 Fuse Types

2.3.1 Class J fuses.

.1 Type J1, time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum.

.2 Type J2, fast acting.

2.3.2 Class L fuses.

.1 Type L1, time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum.

.2 Type L2, fast acting.

2.3.3 Class R fuses.

.1 Type R1, (UL Class RK1), time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum, to meet UL Class RK1 maximum let-through limits.

.2 Type R2, time delay, capable of carrying 500 per cent of its rated current for 10 seconds minimum.

.3 Type R3, (UL Class RK1), fast acting Class R, to meet UL Class RK1 maximum let-through limits.

2.4 **Fuse Requirements**

2.4.1 Dimensions and Performance: CSA C22.2 No. 248 Series, Class as specified or indicated.

2.4.2 Voltage: Provide fuses with voltage rating suitable for circuit phase-to-phase voltage.

2.4.3 Power Load Feeder Switches: HRC-1 Class J time delay type (Gould type AJT).

2.4.4 Other Feeder Switches: HRC-1 Class J time delay type (Gould type AJT).

2.5 **Spare Fuse Cabinet**

2.5.1 Description: Wall-mounted sheet metal cabinet, suitably sized to store spare fuses and fuse pullers specified.

2.5.2 Doors: Hinged, with hasp for Owner's padlock.

2.5.3 Finish: Prime finish for field painting.

2.5.4 Dimensions: Minimum 3 foot by 3 foot by 1 foot.

3. **EXECUTION**

3.1 **Installation**

3.1.1 Install fuses to manufacturer's instructions.

3.1.2 Install fuse with label oriented such that manufacturer, type, and size are easily read.

3.1.3 Install spare fuse cabinet in electrical room.

3.1.4 Provide a complete set of fuses in each fusible device supplied under this Division and provide 3 spare fuses for each size used in spare fuse cabinet.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Materials for Molded-Case Circuit Breakers (MCCB).

1.1.2 Accessories

1.2 Related Requirements

1.2.1 Section 26 24 16 – Panelboards.

1.3 References

1.3.1 CSA C22.1-12 - Canadian Electrical Code, Part I (22nd Edition), Safety Standard for Electrical Installations

1.3.2 Ontario Electrical Safety Code 25th Edition / 2012.

1.3.3 CSA-C22.2 No. 5-02, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.3.4 NEMA AB1 - Molded Case Circuit Breakers, Molded Case Switches, and Circuit - Breaker Enclosures.

1.3.5 NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).

1.4 Submittals

1.4.1 Submit product data in accordance with Section 01 33 00.

1.4.2 Include time-current characteristic curves for breakers with ampacity of 400 A and above, or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

1.4.3 Include termination temperature rating in degrees C.

1.4.4 Certificate of Origin

.1 Prior to any installation of circuit breakers in either a new or existing installation, Contractor must submit three (3) copies of a certificate of origin, from the manufacturer, duly signed by the factory and the local manufacturer's representative, certifying that all circuit breakers come from this manufacturer, they are new and they meet standards and regulations. These certificates must be submitted to the Engineer for approval.

.2 A delay in the production of the certificate of origin won't justify any extension of the contract and additional compensation.

.3 Any work of manufacturing, assembly or installation should begin only after acceptance of the certificate of origin by Engineer. Unless complying with this requirement, Engineer reserves the right to mandate the manufacturer listed on circuit breakers to authenticate all new circuit breakers under the contract, and that, to Contractor's expense.

.4 In general, the certificate of origin must contain:

.1 The name and address of the manufacturer, and the person responsible for authentication. The responsible person must sign and date the certificate;

.2 The name and address of the licensed dealer, and the person of the distributor responsible for the Contractor's account.

.3 The name and address of the Contractor, and the person responsible for the project.

.4 The name and address of the local manufacturer's representative. The local representative must sign and date the certificate.

.5 The name and address of the building where circuit breakers will be installed:
Project title
End user's reference number
The list of circuit breakers

2. PRODUCTS

2.1 General

2.1.1 Molded-case circuit breakers, Circuit breakers, and Ground-fault circuit-interrupters, Fused circuit breakers, and Accessory high-fault protectors: to CSA C22.2 No. 5

2.1.2 Bolt-on Molded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

2.1.3 Plug-in Molded case circuit breakers: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 degrees C ambient.

2.1.4 Common-trip breakers: with single handle for multi-pole applications.

2.1.5 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.

.1 Trip settings on breakers with adjustable trips to range from 3-8 times current rating.

2.1.6 Circuit breakers with interchangeable trips.

2.2 Interrupting Capacity

2.2.1 Protective devices shall be fully rated, for required available fault current. Series rated shall not be used on this installation.

2.2.2 Refer to panelboard and switchboard Specification Sections.

2.3 Molded Case Circuit Breakers – General

2.3.1 Molded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3.2 NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

2.3.3 Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

2.3.4 1-, 2-, or 3-pole bold on, single-handle common trip voltage as indicated on drawings.

2.3.5 Overcentre toggle-type mechanism, quick-make, quick-break action. Trip indication is by handle position.

2.3.6 Calibrate for operation in 40 degree C ambient temperature.

2.4 Molded Case Circuit Breakers – Up to 150 Ampere

2.4.1 Permanent trip unit containing individual thermal and magnetic trip elements in each pole, unless noted otherwise on drawings.

2.5 Molded Case Circuit Breakers – 151 to 399 Ampere

2.5.1 Variable magnetic trip elements. Provide push-to-trip button on cover of breaker for mechanical tripping.

2.6 Molded Case Circuit Breakers – 400 Ampere and Above

2.6.1 Electronic trip type with adjustments for long-time, instantaneous and short-time functions.

2.6.2 Provide ground fault function for breakers greater than 400 Amps.

2.6.3 1000 Amp and Above:

.1 Modbus Communications

.1 Breaker status.
Open.
Closed.
Tripped.

.2 Cause of trip.

.3 Time of trip.

.4 Current at time of trip.

.5 RMS currents per phase and ground.

.6 Peak demand.

.7 Present demand.

.8 Energy consumption.

2.6.4 1200 Amp and Above:

.1 Provide handle mechanisms that are lockable in the open (off) position.

2.7 **Additional Features**

2.7.1 Provide as indicated on drawings:

.1 Shunt trip
.2 Auxiliary switch
.3 Motor-operated mechanism.
.4 Under-voltage release
.5 On-off locking device
.6 Handle mechanism

3. EXECUTION

3.1 **Installation**

3.1.1 Install circuit breakers as per related sections.

END OF SECTION

1. GENERAL

1.1 Summary

1.1.1 Section Includes

.1 These specifications describe pertinent material requirements and installation practices for Low Voltage AC Power Panel Surge Protective Devices (SPDs). Furnish and install the SPDs equipment having the electrical characteristics, ratings and modifications as specified herein and as shown on the contract drawings.

.2 The specifications in this section describe the electrical and mechanical requirements for a protection system provided by high-energy Surge Protective Devices. The specified system shall provide effective, high-energy surge current diversion and be suitable for application in ANSI/IEEE C62.41 Category A, B, and C environments (as tested by ANSI/IEEE C62).

1.1.2 Applicability

.1 SPDs shall be fully applicable for the purpose of protecting all facility AC electrical circuits from the hazardous effects of transient voltages. These transients may be generated externally by lightning induced energies, utility load factor corrections, and substation switching or they can be internally generated due to inductive and/or capacitive load switching.

1.1.3 Suitability

.1 SPDs shall be suitable for all service entrance switchboards, panelboards and motor control centres as indicated on the electrical layouts and single line diagrams. Products are to be configured for parallel installation - no series designs shall be considered acceptable. Design products to allow installation as a stand-alone device allowing mounting adjacent to switchboards, panelboards, and motor control centres. Installation is to be accomplished by a qualified electrical contractor.

1.2 Related Requirements

1.2.1 Section 26 24 16 – Panelboards.

1.2.2 Section 26 28 16.02 – Molded Case Circuit Breakers.

1.3 References

1.3.1 Canadian Standards Association:

.1 CSA C22.1-12 - Canadian Electrical Code, Part I (22nd Edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code (25th Edition / 2012).

.3 C22.2 No. 269.2-13 - Surge Protective Devices - Type 2 - Permanently Connected.

1.3.2 Institute of Electrical and Electronics Engineers (IEEE):

.1 IEEE C62.41.1-2002 - IEEE Guide on the Surge Environment in Low-Voltage (1000 V and less) AC Power Circuits.

.2 IEEE C62.41.2-2002 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and Less) AC Power Circuits.

.3 IEEE C62.45-2002, Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.

.4 IEEE C62.62-2010, Standard Test Specifications for Surge Protective Devices.

.5 IEEE 142-2007, Recommended Practice for Grounding of Industrial and Commercial Power Systems - Green Book.

.6 IEEE 1100-2005, Recommended Practice for Powering and Grounding Electronic Equipment - Emerald Book.

1.3.3 National Electrical Manufacturers Association (NEMA):

.1 NEMA LS-1. Document rescinded in entirety August 19, 2009. No replacement document has been issued.

1.3.4 Ontario Building Code and its referenced standards.

1.3.5 Underwriters Laboratories Inc. (UL):

.1 ANSI/UL 1449, (3rd Edition), Standard for Safety, Surge Protective Devices.

.2 UL 1283 (Fourth Edition) - 2005, Standard for Electromagnetic Interference Filters.

1.3.6 Other relevant standards:

.1 MIL-STD-220C, Method of Insertion-Loss Measurement.

1.4 Definitions

1.4.1 Surge Protective Device: A device composed of at least one non-linear component and intended for limiting surge voltages on equipment by diverting or limiting surge current and is capable of repeating these functions as specified. SPDs were previously known as Transient Voltage Surge Suppressors (TVSS) or secondary surge arresters.

1.4.2 L-G: measurements from phase to equipment grounding conductor as line terminals of utilization equipment.

1.4.3 L-L: measurements from phase to phase in a polyphase system, or from one line to another line in a single phase system.

1.4.4 L-N: measurement from phase(s) to neutral for both single and three phase systems.

1.4.5 N-G: measurements from neutral to equipment grounding conductor at line terminal of utilization equipment.

1.4.6 External mounted surge suppressor: Surge Protective Device (SPD) mounted outside of the power panel as a separate component.

1.5 Submittals for Review

1.5.1 Submit in accordance with Section 01 33 00.

1.5.2 Shop Drawings:

.1 Line drawings or catalog sheets detailing dimensions and weight of enclosure, lifting and support points, and enclosure details.

.2 Internal wiring diagram illustrating all modes of protection in each type of SPD required.

.3 Wiring diagram showing all field connections and manufacturer's recommended wire size, recommended circuit breaker or fuse size, required overcurrent protection type, and maximum lead length.

1.5.3 Provide the following product data:

.1 Voltage Protection Ratings (VPRs), I-nominal ratings, Short Circuit Current Ratings, SPD type designations, dimensions showing construction, per mode and per phase peak surge current, modes of discrete suppression circuitry, warranty period, and replacement terms.

.2 List and detail all protection systems such as fuses, disconnecting means, and protective features.

1.5.4 Submit product data for all components and accessories.

1.5.5 Manufacturer's Installation Instructions:

.1 Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

.2 Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.5.6 Test reports:

.1 Submit cover sheet of test report from a recognized independent testing laboratory certifying compliance with UL 1449 Third Edition.

.2 Provide verification that the SPD complies with the required UL 1449 latest edition, latest revision, and Canadian approvals.

.3 Provide spectrum analysis of each unit based on MIL-STD-220C test procedures between 10 kHz and 100 kHz verifying the devices noise attenuation equals or exceeds values indicated in this section.

.4 UL documentation verifying Short Circuit Current Rating (SCCR).

.5 Proof of UL 1283 listing for EMI filters.

1.5.7 Upon request, present unencapsulated but complete SPD for visual inspection; proprietary technology included. MOV type and quantity shall reflect kA ratings on cut sheets, verification of monitoring, thermal, overcurrent protection, etc.

1.5.8 Include the following information:

.1 Data for each suppressor type indicating conductor sizes, conductor types, and connection configuration and lead lengths.

.2 Manufacturer's certified test data indicating the ability of the product to meet or exceed requirements of this specification.

.3 Drawings, with dimensions, indicating SPD mounting arrangement and lead length configuration, and mounting arrangement of any optional remote diagnostic equipment and assemblies.

.4 List and detail all protection systems such as fuses, disconnecting means and protective materials.

.5 Indicate SPD wiring, bonding, and grounding connections on wiring diagrams for each system. Include installation details demonstrating mechanical and electrical connections to equipment to be protected.

.6 Wiring diagram of SPD diagnostic indicators.

1.6 Submittals for Closeout

1.6.1 Maintenance data: submit operation and maintenance data, and engineering data for incorporation into manual specified in Section 01 78 00.

1.6.2 Warranty Document.

1.7 Environmental Requirements

1.7.1 Operating temperature range: -40 degrees C to 70 degrees C (-40 degrees F to 160 degrees F).

1.7.2 Elevation: Operation up to 3 658 m (12 000 feet) above sea level.

1.7.3 Generate no appreciable magnetic fields.

1.8 Delivery, Storage, and Handling

1.8.1 Deliver, store and handle in accordance with Section 01 61 00.

1.8.2 Store materials in dry, secure location and protect from weather.

1.8.3 Protect from moisture and humidity.

1.8.4 Store in accordance with manufacturer's written instructions.

1.8.5 Waste management and disposal in accordance with Section 01 74 21.

1.9 Manufacturer Warranty

1.9.1 Five-year warranty.

1.9.2 Since "Acts of Nature" or similar statements typically include the threat of lightning to which the SPD shall be exposed, any such clause limiting warranty responsibility in the general conditions of this specification shall not apply to this section. This is, the warranty shall cover the effects of lightning, single phasing, and all other electrical anomalies. The warranty shall cover the entire device, not just various components, such as modules only.

1.10 Manufacturer Qualifications

1.10.1 Manufacturer regularly engaged in the design, manufacturing and testing of SPD’s of the types and ratings required for a period of not less than five years. Manufacturers requesting product approval must meet or exceed the written specification contained herein. Manufacturers requesting approval must receive written verification of product acceptance by the specifying engineer ten days prior to the bid date.

1.11 Quality Assurance

1.11.1 All SPDs manufactured by a single ISO-9001 registered company normally engaged in the design, development and manufacture of such devices for electrical and electronic system equipment protection.

1.11.2 Manufacturer regularly engaged in the manufacture of surge suppression products for the specified categories for minimum of ten years.

1.11.3 Manufacturer shall offer repair or replacement service for all materials and components incorporated in the Surge Protective Devices.

1.11.4 Technical assistance (no cost to customer) provided by manufacturer through a factory representative or a local distributor and a factory staffed toll-free technical hotline.

1.11.5 Manufacturer shall provide a toll-free customer service phone number to facilitate all inquiries regarding product returns, warranty claims, purchasing requirements and payment or credit issues.

1.11.6 Listed to most recent edition of UL 1449 and UL 1283. (UL 1449 Third Edition since September 2009).

1.11.7 Products certified by a recognized testing agency accredited by the Standards Council of Canada, and bear a certification mark from that agency indicating acceptance to Canadian standards.

.1 Equipment certification by one of the following bodies:

.1 Listed by Underwriters Laboratories, Inc. and exhibit the cUL Listing Mark for the category "Surge Protective Devices" or SPD. Provide UL Listing Card under category VZCA7 (SPDs certified for Canada) to confirm compliance to UL 1449 third edition, and assigned Voltage Protection Ratings.

.2 Listed by ETL.

.3 Listed and classified by CSA (Canadian Standards Association).

.2 SPD to be cUL labeled with no less than a 100 kA Short Circuit Current Rating (SCCR).

2. PRODUCTS

2.1 Outdated and Defunct Specification Criteria

2.1.1 Selection of SPD is not be made, solely, or in part, based upon any of the following ambiguous specifications, and obsolete terminology. These terms are no longer recognized by ANSI, NEMA, IEEE, or IEC standards as bonafide suppressor performance parameters. Submittals bearing reference to any of the following will be rejected.

.1 A1 ringwave: removed in 2002 revisions of IEEE C62 documents.

.2 Joule ratings: there is no recognized standard for SPD joule ratings.

.3 NEMA LS-1: document rescinded by NEMA.

.4 Response time: not endorsed by IEEE, NEMA, or UL as a valid SPD rating parameter.

.5 Suppressed Voltage Ratings (SVR): terminology deprecated with UL 1449 third edition.

.6 UL 1449, second edition. Replaced by third edition in 2009.

2.2 Manufacturers

2.2.1 The inclusion of a manufacturer in the following list does not indicate the manufacturer meets all the requirements in this specification. Likewise, the omission of a manufacturer is not indicative of any lack of qualification. The manufacturer and product must meet all the requirements of this specification.

2.2.2 No unit will be accepted as an “approved equal” unless it meets the warranty, strength, safety features, performance ratings, and all other requirements of this specification.

2.2.3 Manufacturers.

.1 Advanced Protection Technologies Inc.

.2 Current Technology.

.3 Emerson Network Power/ASCO.

.4 Mersen.

.5 Raycap Electrical Protection Systems.

.6 Total Protection Solutions.

2.2.4 The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the

specification and manufactured by others not named will be considered only if pre-approved by the Consultant ten (10) days prior to bid date.

2.3 **Surge Protection Devices – General**

2.3.1 Obtain all surge suppression devices through one source from a single manufacturer.

2.3.2 SPD separate from panelboards. Integral SPDs not acceptable.

2.3.3 The SPD listed by recognized testing agency accredited by the Standards Council of Canada, and bear a certification mark from that agency indicating acceptance to Canadian standards, and to UL's 1283 and UL's 1449 standards (latest edition, latest revision), and not merely the components or modules. Label all SPDs as a Type 2 for use in Type 1 and Type 2 locations.

2.3.4 Protect all modes L-G, L-N, L-L, and N-G, have discrete suppression circuitry in L-G, L-N, and N-G, and have bidirectional, positive, and negative impulse protection. Line-to-neutral-to-ground protection is not acceptable where line-to-ground is specified, and accordingly reduced mode units with suppression circuitry built into only four modes are not acceptable. In delta systems, line-to-ground-to-line protection is not acceptable where line-to-line is specified.

2.3.5 If a disconnect switch is specified, the disconnect switch and the SPD as a system shall be capable of interrupting up to a minimum 100 kA symmetrical fault current with 600 VAC applied.

2.3.6 Suppression Components:

.1 Metal Oxide Varistors (MOVs).

.2 Gas tubes, silicon avalanche diodes, or selenium cells: not permitted.

.3 Every suppression component of every mode, including N-G, shall be protected by internal overcurrent and thermal overtemperature controls, such as through the use of Thermally Protected MOVs (TPMOVs).

.4 Where SPD is not equipped with overtemperature controls, pack all surge components, current carrying paths and fusing in fuse grade silica sand or epoxy potting for arc quenching capability, minimization of smoke and contaminates in the event of failure.

2.3.7 Internal Fusing - Overcurrent Protection

.1 Individually fuse each suppression component for safety and performance.

.2 Fusing shall be present in every mode, including Neutral-to-Ground.

.3 All overcurrent protection must be included within the device, and not require external overcurrent protection.

2.3.8 Surge Current Rating

.1 Service Entrance: 200 kA per phase.

.2 Distribution: 100 kA to 200 kA per phase.

.3 Point of Use: 100 kA per phase.

2.3.9 Short Circuit Current Rating (SCCR), sometimes referred to as fault current rating: minimum 100 kA.

2.3.10 Nominal Discharge Current (In, or I-nominal):

.1 UL labelled with a minimum 10 kA I-nominal.

2.3.11 Maximum Continuous Operating Voltage (MCOV): The maximum continuous operating voltage (MCOV) of all components not less than 125 per cent for a 120 V system, 120 per cent for 220 and 240 V systems, and 115 per cent for 347 and 600 V systems.

.1 277 V systems: 320 V MCOV.

.2 480 V systems: 552 V MCOV.

2.3.12 UL 1449 Listed Voltage Protection Ratings (VPRs) to not exceed the following:

Voltage	L-N	L-G	N-G
208Y/120	800 V	800 V	800 V
480Y/277	1200 V	1200 V	1200 V
600Y/347	1500 V	1500 V	1500 V
Voltage	L-L	L-G	
480 Delta	1800 V	1800 V	
600 Delta	2500 V	2500 V	

2.3.13 Minimum EMI/RFI filtering of -50 dB at 100 kHz.

2.3.14 SPD enclosure:

.1 Minimum NEMA type 12 rating in indoor applications.

.2 Minimum NEMA type 4 in outdoor applications.

2.3.15 Diagnostics and Monitoring:

.1 Visual LED diagnostics to indicate failure of a suppression component. Monitor every suppression component of every mode, including N-G.

.2 Form C dry contacts (NO or NC) for remote monitoring capability to indicate the failure of any MOV in the unit.

.3 Surge event counter with backup power source.

2.4 **Service Entrance and Transfer Switch SPDs:**

2.4.1 cUL 1449 Third Edition listed and labeled as a Type 2 device.

2.4.2 SPDs relying on an external breaker or fuse as supplemental overcurrent protection do not meet the intent of this specification and will be rejected.

2.4.3 cUL 1449 Third Edition listed and labeled with a minimum I-nominal rating of 20 kA.

2.4.4 A cUL approved disconnect switch provided as a means of service disconnect if a 60 A breaker is not available.

2.4.5 Connect SPD using the manufacturer's breaker/wire recommendations. If recommendations are not available, use a 60 amp breaker and 6 AWG cable with full size ground.

2.4.6 Minimum Surge Current Rating: 200 kA per phase (100 kA per mode).

2.5 **Distribution Panelboard and Motor Control Centre SPDs:**

2.5.1 cUL 1449 Third Edition listed and labeled as a Type 2 device.

2.5.2 SPDs relying on an external breaker or fuse as supplemental overcurrent protection do not meet the intent of this specification and will be rejected.

2.5.3 cUL 1449 Third Edition listed and labeled with a minimum I-nominal rating of 20 kA.

2.5.4 SPD connected using the manufacturer's breaker/wire recommendations. If recommendations are not available a 60 A breaker and 6 AWG with full size ground will be used.

2.5.5 Minimum Surge Current Rating: 100 kA per phase (50 kA per mode).

2.6 **Lighting and Receptacle Branch Circuit Panelboard SPDs:**

2.6.1 cUL 1449 Third Edition listed and labeled as a Type 2 device.

2.6.2 SPDs relying on an external breaker or fuse as supplemental overcurrent protection do not meet the intent of this specification and will be rejected.

2.6.3 cUL 1449 Third Edition listed and labeled with a minimum I-nominal rating of 10 kA.

2.6.4 SPD connected using the manufacturer's breaker/wire recommendations. If recommendations are not available a 60 A breaker and 6 AWG will be used.

2.6.5 Minimum Surge Current Rating: 100 kA per phase (50 kA per mode).

3. EXECUTION

3.1 **Pre-Installation Meetings**

3.1.1 Pre-installation meetings: conduct pre-installation meeting one week prior to commencing work of this Section and on-site installations to verify project requirements, substrate conditions and co-ordination with other building sub-trades, to review manufacturer's installation instructions and warranty requirements.

3.2 **Field Quality Control**

3.2.1 Have manufacturer of products supplied under this Section review Work involved in the handling, installation, application, protection, and cleaning of its products. Submit written reports in acceptable format to verify compliance of Work with Contract in accordance with Section 01 33 00 and Section 01 78 00.

3.2.2 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.

3.2.3 Schedule site visits to review work at stages listed:

.1 After delivery and storage of products, and when preparatory work on which the work of this Section depends is complete, but before installation begins.

.2 Twice during progress of work at 66 per cent and 99 per cent complete.

.3 Upon completion of the work, after cleaning is carried out.

3.2.4 Obtain reports within three (3) days of review and submit immediately to Consultant.

3.3 **Examination**

3.3.1 Verify service and separately derived system Neutral to Ground bonding jumpers.

3.4 **Installation**

3.4.1 Do complete installation in accordance with CSA-C22.1, CAN/CSA-C22.2 No. 0, ANSI/IEEE C62.41, and all other applicable codes.

3.4.2 Manufacturer’s instructions

.1 Install SPD in accordance with manufacturer’s installation instructions with lead lengths as short and as straight as practically possible. Lead lengths no greater than 600 mm (24 inches). Gently twist conductors together.

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

3.4.3 Connect SPD to service panel being protected via a circuit breaker for each phase, based on the number of poles and the connecting wire size, with a 100 A maximum.

3.4.4 Follow the SPD manufacturer’s recommended installation practice as outlined in the equipment installation manual. Ensure that all neutral conductors are bonded to the system ground at the service entrance or the serving isolation transformer prior to installation of the associated SPD.

3.4.5 Installation position of SPD:

.1 Locate SPD adjacent to the panelboard, in a position as close as possible to the neutral and ground lugs. Rearrange breaker positions for SPDs to minimize the length of the phase, neutral, and ground conductors.

.2 Mount SPD as close as possible to panel being protected in a position that will minimize lead lengths between suppressor and control breaker(s) to which suppressor connects. Utilize conduit, preferably metallic, to accomplish these connections with a recommended minimum wire size of 10 AWG, a maximum wire size of 4 AWG (for ease of dressing), or as noted on the single line diagram. Do not extend suppressor leads beyond manufacturer's recommended maximum length without specific engineering approval. The rationale for this is the longer connecting leads between the SPD and the power panel, the higher the residual transient voltage.

.3 Locate surge suppressors as indicated and mount securely, plumb, true, and square to adjoining surfaces.

.4 Install surface mounted surge suppressors on fire-retardant plywood backboards as recommended in manufacturer's written instructions. Where practical, group SPDs on common backboard with other equipment.

.5 Mount housings and enclosures on fire-retardant plywood backboard with top not higher than 1.8 m (6 feet) above finished floor.

3.4.6 Wiring:

.1 Install units on a breaker, sized, where indicated, that meets or exceeds the fault current rating of the switchgear or panelboard.

.2 Connect SPD to service panel being protected via a circuit breaker for each phase, based on the number of poles and the connecting wire size. Connect SPD using the manufacturer's breaker/wire recommendations.

.1 If recommendations are not available, a 60 A breaker and 6 AWG phase, neutral, and ground conductors will be used.

.2 If the SPD is supplied with lead wires, the match overcurrent protection to the 75 degree C ampacity of the wiring as described in Ontario Electrical Safety Code, Table 2; i.e. a 30 A breaker to suit 10 AWG lead wires.

.3 Install SPD in a neat, workmanlike manner. Lead dress as short and as straight as possible and be consistent with recommended industry practices for the application on which these units are installed. Bind phase, neutral, and ground conductors tightly (one twist per 30 cm) over entire run, from suppressor to service panel, and always use the shortest length of connecting cable possible.

.4 If the SPD is supplied by the manufacturer with lead wires, cut excess lead length.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Solid state, light emitting diode (LED) source interior luminaires.

1.1.2 New, fully integrated luminaires for indoor applications.

1.2 Related Requirements

1.2.1 Section 26 09 23 – Lighting Control Devices.

1.2.2 Section 26 52 13.13 – Emergency Lighting.

1.3 References

1.3.1 Canadian Standards Association (CSA)

.1 CSA C22.1-12, Canadian Electrical Code, Part 1 (22nd edition), Safety Standard for Electrical Installations.

.2 Ontario Electrical Safety Code, 25th Edition / 2012.

.3 CSA C22.2 No. 9.0 - General Requirements for Luminaires.

.4 CSA C22.2 No. 250.0 - Luminaires (Bi-National Standard, with UL 1598).

1.3.2 DesignLights Consortium (DLC).

.1 Technical Requirements Table v2.1, or latest edition.

.2 While the specifications do not explicitly call for DLC qualified LED luminaires, the technical criteria provided in the DLC Technical Requirements provide the basis of the requirements for this section of the Specification.

1.3.3 Energy Star

.1 Program Requirements for Luminaires - Eligibility Criteria, Version 1.2, or latest edition.

1.3.4 Illuminating Engineering Society (IES)

.1 IES HB-10-11 – The Lighting Handbook, 10th Edition.

.2 IES LM-79-08 – Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products.

.3 IES LM-80-08 – IES Approved Method for Measuring Lumen Maintenance of LED Light Sources.

.4 TM-21-11- IES Technical Memorandum on Projecting Long Term Lumen Maintenance of LED Light Sources.

1.3.5 National Electrical Manufacturer's Association (NEMA)

.1 SSL-1-10 – Electronic Drivers for LED Devices, Arrays, or Systems.

.2 WD 6 - Wiring Devices - Dimensional Requirements.

1.4 Definitions

1.4.1 CCT: Correlated colour temperature.

1.4.2 CRI: Colour-rendering index.

1.4.3 LED: Light Emitting Diode.

1.4.4 Lumen: Measured output of lamp and luminaire, or both.

1.4.5 Luminaire: Complete lighting fixture, including ballast housing if provided.

1.5 Action Submittals

1.5.1 Refer to Section 01 33 00.

1.5.2 Product submittals shall be accompanied by product specification sheets or other documentation that includes the designed parameters as detailed in this specification. These parameters include (but not limited to):

.1 Maximum power in Watts.

.1 If a transformer is used in conjunction with a driver (for example on some 347 volt lighting circuits), the maximum power shall include the transformer losses.

.2 L70 in hours, when extrapolated for the worse case operating temperature. TM-21 report shall be submitted to demonstrate this.

.3 Product submittals shall be accompanied by performance data that is derived in accordance with appropriate IESNA testing standards and tested in a laboratory that is NVLAP accredited for Energy Efficient Lighting Products.

1.6 **Informational Submittals**

1.6.1 Installation instructions.

1.7 **Closeout Submittals**

1.7.1 Section 01 33 00 and Section 01 78 00: Submittals for project closeout.

1.7.2 Submit manufacturer's operation and maintenance instructions for each product.

1.7.3

1.8 **Qualifications**

1.8.1 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum five years documented experience.

1.9 **Regulatory Requirements**

1.9.1 Products shall be listed and classified by CSA (Canadian Standards Association), ULC (Underwriter's Laboratories of Canada), or certified by recognized independent testing organizations that test to CSA standards.

1.9.2 Products shall be certified by a recognized testing agency accredited by the Standards Council of Canada and bear a certification mark from that agency.

1.9.3 All luminaires shall be listed and labeled for installation in fireproof or non-fireproof construction, dry, damp, or wet locations as required.

1.9.4 Recessed fixtures mounted in an insulated ceiling shall be listed for use in insulated ceilings.

1.10 **Delivery, Storage, and Handling**

1.10.1 Deliver, store and handle materials in accordance with Section 01 61 00.

1.10.2 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.

1.11 **Extra Stock Materials**

1.11.1 Refer to Section 01 78 00.

1.11.2 Provide the following additional equipment as listed herein.

.1 Provide an additional 2 per cent spare luminaires of each new type to be provided.

.2 Provide 1 per cent of each plastic lens type.

.3 Provide three of each type of any special tools required for system use and maintenance.

1.12 **Warranty**

1.12.1 Refer to Section 01 78 00 and Section 26 05 00.

1.12.2 The manufacturer shall provide a warranty against loss of performance and defects in materials and workmanship for the luminaires for a period of 5 years after acceptance of the luminaires. Warranty shall cover all components comprising the luminaire.

1.12.3 All warranty documentation shall be provided to customer prior to the first shipment.

1.12.4 LED Luminaires shall have a manufacturer's warranty for a period of not less than five years.

1.12.5 LED boards, drivers and associated components shall have a warranty of 5 years on the LEDs, 5 years on the driver, 10 years on the paint finish.

2. PRODUCTS

2.1 Indoor LED Luminaires, General

2.1.1 Initial delivered lumens – thermal losses should be less than 10 per cent when operated at a steady state at an average ambient operating temperature of 25 degrees C, and optical losses should be less than 15 per cent.

2.1.2 Average Delivered Lumens – Average delivered lumens over 50 000 hours should be minimum of 85 per cent of initial delivered lumens.

2.1.3 All luminaires shall be tested per LM79/80 and published L70 data.

2.1.4 Available in 3500 K correlated colour temperature, CRI greater than or equal to 80, or as indicated.

2.1.5 Accessibility and Maintenance:

.1 All LED luminaires shall be field serviceable, with LED arrays, LED modules, drivers, etc. fully serviceable and easily accessible. In the case of recessed ceiling mounted, and in the case of surface mounted ceiling fixtures, these components must be accessible from below. Luminaires in which any of these components are accessible only from above are not acceptable.

.2 Ballasts, drivers, LED arrays, LED modules, and lamps shall be serviceable while the fixture is in its normally installed position. Ballasts or drivers shall not be mounted to removable reflectors or wireway covers unless so specified. In the case of ceiling mounted luminaires, the serviceable components must be accessible from below.

2.1.6 Housings:

.1 Formed to prevent warping and sagging. Housing, trim and lens frame shall be true, straight (unless intentionally curved), and parallel to each other as designed.

.2 Sheet steel housings to be minimum 20 gauge.

.3 Wireways and fittings: free of burrs and sharp edges, and shall accommodate internal and branch circuit wiring without damage to the wiring.

.4 When installed, any exposed fixture housing surface, trim frame, door frame, and lens frame shall be free of light leaks.

.5 Hinged door frames shall operate smoothly without binding. Latches shall function easily by finger action without the use of tools.

.6 Drivers shall not be mounted to removable reflectors or wireway covers unless so specified.

2.1.7 Mechanical Safety: Lighting fixture closures (lens doors, trim frame, hinged housings, etc.) shall be retained in a secure manner by captive screws, chains, aircraft cable, captive hinges, or fasteners such that they cannot be accidentally dislodged during normal operation or routine maintenance.

2.1.8 Metal Finishes:

.1 Fixture finish and construction to meet ULC listings and CSA certifications related to intended installation.

.2 All metal components of fixtures shall be painted after fabrication to mitigate raw metal edges, and thus prevent premature corrosion.

.3 The manufacturer shall apply standard finish (unless otherwise specified) over a corrosion-resistant primer, after cleaning to free the metal surfaces of rust, grease, dirt and other deposits. Edges of pre-finished sheet metal exposed during forming, stamping or shearing processes shall be finished in a similar corrosion resistant manner to match the adjacent surface(s). Fixture finish shall be free of stains or evidence of rusting, blistering, or flaking, and shall be applied after fabrication.

.4 Interior light reflecting finishes shall be white with not less than 85 per cent reflectance, except where otherwise shown on the drawing.

2.1.9 Wiring:

.1 Lighting fixtures shall have a specific means for grounding metallic wireways and housings to an equipment grounding conductor.

.2 Supplied complete with a luminaire disconnect plug.

2.2 **Drivers, General**

2.2.1 Electronic LED drivers shall be integral to the luminaire, and be designed to be accessible in the field for replacement and servicing.

2.2.2 Input Voltage:

.1 Driver with a voltage range of (120-277) +/- 10% or (347-480) +/- 10%.

.2 Refer to lighting fixture schedule.

.3 For luminaires connected to a 347 volt circuit and utilizing a natively 120-277 volt driver, provide an appropriately sized step down transformer.

2.2.3 Input frequency 60 Hz.

2.2.4 Load regulation: +/- 1 per cent from no load to full load.

2.2.5 Output ripple less than 10 per cent.

2.2.6 Output should be isolated.

2.2.7 Case temperature: rated for -40 degrees C through +80 degrees C.

2.2.8 Overheat protection, self-limited short circuit protection and overload protected.

2.2.9 Primary fused.

2.2.10 Driver life rating not less than 50 000 hours

2.2.11 Power Factor and Total Harmonic Distortion

.1 Power factor of greater than or equal to 0.9 at full load.

.2 THD of less than or equal to 20 per cent at full load.

2.2.12 Dimming Control:

.1 Coordinate with Section 26 09 23.

.2 0-10 V dimming control typical for all fixtures unless otherwise noted.

.3 Control range: 10 per cent to 100 per cent typical, unless noted otherwise.

.4 Provide a mock-up to demonstrate the luminaire is free of flicker throughout the dimming range when used with the dimming controllers described in related sections.

2.3 **Interior Wall-Wash LED Luminaires**

2.3.1 Minimum Light Output: 575 lm.

2.3.2 Zonal lumen density:

.1 Minimum 60 per cent between 0 degrees and 90 degrees from nadir.

.2 Minimum 60 per cent of the lumens must be produced in the “forward” hemisphere, towards the wall.

2.3.3 Minimum luminaire efficacy: 45 lumens per watt.

2.3.4 Correlated Colour Temperature (CCT): 3500 K

2.3.5 Colour Rendition Index (CRI): 80 CRI minimum.

2.3.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.4 **Track or Mono-Point Directional LED Luminaires**

2.4.1 Minimum Light Output: 250 lm.

2.4.2 Zonal lumen density:

.1 Minimum 85 per cent between 0 degrees and 90 degrees from nadir.

2.4.3 Minimum luminaire efficacy: 45 lumens per watt.

2.4.4 Correlated Colour Temperature (CCT): 3500 K

2.4.5 Colour Rendition Index (CRI): 80 CRI minimum.

2.4.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.5 **Downlight Luminaires**

2.5.1 Minimum Light Output: 500 lm.

2.5.2 Zonal lumen density: Minimum 75 per cent between 0 degrees and 60 degrees from nadir.

2.5.3 Minimum luminaire efficacy: 45 lumens per watt.

2.5.4 Correlated Colour Temperature (CCT): 3500 K

2.5.5 Colour Rendition Index (CRI): 80 CRI minimum.

2.5.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.6 **Nominal 610 mm by 610 mm (2 foot by 2 foot) Luminaires for Ambient Lighting of Interior Spaces**

2.6.1 Minimum Light Output: 2 000 lm.
2.6.2 Zonal lumen density:
.1 Minimum 75 per cent between 0 degrees and 60 degrees from nadir.
2.6.3 Spacing Criteria:
.1 0 degrees to 180 degrees: 1.0 to 2.0
.2 90 degrees to 270 degrees: 1.0 to 2.0
2.6.4 Minimum luminaire efficacy: 85 lumens per watt.
2.6.5 Correlated Colour Temperature (CCT): 3500 K
2.6.6 Colour Rendition Index (CRI): 80 CRI minimum.
2.6.7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.7 **Nominal 305 mm by 1220 mm (1 foot by 4 foot) Luminaires for Ambient Lighting of Interior Spaces**

2.7.1 Minimum Light Output: 1 500 lm.
2.7.2 Zonal lumen density:
.1 Minimum 75 per cent between 0 degrees and 60 degrees from nadir.
2.7.3 Spacing Criteria:
.1 0 degrees to 180 degrees: 1.0 – 2.0
.2 90 degrees to 270 degrees: 1.0 – 2.0
2.7.4 Minimum luminaire efficacy: 85 lumens per watt.
2.7.5 Correlated Colour Temperature (CCT): 3500 K
2.7.6 Colour Rendition Index (CRI): 80 CRI minimum.
2.7.7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.8 **Nominal 610 mm by 1220 mm (2 foot by 4 foot) Luminaires for Ambient Lighting of Interior Spaces**

2.8.1 Minimum Light Output: 3 000 lm.
2.8.2 Zonal lumen density:
.1 Minimum 75 per cent between 0 degrees and 60 degrees from nadir.
2.8.3 Spacing Criteria:
.1 0 degrees to 180 degrees: 1.0 – 2.0
.2 90 degrees to 270 degrees: 1.0 – 2.0
2.8.4 Minimum luminaire efficacy: 85 lumens per watt.
2.8.5 Correlated Colour Temperature (CCT): 3500 K
2.8.6 Colour Rendition Index (CRI): 80 CRI minimum.
2.8.7 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.9 **Linear Ambient Luminaires: Indirect**

2.9.1 Minimum Light Output: 500 lm per foot.
2.9.2 Zonal lumen density:
.1 Minimum 50 per cent between 90 degrees and 150 degrees from nadir.
2.9.3 Minimum luminaire efficacy: 85 lumens per watt.
2.9.4 Correlated Colour Temperature (CCT): 3500 K
2.9.5 Colour Rendition Index (CRI): 80 CRI minimum.
2.9.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.10 **Linear Ambient Luminaires: Indirect/Direct**

2.10.1 Minimum Light Output: 500 lm per foot.

2.10.2 Zonal lumen density:

.1 Minimum 25 per cent between 0 degrees and 60 degrees from nadir.

.2 Minimum 50 per cent between 90 degrees and 150 degrees from nadir.

2.10.3 Minimum luminaire efficacy: 85 lumens per watt.

2.10.4 Correlated Colour Temperature (CCT): 3500 K

2.10.5 Colour Rendition Index (CRI): 80 CRI minimum.

2.10.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.11 **Linear Ambient Luminaires: Direct/Indirect**

2.11.1 Minimum Light Output: 500 lm per foot.

2.11.2 Zonal lumen density:

.1 Minimum 40 per cent between 0 degrees and 60 degrees from nadir.

.2 Minimum 35 per cent between 90 degrees and 150 degrees from nadir.

2.11.3 Minimum luminaire efficacy: 85 lumens per watt.

2.11.4 Correlated Colour Temperature (CCT): 3500 K

2.11.5 Colour Rendition Index (CRI): 80 CRI minimum.

2.11.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.12 **Linear Ambient Luminaires: Direct**

2.12.1 Minimum Light Output: 375 lm per foot.

2.12.2 Zonal lumen density:

.1 Minimum 40 per cent between 0 degrees and 60 degrees from nadir.

2.12.3 Minimum luminaire efficacy: 85 lumens per watt.

2.12.4 Correlated Colour Temperature (CCT): 3500 K

2.12.5 Colour Rendition Index (CRI): 80 CRI minimum.

2.12.6 Minimum L70 lumen maintenance to occur at 50 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.13 **High-Bay Luminaires for Commercial and Industrial Buildings**

2.13.1 Minimum Light Output: 10 000 lm.

2.13.2 Zonal lumen density:

.1 Minimum 30 per cent between 20 degrees and 50 degrees from nadir.

2.13.3 Minimum luminaire efficacy: 80 lumens per watt.

2.13.4 Correlated Colour Temperature (CCT): 4000 K

2.13.5 Colour Rendition Index (CRI): 70 CRI minimum.

2.13.6 Minimum L70 lumen maintenance to occur at 35 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.14 **Low-Bay Luminaires for Commercial and Industrial Buildings**

2.14.1 Minimum Light Output: 5 000 lm.

2.14.2 Zonal lumen density:

.1 Minimum 30 per cent between 20 degrees and 50 degrees from nadir.

2.14.3 Minimum luminaire efficacy: 80 lumens per watt.

2.14.4 Correlated Colour Temperature (CCT): 4000 K

2.14.5 Colour Rendition Index (CRI): 70 CRI minimum.

2.14.6 Minimum L70 lumen maintenance to occur at 35 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

2.15 **High-Bay Aisle Luminaires**

2.15.1 Minimum Light Output: 10 000 lm.

2.15.2 Zonal lumen density:

.1 Minimum 30 per cent between 0 degrees and 20 degrees from nadir.

.2 Minimum 50 per cent between 20 degrees and 50 degrees from nadir.

2.15.3 Minimum luminaire efficacy: 80 lumens per watt.

2.15.4 Correlated Colour Temperature (CCT): 4000 K

2.15.5 Colour Rendition Index (CRI): 70 CRI minimum.

2.15.6 Minimum L70 lumen maintenance to occur at 35 000 hours in accordance with LM-80 testing data and TM-21 extrapolation.

3. EXECUTION

3.1 Verification of Conditions

3.1.1 Coordinate the lighting system installation with the relevant trades so as to eliminate interferences with hangers, mechanical ducts, sprinklers, piping, steel, etc.

3.2 Installation

3.2.1 Install lighting equipment, including but not limited to luminaires, controls, auxiliary devices and the integration of same in strict conformance with all manufacturers' recommendations and instructions the securing of which shall be the responsibility of the Contractor.

3.2.2 Integrate luminaires with controls in accordance with respective luminaire manufacturers' and controls manufacturers' recommendations and instructions and to provide a complete, trouble-free operation without compromising safety, code and CSA requirements.

3.2.3 Seal all luminaires for wet locations (i.e. all knock-outs, all pipe and wire entrances, etc.) as is standard industry practice to prevent water from entering luminaires.

3.2.4 Luminaire Alignment

.1 Locate recessed ceiling luminaires as indicated on reflected ceiling plan. Install recessed luminaires to permit removal from below. Include accessories and materials to meet applicable codes and regulatory requirements.

.2 Align luminaires mounted in continuous rows to form straight uninterrupted line.

.3 Align luminaires mounted individually parallel or perpendicular to building grid lines.

.4 Install surface mounted luminaires plumb and adjust to align with building lines and with each other. Secure to prevent movement.

.5 Locate and install luminaires as indicated. Mounting heights and configuration of the luminaires shall be as specified in the Luminaire Schedule portion of the Specification or indicated on the drawings, and where conflicts exist, as approved by the Consultant.

.6 Installed all luminaires plumb and true and level as viewed from all directions unless specifically identified otherwise in the Lighting Fixture Schedule. Luminaires shall remain plumb and true without continual adjustment or visibly obvious means beyond what is shown on luminaire submittal drawings.

.7 For installation in suspended ceilings, ensure that the luminaires are supported such that there is no resultant bowing or deflection of the ceiling system greater than 1/360 of the length of the total span of the ceiling member.

3.2.5 Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

3.2.6 Whenever a luminaire or its hanger canopy is installed directly to a surface mounted junction box, use a finishing ring painted to match the ceiling to conceal the junction box.

3.2.7 Suspended Luminaires:

.1 Install suspended luminaires and exit signs using pendants supported from swivel hangers. Provide pendant length required to suspend luminaire at indicated height.

.2 Suspended luminaires shall be installed plumb and true and level unless specifically identified otherwise in the Luminaire Schedule portion of this Specification and at a height from finished floor as specified on the drawings, details and Luminaire Schedule. In cases where this is impractical, refer to the Consultant for a decision. All appurtenances shall be consistently organized for a neat, uniform appearance.

3.2.8 Install wall mounted luminaires at height as indicated.

3.2.9 Accessories:

.1 Reflector cones, louvers, baffles, lenses, trims and other decorative elements shall be installed after completion of ceiling tile installation, plastering, painting and general cleanup.

.2 Install accessories provided with each luminaire.

.3 All accessories shall be properly installed and adjusted by Contractor in accordance with specification and installation instructions. Any spare items shall be clearly labeled (indicate type of accessory and associated luminaire types).

3.3 Testing and Adjustment

3.3.1 As required, all adjustable luminaires shall be aimed, focused, locked, etc., by the Contractor under the observation of the Consultant. As aiming and adjusting is completed, locking setscrews and bolts and nuts shall be tightened securely by the Contractor.

3.3.2 All ladders, scaffolds, lifts, etc. required for aiming and adjusting luminaires shall be furnished by the Contractor.

3.3.3 Where possible, units shall be focused during the normal working day. However, where daylight interferes with seeing lighting effects, aiming shall be accomplished at night.

3.4 Luminaire Supports

3.4.1 Provide adequate support to suit ceiling system.

3.4.2 Support luminaires independently of ceiling framing, unless ceiling is certified by the manufacturer to support weight of installed devices. Confirm if T-bar ceilings are metric or imperial and provide luminaires to suit ceiling dimensions.

3.4.3 Provide chain hangers for new and existing luminaires.

3.4.4 Install clips to secure recessed grid-supported luminaires in place.

3.4.5 Fixtures supported by suspended ceiling systems shall be securely fastened to the ceiling framing member by mechanical means, such as bolts, screws, or rivets. Ceiling framing members must be securely attached to each other and to the building structure as required by all applicable codes and standards. Use of integral clips is not acceptable.

3.5 Wiring

3.5.1 Install luminaire disconnect plugs on all new luminaires not provided as such from the manufacturer.

3.5.2 Connect luminaires to branch circuit outlets provided under Section 26 05 33.13 using flexible conduit.

3.5.3 Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

3.5.4 Bond products and metal accessories to branch circuit equipment grounding conductor.

3.6 Field Quality Control

3.6.1 Operate each luminaire after installation and connection. Inspect for proper connection and operation.

3.6.2 Make wiring connections to the branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

3.6.3 Occupancy Sensors.

.1 Locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas.

.2 Rooms shall have 90 per cent to 100 per cent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room.

.3 Exercise proper judgment in executing the work to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.

3.7 **Cleaning**

3.7.1 Thoroughly clean all luminaires and accessories after installation. All fingerprints, dirt, tar, smudges, drywall mud, dust, etc. shall be removed by the Contractor from the luminaire bodies, reflectors, trims, and lens or louvers prior to final acceptance. All reflectors shall be free of paint other than factory-applied, if any. All reflectors, cones and lenses shall be cleaned only according to manufacturers' instructions.

3.7.2 Clean electrical parts to remove conductive and deleterious materials.

3.7.3 Remove dirt and debris from enclosures.

3.7.4 Clean photometric control surfaces as recommended by manufacturer.

3.7.5 Clean finishes and touch up damage.

3.7.6 Luminaire finishes which are disturbed in any way during construction shall be touched up or refinished in a manner satisfactory to the Consultant.

3.8 **Commissioning**

3.8.1 In accordance with Section 26 08 50.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Emergency lighting units with battery back-up and constant power supply to internally illuminated exit signs.

1.1.2 Remote emergency fixtures.

1.2 Related Requirements

1.2.1 Section 26 51 19 – LED Interior Lighting.

1.2.2 Section 26 52 13.16 – Exit Signs.

1.3 References

1.3.1 Underwriters Laboratories, Inc. (UL):

.1 UL924 – Standard for Safety of Emergency Lighting and Power Equipment

1.3.2 Canadian Standards Association (CSA):

.1 CSA C22.2 No.141 - Unit Equipment for Emergency Lighting.

.2 CSA C22.1 - Canadian Electrical Code, Part I, Safety Standard for Electrical Installations.

.3 Ontario Electrical Safety Code.

1.3.3 Ontario Building Code.

1.4 Action and Informational Submittals

1.4.1 Submit in accordance with Section 01 33 00.

1.4.2 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.

.2 Submit lamp for LED MR16 lamps.

1.5 Closeout Submittals

1.5.1 Submit in accordance with Section 01 78 00.

1.5.2 Operation and Maintenance Data: submit operation and maintenance data for emergency lighting for incorporation into manual.

1.6 Extra Materials

1.6.1 Allow the cost for material and for installation of the following to be installed as directed by the Consultant during construction:

.1 An additional five single head emergency remote units.

1.7 Quality Assurance

1.7.1 Manufacturer Qualifications: Products shall be free of defects in material and workmanship.

1.7.2 Furnished products are listed and/or certified by third party agencies as suitable for the intended purpose.

1.7.3 All units will be certified that they have been tested prior to shipping.

1.7.4 The remote fixtures shall be certified to CSA 22.2 No.141-15.

1.8 Delivery, Storage, and Handling

1.8.1 Deliver, store, and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.

1.8.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.8.3 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.

1.8.4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 21.

1.8.5 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 21.

1.9 **Warranty**

1.9.1 Product is warranted free of defects in material and workmanship.

1.9.2 Product is warranted to perform the intended function within design limits.

1.9.3 For batteries in this Section, 12 month warranty period is extended to 24 months.

2. PRODUCTS

2.1 **Emergency Battery Units**

2.1.1 Acceptable Manufacturers:

.1 Lumacell RG12S series, battery size as indicated on schedule.

.2 Approved equal by Emergi-Lite.

.3 Approved equal by Stanpro.

.4 Approved equal by Beghelli.

2.1.2 Battery Unit Features:

.1 Self-contained unit equipment for incandescent emergency lighting shall be manufactured and labeled as certified to meet CSA C22.2 No 141.

.2 Housing: Constructed of formed and welded 18 gauge cold rolled steel with knockouts for conduit, finished in baked white enamel. Cabinet suitable for direct or shelf mounting to wall. Removable or hinged front panel for easy access to batteries.

.3 Charger:

.1 Solid-state micro-controller PCB, Pulse-Guard charger, features include; auto-equalized, temperature compensated, current limited, short circuit and reverse polarity protected.

.2 Recharges battery within 24 hours in accordance with CSA requirements.

.4 Transfer: Upon failure of the power supply or voltage dips below 75 per cent of nominal, a sealed relay automatically and instantaneously connects the battery to the emergency lighting load and disconnects when battery discharge reaches 87.5 per cent expectancy.

.5 Batteries: seal lead calcium, maintenance free, and 10 year pro-rated service life.

2.1.3 Battery Electrical Features:

.1 Input Voltage: 120-347 VAC universal input; direct connected to source panelboard.

.2 Output Voltage: 24 VDC; balance loads to battery unit terminals.

.1 Normally "Off" output: 330W for emergency remotes.

.2 Battery Run Time at full load: must meet OBC minimum, 30 minutes.

.3 Voltage regulation: ± 5 per cent of nominal maximum.

.3 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.

2.1.4 Lamp heads:

.1 Integral on unit, 345 degrees horizontal and 180 degrees vertical adjustment.

.2 Lamp type: MR16 LED lamps mounted on top of the battery cabinet, injection molded thermoplastic, white finish, quantity as indicated on schedule.

2.1.5 Auxiliary equipment:

.1 Ammeter.

.2 Voltmeter.

.3 Test switch.

.4 Time delay relay.

.5 Battery disconnect device.

.6 AC input and DC output terminal blocks inside cabinet.

.7 Shelf Bracket.

.8 Cord and single twist-lock plug connection for AC.

.9 RFI suppressors.

2.2 **LED Remote Head Lamps**

2.2.1 12 V, 6 W MR16 LED lamps for battery units and remote heads:

.1 Average lamp lumens: 540 lm.

.2 Beam angle: 25 degrees.

.3 Basis of design: Lumacell LD10 series.

2.3 **Recessed Remote Heads**

2.3.1 Recessed heads will be constructed of durable powder coated, metal and use MR16 halogen lamps, and made die cast aluminum. The light source will be 12 V, MR16 LED lamps as noted on the lighting fixture schedule.

2.3.2 Basis of design: Lumacell RSTH19 series.

3. EXECUTION

3.1 **Examination**

3.1.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for emergency lighting installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Owner.

.2 Inform Owner of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Owner.

3.2 **Installation**

3.2.1 Install emergency lighting in compliance with local inspection authorities.

3.2.2 Wiring:

.1 Connect battery input to source panelboard. Balance the emergency lighting loads connected to battery output terminal blocks. Provide and connect incandescent remote fixtures as specified and as required for system performance in compliance with OBC minimum egress illumination requirements. Install remotes in locations as shown on the drawings. Connect all incandescent remotes to normally "Off" output from battery units.

.2 Contractor is responsible for revisions to system, including relocations, aiming and additional remote heads as determined by testing results. All wiring shall be in accordance with manufacturer's recommendations.

.3 Use minimum #10 gauge or heavier if needed to provide a maximum voltage drop of 5 per cent. Consult manufacturer's table for sizing the minimum gage and length of wire runs permitted for connected loads to ensure a maximum voltage drop of 5 per cent from the battery unit to the farthest emergency remote, in accordance with OBC and local inspection authorities.

3.2.3 Mounting: Suitable for wall mounting, complete with bracket from manufacturer lighting heads, test switch and diagnostic LED indicator shall be visible.

3.2.4 Connect all exit lights to normally "ON" output from battery units, complete. Output conductors shall be minimum #10 and run in conduit.

3.3 **Testing and Commissioning**

3.3.1 When installation of emergency lighting equipment is complete, contractor shall commission and test the entire system and adjust if necessary.

3.3.2 Contractor is responsible for arranging and cost of a verification test of emergency illumination levels by the manufacturer’s representative.

.1 Verification test shall be performed with a lux/footcandle meter at 1 m intervals along all paths of egress throughout the space, and record light level readings on floor plans provided by the consultant.

.2 The contractor shall also provide consultant with a letter stating the recorded emergency lighting levels meet the OBC requirements of 10 lx (1 fc) average with minimum readings not less than 1 lx (0.1 fc) on the path of egress.

.3 The manufacturer is to provide a letter of verification confirming testing and operation of all emergency lighting as well as installation to all applicable codes.

3.3.3 Testing shall be performed during non-daylight hours. Contractor shall aim all remotes to optimise illumination on the floor and stair.

3.3.4 Contractor shall certify in writing to the consultant that the system is complete, installed per CSA C22.2 No. 141, has been tested, and operates for the specified battery run time.

3.3.5 Contractor shall notify owner and consultant at least ten days prior to proposed testing date and schedule testing at time and date acceptable to the owner.

3.3.6 Installation shall be in accordance to the electrical code and manufacturer's instructions.

3.3.7 Provide breaker lock on emergency lighting circuit at source panelboard.

3.4 Protection

3.4.1 Protect installed products and components from damage during construction.

3.4.2 Repair damage to adjacent materials caused by emergency lighting installation.

3.5 Testing, Maintenance, and Warranty Service

3.5.1 Provide complete instructions for the operation and care of the emergency power supply or unit equipment that shall specify testing at least once every month to ensure security of operation. Instructions to be framed under glass.

3.5.2 OBC testing obligations: Owner's facility maintenance personnel are required to document one manual test .of the battery units each month and conduct one full discharge test once a year per OBC / CSA C22.2 No.141 requirements.

3.5.3 Annual Maintenance: The manufacturer recommends maintenance to be performed by a qualified service provider. Contact the manufacturer for any warranty service.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Internally illuminated “Running Man” exit sign units for ordinary location use.

1.2 Related Requirements

1.2.1 Section 26 52 13.13 – Emergency Lighting: Emergency Battery Units.

1.3 References

1.3.1 Canadian Standards Association (CSA International)
- .1 CSA C22.2 No.141-10, Unit Equipment for Emergency Lighting.
- .2 CAN/CSA-C860-07, Performance of Internally Lighted Exit Signs.

1.3.2 International Organization for Standardization (ISO)
- .1 ISO 7010:2011 – Graphical symbols – Safety colours and safety signs.
- .2 ISO 3864-1:2011 – Graphical symbols -- Safety colours and safety signs -- Part 1: Design principles for safety signs and safety markings

1.3.3 Underwriters Laboratories of Canada (ULC)
- .1 ULC/ORD-924-02, Standard for Emergency Lighting and Power Equipment.
- .2 CAN/ULC-S572-10, First Edition Standard for Photoluminescent and Self-Luminous Exit Signs and Path Marking Systems.

1.3.4 Ontario Electrical Safety Code.

1.3.5 Ontario Building Code.

1.4 Submittals

1.4.1 Provide submittals in accordance with Section 01 33 00.

1.4.2 Product Data: Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.4.3 Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures and maintenance.

1.5 Extra Materials

1.5.1 Allow the cost for material and for installation of an additional five exit signs, single face or dual face, to be installed as directed by the Consultant during construction. Include 15.24 m (50 feet) of wire and conduit for AC and for DC circuits per exit sign.

1.6 Quality Assurance

1.6.1 Exit signs units shall be ULC Listed and/or CSA Certified to CSA C22.2 No 141 and C860.

1.6.2 Furnished products are listed and/or certified by third party agencies as suitable for the intended purpose.

1.6.3 Manufacturer Qualifications: Products shall be free of defects in material and workmanship.

1.6.4 All units will be certified that they have been tested prior to shipping.

1.7 Delivery, Storage, and Handling

1.7.1 In accordance with Section 01 61 00.

1.8 Waste Management and Disposal

1.8.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21.

1.9 Warranty

1.9.1 Product is warranted free of defects in material and workmanship for a minimum of two years from substantial completion.

2. PRODUCTS

2.1 Exit Signs, General

2.1.1 Manufacturers

.1 Beghelli.
.2 Emergi-Lite
.3 Lumacell.
.4 Stanpro.
.5 Other manufacturers as indicated in Section 26 52 13.13.

2.1.2 Substitution Limitations:
.1 No alternate manufacturers will be accepted.
.2 Manufacturer of exit signs to be the same as manufacturer of emergency lighting battery units and remote heads specified in Section 26 52 13.13.

2.1.3 Description
.1 Green and White LED Pictogram "Running Man" exit sign.
.2 Pictogram sign certified to CSA 22.2 No.141-10, and meet ISO 3864-1 and ISO 7010.
.3 The pictogram legend shall have a minimum illuminated dimension of 150 mm (5.9 in) high and 283 mm (11.13 in) wide with ISO 3864-1 and 7010 pictogram printed on a pure-acrylic panel.
.4 Signs to include a standard single face with optional double-faceplate included.
.5 Not acceptable:
.1 Red LED EXIT signs.
.2 Externally illuminated photoluminescent, or non-electrical radioluminescent type of pictogram signs are unacceptable.

2.1.4 Mounting
.1 Universal canopy to allow for wall, end, or ceiling mount.

2.1.5 Electrical
.1 The LED light source shall be long-life white Light-Emitting Diodes and shall provide uniform illumination of the pictogram in normal and emergency operation.
.2 The sign shall operate with universal 2-wire AC input voltage of 120 to 347 Vac at less than 3 Watts, and universal 2-wire DC input voltage from 6 to 24 Vdc at less than 2.5 Watts for single and double face legends with a single arrow either left or right.
.3 If arrow left and arrow right is required for T intersection, the contractor shall supply and install two separate pictogram signs.
.4 The pictogram edge-lit exit sign in a self-powered configuration shall use a sealed Nickel-Cadmium battery of 2.4V nominal voltage and shall stay illuminated during emergency operation for at least two hours upon AC failure.

2.2 **Die-Cast Edge-Lit Pictogram Exit Signs for Surface or Recessed Mounting Applications**

2.2.1 Manufacturers
.1 Lumacell LDE series.
.2 Equivalent products from manufacturers as described in Article 2.01 of this specification.

2.2.2 Materials
.1 Surface mount:
.1 When specified for surface mount, the unit shall come standard with a trim plate, trim ring, back box and canopy made of die-cast aluminum with brushed aluminum finish.
.2 The trim plate shall have a flat (fully recessed) profile and allow for wall or ceiling mount installation.
.2 Recessed ceiling mount:
.1 When specified for recessed ceiling-mount, the unit shall come standard with a flat trim plate of die-cast aluminum with brushed aluminum finish, a back box of galvanized steel, and a hardware kit for back box installation between ceiling joists. The back box shall be provided with conduit knock-outs at the top, back and end.
.3 Legend printed on a pure-acrylic panel.
.4 The panel shall come standard with double-face legend, for single-face and double-face applications.

3. EXECUTION

3.1 Manufacturer's Instructions

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

3.2 Installation

3.2.1 Install exit lights to manufacturer's recommendations, listing requirements, CSA standard and local regulatory requirements.

3.2.2 Connect fixtures to exit light circuits normal power supply and emergency battery units specified in Section 26 52 13.13.

3.2.3 Ensure that emergency lighting circuit breaker is locked in ON position.

3.2.4 If arrow left and arrow right is required for T intersection, the contractor shall supply and install two separate pictogram signs.

3.3 Cleaning

3.3.1 Proceed in accordance with Section 01 74 11.

3.3.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.4 Testing and Commissioning

3.4.1 When installation of emergency lighting equipment is complete, contractor shall commission and test the entire system and adjust if necessary.

3.4.2 Contractor shall certify in writing to the consultant that the system is complete, installed per CSA C22.2 No. 141, has been tested, and operates for the specified battery run time.

3.4.3 Contractor shall notify owner and consultant at least ten days prior to proposed testing date and schedule testing at time and date acceptable to the owner.

3.4.4 Installation shall be in accordance to the electrical code and manufacturer’s instructions.

3.4.5 Provide breaker lock on emergency lighting circuit at source panelboard.

3.5 Protection

3.5.1 Protect installed products and components from damage during construction.

3.5.2 Repair damage to adjacent materials caused by exit sign installation.

END OF SECTION

1. GENERAL

1.1 Conditions and Requirements

1.1.1 Refer to the General Conditions, Supplementary General Conditions, and General Requirements.

1.1.2 Provisions of this Section shall apply to all Sections of Division 27.

1.1.3 Refer to Consultant's drawings for exact location of electrical equipment and devices. Refer to Designer drawings for additional notes which complement these specifications.

1.1.4 The Division 26 specification documents shall be followed in conjunction with the specification in this section.

1.1.5 Coordinate with the electrical trade.

1.2 Related Divisions

1.2.1 Division 26 – Electrical.

1.2.2 Division 28 – Electronic Safety and Security.

1.3 Intent

1.3.1 Include all material, labour, equipment, and plant construction as necessary to make a complete installation as shown and specified hereinafter. Sections of this specification are not intended to delegate functions nor to delegate work and supply to any specific Trade. It shall be your responsibility to ensure that the systems specified hereafter are complete and operative.

1.4 Codes and Standards

1.4.1 The equipment, material and installation shall conform to the latest version of the applicable Codes, Standards (including technical service bulletins and addenda) and regulations of authorities having jurisdiction.

1.4.2 BICSI

.1 Telecommunications Distribution Methods Manual

.2 Cabling Installation Manual

.3 Outside Plant Manual

1.4.3 Canadian Standards Association (CSA)

.1 CSA C22.1 – Canadian Electrical Code, Part 1

.2 CSA T529 – Commercial Building Telecommunications Cabling Standard (ANSI/EIA/TIA-568-B).

.3 CSA T530 – Commercial Building Standard For Telecommunications Pathways And Spaces (TIA/EIA 569-A).

.4 CSA T528 – Administration Standard For The Telecommunications Infrastructure Of Commercial Buildings (ANSI/EIA/TIA-606).

.5 CSA T527 – Commercial Building Grounding And Bonding Requirements For Telecommunications (ANSI/EIA/TIA-607).

.6 CSA C22.2 No. 214 – Communications Cables.

.7 CSA C22.2 No. 232-M – Fibre Optic Cables.

.8 CSA C22.2 No. 182.4-M90 – Plugs, Receptacles, and Connectors for Communication Systems.

1.4.4 TIA

.1 TIA/EIA-568-B.1 – Commercial Building Telecommunications Cabling Standard

.2 TIA/EIA-568-B.2 – Balanced Twisted Pair Cabling Components

.3 TIA/EIA-568-B.3 – Optical Fibre Cabling Components Standard

1.4.5 ISO

.1 ISO/IEC IS 11801A – Generic Cabling for Customer Premises.

1.4.6 CENELEC EN 50173 – Performance Requirements for Generic Cabling Schemes.

1.4.7 IEC

.1 IEC 603-7, PART 7 – Detailed Specification For Connectors, 8-Way, Including Fixed And Free Connectors With Common Mating Features.

.2 IEC 807-8 – Rectangular Connectors For Frequencies Below 3 MHz, Part 8: Detailed Specification For Connectors, Four-Signal Contacts And Earthing Contacts For Cable Screens, First Edition.

1.4.8 FIPS PUB 174 – Commercial Building Telecommunications Wiring Standard. Federal Information Standard Publication.

1.4.9 UL 444 and 13 – Adopted Test and Follow-Up Service Requirements For the Optional Qualification of 100Ω Twisted-Pair (Cables).

1.4.10 NEMA WC 63 – Performance Standard For Field Testing Of Unshielded Twisted-Pair Cabling System.

1.4.11 ANSI/EIA/TIA

.1 ANSI/EIA/TIA-492AAAA – Detailed Specification For 62.5µm Core Diameter / 125µm Cladding Diameter Class 1a Multimode, Graded-Index Optical Waveguide fibres.

.2 ANSI/EIA/TIA-492BAAA – Detailed Specifications For Class Iva Dispersion-Unshifted Singlemode Optical Waveguide Fibres Used In Communication Systems.

.3 ANSI/EIA/TIA-472CAAA – Detailed Specifications For All Dielectric (Construction 1) Fibre optic Communications Cable For Indoor Plenum Use, Containing Class 1a, 62.5µm Core Diameter / 125µm Cladding Diameter Fibre optic(s).

.4 ANSI/EIA/TIA-472DAAA – Detailed Specifications For All Dielectric Fibre optic Communications Cable For Outdoor Plant Use, Containing Class 1, 62.5µm Core Diameter / 250µm Cladding Diameter Fibre optic(s).

.5 ANSI/EIA/TIA-455 – Test Procedures For Fibre optics, Cables And Transistors.

.6 ANSI/EIA/TIA-598 – Colour Coding of Fibre Optic Cables.

.7 ANSI/EIA/TIA-604-3 – FOCIS 3 Fibre Optic Connector Intermateability Standard.

.8 ANSI/EIA/TIA-606 – Administration Standard for the Telecommunications Infrastructure of Commercial Buildings.

.9 ANSI/EIA/TIA-607 – Commercial Building Grounding and Bonding Requirements for Telecommunications.

1.4.12 ANSI Z136.2 – American Standards For The Safe Operation of Fibre optic Communication Systems Utilizing Laser Diode And LED Sources.

1.4.13 ANSI/CEA

.1 ANSI/ICEA S-83-640 – Fibre Optic Outside Plant Communications Cable.

.2 ANSI/ICEA S-83-596 – Fibre Optic Premises Distribution Cable.

1.5 Work Sequence

1.5.1 Prior to start of each work period in occupied area, temporary protection shall be installed to prevent damage to any personal property or furnishing. Coordinate with Owner's representative if any furniture must be relocated to facilitate work.

1.5.2 Owner's representative shall approve temporary protection plan prior to use.

1.5.3 Necessary steps shall be taken by contractor to ensure that required fire fighting apparatus is accessible at all times. Flammable materials shall be kept in suitable places outside the building.

1.6 Inspections

1.6.1 The Engineer and/or the Project Manager will carry out inspections and prepare deficiency list for action by the Contractor, during and on completion of project.

1.7 Drawings and Specifications

1.7.1 The drawings and specifications are complementary each to the other and what is called for by one to be binding as if called for by both. Should any discrepancy appear between the drawings and specifications which leaves the Contractor in doubt as to the true intent and meaning of plans and specifications, a ruling is to be obtained from the Engineer in writing before submitting Tender. If this is not done, the maximum, the most expensive alternate or option will be provided in base tender bid.

1.7.2 All drawings and all Divisions of these specifications shall be considered as a whole and work of this Division shown anywhere therein shall be furnished under this Division.

1.7.3 Drawings are diagrammatic and indicate the general arrangement of equipment and pathways. Most direct routing of cabling is not assured. Exact requirements shall be governed by architectural, structural, and mechanical conditions of the job. Consult all other drawings in preparation of the bid. Extra lengths of wiring or addition of pull and junction boxes, etc. necessitated by such conditions shall be included in the bid. Check all information and report and apparent discrepancies before submitting the bid.

1.7.4 Contractor shall determine the exact locations of equipment and rough-ins, and the exact routing of pathways so as to best fit the layout of the job.

1.7.5 Scaling off the drawings will not be sufficient or accurate for determining these locations. Where job conditions require reasonable changes in indicated arrangement and locations, such changes shall be made by the Contractor at no additional cost to the Owner.

1.7.6 Before ordering any conduit, cable tray, cables, fittings, etc., this Contractor shall verify all pertinent dimensions at the job site and be responsible for their accuracy.

1.8 **Material**

1.8.1 This contractor is responsible to ensure that all items submitted meet all requirements of the drawings and specification, and fits in the allocated space. The final determination of a product being acceptable shall be determined by the Engineer.

1.9 **Testing Data**

1.9.1 The contractor shall provide a complete testing report utilizing a testing device as specified in the applicable TIA/EIA standard with the correct adapter and test. All copper tests shall be compliant to the current TIA/EIA standards: Perm Link or Channel.

1.9.2 The Summary report shall provide be provided to the end user in a universal format so that there is no need to purchase any software to read and print the report.

.1 Utilizing Adobe Acrobat is an acceptable manner.

1.10 **Painting and Finishes**

1.10.1 Minor damages to finish on factory finished equipment shall be touched up to the Engineer's satisfaction. Items suffering major damage to finish shall be replaced at the direction of the Engineer. Protect work so that finishes will not be damaged or marred during construction. Maintain the necessary protection until completion of the work.

1.11 **Safety**

1.11.1 The Contractor shall be responsible for the safety of his workmen and the equipment on the project in accordance with all applicable safety legislation passed by Federal, Provincial, and local authorities governing construction safety. The more stringent regulations shall prevail.

1.12 **Warranty**

1.12.1 Submit a written performance warranty to the Owner for two years for the complete installation for a period of no less than five years from the date of testing and acceptance. The system warranty shall be based on industry standards.

1.12.2 The contractor shall also provide a two year labour warranty on the installation.

2. PRODUCTS

2.1 **Material Approval**

2.1.1 The design, manufacture and testing of electrical equipment and materials shall conform to or exceed the latest applicable CSA, IEEE, and ANSI standards.

2.1.2 All materials must be new and be ULC or CSA listed. Any materials not covered by the aforementioned listing standards shall be tested and approved by an independent testing laboratory, Technical inspection Services, or other government agency.

2.2 **Shop Drawings**

2.2.1 Before delivery to site of any item of equipment, the electrical contractor shall submit 6 copies of shop drawings c/w all data, pre-checked and stamped accordingly, for approval to the Engineer. Indicate project name on each brochure or sheet. Submit shop drawings within 1 week after award of contract, for the following:

.1 Copper Cabling
.2 Fibre Optic Cabling
.3 Fabric Innerduct
.4 Racks, managers
.5 Patch Panels
.6 Telecommunications Outlets, Faceplates
.7 Fibre Optic Routing System
.8 Rack Power Distribution Units

2.3 **As-Built Drawings**

2.3.1 To Section 01 78 00.

2.3.2 Red lines, mark-ups by this contractor.

2.4 **Operation and Maintenance Manuals**

2.4.1 Refer to Division 01.

3. **EXECUTION**

3.1 **Workmanship and Contractor's Qualifications**

3.1.1 Only first class workmanship will be accepted, not only in regards to durability, efficiency and safety, but also in regards to neatness of detail. Present a neat and clean appearance on completion to the satisfaction of the Engineer. Any unsatisfactory workmanship will be replaced at no extra cost.

3.1.2 Conform to the best practices applicable to this type of work. Install all equipment and systems in accordance with the manufacturer's recommendations, but consistent with the General Requirements of this Specification. This Contractor will be held responsible for all damage to the work of his own or any other trade, resulting from the execution of his work. Store all equipment and materials in dry locations.

3.1.3 Provide foreman in charge of this work at all times.

3.1.4 The contractor shall be fully liable to provide and maintain in force during the life of this Contract, such insurance, including Public Liability Insurance, Product Liability Insurance, Auto Liability Insurance, Worker's Compensation, and Employer's Liability Insurance.

3.2 **Coordination**

3.2.1 Coordinate work with other trades.

3.2.2 Verify equipment dimensions and requirements with provision specified under this Section. Check actual job conditions before fabricating work. Report all necessary changes in time to prevent needless work. Changes or additions subject to additional compensation, which are made without written authorization and an agreed price, shall be at Contractor's risk and expense.

3.2.3 Read specifications and drawings of other trades and conform with their requirements before proceeding with any work specified in this Division related to other trades. Cooperate with all other trades on the job, so that all equipment can be satisfactorily installed, and so that no delay is caused to any other Trades.

3.3 **Manufacturers' Instructions**

3.3.1 Where the specifications call for an installation to be made in accordance with Manufacturer's recommendations, a copy of such recommendations shall be at all times be kept on the job site and be available to the Owner's Representative.

3.3.2 Follow manufacturer's instructions where they cover points now specifically indicated on the drawings and specifications. If they are in conflict with the drawings and specifications obtain clarification from the Consultant before starting work.

3.4 Quality Assurance

3.4.1 See General Provisions of the Contract.

3.4.2 The specifications contained herein are set forth as the minimum acceptable requirements. This does not relieve the Contractor from executing other quality assurance measures to obtain a complete operating system within the scope of this project.

3.4.3 The Contractor shall ensure that all workmanship, all materials employed, all required equipment and the manner and method of installation conforms to accepted construction and engineering practices, and that each piece of equipment is in satisfactory working condition to satisfactorily perform its functional operation.

3.4.4 Provide quality assurance tests and operational check on all components of the electrical distribution system, all lighting fixtures, and communication systems.

3.5 Labels and Signs

3.5.1 Labelling shall be as per TIA/EIA-606.

3.6 Adjust and Clean-Up

3.6.1 The Contractor and associated sub trades, at all times during construction, to keep the site free of all debris, boxes, packing, etc., resulting from work of this Trade. At the completion of this work, the installation is to be left in a clean and finished condition to the satisfaction of the Engineer.

3.7 Tests and Acceptance

3.7.1 The operation of the equipment does not constitute an acceptance of the work by the Owner. The final acceptance is to be made after the Contractor has adjusted his equipment and demonstrated that it fulfils the requirements of the drawings and the specifications.

3.7.2 Testing of all systems shall be performed in the presence of the Owner's designated representative. The contractor shall give 72 hours advance notice to the Owner before beginning the tests.

3.7.3 Upon completion of the installation, the Contractor shall furnish certificates of approval from all authorities having jurisdiction, as applicable. Contractor shall demonstrate that work is complete and in perfect operating condition. In the presence of the Owner, the Contractor shall demonstration the proper operation of all miscellaneous systems.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Cable TV from service provider.

2. PRODUCTS

2.1 Service Provider

2.1.1 Rogers

2.2 RG6 Coax Cable

2.2.1 Plenum rated, to Cable TV provider requirements.

2.3 HDMI Patch Cords

2.3.1 Provide HDMI patch cords of sufficient length to suit project.

3. EXECUTION

3.1 Coordination

3.1.1 Owner to set up account with service provider.

3.1.2 Contractor to coordinate TV service installation and sequencing with provider.

3.2 Field Quality Control

3.2.1 Test operation of equipment under supervision of Manufacturer's representative.

END OF SECTION

1. GENERAL

1.1 Summary

1.1.1 The work covered under this section consists of the furnishing of all necessary labor, supervision, materials, equipment, and services to completely execute the system of non-continuous cable supports ("J-Hooks") as described in this specification.

1.2 Scope

1.2.1 Non-continuous cable supports.
1.2.2 Adjustable non-continuous cable support sling.
1.2.3 Multi-tiered non-continuous cable support assemblies.
1.2.4 Non-continuous cable support assemblies from tee bar.
1.2.5 Non-continuous cable support assemblies from drop wire/ceiling.
1.2.6 Non-continuous cable support assemblies from beam, flange.
1.2.7 Non-continuous cable support assemblies from C & Z Purlin.
1.2.8 Non-continuous cable support assemblies from wall, concrete, or joist.
1.2.9 Non-continuous cable support assemblies from threaded rod.
1.2.10 Raised floor non-continuous cable support assemblies.
1.2.11 Cantilever-Mounted Option for non-continuous cable supports.
1.2.12 Installation accessories for non-continuous cable supports.

1.3 Definitions

1.3.1 UTP: Unshielded twisted pair.
1.3.2 ANSI: American National Standards Institute
1.3.3 ASTM: American Society for Testing and Materials
1.3.4 EIA: Electronic Industries Alliance
1.3.5 TIA: Telecommunications Industry Association
1.3.6 cULus: Listed by Underwriters Laboratories based on both Canadian and US (United States) standards requirements.

1.4 Submittals

1.4.1 Submit product data on non-continuous cable support devices, including attachment methods. Product data to include, but not limited to materials, finishes, approvals, load ratings, and dimensional information.

1.5 Quality Assurance

1.5.1 Non-continuous cable supports and cable support assemblies shall be listed by Underwriters Laboratories for both Canadian and US standards (cULus).
1.5.2 Non-continuous cable supports shall have the manufacturers name and part number stamped on the part for identification.
1.5.3 Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of five years documented experience in the industry, and certified ISO 9000.

2. PRODUCTS

2.1 Acceptable Manufacturers

2.1.1 Subject to compliance with these specifications, non-continuous cable supports shall be as manufactured by ERICO, Inc or approved equal.

2.2 References

2.2.1 ASTM B633 Standard Specification for Electro-deposited Coatings of Zinc on Iron and Steel
2.2.2 ASTM B 695-90 Standard Specification for coatings of Zinc Mechanically Deposited on Iron and Steel

2.2.3 ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

2.2.4 ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

2.2.5 ASTM A109 Standard Specification for Steel, Strip, Carbon, Cold-Rolled

2.2.6 ASTM A167 Standard Specification for Stainless and heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip

2.2.7 ASTM A480/A480M Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip.

2.2.8 ASTM A568 Standard Specification for Steel, Sheet, Carbon, and High-Strength, Low-Alloy Hot-Rolled and Cold-Rolled

2.2.9 A653 G60-Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-coated (Galvannealed) by the Hot-Dip process

2.2.10 ASTM A666 Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar

2.2.11 ASTM A682 Standard Specification for Steel, Strip, High-Carbon, Cold-Rolled, Spring Quality

2.2.12 ASTM A879 Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface

2.2.13 ASTM B117 Standard Method of Salt Spray (Fog) Testing

2.2.14 ASTM D610 Standard test Method for Evaluating Degree of Rusting on Painted Steel Surfaces UL 2043 - Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products and Their Accessories Installed in Air-Handling Spaces.

2.2.15 ANSI/ TIA/ EIA 568 Commercial Building Telecommunications Cabling Standard, current revision level.

2.2.16 ANSI/ TIA/ EIA 569 Commercial Building Standard for Telecommunications Pathways and Spaces, current revision level.

2.2.17 NFPA 70 National Electrical Code®

2.3 Non-Continuous Cable Support Systems

2.3.1 Non-continuous cable supports

.1 Non-continuous cable supports shall provide a bearing surface of sufficient width to comply with required bend radii of high-performance cables; cULus Listed.

.2 Non-continuous cable supports shall have flared edges to prevent damage while installing cables.

.3 Non-continuous cable supports sized 1 5/16” and larger shall have a cable retainer strap to provide containment of cables within the hanger. The cable retainer strap shall be removable and reusable and be suitable for use in air handling spaces.

.4 Non-continuous cable supports shall have an electro-galvanized or G60 finish and shall be rated for indoor use in non-corrosive environments.

.5 Stainless Steel non-continuous cable supports are intended for indoor and outdoor use in non-corrosive environments or where only mildly corrosive conditions apply.

.6 Non-continuous cable supports shall be ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64, CAT21SS, CAT32SS, CAT64SS; CAT-CMTM Double J-Hook CAT100CM; CAT-CMTM U-hook series CAT200CMLN, CAT300CMLN; and CAT-CMTM retainer CATRT200CM, CATRT300CM or approved equal.

2.3.2 Adjustable non-continuous cable support sling

.1 Constructed from steel and woven laminate; sling length can be adjusted to hold up to 425 4-pair UTP; rated for indoor use in non-corrosive environments. Rated to support Category 5 and higher cable, or optical fiber cable; cULus Listed.

.2 Adjustable non-continuous cable support sling shall have a static load limit of 100 lbs.

.3 Adjustable non-continuous cable support sling shall be suitable for use in air handling spaces.

.4 If required, assemble to manufacturer recommended specialty fasteners including beam clips, flange clips, C and Z purlin clips.

.5 Acceptable products: ERICO CADDY CableCatTM CAT425; or approved equal.

2.3.3 Multi-tiered non-continuous cable support assemblies

.1 Multi-tiered non-continuous cable support assemblies shall be used where separate cabling compartments are required. Assemblies may be factory assembled or assembled from pre-packaged kits. Assemblies shall consist of a steel angled hanger bracket holding up to six non-continuous cable supports, rated for indoor use in non-corrosive environments; cULus Listed.

.2 If required, the multi-tier support bracket may be assembled to manufacturer recommended specialty fasteners including beam clamps, flange clips, C and Z purlin clips.

.3 The multi-tiered support bracket shall consist of ERICO CADDY CATHBA and CableCatTM J-Hooks with screws; or approved equal.

2.3.4 Non-continuous cable support assemblies from tee bar

.1 Tee bar support bracket with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.

.2 Acceptable products: ERICO CADDY CAT12TS, CAT21528, CAT32528; or approved equal.

2.3.5 Non-continuous cable support assemblies from drop wire/ceiling

.1 Fastener to wire/rod with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.

.2 Acceptable products: ERICO CADDY CAT124Z34, CAT126Z34, CAT214Z34, CAT216Z34, CAT324Z34 or CAT326Z34; or approved equal.

2.3.6 Non-continuous cable support assemblies from beam, flange

.1 Fastener to beam or flange with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments; cULus Listed.

.2 Acceptable products: ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY beam clamps and CADDY flange clips; or approved equal.

2.3.7 Non-continuous cable support assemblies from C & Z Purlin

.1 Fastener to C or Z purlin with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus Listed.

.2 Acceptable products: ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64 with CADDY Purlin hangers; or approved equal.

2.3.8 Non-continuous cable support assemblies from wall, concrete, or joist

.1 Fastener to wall, concrete, or joist with one non-continuous cable support, factory or jobsite assembled; rated for indoor use in non-corrosive environments, cULus Listed.

.2 Acceptable products: ERICO CableCatTM J-hook series CAT12, CAT21, CAT32, CAT64, with CADDY angle bracket; or approved equal.

2.3.9 Non-continuous cable support assemblies from threaded rod

.1 Fastener to threaded rod with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments, cULus Listed.

.2 The multi-tiered support bracket shall have a static load limit of 300 lbs.

.3 U-hooks and Double J-hook shall attach directly to threaded rod using standard nuts.

.4 Acceptable products: ERICO CableCatTM J-hook, CAT12, CAT21, CAT32, CAT64 with CADDY CATHBA series; CAT-CMTM Double J-hook CAT100CM, CAT-CMTM Direct mount U-hook CAT200CMLN, CAT300CMLN; or AFAB series; or approved equal.

2.3.10 Raised floor non-continuous cable support assemblies

.1 Fastener to raised (access) floor pedestal with one non-continuous cable support, factory or jobsite assembled, rated for indoor use in non-corrosive environments; cULus Listed.

.2 Acceptable products: ERICO CADDY CAT12CD1B, CAT21CD1B or CAT32CD1B; CAT64CD1B; or approved equal.

2.3.11 Cantilever-Mounted cable supports

.1 U-hook shall be able to be assembled to a wide variety of wall mount brackets.

.2 Spacing of individual U-hooks as needed, max of 4’ to 5’ apart.

.3 U-hooks may have the optional attachment of a cable roller for ease in pulling cables.

.4 Acceptable products: ERICO CAT-CMTM U-hooks CAT200CMLN, CAT300CMLN: CAT-CM roller assemblies CATRL200CM, CATRL300CM; CATWMCM bracket; or approved equal.

2.3.12 Installation accessories for non-continuous cable supports

.1 Cable Pulley

.1 Non-continuous cable supports may be used as an installation tool when a removable pulley assembly is included. The pulley shall be made of plastic and be without sharp edges. The pin and bail assembly must be able to be secured to the J-Hook during cable installation. The pulley must remain secured while cables are being pulled.

.2 The pin and roller assembly must be removed after cables are installed.

.3 Acceptable products: ERICO CADDY CAT32PLR, CAT64PLR, or approved equal.

.2 Cable Protector

.1 The protective steel tube shall fit over threaded rod and be at least 4" in length.

.2 The tube shall prevent damage to cables placed in or pulled through CAT-CMTM U-hooks. The tube shall not inhibit the pulling of cables.

.3 Acceptable products: ERICO CAT-CMTM CATTBCM, or approved equal.

2.4 **Finishes**

2.4.1 ASTM B633 Standard Specification for Electro-deposited Coatings of Zinc on Iron and Steel

2.4.2 ASTM B 695 Standard Specification for coatings of Zinc Mechanically Deposited on Iron and Steel

2.4.3 ASTM A123 Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

2.4.4 ASTM A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process

2.4.5 Non-continuous cable supports used where only mildly corrosive conditions apply shall be stainless steel, AISI type 304.

3. EXECUTION

3.1 **Installation**

3.1.1 Installation and configuration shall conform to the requirements of the current revision levels of ANSI/ EIA/TIA Standards 568 & 569, NFPA 70 (National Electrical Code), applicable local codes, and to the manufacturer's installation instructions.

3.1.2 Install cables using techniques, practices, and methods that are consistent with Category 5 or higher requirements and that supports Category 5 or higher performance of completed and linked signal paths, end to end.

3.1.3 Install cables without damaging conductors, shield, or jacket.

3.1.4 Do not bend cables, in handling or in installing, to smaller radii than minimums recommended by manufacturer.

3.1.5 Pull cables without exceeding cable manufacturer's recommended pulling tensions. Use pulling means that will not damage media.

3.1.6 Do not exceed load ratings specified by manufacturer.

3.1.7 Adjustable non-continuous support sling shall have a static load limit of 100 lbs.

3.1.8 Follow manufacturer's recommendations for allowable fill capacity for each size non-continuous cable support.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Cable trays, including ladder rack, wire mesh, optical fibre trough, and accessories.

1.2 Related Requirements

1.2.1 Section 26 05 26 – Grounding and Bonding for Electrical Systems.

1.2.2 Section 26 05 29 – Hangers and Supports for Electrical Systems.

1.3 References

1.3.1 CSA C22.1-12 - Canadian Electrical Code, Part I (22nd Edition), Safety Standard for Electrical Installations

1.3.2 Ontario Electrical Safety Code (25th Edition / 2012).

1.3.3 CSA C22.2 No. 126.1 (CSA/NEMA) - Metal Cable Tray Systems.

1.4 Submittals for Review

1.4.1 Product Data: Provide data for fittings and accessories.

1.4.2 Shop Drawings: Indicate tray type, dimensions, support points, and finishes.

1.5 Submittals for Information

1.5.1 Manufacturer's Instructions:

.1 Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements.

.2 Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 Submittals for Closeout

1.6.1 Project Record Documents: Record actual routing of cable tray and locations of supports.

1.7 Regulatory Requirements

1.7.1 Products: Listed and classified by CSA (Canadian Standards Association as suitable for the purpose specified and indicated.

2. PRODUCTS

2.1 Ladder Rack-Type Cable Tray

2.1.1 Description: CSA 22.2 No. 126.1, Class ladder type tray.

2.1.2 Material: Aluminum.

2.1.3 Inside width: As indicated.

2.1.4 Inside depth: As indicated.

2.1.5 Straight section rung spacing: 152 mm on centre.

2.1.6 Inside Radius of Fittings: As indicated.

2.1.7 Unless otherwise noted, provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.

2.1.8 Refer to drawings for details.

2.1.9 Manufacturers:

.1 Hubbell Nextframe Ladder Rack

.2 Canadian Electrical Raceways “Telecom Cable Rack”

.3 Approved Equal.

2.2 Wire Basket Cable Tray

2.2.1 Description: CSA 22.2 No. 126.1, Class Basket type tray.

2.2.2 Material: Carbon Steel, Hot Dipped Galvanized to ASTM A 123.

2.2.3 Inside Width: As indicated.

2.2.4 Inside Depth: As indicated.

2.2.5 Straight Section Rung Spacing: refer to drawings.
2.2.6 Inside Radius of Fittings: As indicated.
2.2.7 Unless otherwise noted, provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.
2.2.8 Refer to drawings for details.
2.2.9 Rung spacing 6 inch.
2.2.10 Radius for tees 12 inch minimum. Exact size to be verified on site.
2.2.11 Do not employ tray elbows. Use Tees to permit future extension of tray.
2.2.12 Radius for the dropouts 5 inch minimum. Exact size to be verified on site.
2.2.13 Manufacturers:
.1 Cablofil.
.2 Canadian Electrical Raceways Inc.
.3 Hubbell.
.4 Thomas & Betts

2.3 **Optical Fibre Routing System (Fibre Tray):**
2.3.1 The optical fiber routing system shall be used to route, segregate and protect fiber optic communication cabling.
2.3.2 ULC Listed (UL2024A)
2.3.3 Size:
.1 4" x 4"
.2 As otherwise indicated on drawings.
2.3.4 2" minimum bend radius through-out pathway.
2.3.5 Impact Resistant and flame retardant material. (UL94-V0 Flammability).
2.3.6 Color: Black
2.3.7 Will include all mounting hardware, waterfalls, directional fittings and other accessories required for installation
2.3.8 Manufacturers:
.1 Panduit Fiberrunner series.
.2 ADC FiberGuide series.
.3 Commscope SpeedPRO series.

3. EXECUTION

3.1 **Installation**
3.1.1 Trays to be sized to 40 per cent maximum capacity.
3.1.2 Install metallic cable tray to CSA C22.1 SB-02 and C22.2 No. 126.1.
3.1.3 Install fibreglass cable tray to CSA C22.1 SB-02 and C22.2 No. 126.2.
3.1.4 Support trays to Section 26 05 29. Provide supports at each connection point, at the end of each run, and at other points to maintain spacing between supports.
3.1.5 Use expansion connectors where required.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Firestopping through penetrations in fire rated assemblies.

1.2 Related Requirements

1.2.1 Section 07 84 00 – Firestopping.

1.3 References

1.3.1 ASTM E 84, “Surface Burning Characteristics of Building Materials”.
1.3.2 ASTM E 119, “Fire Tests of Building Construction and Materials”.
1.3.3 ASTM E 814, “Fire Tests of Penetration Firestop Systems”.
1.3.4 ANSI/UL263, “Fire Tests of Building Construction and Materials”.
1.3.5 ANSI/UL723, “Surface Burning Characteristics of Building Materials”.
1.3.6 ANSI/UL1479, “Fire Tests of Through Penetration Firestops”.
1.3.7 Underwriters Laboratories Inc. (UL) – Fire Resistance Directory

1.4 Performance Requirements

1.4.1 Fire rated pathway devices shall be the preferred product and shall be installed in all locations where frequent cable moves, add-ons and changes will occur, such devices shall:
- .1 Meet the hourly rating of the floor or wall penetrated.
- .2 Permit the allowable cable load to range from 0% to 100% visual fill thereby eliminating the need to calculate allowable fill ratios.
- .3 Not require any additional action on the part of the installer to open or close the pathway device or activate the internal smoke and fire seal, such as, but not limited to:
  - .1 Opening or closing of doors.
  - .2 Twisting an inner liner.
  - .3 Removal or replacement of any material such as, but not limited to, sealant, caulk, putty, pillows, bags, foam plugs, foam blocks, or any other material.
- .4 Permit multiple devices to be ganged together to increase overall cable capacity.
- .5 Allow for retrofit to install around existing cables.
- .6 Include an optional means to lengthen the device to facilitate installation in thicker barriers without degrading fire or smoke sealing properties or inhibiting ability of device to permit cable moves, add-ons, or changes.

1.4.2 Where single cables (up to 0.27 in. (7 mm) diameter) penetrate gypsum board/stud wall assemblies, a fire-rated cable grommet may be substituted. Acceptable products shall be molded from plenum-grade polymer and conform to the outer diameter of the cable forming a tight seal for fire and smoke. Additionally, acceptable products shall lock into the barrier to secure cable penetration.

1.4.3 Where non- mechanical products are utilized, provide products that upon curing do no re-emulsify, dissolve, leach, breakdown or otherwise deteriorate over time from exposure to atmospheric moisture, sweating pipes, ponding water or other forms of moisture characteristic during or after construction.

1.4.4 Where it is not practical to use a mechanical device, openings within floors and walls designed to accommodate telecommunications and data cabling shall be provided with re-enterable products that do not cure or dry.

1.4.5 Cable trays shall terminate at each barrier and resume on the opposite side such that cables pass independently through fire-rated pathway devices. Cable tray shall be rigidly supported independent from fire-rated pathway devices on each side of barrier.

1.5 Submittals

1.5.1 Submit under provisions of Section 01 33 00.

1.5.2 Product Data: Provide manufacturer's standard catalog data for specified products demonstrating compliance with referenced standards and listing numbers of systems in which each product is to be used.

1.5.3 Shop Drawings: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance ratings.

1.5.4 Certificates: Product certificates signed by firestop system manufacturer certifying material compliance with applicable code and specified performance characteristics.

1.5.5 Installation Instructions: Submit manufacturer's printed installation instructions.

1.6 **Quality Assurance**

1.6.1 Products/Systems: Provide firestopping systems that comply with the following requirements:

.1 Firestopping tests are performed by a qualified, testing and inspection agency. A qualified testing and inspection agency is UL, or another agency performing testing and follow-up inspection services for firestop system acceptable to authorities having jurisdiction.

.2 Firestopping products bear the classification marking of qualified testing and inspection agency.

1.6.2 Installer Qualifications: Experience in performing work of this section who is qualified by the firestopping manufacturer as having been provided the necessary training to install firestop products in accordance with specified requirements.

1.7 **Delivery, Storage, and Handling**

1.7.1 Delivery:

.1 Manufacturer's original, unopened, undamaged containers, identification labels intact identifying product and manufacturer, date of manufacture; lot number; shelf life, if applicable; qualified testing and inspection agency's classification marking; and mixing instruction for multicomponent products.

.2 Handle and store products according to manufacturer's recommendations published in technical materials. Leave products wrapped or otherwise protected and under clean and dry storage conditions until required for installation.

1.7.2 Storage and Protection:

.1 Store materials protected from exposure to harmful weather conditions and at temperature and humidity conditions recommended by manufacturer.

1.8 **Project Conditions**

1.8.1 Do not install firestopping products when ambient or substrate temperatures are outside limitations recommended by manufacturer.

1.8.2 Do not install firestopping products when substrates are wet due to rain, frost, condensation, or other causes.

1.8.3 Maintain minimum temperature before, during, and for a minimum 3 days after installation of materials.

1.8.4 Do not use materials that contain flammable solvents.

1.8.5 Coordinate construction of openings and penetrating items to ensure that through-penetration firestop systems are installed according to specified requirements.

1.8.6 Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate through-penetration firestop systems.

1.8.7 Schedule installation of firestopping after completion of penetrating item installation but prior to covering or concealing of openings.

2. PRODUCTS

2.1 **Manufacturers**

2.1.1 Specified Technologies Inc., 200 Evans Way, Somerville, NJ 08876. Tel: (800) 992-1180, Fax: (908) 526-9623, Email: specseal@stifirestop.com, Website: www.stifirestop.com.

2.1.2 Substitutions: as approved by the Engineer prior to tender closing.
2.1.3 Single Source: Obtain firestop systems for each type of penetration and construction condition indicated only from a single manufacturer.

2.2 **Materials**
2.2.1 General: Use only firestopping products that have been tested for specific fire resistance rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements, and fire rating involved for each separate instance.

2.3 **Fire Rated Cable Pathways**
2.3.1 Steel raceway with intumescent foam pads allowing 0 to 100 percent cable fill, the following products are acceptable:
.1 Specified Technologies Inc. (STI) EZ-PATH™ Fire Rated Pathway.

3. EXECUTION

3.1 **Examination**
3.1.1 Before beginning installation, verify that substrate conditions previously installed under other sections are acceptable for installation of firestopping in accordance with manufacturer's installation instructions and technical information.
3.1.2 Surfaces shall be free of dirt, grease, oil, scale, laitance, rust, release agents, water repellants, and any other substances that may inhibit optimum adhesion.
3.1.3 Provide masking and temporary covering to protect adjacent surfaces.
3.1.4 Do not proceed until unsatisfactory conditions have been corrected.

3.2 **Installation**
3.2.1 General: Install through-penetration firestop systems in accordance with Performance Criteria and in accordance with the conditions of testing and classification as specified in the published design.
3.2.2 Manufacturer's Instructions: Comply with manufacturer's instructions for installation of firestopping products.

3.3 **Field Quality Control**
3.3.1 Inspections: Owner shall engage qualified independent inspection agency to inspect through-penetration firestop systems.
3.3.2 Keep areas of work accessible until inspection by authorities having jurisdiction.
3.3.3 Where deficiencies are found, repair firestopping products so they comply with requirements.

3.4 **Adjusting and Cleaning**
3.4.1 Remove equipment, materials, and debris, leaving area in undamaged, clean condition.
3.4.2 Clean all surfaces adjacent to sealed openings to be free of excess firestopping materials and soiling as work progresses.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Labelling and identification requirements for communications systems.

1.2 References

1.2.1 ANSI/TIA/EIA-606-A – Administration Standard for Commercial Telecommunications Infrastructure.

1.2.2 UL 969 – Marking and Labeling Systems.

2. PRODUCTS

2.1 Summary

2.1.1 Adhesive cable labels to meet the legibility, defacement, and adhesion requirements specified in UL 969 (Ref. D-16). In addition, the labels shall meet the general exposure requirements in UL 969 for indoor use.

2.1.2 Self-laminating vinyl construction cable labels with a white printing area and a clear tail that self laminates the printed area when wrapped around a cable. The clear area should be of sufficient length to wrap around the cable at least one and one-half times.

2.1.3 ANSI/EIA/TIA-606 for colour codes shall be followed. Labels are to be mechanically printed using a laser printer. Hand written labels will not acceptable.

2.2 Label Printer

2.2.1 Thermal Transfer Printer shall print high quality, industrial labels on a wide variety of materials for electrical and network applications such as wire/cable, components, safety and facility identification.

2.2.2 Laminated Adhesive Label Cassettes:

.1 For flat label applications.

.2 Polyester material.

2.2.3 Non-Laminated Adhesive Label Cassettes:

.1 For marking wire and cable and flat label applications.

.2 Polyester material

2.2.4 Example Products:

.1 Panduit LS7 series hand-held printer.

.2 Panduit LS8 series hand-held printer.

2.3 Nameplates

2.3.1 Engraved three-layer laminated plastic, letters on contrasting background:

2.3.2 Rack and Cabinet ID labels: 25 mm (1”) high White Text on Black Background

3. EXECUTION

3.1 Installation

3.1.1 Cable identification labels should appear at the following locations with the numbers indicated on the cable schedule and drawings:

.1 300 mm (12 inches) from each end of the cable – after termination.

.2 Front of patch panels.

.3 Front of IDC termination blocks.

.4 Front of workstation/communications outlet faceplates.

.5 Each end of each Telecommunications Conduit.

3.1.2 Fibre Optic safety labels shall appear at the following locations:

.1 Along the length of the conduit or innerduct at 3 m (10 foot) intervals.

.2 At all junction boxes

.3 At all pull boxes.

.4 On all fibre optic patch panels.

3.1.3 Provide 25 per cent additional labels to be left in each telecommunications room on site for future growth.

3.1.4 Provide two Rack/Cabinet nameplates. Mount one on the front, and one on the rear of the rack.

3.2 **Identification Conventions**

3.1 All cabling will be labelled with the closet letter, followed by a dash and the wire number (i.e. A-001 would be the first wire in closet A).

3.1.1 Labelling for backbone wiring will be preceded with BB followed by the wire number (i.e. BB-001 would be the first backbone.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Commissioning Requirements.

1.2 References

1.2.1 Refer to Section 27 05 00 for references.

1.3 Submittals for Review

1.3.1 Provide testing reports.

2. PRODUCTS – NOT USED

3. EXECUTION

3.1 Installation

3.1.1 Testing of all horizontal copper cables are to be completed in accordance with the follow test criteria:

- .1 Basic Link
- .2 Grounds
- .3 NEXT
- .4 ELFEXT
- .5 Continuity
- .6 correct polarity
- .7 PSNEXT
- .8 PSELFEXT
- .9 Shorts
- .10 Length
- .11 ACR
- .12 Return Loss
- .13 Opens
- .14 Attenuation
- .15 PSACR
- .16 Resistance

3.1.2 Fibre strands in excess of 122m (400 ft) shall be tested with an Optical Time Domain Reflectometer for length and attenuation.

3.1.3 Test each stand of fibre, bi-directionally, with a Power Meter / Light Source combination operating at wavelengths of 850 nm and 1300 nm for multimode fibres.

3.1.4 Maximum multi-mode passive link loss (including patch cords) is not to exceed -2.35dB.

3.1.5 Maximum single-mode passive link loss (including patch cords) is not to exceed -1.0dB.

3.2 Documentation

3.2.1 The Telecommunications Cabling Contractor is required to submit test results in native tester format or a format which can be read with a text reader (i.e. ".txt" extension). Paper results shall not be submitted for projects with 100 or more horizontal cable drops and/or fibre cables.

3.2.2 The Telecommunications Cabling Contractor is required to provide the software required to view the results.

3.2.3 The report should be divided into sections by Telecommunications Room.

3.2.4 The report should indicate for each cable when it was tested successfully, the result, and the length.

3.2.5 The Telecommunications Cabling Contractor shall sign off on the entire test report prior to submitting to the General Contractor/Construction Manager or The Consultant.

3.2.6 The test result documentation is to be submitted to the General Contractor/Construction Manager or The Consultant for review no later than 10 working days following the completion of the installation.

3.2.7 All deficiencies must be corrected before the General Contractor/Construction Manager or The Consultant will provide a certificate to release the Holdback on the project.

3.3 **Record Drawings**

3.3.1 The Telecommunications Cabling Contractor is required to maintain one set of correct and accurate record drawings on-site at all times. These drawings are to be made available to the General Contractor/Construction Manager or the Consultant for review during the project.

3.3.2 The Telecommunications Cabling Contractor is required to provide record drawings of the telecommunication cabling installation in relation to the drawings provided in this specification.

3.3.3 The record drawings shall be updated electronically and include, but are not limited to;

.1 Horizontal cable numbers on the floor plans
.2 Horizontal Cable Routing on the floor plans
.3 Changes on the floor plans
.4 Backbone cable Routing between Telecommunications Rooms
.5 Paging Speaker Locations including daisy chain cable run
.6 Wireless Access Points and Cell coverage
.7 Cabinet/Rack Elevation drawings
.8 Backboard Elevation Drawing

3.3.4 The Telecommunications Cabling Contractor shall provide one soft copy in AutoCAD 2007 and one plotted copy for the Consultant to review prior to complete substantial performance and close-out documentation submission.

3.3.5 After approval, the Telecommunications Cabling Contractor shall submit one plotted copy of the drawings for;

.1 The Main Computer Room
.2 Each Telecommunications Room
.3 The Consultant

3.3.6 All close-out documentation must be submitted to the General Contractor/Construction Manager or The Consultant within 10 working days of the completion of the project before the documentation holdback will be released.

END OF SECTION

1. GENERAL

1.1 Summary

1.1.1 Supply, install and test complete data cabling system and accessories, based on physical star wiring topology, and as specified herein and indicated on drawings.

1.1.2 Include data cabling system the following sub-systems:

.1 Backbone Terminal Systems, located in Communications Closets, to serve as connection points between backbone cables and horizontal distribution cables.

.2 Horizontal distribution system links backbone terminal system to telecommunications outlets.

.3 Contractor is to submit details on equipment types and locations for review and approval prior to installation.

1.2 Related Requirements

1.2.1 Appendix E1 – City of Toronto Structured Cabling Standard, v4.3 2014-Aug-25.

1.2.2 Active electronics, including servers, hubs, routers, switchers, and, PCs are by Owner and are not part of this contract.

1.3 Abbreviations and Acronyms

1.3.1	MTER	Main Telecommunication Equipment Room
1.3.2	TC	Telecommunications Closet
1.3.3	TCs	Telecommunications Closets
1.3.4	RCDD	Registered Communications Distribution Designer
1.3.5	BICSI	Building Industry Consulting Service International
1.3.6	MDTS	Main Distribution Terminal System
1.3.7	IDC	Insulation Displacement Connection
1.3.8	OTDR	Optical Time-Domain Reflectometer
1.3.9	BCS	Backbone Cabling System
1.3.10	IDT	Intermediate Distribution Terminal
1.3.11	BTS	Backbone Terminal System

1.4 Reference Standards

1.4.1 Conform to CAN/CSA-T530 for new buildings and areas of substantial renovations of telecommunications, spaces and pathways.

1.4.2 Ensure that cabling system shall conform to current issue of industry standard CAN/CSA-T529. This standard is currently being revised and is available as document EIA/TIA SP-2840A (future CAN/CSA-T529). All requirements of this new document must be followed including: Structural Return Loss (section 10.2.4.5), Power Sum Testing (section 10.3.4.7) and End to End Link Performance and continuity, attenuation, cable open and shorts, NEXT; mutual capacitance, pair polarity and cable impedance, S/N ratio, and Pass/Fail status. Tests are to be conducted and recorded using a Penta Scanner. Fibre optic cables shall be tested in conformance to ISO/IEC IS 11801 standards using an EXFO Optical Time Domain Reflectometer. Test results such as; dB loss, cable length and fibre deficiencies (if any) shall be conducted. Verification, documentation, and warranty shall be provided.

1.4.3 Where applicable, have performance of Category 5e cabling components used, verified by nationally recognized testing laboratory. Submit test results upon request.

1.4.4 Conform to applicable Building and Electrical Safety Codes.

1.5 Submittals

1.5.1 Shop Drawings

.1 Provide submittals in accordance with Section 01 33 00 prior to commencing installation.

.2 Submit complete cabling system layout for Consultant review for data, cable routing summary and cable outlet designation. Have cabling system layout performed by accredited RCDD (Registered Communications Distribution Designer) as defined by

BICSI (Building Industry Consulting Service International). The Data Cabling system will not be accepted without this submission.

.3 Documentation proving compliance to End-to-End Link Performance test, as specified in Annex E of EIA/TIA SP-2840A shall be provided prior to structured cabling being installed.

.4 Submit detailed layout drawings, including termination racks prior to commencing this installation.

.5 Manufacturer's product information documents on all components of the cabling system, including horizontal and vertical cable management systems and all auxiliary components/devices and equipment prior to commencing this installation.

.6 The following documentation shall be submitted with a following cover letter listing attachments prior to commencement of work.

.1 A list of personnel for the project that will include the name of the Project Manager, Site Manager(s), Lead Hands, and Installers.

.2 Permits and notifications as may be required for the project.

1.6 **Closeout Submittals**

1.6.1 Provide manufacturer’s certificate at completion of installation certifying the installation.

1.6.2 Prepare and submit "As-built" drawings reviewed by an RCDD.

1.6.3 "As-built" drawings are to detail the exact location of equipment indicating wiring runs and raceways, pull, junction and terminal boxes. Also to include outlet locations, cable numbers and equipment rack profiles.

1.6.4 Upon completion of work and prior to final acceptance, the contractor will submit to the Owner the required copies of Network Certification and Documentation in the form of manuals that will include the following:

.1 Detailed information on types of materials and equipment used and their locations including: distribution frame equipment (rack), equipment types and locations; a detailed listing of cable and outlet types and locations.

.2 Accurately and neatly recorded test results.

.3 Accurately and neatly record locations including room numbers, of all network components in list form for easy reference.

.4 Identify drawings as ‘Project Record Copy’ and maintain in new condition making available for inspection by Owner.

.5 Bind all items listed above in a 3-ring hard covered binder suitably labelled with the names of each school/site project.

1.7 **Quality Assurance**

1.7.1 Qualifications of Manufacturer

.1 Supply equipment manufactured by experienced reputable manufacturer, whose installations have rendered satisfactory service for at least 2 years and who would provide factory trained technicians fully experienced in telecommunications wiring. Submit information regarding number of employees, and proof of VAR/CSV certification, including length of time Contractor or employee(s) have been certified to install Cable systems.

.2 Provide certification that cabling solution offered will perform as a system as is defined in standards documents such as EIA-TIA SP-2840A and T568A configuration for Category 5E system standards. Provide certification supported by manufacturer of cabling components used.

.3 In addition to certificate of assurance, evidence of support by manufacturer for above items shall be provided upon request in writing with bidding response.

.4 Use components sourced completely from single manufacturer.

1.7.2 Qualifications of Installer

.1 Provide installation and supervision work supervised by telecommunications technicians qualified to install voice and data cabling system and to perform related tests as required by manufacturer. Installers/company must have valid certification.

.2 Provide fully qualified telecommunications technicians, trained and certified by manufacturer in installation and testing of equipment specified. Provide evidence upon request in writing prior to work commencement of manufacturer's certification of supplier's ability to properly install structured cabling for building.

.3 Submit proven track record in cabling projects of similar size. Include details of minimum 3 projects of similar size involving category 5E cabling, Multimode and Single-mode fibre optic cabling which have been completed in last 2 years. Include names, addresses, and phone numbers of references for 3 projects.

1.7.3 Certifications

.1 UTP network wiring shall conform to T568A configuration, Category 5e system standards. All UTP cables shall provide minimum signal impairment by preserving wire pair twists as closely as possible to the point of mechanical termination at each end. The following tests will be conducted and recorded using a Penta Scanner:

.2 End to end continuity, attenuation, cable open and shorts; NEXT; mutual capacitance; pair polarity and cable impedance; S/N ratio and pass/fail status.

1.8 **Warranty**

1.8.1 The structured cabling systems shall be warranted for 25 years, covering all system products manufactured and provided by the single source supplier. The warrantor shall guarantee the following:

.1 All passive system components, e.g. patch panels, UTP cable and outlet jacks are free from manufacturing defects in material or workmanship

.2 Approved cabling systems exceed the specifications of the T1A-568A standards and ISO/IEC IS 11801, if applicable.

.3 The installation exceeds attenuation and near end cross talk, loss and bandwidth requirements TIA Bulletin TIA TSB-67 and ISO/EIC IS 11801.

1.8.2 General workmanship and apparatus installed under this contract shall be warranted against defects of workmanship and material for a period of two years after final acceptance of work by the Owner, unless otherwise specified. The contractor will make good any defects developed as a result of their work during such time without expense to the Owner.

2. PRODUCTS

2.1 **Manufacturers**

2.1.1 As noted in Appendix E1

2.2 **UTP Cabling**

2.2.1 100 ohm 4 pair UTP, compliant with TIA/EIA-568-C.2

2.2.2 Category 3 cabling for telephone communication.

2.2.3 Category 5e for data communication, security cameras.

.1 Unshielded twisted pair, 4 pair twisted, #24AWG, FT-6/CMP plenum rated, blue outer insulation,

2.2.4 CMP (FT6) Plenum rated.

2.2.5 No splicing of any data network cabling will be permitted.

2.3 **Data Outlets**

2.3.1 All data jacks must meet specifications.

2.3.2 Computer outlets complete with termination jacks shall be single, duplex or quad flush faceplates complete with Category 5e, 8-position jacks.

2.3.3 Supply and install one – 4 pair cable to the single outlet, two – 4 pair cables to the duplex outlet, and three – 4 pair cables to quad outlet.

2.4 **Patch Panels/Equipment Racks**

2.4.1 All data UTP, 4 pair, Category 5e horizontal cables are to be terminated on cabinet or rack mounted 24/48 port panels wired.

.1 PS5 HD-BIX Patch panel, 1U, 24 Port (Belden AX100465 or equal)

.2 PS5 HD-BIX Patch panel, 2U, 48 Port (Belden AX100473 or equal)

2.4.2 In addition to the above, provide all necessary ancillary equipment such as cable management, label holders, and patch cords.

2.5 **Patch Cords**

2.5.1 Provide Category 5e patch cords, consisting of 4 pair stranded cable rated FT4 or higher and stamped accordingly. They must conform to EIA/TIA 568A and meet or exceed the EIA/TIA TSB-36 specifications for cordage.

2.5.2 Patch cords at the workstation end shall be 3050 mm in length, one per data cable.

2.5.3 Patch cords at the TC end shall be 2133 mm in length, one per data cable.

3. EXECUTION

3.1 **Pathways for Communications**

3.1.1 Conduit to Section 26 05 33.13. J-Hooks: as described in Section 27 05 29.

3.1.2 Cabling between cable tray/j-hooks and data outlets to be enclosed in EMT conduit.

3.1.3 Cables/data outlets may be enclosed in pre-finished non-metallic raceways computer labs, classrooms, etc. where indicated.

3.1.4 Data network cables shall be installed in cable tray. Data network cables shall not be tie-wrapped to electrical conduits, mechanical piping, etc. and shall be run as far as possible from fluorescent lighting fixtures, transformers and electrical power service conduits.

3.2 **Installation**

3.2.1 Each equipment rack shall be anchored securely to the floor and grounded to the building ground with a #6 AWG Insulated Ground Wire in accordance with applicable code requirements (refer to CAN/CSA T5238).

3.2.2 Ground all data cables shields and associated equipment in Telecommunications rooms to meet applicable code requirements.

3.2.3 Supply vertical cables and backbone cabling using cable clamps or wiring harnesses.

3.2.4 Conform to Telecommunications Industry Standards (refer to EIA/TIA 568A) for all cable termination and pinning assignments.

3.2.5 Utilize cable trays in MTER and TCs to manage cable in orderly fashion.

3.2.6 All sleeves containing cable or unused shall be fire sealed. Coordinate with Section 07 84 00 for provision and installation of fire barriers.

3.2.7 Cabling is to be run at 90 degrees to the building grid except where the distance would exceed 90m in length if installed in this manner.

3.2.8 The maximum horizontal run length is not to exceed 90 metres. If the 90 metre constraint cannot be met, the Cabling Contractor is to notify the Owners Designee of any cables that exceed 90 metres, prior to the installation.

3.2.9 Ensure all grounding conductors are rated FT-6. Tie into bundles and support using j-hooks outside of tray or conduit and fasten to under-slab at intervals not to exceed 1500 mm.

3.2.10 Route all cable in such a way as to ensure minimum separations are maintained from sources of EMI as defined in EIA/TIA SP-2840A.

3.2.11 Place all exposed cabling in TC in neat and professional manner and route as per specifications and drawings. Cables are to be combed, bundled, and routed in a neat and organized manner. Tie-wrap all exposed cable bundles at maximum of every 200 mm using black ‘hook-and-loop- fastening ties.

3.2.12 Securely mount voice outlets at all work area locations and locate so that cable required to reach work area equipment will be no more than 3 m long.

3.2.13 Ensure that optical fibre splices, fusion or mechanical, do not exceed maximum optical attenuation of 0.3 dB when measured in accordance with EIA/TIA 455-34 and CSA Standard C22.2 No. 232.

3.2.14 All cables must be properly handled and installed in accordance with the manufacturer's specification. Undue pulling tension, abrasion or rough handling must be avoided to ensure that the cables will permit transmission of the intended information with no impairment or degradation of signal quality. Cable runs between the wiring closets and wall plates must be

performed with no splices or cuts to ensure the elimination of reflections, discontinuities, impedance, mismatches, and egress/ingress of undesired signals. Cables must be installed at a specified distance (shown below) from any electrical equipment such as radios, televisions, fluorescent lights or fixtures, motors, transformers, or other significant sources of RFI/EMI interference

3.2.15 Label all cables in accordance with Industry Standards and CAN/CSA T528 specifications. Number cables as per drawings.

3.2.16 In cases where the routing may bring the cable in close proximity to the above mentioned sources of disruption, the following minimum distances must be maintained:

.1 125 mm (5 inches) from power lines of 2 kVA or less.
.2 305 mm (12 inches) from lighting (including fluorescent).
.3 914 mm (36 inches) from power lines of 5 kVA or greater
.4 40 inches from transformers and motors

3.2.17 As well, cables must be routed to avoid direct contact with steam pipes or other heat sources so as to avoid thermal degradation of the cable insulation or other undesired effects.

3.2.18 Cables shall be located in ceiling spaces neatly, tied in bundles and installed in cable management “trays”, J-hooks, and conduit as indicated on the drawings.

3.2.19 All cables entering the wiring closets must be neatly dressed in bundles and run to the appropriate terminating location.

3.2.20 Each cable sheath must be clearly and permanently identified with a labelling scheme acceptable to the owner. Each patch panel port a must be clearly and indelibly marked with a structured, user friendly numbering scheme. This numbering scheme must be capable of accepting cable additions so as not to disrupt the logical flow of the scheme. All testing documentation is to reference this numbering scheme.

3.2.21 NOTE: The faceplate identification numbers/tags MUST be added to the electronic versions of the floor plans. This will be considered part of the As Built contract closeout submittals. The electronic version of the floor plan will be provided in ACAD 14 format by the consultant.

3.2.22 The wiring closets shall be labelled C1 etc.

3.2.23 Fibre optic cable installation procedures shall be as follows:

.1 All cables must be properly handled and installed in accordance with the manufacturer's specification. Undue pulling tension, abrasion or rough handling must be avoided to ensure that the cables will permit transmission of the intended information with no impairment or degradation of signal quality. Cable runs between the wiring closets and must be performed with no splices or cuts to ensure the elimination of reflections, discontinuities, excess signal loss, or other undesirable problems.
.2 All fibre cables shall be installed in conduits from end-to-end.
.3 If, during the course of cable installation, it is necessary to bore holes through a firewall, the holes must be sealed with an acceptable sealing material of compound once the cables are in place.
.4 All cables entering the computer room must be neatly dressed in bundles and run to the appropriate terminating location.
.5 Cable runs shall be free of tension at both ends as well as over the length of the run.
.6 Each cable sheath must be clearly and permanently identified at each end using an appropriate labelling scheme accepted by the customer.

3.3 **Cable Identification and Labels**

3.3.1 To Section 27 05 53.

3.3.2 All adhesive cable labels shall meet the legibility, defacement, and adhesion requirements specified in UL 969 (Ref. D-16). In addition the labels shall meet the general exposure requirements in UL 969 for indoor use.

3.3.3 Cable labels shall be of self-laminating vinyl construction with a white printing area and a clear tail that self laminates the printed area when wrapped around a cable. The clear area should be of sufficient length to wrap around the cable at least one and one-half times.

3.3.4 All labels must be mechanically printed using a laser printer. Hand written labels are not permitted.

3.3.5 Labels are to be attached to:

.1 front of the IDC connector or communication outlet faceplate

.2 each patch panel jack

.3 each end of the horizontal cable at maximum distance of 50mm from the end of the sheath

3.3.6 Affix faceplate label printed with Workstation Identification number to faceplate cover of in-tile service box.

3.4 **Testing**

3.4.1 All UTP distribution cabling must be tested with a specialized UTP cable tester to measure the following characteristics:

.1 DC Resistance

.2 Characteristic Impedance

.3 Cable Length

.4 Pair Sequence Testing

.5 Hardcopy checklists indicating room number and faceplate ID, should be prepared, These results should be documented and form part of the Certification Report, Any documentation supplied in hardcopy form should also be supplied in electronic format (suitable word processing file, spread sheet, graphics file (e.g. AutoCAD, etc.).

.6 In addition to the above UTP testing, each cable and termination must be tested to 100 MBS standards.

.7 The specific tests to be performed, after all jack plates are mounted on boxes and labelled, are as follows,

.1 Mutual Capacitance

.2 Attenuation

.3 Near End Cross Talk

3.4.2 Fibre Optic Cable Testing Procedure

.1 System acceptance tests must be performed to verify that the cable plant can be certified fully operational. All optical fibre strands must be properly measured with approved optical fibre test equipment for the following characteristics:

.1 End to end attenuation loss in dB as measured by a calibrated optical power meter.

.2 Splice loss (if any)

.3 Cable length

.2 The above results are to be obtained by the following test procedures:

.1 Power meter and light source.

.2 OTDR - provide hard copy of signature trace in report.

.3 Detailed results of these tests must be included as part of a Certification Report.

.4 No connector should exceed 0.5 dB loss. Splices shall not exceed 0-3 dB loss. Total attenuation of link including fibre cable, connectors and splices shall not exceed 5 dB.

3.4.3 These test results must be documented and form part of the Certification Report.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 HDBaseT adaptors.

1.2 Informational Submittals

1.2.1 Coordinate with Owner for manufacturer's submittal package, including:

.1 Cut sheets of all components.

.2 Installation instructions.

2. PRODUCTS

2.1 HDMI Patch Cords

2.1.1 Manufacturers:

.1 Cables 2 Go (C2G)

.2 Approved equal.

2.2 HDBaseT Cabling

2.2.1 Solid Conductor Category 6 UTP cabling to Section 27 10 00.

2.3 HDBaseT Extenders (HDMI Over Cat6)

2.3.1 Basis of Design: C2G 29269 kit.

3. EXECUTION

3.1 Installation

3.1.1 Install all components as directed by manufacturer's representative, and installation instructions.

3.2 Field Quality Control

3.2.1 Manufacturer's Services

.1 Test operation of equipment under supervision of Manufacturer's representative.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Table boxes for power, communications and A/V connectivity.
1.1.2 Cable retractors.
1.1.3 Under table cable management kit.
1.1.4 Transition channel.

1.2 Related Requirements

1.2.1 Division 26 - Electrical: Electrical systems and components.
1.2.2 Division 27 - Communications: Communications and audio-video systems and components.
1.2.3 Division 28 - Electronic Safety and Security: Security systems and components.

1.3 Submittals

1.3.1 Submit under provisions of Section 01 33 00.
1.3.2 Product Data: Submit for table boxes, cable retractors, under table cable management, and transition channel.
1.3.3 Samples: Submit three (3) with required color and finish. Show standard color ranges available.

1.4 Quality Assurance

1.4.1 Manufacturer Qualifications: Firms regularly engaged in manufacture of electrical table boxes, fittings, cable retractors, under table cable management, and transition channel of the types and sizes required, whose products have been in satisfactory use in similar service for not less than 10 years. Provide electrical table boxes, fittings, cable retractors, under table cable management kit, and transition channel produced by a manufacturer listed in this section.
1.4.2 Source Limitations: Obtain each type of table box, fitting, cable retractor, under table cable management kit, and transition channel through one (1) source from a single manufacturer.
1.4.3 Electrical Boxes and Fittings: Comply with requirements of applicable local codes, NEC, UL, ETL, and NEMA Standards pertaining to boxes and fittings.

1.5 Delivery, Storage, and Handling

1.5.1 Deliver table boxes, fittings, cable retractors, under table cable management kits, and transition channels in factory labeled packages.
1.5.2 Store and handle in strict compliance with manufacturer's written instructions and recommendations.
1.5.3 Protect from damage due to weather, excessive temperature, and construction operations.

2. PRODUCTS

2.1 Manufacturers

2.1.1 Basis-of-Design Product: The design for table boxes, fittings, cable retractors, under table cable management kits, and transition channels is based on InteGreat products manufactured by Legrand/Wiremold.
2.1.2 Alternate manufacturers:
.1 Crestron.
.2 Approved equal.

2.2 Table Boxes

2.2.1 Classification and Use: Table boxes shall be cETLus listed furniture power distribution units.
2.2.2 Table Boxes, General: InteGreat A/V Table Boxes shall provide convenience outlets for power, data and A/V services.
.1 Table Boxes are designed to fit together with other InteGreat products providing cable protection and organization.

2.2.3 Table Boxes: InteGreat A/V Table Boxes Catalog No TB672APBK.

.1 Cover: Brushed, anodized aluminum cover in a black finish with beveled edges and "soft-touch" handle.

.1 Cover contains a "pocket" door which fully recesses into the box when open, giving access to connections without obstructing work surface. A finishing plate hides hardware on activation surface and permits labeling of the AVIP plates.

.2 Cover flange allows for 6.4 mm (1/4 inch) of forgiveness in the cut out opening.

.2 Activation Surface: Adjustable downward in 12.7 mm (1/2-inch) increments, from one 25 mm (1 inch) to 102 mm (4 inch) to allow cover to close even when large style connectors are used.

.3 Provide table boxes with a 12 foot SJT cord for easy connection to electrical infrastructure.

.4 Supply tables boxes with a cable grommet kit that can accommodate up to eight pull out connections. Boxes shall also be capable of accepting up to five Wiremold AVIP or Extron MAAP connectors.

.5 Provide table boxes with two 15 amp receptacles in top compartment and one 15 amp receptacle on underside of box.

2.3 Cable Retractors

2.3.1 Cable Retractors: InteGreat Series cable retractors; mounts directly to InteGreat Series A/V Table Box or underside of conference room table using a horizontal mounting bracket.

.1 Cable Retractors with Category 6 Cable: Catalog No. TBCRCAT6; loaded with 3660 mm (12 feet) of Cat6 cable that extends out 1520 mm (5 feet) from retractor. Supply retractor with a female input from building infrastructure and a male connector on the output side.

.2 Cable Retractors with VGA Cable: Catalog No. TBCRVGA; loaded 3660 mm (12 feet) of VGA cable that extends out 1520 mm (5 feet) from retractor. Supply retractor with a female input from building infrastructure and a male connector on the output side.

.3 Cable Retractors with HDMI Cable: Catalog No. TBCRHDMI; loaded with 3660 mm (12 feet) of HDMI cable that extends out 1520 mm (5 feet) from retractor. Supply retractor with a female input from building infrastructure and a male connector on the output side. Provide input side with mounting tab that allows installer to cable tie HDMI to retractor to minimize chances of loose connections.

.4 Cable Retractors with 3.5 mm Audio Cable: Catalog No. TBCR3.5 mm; loaded with 3660 mm (12 feet) of audio cable that extends out 1520 mm (5 feet) from retractor. Supply retractor with a female input from building infrastructure and a male connector on the output side.

2.3.2 Cable Retractor Horizontal Mounting Brackets: Catalog No. TBCRHMK; permits retractor to mount horizontally under conference room table, enabling cable access through a table grommet. Multiple retractors can be mounted to each other by attaching the mounting brackets to each other.

2.4 Under Table Cable Management Kit

2.4.1 Under Table Cable Management Kit: InteGreat Series under table cable management kit provides clean cable management for power, communication and A/V cables on horizontal underside of table.

.1 Under Table Cable Management Kit: Catalog No. UTCM5; includes 1524 mm (5 feet) length of divided base, 1524 mm (5 feet) length of mounting hinge rail and four latching clips; black, non-metallic construction.

2.5 **Transition Channels**

2.5.1 Transition Channels: InteGreat Series transition channels continue cable management and protection from underside of the table to the floor, where cables can gain access to building infrastructure. Channel fits directly into under table cable management kit on underside of table and mates with poke-thru device or over floor raceway for smooth transition to building infrastructure.

.1 Transition Channels: Catalog No. MRTC; consists of aluminum center spline with steel mounting plate and four (4) screws, black aluminum side channels, black non-metallic bottom boot and two (2) black non-metallic transition covers.

3. EXECUTION

3.1 **Examination**

3.1.1 Examine conditions under which table boxes, cable retractors, under table cable management kit, and transition channels are to be installed. Notify the Consultant in writing of conditions detrimental to proper completion of the work. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 **Installation**

3.2.1 Strictly comply with manufacturer's installation instructions and recommendations. Coordinate installation with adjacent work to ensure proper clearances and to prevent electrical hazards.

3.3 **Cleaning and Protection**

3.3.1 Clean exposed surfaces using non-abrasive materials and methods recommended by manufacturer.

3.3.2 Protect products until acceptance.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Customer service queuing system.

1.2 Related Requirements

1.2.1 Section 27 05 13.43 – Cable Services.
1.2.2 Section 27 10 00 – Structured Cabling.
1.2.3 Section 27 16 16 – Communications Media Converters, Adapters, and Transceivers.

1.3 Alternates

1.3.1 Alternate price to provide one additional ticket printer.

1.4 Administrative Requirements

1.4.1 Pre-installation Meetings
.1 Contractor to arrange for meeting with Manufacturer's representative prior to start of installation to confirm site specific installation requirements.
.2 Coordinate with all other systems being installed on same wall mounted backboard in the IT room.

1.5 Informational Submittals

1.5.1 Coordinate with Owner for manufacturer's submittal package, including:
.1 Cut sheets of all components.
.2 Installation instructions.

1.6 Closeout Submittals

1.6.1 Operation and Maintenance Data
.1 Instruction manuals.
1.6.2 Record Documentation
.1 Record as-installed pathways and cable routing.
1.6.3 Maintenance Contracts
.1 The Owner has an existing maintenance Contract with Qmatic.
1.6.4 Software
.1 Provide all software and licencing as required for the complete system.

1.7 Delivery, Storage, and Handling

1.7.1 Delivery and Acceptance Requirements
.1 Contractor to receive equipment delivered to site, move into final position, uncrate, and install as directed by the manufacturer.

2. PRODUCTS

2.1 Manufacturers

2.1.1 QMatic, represented in Canada by Trica CXM Solutions Ltd.
2.1.2 No alternates (match Owner's existing system).

2.2 System Components

2.2.1 Wall mounted central control equipment ("Hub").
2.2.2 Display panels ("Now Serving").
2.2.3 Media player: takes HDMI input from TV receiver and overlays "Now Serving" data, including HDBaseT converters.
2.2.4 One (1) ticket printer. Refer to article ALTERNATES for second ticket printer.
2.2.5 Rack mounted server and workstation software.
2.2.6 HDMI to HDBaseT Extender Kit (transmitter and receiver).

2.3 **Components supplied by Owner, for installation by Contractor:**

2.3.1 Wall mounted television for APT Waiting Area, room 253-3, including wall mount bracket.

2.4 **System Cabling**

2.4.1 HDMI Patch Cords to Section 27 16 16.

2.4.2 Category 6 UTP cabling to Section 27 10 00.

2.4.3 Cabling from hub to workstation displays category 3 UTP c/w RJ-11 connectors.

2.5 **Operation Sequence**

2.5.1 Upon entry at Reception, room 253-2, the customer checks in at reception. The reception representative completes the check-in procedure, and prints a service ticket from the ticket printer for the customer.

2.5.2 The customer waits in the waiting area, where the television will show Owner selected programming (typically CP24 or other news programming). The queuing system overlays the "now serving" data.

2.5.3 When the customer service agent in the APT Hearing Area, room 253.-4, is available to serve the next customer, they use the software interface installed at that workstation/service wicket to indicate availability. The queuing system will then indicate the "now serving" ticket number on the television screen in the waiting area, and will display the ticket number on the corresponding display panel mounted above that workstation/service wicket.

3. EXECUTION

3.1 **Examination**

3.1.1 Verification of Conditions

.1 Verity underlying conditions are prepared for installation of this system:

.1 Wall mount backboard installed in IT room for installation of Qmatic hub.

.2 Data outlets from local area network.

.3 Power receptacles.

.4 Cable TV service: ensure service is operational.

3.2 **Installation**

3.2.1 Install all components as directed by manufacturer's representative, and installation instructions.

3.2.2 Interface with Other Work.

.1 Connect media player to TV service supplied under Section 27 05 13.43.

3.3 **Field Quality Control**

3.3.1 Manufacturer's Services

.1 Test operation of equipment under supervision of Manufacturer's representative.

3.4 **Systems Startup**

3.4.1 Contractor to be present during manufacturer's startup session to provide troubleshooting and cabling adjustments on installation.

3.5 **Closeout Activities**

3.5.1 Contractor to be present during manufacturer's Demonstration and Training session.

3.5.2 Contractor to include two training sessions of minimum 2 hours duration.

END OF SECTION

1. GENERAL

1.1 Summary

1.1.1 Furnish and install a complete new Time Synchronization System using the Primex Wireless XR Time Synchronization System.

1.1.2 Furnish and install all system equipment, devices, accessories, and material in accordance with these specifications and drawing to provide a complete and operating system.

1.1.3 All bids shall be based on the equipment as specified herein. The model designations are that of Primex Wireless, Inc. The specifying authority must approve any alternate system.

1.2 Section Includes

1.2.1 Transmitter (Master).

1.2.2 GPS Receiver.

1.2.3 Digital Clocks.

1.3 Related Requirements

1.3.1 Section 26 27 26 – Wiring Devices: 120 volt grounded outlet required for transmitter and for digital clocks.

1.4 References

1.4.1 Internet Engineering Task Force (IETF)

.1 Network Time Protocol Version 4: Protocol and Algorithms Specification.

1.5 Definitions

1.5.1 GPS: Global Positioning System, a worldwide system that employs a constellation of satellites in an integrated network to determine geographic location anywhere in the world, and which employs and transmits Universal Coordinated Time, the world's most accurate and reliable time.

1.5.2 NTP: Network Time Protocol, used for synchronizing the clocks on computer networks and devices from either a public server or a separate server on a private local area network.

1.5.3 UTC: Universal Coordinated Time

1.6 System Description

1.6.1 System shall continually wirelessly synchronize clocks and/or timers, and shall be capable of clock readouts in multiple time zones where desired.

1.6.2 System shall operate on a 72 MHz frequency. The 72 MHz frequency transmitter efficiently sends time synchronization signals through commercial building materials to ensure all devices receive important time updates, even for Daylight Saving Time and after a power outage.

1.6.3 The system transmitters can be configured with a variety of power output levels to provide coverage for a single building or an entire campus.

1.6.4 The system supports an Industry Canada license for operation of a 72 MHz transmitter result in safe and interference free operation for users.

1.6.5 System provides wireless time from a master time source. This time source will either be the clock from a defined NTP server that the XR transmitter can access via the customer Local Area Network (LAN). In future, the Owner can also use the atomic clock on the GPS system as the time source. The master time will be synchronized to UTC.

1.6.6 Hard wiring for data communication will not be required to the clocks installed for the system.

1.6.7 Clocks automatically adjust for Daylight Saving Time in locations where DST is observed.

1.6.8 Each clock and/or timer and every other component in the system shall use both precise time and synchronized time.

1.6.9 Digital clocks shall be synchronized to within 10 milliseconds every 10 minutes and the system shall have an internal oscillator that maintains plus or minus four seconds per day between synchronization, so that clock accuracy shall not exceed plus or minus 0.2 seconds.

1.6.10 The system shall include an internal clock reference so that failure to detect the master time source shall not result in the clocks failing to indicate time. Additionally, XR transmitters will have an internal battery backup of up to eight hours in the event of a power failure so that settings and the correct master time will be instantly recalled upon restoration of power.

1.6.11 System shall incorporate a "fail-safe" design so that failure of any component shall not cause failure of the system. Upon restoration of power or repair of failed component, the system shall resume normal operation without the need to reset the system or any component thereof.

1.6.12 If transmitter stops transmitting valid time signals due to power failure, the clocks will continue to function as accurate quartz clocks until a valid time signal is decoded. Should the clocks lose power and signal, the clocks will not function.

1.6.13 Clock locations shall be as indicated and clocks shall be fully portable, capable of being relocated at any time.

1.6.14 The system must operate in accordance with a "Technical Acceptance Certificate" issued under the authority of Industry Canada and the Ministry of Industry. This license will be granted to and held by the end user.

1.7 **Regulatory Requirements**

1.7.1 Equipment and components furnished shall be of manufacturer latest model.

1.7.2 System shall be installed in compliance with local and state authorities having jurisdiction.

1.7.3 The end user will hold a license, known as a "Non Complex Fixed Station" Radio License granted by Industry Canada and the Ministry of Industry. This license grants the end user protected use for wireless transmission at the designated frequency.

1.7.4 IC-2365: Application for "License to Install and Operate a Radio Station in Canada" must be completed and signed by end user prior to license issuance. The end user will grant permission for Primex Wireless to apply for the license on their behalf. Primex Wireless will provide all documents and technical information to Industry Canada for approval. This license will designate a unique "call sign" for each end user.

1.7.5 Transmitter and receiver shall comply with RSS 119 of Issue 6 of Industry Canada specifications as follows: This device may not cause harmful interference, and this device must accept interference received, including interference that may cause undesired operation. Transmitter frequency shall be governed by IC: RSS119 Issue 6. Transmitter output power shall be governed by IC: RSS119 Issue 6.

1.8 **Submittals**

1.8.1 Product Data: Submit complete catalog data for each component, describing physical characteristics and method of installation. Submit brochure showing available colors, styles, sizes, and finishes of clocks.

1.8.2 Samples: Submit one specified system device model(s) for approval. Approved sample(s) shall be tagged and shall be installed in the work at location directed.

1.8.3 Manufacturer Instructions: Submit complete installation, set-up and maintenance instructions.

1.8.4 Floor plans indicating the location of system transmitter(s), approved by manufacturer, will be submitted to owner prior to installation.

1.8.5 Submit Industry Canada Technical Acceptance Certificate prior to installing equipment. Furnish the license or a copy of the application for the license, to the Owner/End User prior to operating the equipment. The original license must be delivered to the Owner/End User.

1.9 **Quality Assurance**

1.9.1 IC-2365: Application for "License to Install and Operate a Radio Station in Canada" must be completed and signed by end user prior to license issuance.

1.9.2 Qualifications: Manufacturer: Company specializing in manufacturing commercial time system products with a minimum of 30 continuous years of documented experience including 10 or more years of experience producing GPS wireless time systems.

1.9.3 Installer: Company with documented experience in the installation of commercial time systems.

1.9.4 Prior to installation a site survey must be performed to determine proper transmitter placement.

1.10 **Delivery, Storage, and Handling**

1.10.1 Deliver all components to the site in the manufacturer original packaging.

1.10.2 Include manufacturer name and address, product identification number, and other related information in packaging.

1.10.3 Store equipment in finished building, unopened containers until ready for installation.

1.11 **Project Site Conditions**

1.11.1 Commence installation after painting and other finish work in each room is complete.

1.12 **System Startup**

1.12.1 At completion of installation and prior to final acceptance, turn on the equipment; ensure that all equipment is operating properly, and that all system devices and components are functioning.

1.13 **Warranty**

1.13.1 Manufacturer will provide a two year warranty on all components.

1.13.2 Manufacturer offers a two, three, or five-year extended transmitter warranty.

1.13.3 Manufacturer offers a five-year extended clock warranty.

1.13.4 Manufacturer offers an extended warranty on system devices.

2. PRODUCTS

2.1 **Manufacturers**

2.1.1 Primex Wireless, Inc., 965 Wells Street, Lake Geneva, WI 53147.

.1 Phone: (800) 537-0464 | Fax: (262) 248-0061 | Email: info@primxinc.com | www.primexinc.com.

2.1.2 Substitutions: None permitted. Owner's standard.

2.2 **Sequence of Operation**

2.2.1 Configure and install system appliance detailed in manufacturer installation instructions.

2.2.2 Configure and install system devices per model specifications detailed in manufacturer installation instructions.

2.2.3 Transmitter Operation

.1 When power is first applied to the transmitter, it checks for and displays the software version. It then checks the position of the switches and stores their position in memory. The transmitter looks for the master time source.

2.2.4 Master Time Source Operation

.1 NTP Time Source: With the transmitter in NTP mode, it connects over the Ethernet to the IP address of the NTP server. This IP address is programmed into the transmitter as part of its configuration. Once the connection to the NTP server is acknowledged, it downloads time data and synchronizes its internal master clock to NTP time. The transmitter then starts to transmit its internal time once every second. The transmitter updates its internal clock in this mode once per hour.

2.2.5 Clock and/or Timer Operation

.1 After initial setup, the clock and/or timer will shut off the receiver. Six times each day an Analog Clock microprocessor will activate the receiver and starting with the stored channel it will again look for a valid time signal. Every 10 minutes a Digital Clock/Timer will activate the receiver and starting with the stored channel it will again look for a valid time signal. If necessary, the clocks will resynchronize to the correct time.

.2 If a Digital Clock/Timer has not decoded a valid time signal for a pre-determined number of days, the display colon indicator will flash continuously until a valid time signal is received.

2.3 **Transmitter Equipment**

2.3.1 1 Watt Transmitter, 49 channel, Internal Antenna, NTP and GPS Time Source:

Parameter	Specification
Transmission Frequency Ranges	72.020 Mhz to 72.980 MHz
Maximum Transmission	1 watt (30 dBm) maximum at transmitter
Radio Technology	Narrowband FM
Channel Bandwidth	20 kHz maximum
Transition Mode	One-way communication
Data Rate	2 KBps
Operating Range	32°F - 122°F (0° - 50°C)
Transmitter output power	+26 to +30 dBm
Frequency Deviation	+/- 4 kHz
Power	120 VAC 60 Hz
Internal Power	5 VDC
Carrier Frequency Stability	+/- 20 ppm
Channels	49 selectable channels to assure interference-free reception
Housing/Enclosure	Transmitter housing shall be black metal case, 40.64 cm W x 4.52 cm H x 30.48 cm D (16"W x 1 7/8" H x 12" D)
Power Supply	Power supply (included): Input: 120 volt AC 50/60 Hz, 0.6 amps Output: 9 volt DC
Internal Antenna Model	Internal antennal: 116.8 cm (46.0 inch) long, weight: 3.1 kg (7 lbs).

2.3.2 Internal Antenna Model only: Transmitter shall transmit time continuously to all clocks in the system.

2.3.3 Internal clock: Transmitter shall contain an internal clock such that failure to update time from source will not disable the operation of the clocks.

2.3.4 Transmitter shall include a surge suppressor/battery backup and a mounting shelf.

2.3.5 Transmitter shall have the following switches

.1 Time zone adjustment switches for all time zones in the world. Includes: Eastern, Central, Mountain, Pacific, Alaska, and Hawaii.

.2 Switch to allow the following configuration: Daylight Saving Time bypass option, 12-hour or 24-hour display, GPS or NTP time source, Local or LAN configuration, UTC+ or UTC-, 30 minute UTC offset option CANADA (for Newfoundland).

2.3.6 Incorporate a display in the transmitter housing, including the following:

.1 Time readout.

.2 AM and PM indicator if 12-hour time display is set.

.3 Day and date readout.

.4 Time zone indicator including Standard or Daylight Savings Time.

.5 On screen menu to verify diagnostics, errors, time updates, and switch settings, toggled by sequence of push buttons next to display.

.6 Status LEDs: The LED signal indicator consists of three visual LEDs that indicate the status of the transmitter. The green LED indicates one of the three statuses, including (1) solid green: transmitter is transmitting, (2) not illuminated: transmitter has not received an initial time signal after power up and/or reset, and (3) flashing: transmitter is not broadcasting due to standby mode or there is a condition that is causing the transmitter not to broadcast properly. The yellow LED indicates one of the two statuses, including (1) not illuminated: no warning conditions, (2) flashing: transmitter has not received a time update for 48 hours or a 1PPS (one pulse per second) has not

been detected within the last 48 hours. The red LED indicates one status, (1) solid red: defined error condition exists.

2.3.7 NTP or GPS Time Source

.1 Transmitter will allow for either NTP time input or GPS satellite time input with use of a GPS Receiver unit.

.2 Unit shall obtain current time from either satellite via GPS or via NTP through an Ethernet port.

2.3.8 GPS Receiver (Supply Only).

.1 GPS roof mounted with 5 m (16 foot) cable attached. The GPS Receiver shall be a complete GPS receiver including antenna in a waterproof case, designed for roof or outdoor mounting. Supply mounting bracket for attachment to roof structure.

.2 An extension cable is available from the manufacturer, including either a 15.25 m (50 foot), 30.5 m (100 foot), or 61 m (200 foot), which will be purchased separately by the Owner if required.

.3 The GPS Receiver cable must be plenum rated where required by local code.

2.3.9 Transmitter Rack

.1 Transmitter rack, 76.2 mm (3 inch) x 419 mm (16.5 inch) x 457 mm (18") gauge metal, epoxy covered, will be supplied.

2.4 Digital Clocks

2.4.1 Digital Clock must be able to receive synchronized time signal from the master or satellite transmitter.

2.4.2 Digital Clock display must include a 12 or 24-hour time display, a PM indicator light, and an alternating time and date display option.

2.4.3 Wall surface-mount models are available from the manufacturer. Alternate Flush and Dual mount models also available.

2.4.4 Capable of automatically adjusting for Daylight Saving Time.

2.4.5 Have either a 120 VAC power supply built into the clock assembly.

2.4.6 120 VAC Digital Timer will include a power cord with a plug or a cord with pigtail.

2.4.7 Viewable from 45.7 m (150 feet) with highly visible 7-segment LED digits, and three display dimmer options, 75%, 50%, and 25%.

2.4.8 Digital Clock LED colors, sizes, digit layouts, and mount options are available from the manufacturer.

2.4.9 Supply Models

.1 Surface-Mount Models with 100 mm (4 inch) digits

Description	Note	Model
4 degree slope Bracket, 3.0 m (10 foot) cord with plug	4-Digit	XRA7A201

.2 Dual clock bracket kit: provides ability to mount one clock or two clocks back to back:

Description	Model
Ceiling mount bracket for 100 mm (4 inch), 4-digit clocks	4XBRK

3. EXECUTION

3.1 Examination

3.1.1 Examine conditions with the Installer present for compliance with requirements and other conditions affecting the performance of the system and the system devices.

3.1.2 Arrange for a site survey to be performed by the manufacturer, or manufacturer's certified installation company.

3.1.3 Do not proceed until unsatisfactory conditions have been corrected.

3.1.4 Verify that construction is complete in spaces to receive equipment and that rooms are clean and dry.

3.1.5 Verify that 120 volt electrical outlet is located within 1.83 m (6 feet) of location of transmitter and the outlet is operational and properly grounded.

3.1.6 AC-powered devices: Verify that electrical power outlet is near location of clock or timer and the outlet is operational and properly grounded.

3.1.7 Verify that the network drop used to connect the XR transmitter has connectivity to the NTP server, which can be verified by the Owner's Information Technology department manager.

.1 The default NTP address is time.nist.gov. Confirm with the Owner if their network has a different NTP IP address. If so, program this address into the transmitter to allow connection to the proper network time.

3.2 Installation

3.2.1 General:

.1 Install system in accordance with applicable codes.

.2 Install system equipment in accordance with manufacturer written instructions.

.3 Provide all system equipment necessary for a complete and operable system.

3.2.2 NTP Master Time Source:

.1 Connect CAT5/CAT5e/CAT6 EIA/TIA standard Ethernet cable from transmitter LAN port to available network drop.

.2 Set GPS/LAN DIP switch to NTP.

3.2.3 Transmitter (Internal Antenna):

.1 Locate transmitter where indicated, a minimum of 0.6 m to 1 m (2 feet to 3 feet) above the floor, away from large metal objects such as filing cabinets, lockers or metal framed walls.

.2 Transmitter(s) will be placed at locations indicated within specifications and drawings.

.3 Connect antenna to transmitter, using care not to strip threads.

.4 Connect power supply to the transmitter.

.5 Set the channel number on the display to correspond to the Industry Canada license.

.6 Plug power supply into electrical outlet.

3.2.4 Digital Clocks:

.1 Cable routing must comply with ANSI EIA/TIA- 569-A and local building codes.

.2 Furnish all equipment necessary for a complete and operational system.

.3 Perform the following operations with each clock:

.1 Configure and set clock to correct time in accordance with manufacturer instructions.

.2 Observe clock until valid signals are received and clock adjusts itself to correct time.

.3 Install each clock per its model mounting specifications per manufacturer instructions and mounting instructions at the indicated location.

.4 Field modify supplied power cord to suit desired length.

3.3 Field Inspection

3.3.1 Inspection: Make observations to verify that system devices and components are properly labeled.

3.3.2 Prior to final acceptance, inspect each system device and component, adjust as required, and replace parts which are found defective.

3.4 Manufacturer Services

3.4.1 If needed, provide technical assistance as demonstrated in the manufacturer guides, on product start-up and system setup, to owners or installers representatives via phone, fax, or email.

3.4.2 Installation and user guides shall be provided.

3.5 Cleaning

3.5.1 Prior to final acceptance, clean exposed surfaces of devices, using cleaning methods recommended by manufacturer.

3.5.2 Remove temporary labels from clock faces. Do not remove labels from backs of clocks.

3.6 **Demonstration**

3.6.1 Provide training to Owner's representative on setting, adjusting and configuring device and routine maintenance.

3.6.2 Provide training to Owner's representative on installing the software, adjusting and programming the transmitter, setting and adjusting system devices and routine maintenance.

3.7 **Protection**

3.7.1 Protect finished installation until final acceptance of the project.

3.8 **Testing**

3.8.1 All devices must be tested at their operational location under normal operational conditions to assure reception of signal.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Modifications to existing fire alarm system, including provision of new zones as indicated, relocating and new fire alarm devices as indicated on the drawings, and system verification to the appropriate codes and standards. Complete systems shall be left ready for continuous and efficient satisfactory operation.

1.1.2 Update annunciators to include additions and renovated areas, as applicable.

1.1.3 New devices connected directly to the existing fire alarm system shall of the manufacturer's current product selection, and to match the existing system.

1.1.4 Verify system upon completion of installation and submit verification report to the Consultant with close-out documents and as-built drawings.

1.2 Related Requirements

1.2.1 Section 26 05 33.13 – Conduit for Electrical Systems.

1.2.2 Section 26 05 33.16 – Boxes for Electrical Systems.

1.2.3 Section 26 05 33.23 – Surface Raceways for Electrical Systems.

1.2.4 Latest fire alarm verification report.

1.3 References

1.3.1 The publications listed below form a part of this specification. The publications are referenced in text by the basic designation only. Comply with latest edition/amendment referenced Code/Publication.

.1 Ontario Building Code.

.2 Ontario Fire Code.

.3 ULC-S524 Installation of Fire Alarm Systems.

.4 ULC-S537 Verification of Fire Alarm Systems.

.5 Ontario Electrical Safety Code.

.6 All requirements of the Authority Having Jurisdiction (AHJ).

1.4 Submittals

1.4.1 Provide submittals to the Consultant for review in accordance with Section 01 33 00.

1.4.2 Submit to the Fire Department, drawings showing bells, manual pull stations, complete wiring diagrams and annunciator details and obtain their approval.

1.4.3 All references to manufacturer's model numbers and other pertinent information herein is intended to establish minimum standards of performance, function and quality.

1.4.4 Shop Drawings

.1 Include sufficient information, clearly presented, to determine compliance with drawings and specifications.

.2 Include manufacturer's name(s), model numbers, ratings, power requirements, equipment layout, and device arrangement.

.3 Show annunciator layout and main control panel module layout, configurations and terminations.

.4 Show device layout, complete riser diagram, and auxiliary functions.

.5 The supplier of the system shall prepare a complete zoning schedule and artwork layout for active graphic to be included with submittal package.

1.4.5 Manuals

.1 Submit complete operating and maintenance manuals listing the manufacturer's name(s) including technical data sheets (with model numbers to be used indicated).

.2 Wiring diagrams indicating terminals and the interconnections between the items of equipment.

.3 Provide a clear and concise description of operation which gives, in detail, the information required to properly operate the equipment.

1.5 **Quality Assurance**

1.5.1 Approvals

.1 The system shall have proper listing and/or approval from the following nationally recognized agencies:

.1 FM Factory Mutual.

.2 UL Underwriters Laboratories Inc.

.3 ULC Underwriters Laboratories Canada.

.2 The fire alarm control, panel shall meet the modular listing requirements of ULC. Each subassembly of the FACP, including all printed circuit boards, shall include the appropriate ULC modular label.

1.5.2 Fire alarm shall conform to the Building Code, Ontario Regulations 925/75 and as amended subsequently.

1.5.3 Fire alarm system installation shall conform to ULC Standard S524-M, latest edition.

1.5.4 All devices/components shall be suitable for the locations, environment, temperatures in which they are to be installed.

1.5.5 The fire alarm system shall be manufactured by an ISO 9001 certified company and meet the requirements of BS EN9001: ANSI/ASQC Q9001-1994.

1.5.6 The FACP and peripheral devices shall be manufactured 100% by a single manufacturer (or division thereof).

1.6 **Warranty**

1.6.1 All work performed and all material and equipment furnished under this contract shall be free from defects and shall remain so for a period of at least two years from the date of acceptance.

2. **PRODUCTS**

2.1 **Existing Systems**

2.1.1 The existing Fire Alarm System is as indicated on drawings.

.1 The location of the Fire Alarm Control Panel is as indicated on the drawings.

.2 There are no passive graphic annunciators to be updated.

2.2 **Manufacturers**

2.2.1 The system components shall be selected so as to match and be compatible with the existing Fire Alarm System.

2.3 **Equipment and Material, General**

2.3.1 Review latest verification report, and review existing system during tender walkthrough and note all required modifications.

2.3.2 All equipment and components shall be new, and the manufacturer's current model.

2.3.3 All equipment and components shall be installed in strict compliance with manufacturers' recommendations.

2.3.4 All Equipment shall be attached to walls and ceiling/floor assemblies and shall be held firmly in place. (e.g., detectors shall not be supported solely by suspended ceilings). Fasteners and supports shall be adequate to support the required load.

2.4 **Conduit and Wire**

2.4.1 Existing conventional zone wiring is existing to remain.

2.4.2 Conduit

.1 Conduit shall be in accordance with the Electrical Safety Authority (ESA), local and provincial requirements.

.2 All wiring shall be installed in conduit or raceway to Section 26 05 33.13 and Section 26 05 33.23.

2.4.3 Wire

.1 All fire alarm system wiring to suit new devices shall be new.

.2 Wiring shall be in accordance with local, provincial and national codes and as recommended by the manufacturer of the fire alarm system. Number and size of conductors shall be as outlined in the Ontario Electrical Safety Code and as recommended by the fire alarm system manufacturer.

.3 All wire and cable shall be listed and/or approved by a recognized testing agency for use with a protective signalling system, as outlined in the Ontario Electrical Safety Code.

2.4.4 Terminal Boxes, Junction Boxes and Cabinets:

.1 All boxes and cabinets shall be listed for their purpose and use.

2.5 **Main Fire Alarm Control Panel**

2.5.1 Add new zones, zone modules, etc., for new work as required, and connect all new devices to Fire Alarm Control Panel.

3. EXECUTION

3.1 **Verification of Conditions**

3.1.1 Conduct an impedance test of initiation and signal circuits, and submit report to the Consultant. Report any discrepancies in circuit loading.

3.2 **Installation**

3.2.1 Install fire alarm system devices in accordance with specification, codes, and manufacturer's instructions.

3.2.2 Entire installation shall be done under supervision of manufacturer. Upon completion of installation, check entire system to approval and correct any malfunction immediately.

3.2.3 Align alarm devices and signals, where grouped together, one above the other.

3.2.4 Mount devices at the following heights unless otherwise shown:

.1 Signal devices:

.1 300 mm below finished ceiling

.2 2050 mm above floor in unfinished areas.

.2 Manual Pull Stations:

.1 1200 mm above finished floor level.

3.2.5 Test each automatic detector to ensure correct wiring and zoning by setting off its rate of rise component and sounding the bells or by ringing it out. Test each smoke detector, sprinkler system and standpipe valves to ensure correct wiring.

3.2.6 Manufacturer shall examine Drawings and Specifications prior to award of Contract to ensure that detectors, control panels and miscellaneous devices being supplied will provide a satisfactory working installation.

3.3 **Field Quality Control**

3.3.1 Testing and Verification

.1 Provide the service of a competent, factory trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system. All testing shall be in accordance with CAN/ULC S537.

.2 Check for correct connections and test for short circuits, ground faults, continuity, and insulation.

.3 Perform audibility test of space and provide annunciation devices to suit ambient sound levels. Ensure coverage for fire alarm signalling devices on base building fire alarm system. Provide audible test of signaling devices after other systems have been commissioned to verify operation at computer room ambient sound level.

.4 Provide the service of a competent, factory-trained engineer or technician authorized by the manufacturer of the fire alarm equipment to technically supervise and participate during all of the adjustments and tests for the system.

.5 All initial testing shall be in accordance with CAN/ULC-S537. A representative of the electrical contractor shall be present to participate and assist the manufacturer representative during the course of the verification. The electrical contractor shall make good any deficiencies discovered during the verification. All devices, new and existing, shall be verified. The electrical contractor shall provide one person for assistance with the verification.

.6 Include associated costs in Tender Price.

.7 Carry out a complete audibility test and submit report.

.8 On completion of the verification the manufacturer shall supply a certificate, together with detailed inspection record sheets showing location of each device and certifying the test results per unit, confirming that the system is installed, supervised and operational.

3.3.2 Manufacturer Services

.1 The manufacturer(s) of the fire alarm shall make a complete inspection of all existing and new components installed for system(s), such as manual stations, horns, and annunciators and sprinkler and standpipe valves and smoke detectors to ensure the following:

.1 That the system is complete in accordance with Specifications.

.2 That the system is connected according to ULC requirements.

.3 That the system is connected in accordance with the Manufacturer's recommendations.

.4 That the regulations concerning the supervision of components have been adhered to (e.g. stations, detectors, supervised valves, bells), and are properly wired and supervised.

.5 That all valves are properly connected and displayed correctly on each annunciator.

.6 That any subsequent changes necessary to conform to the above will be carried out with technical advice supplied by the Manufacturer.

.7 That all thermal detectors, smoke detectors and manual pull stations have been operated and are in good working order.

.8 That all sprinkler system and standpipe system valves have been operated and are in good working order.

.9 That all annunciators correctly pin-point the origin of any fire alarm.

.10 That actual smoke concentration of sufficient density, have been applied to each smoke detector to cause the detector to be set off and that the sensitivity of each smoke detector has been set.

.11 That all existing devices are in good working order. Include for replacement of any defective/damaged devices at no extra cost to Owner.

.12 That signal audibility is acceptable in all areas. Submit audibility readings for every room.

.1 If existing audible signal devices have been discontinued by the manufacturer (for example mechanical horns), allow for replacement of all audible devices so that all devices generate similar sounds and sound patterns when activated.

3.4 **Demonstration**

3.4.1 At the final inspection a factory trained representative of the manufacturer of the major equipment shall demonstrate that the systems function properly in every respect.

3.5 **Training**

3.5.1 Provide instruction as required to the building personnel and fire and safety personnel. "Hands-on" demonstrations of the operation of the system shall be provided.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Duress Buttons

1.2 Related Requirements

1.2.1 Door hardware schedule.

1.2.2 Section 08 71 00 – Hardware.

1.2.3 Appendix E3 - City of Toronto Corporate Security Access Control System Installation and System Requirements, Revision 1.2, 2014-Aug-13.

.1 The requirements of this Appendix form a part of this Section.

1.3 Submittals

1.3.1 To Section 01 33 00.

2. PRODUCTS

2.1 Access Control Devices

2.1.1 In accordance with Appendix E3.

2.2 Wiring

2.2.1 Installed in conduit in accordance with Appendix E3.

3. EXECUTION

3.1 Installation

3.1.1 In accordance with Appendix E3.

3.1.2 Connect to iStar system as described in Appendix E3.

END OF SECTION

1. GENERAL

1.1 Related Requirements

1.1.1 Section 27 10 00 – Structured Cabling.

1.2 References

1.2.1 Canadian Standards Association (CSA):

.1 CSA C22.2 No.60950-1-07, (R2012) - Information Technology Equipment - Safety – Part 1: General Requirements (Bi-National standard, with UL 60950-1)

1.2.2 Institute of Electrical and Electronics Engineers (IEEE)

.1 IEEE 802.3af-2003 – Power over Ethernet (12.95 W).

.2 IEEE 802.3at-2009 – Power over Ethernet Enhancements (25.5 W).

1.2.3 Underwriters Laboratories of Canada (ULC):

.1 ULC-S317-1996, Installation and Classification of Closed Circuit Video Equipment (CCVC) Systems for Institutional and Commercial Security Systems.

1.3 Submittals

1.3.1 Submit in accordance with Section 01 33 00.

1.3.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for video surveillance equipment and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit:

.1 Functional description of equipment.

.2 Technical data sheets of all devices.

.3 Device location plans and cable lists.

.4 Video camera surveillance chart.

.5 Video interconnection detail drawings.

1.3.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.2 Submit shop drawings to indicate project layout, camera locations, point-to-point diagrams, cable schematics, risers, mounting details and identification labeling scheme.

.3 Submit zone layout drawings indicating number and location of zones and areas covered.

1.3.4 Samples:

.1 Submit for review and acceptance of each unit.

.2 Samples will be returned for inclusion into work.

.3 Submit 1 sample of each camera selected complete with housing, brackets and mounting hardware.

.4 Camera will be returned for incorporation into work as appropriate.

1.3.5 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.

.1 Submit UL Product safety Certificates.

.2 Submit verification Certificate that video surveillance system is "Certified alarm system".

1.3.6 Test and Evaluation Reports:

.1 Submit certified test reports from approved independent testing laboratories indicating compliance with specifications for specified performance characteristics and physical properties.

1.3.7 Manufacturer's Instructions: submit manufacturer's installation instructions.

1.3.8 Manufacturer's Field Reports: submit manufacturer's written reports within 3 days of review, verifying compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

1.4 **Closeout Submittals**

1.4.1 Operation and Maintenance Data: submit maintenance data for incorporation into manual specified in Section 01 78 00. Include following:

.1 System configuration and equipment physical layout.

.2 Functional description of equipment.

.3 Manufacturer's Instructions for operation, adjustment and cleaning.

.4 Illustrations and diagrams to supplement procedures.

1.5 **Delivery, Storage, and Handling**

1.5.1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.

1.5.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

1.5.3 Storage and Handling Requirements:

.1 Store materials indoors and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect video surveillance materials from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

1.6 **Warranty**

1.6.1 Manufacturer's Warranty: submit, for Departmental Representative's acceptance, manufacturer's standard warranty document executed by authorized company official.

2. **PRODUCTS**

2.1 **Manufacturers**

2.1.1 Cameras

.1 Axis Communications.

2.1.2 Video Management System

.1 Milestone.

2.2 **IP Cameras**

2.2.1 Transmission Method: Internet Protocol (IP) over Unshielded Twisted Pair (UTP).

2.2.2 Axis Communications, P3707-PE 360 degree multisensory camera.

2.3 **Camera Power Supply**

2.3.1 Power supply for indoor camera and IR illuminator: Power over Ethernet (PoE) to IEEE 802.3af.

2.3.2 PoE switch by Owner.

2.4 **Network Video Recorder Server**

.1 Milestone Xprotect Corporate Device Channel License.

.2 One year SUP Milestone Xportect Corporate Device Channel License.

2.5 **Client Workstation**

2.5.1 By Owner.

3. **EXECUTION**

3.1 **Examination**

3.1.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for video surveillance installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Owner of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 **Installation**

3.2.1 Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheet.

3.2.2 Install video surveillance equipment and components in accordance with ULC-S317.

3.2.3 Install cable, boxes, mounting hardware, brackets, video cameras and system components in accordance with manufacturer's written installation instructions.

3.2.4 Install components secure, properly aligned and in locations shown on reviewed shop drawings.

3.2.5 Connect cameras to cabling in accordance with installation instructions.

3.2.6 Install ULC labels where required.

3.3 **Field Quality Control**

3.3.1 Manufacturer's Field Services:

.1 Obtain written reports from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product.

.2 Submit manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

.3 Schedule site visits to review Work at stages listed:

.1 After delivery and storage of products, and when preparatory Work, or other Work, on which the Work of this Section depends, is complete but before installation begins.

.2 Twice during progress of Work at 25% and 60% complete.

.3 Upon completion of Work, after cleaning is carried out.

3.4 **System Startup**

3.4.1 Perform verification inspections and test in the presence of Departmental Representative.

.1 Provide all necessary tools, ladders and equipment.

.2 Ensure appropriate subcontractors, and ·manufacturer's representatives and security specialists are present for verification.

3.4.2 Visual verification: objective is to assess quality of installation and assembly and overall appearance to ensure compliance with Contract Documents. Visual inspection to include:

.1 Sturdiness of equipment fastening.

.2 Non-existence of installation related damages.

.3 Compliance of device locations with reviewed shop drawings.

.4 Compatibility of equipment installation with physical environment.

.5 Inclusion of all accessories.

.6 Device and cabling identification.

.7 Application and location of ULC approval decals.

3.4.3 Technical verification: purpose to ensure that all systems and devices are properly installed and free of defects and damage. Technical verification includes:

.1 Measurements of tension and power.

.2 Connecting joints and equipment fastening.

.3 Measurements of signals (dB, lux, baud rate, etc).

.4 Compliance with manufacturer's specification, product literature and installation instructions.

3.4.4 Operational verification: purpose to ensure that devices and systems' performance meet or exceed established functional requirements. Operational verification includes:

.1 Operation of each device individually and within its environment.

.2 Operation of each device in relation with programmable schedule and or/specific functions.

.3 Operation control of camera lens, pan, tilt and zoom.

.4 Switching of camera to any monitor.

.5 Switching of system video recorder to selective monitor.
.6 Set dwell times.
.7 Demonstrate:
.1 Sequence viewing of cameras on each monitor.
.2 Bypass capability.
.3 Display of stored image to cardholder.

3.5 Adjusting

3.5.1 Remove protective coverings from cameras and components.
3.5.2 Adjust cameras for correct function.

3.6 Cleaning

3.6.1 Progress Cleaning: clean in accordance with Section 01 74 11.
.1 Leave Work area clean at end of each day.
3.6.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
.1 Clean camera housing, system components and lens, free from marks, packing tape, and finger prints, in accordance with manufacturer's written cleaning recommendations.
3.6.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 Protection

3.7.1 Protect installed products and components from damage during construction.
3.7.2 Repair damage to adjacent materials caused by video surveillance installation.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Motion Detectors

1.2 Related Requirements

1.2.1 Section 28 10 00 – Access Control.

1.2.2 Appendix E3 - City of Toronto Corporate Security Access Control System Installation and System Requirements, Revision 1.2, 2014-Aug-13.

.1 The requirements of this Appendix form a part of this Section.

1.3 Submittals

1.3.1 To Section 01 33 00.

2. PRODUCTS

2.1 Motion Detectors

2.1.1 As specified in Appendix E3.

2.2 Wiring

2.2.1 Installed in conduit in accordance with Appendix E3.

3. EXECUTION

3.1 Installation

3.1.1 In accordance with Appendix E3.

3.1.2 Connect to iStar system as described in Appendix E3.

END OF SECTION

1. GENERAL

1.1 Section Includes

1.1.1 Duress Buttons

1.2 Related Requirements

1.2.1 Appendix E3 - City of Toronto Corporate Security Access Control System Installation and System Requirements, Revision 1.2, 2014-Aug-13.

.1 The requirements of this Appendix form a part of this Section.

1.3 Submittals

1.3.1 To Section 01 33 00.

2. PRODUCTS

2.1 Furniture Mounted Duress Buttons

2.1.1 Furniture mounted duress buttons as specified in Appendix E3.

2.2 Wall Mounted Duress Buttons

2.2.1 Basis of design: ST Stopper Station Series, SS2 series.
2.2.2 Colour: Blue housing.
2.2.3 Cover: Universal stopper, label shell.
2.2.4 Switch configuration: Turn-to-reset.
2.2.5 Text: “EMERGENCY”.
2.2.6 Language: English.

2.3 Wiring

2.3.1 Installed in conduit in accordance with Appendix E3.

3. EXECUTION

3.1 Installation

3.1.1 In accordance with Appendix E3.
3.1.2 Connect to iStar system as described in Appendix E3.

END OF SECTION

APPENDIX E1
CITY OF TORONTO STRUCTURED CABLING STANDARD
V4.3, 2014-AUG-25

STANDARDS AND PROCEDURES

Cabling Standard

Issued by:
IT
Network Services
Version 4.3 – Aug 25, 2014

Revision History

Date of this revision	Author
May 13, 2002	Michael Dors
Sept. 23,2003	Mark LaFleche
April 1, 2004	Mark LaFleche
Nov 4, 2004	Mark LaFleche
Oct 2, 2007	Mark LaFleche
Jan 28, 2009	Mark LaFleche
Jan 28, 2010	Mark LaFleche

Revision Number	Revision Date	Summary of Changes	Changes marked
1.0	June 19, 2002	Old Format	N/A
2.0	May 13, 2002	Update doc and format	Format changed to standard
3.0	Sep 26, 2003	Update specification for corporate cabling standards and cabinets	
3.1	April 1, 2004	Added Voice exceptions at the introduction, update cabinet and electrical specifications.	
3.2	Nov 4, 2004	Added some room details and updated some cabinet details	
4.0	Oct 2. 2007	Add more details relating to process, cable installation and times lines and appendices.	
4.1	Jan 28, 2009	Changed some typos, added details regarding transition to new VOR.	
4.2	Jan 28, 2010	Added in section 3.0 Updated 1.2.1 to 1.2.6	
4.3	March 19 2014	Updating sections	

TABLE OF CONTENTS

Introduction

This document addresses the cabling design specifications of data cabling within the City of Toronto controlled buildings or leased spaces, where the network is controlled by IT-Network Services. This document should be considered a guideline, consideration for some of the content should be reviewed before placing this into a tender document, specifically extra costs and Bell standard pricing.

Though every attempt is made to cover unforeseen issues, every building and project has it's own issues, therefore IT - Network services and Telecommunication services should be included right at beginning of the project and the communication specs must be reviewed and approved by these groups within the City of Toronto.

Cabling Agreement

Effective January 10, 2010 the City of Toronto has entered a multiyear Voice and Data cabling agreement with Bell Canada. Bell Canada is to be used for all Data and Voice cabling for all owned and leased City of Toronto buildings

A pricing table of services with this agreement with unit costing is available from IT with permission to authorized recipients.

When the agreement is replaced or renewed the, current cabling vendor of record (VOR) should be used. The cable VOR should be verified by IT network Services at time of proposed work or RFP.

When a new VOR is selected, some changes may occur to some of the site specific details, standard and non-standard work in this document.

Voice Cabling

As Part or the ITI agreement Unified Communications (UC) Devices are now deployed. Also known as VOIP. Where it is cost effective and proper planning and acceptance has been completed UC phones that plug into the data network will be utilized.

It is the responsibility of the voice applications group, (telecommunication) to direct is the location will be centrex or UC. If the location is centrex or undetermined, thn cat3 cable should be installed to every phone location as well as 1 data.

The typical user workstation is for one Data jack Cat5e or Cat 6 that will support the phone plugged into the jack and the users computer plugged into the phone. Any other special requirements must be identified by the client.

For Analog Devices such as Fax's, POS (Dialup), modems and other specialized monitoring lines, are considered to be using Centrex, but is prudent to also supply a data cat5e/6 cable for future use and conversion.

The voice cabling system for Centrex will be supplied and installed by Bell as part of an agreement between Bell and the City of Toronto. Bell will have ownership of the voice cabling system. The system will be based on Category 3 wiring and will be provided in accordance with

Bell's specifications. There is no cost to the contractor from Bell for this service. The cost will occur when the line is energized with service

All cables and related terminations, support and grounding hardware shall be furnished, installed, wired, tested, labeled, and documented by the Telecommunications contractor as detailed in this document.

Also review business requirements with both Voice Infrastructure Group and network groups to ensure the appropriate technology is used in the locations.

Please contact IT-Telecommunications Services, voice infrastructure group for more details.

Commercial Building Wiring Standard

In Canada this is the CSA T529-95 standard “Telecommunications Cabling Systems in Commercial Buildings”, which adopts the American ANSI/TIA/EIA-568-A standard “Commercial Building Telecommunications Cabling Standard”. This standard covers the following:

- Horizontal cabling
- Backbone cabling
- Telecommunications Closets
- Equipment rooms
- Entrance facilities
- Cable standards

Other cabling system standards and recognized telecommunications industry standards. Are incorporated for reference:

- ANSI/TIA/EIA-568-B.1 and its addendum
- ANSI/TIA/EIA-568-B.2 and its addendum
- ANSI/TIA/EIA-568-B.3 and its addendum
- ANSI/TIA/EIA-568-B.2-1 (category 6 addenda)
- ANSI/TIA/EIA-569-A and its addendum
- ANSI/TIA/EIA-606-A
- ANSI/TIA/EIA-J-STD-607
- ANSI/ICEA S-90-661
- ANSI/ICEA S-80-576
- ANSI/ICEA S-83-596
- ANSI/ICEA S-83-640
- ANSI/EIA/TIA-492AAAA
- ANSI/TIA/EIA-472CAAA
- ANSI/TIA/EIA-472DAAA
- ANSI/TIA/EIA-598
- ANSI/TIA/EIA-455
- ANSI/TIA/EIA-604
- ISO/IEC 11801 2nd edition
- CENELEC EN50173
- IEC 603-7

Commercial Building Standard for Telecommunications Pathways and Spaces

This is the American ANSI/EIA/TIA-569 standard that specifies the architectural requirements that support and enable the Commercial Building Wiring Standard.

Intelligent Building Distribution Network

Originally developed by Nortel, but now owned by Belden, the IBDN standard is a commercial implementation of the ANSI/CSA cabling specifications.

1.0 Building Area Network

1.1 Cabling Standards

These standards address specifications that comply with the conventions established by CCITT, IEEE, ISO, BICSI or other organizations with responsibilities for setting international standards. The City of Toronto has, where possible, selected international standards for the implementation of CITYNET. Building cabling must conform to the Intelligent Building Distribution Network (IBDN) standard which is, in turn, compliant with the Electronics Industry Association / Telecommunications Industry Association (EIA/TIA) Commercial Building Wiring Standard. The IBDN standard specifies the configuration of the cable distribution and termination within the building from the outlet in each office to the exit point from the building to the external carrier system.

1.1.1 Where fiber is being used within buildings to support 10basefFL 100BaseFX or Gigabit Ethernet and/or any other LAN technology,

a. Always determine with IT Network Services Fiber and type as part of the design. But the guidelines below can followed.
b. In existing buildings new fiber should be OM3 unless otherwise specified. All terminated in Patch panel with LC terminations. Patch cables are determined by what network equipment will terminate on the fiber.
c. In new buildings where installing new fiber, OM3 multimode fiber cable will be used with LC terminations on the fiber patch panels. OM4 Considered in computer room type applications or core locations.
d. Where there is a mixture of old and new terminations, the cable connectors and patch panels should be replaced with current standard at the time of major reconstruction.
e. Relocation of the fiber termination point, must include updating connectors and fiber patch panels.
f. Where a pathway is open or harsh environment armored cable should be used or conduit installed.

1.1.2 Unshielded Twisted Pair used between the workstations and the Hub Room or for vertical Hub Room to Hub Room service must be 4 pair unshielded twisted pair enclosed in Plenum rated jacket with a minimum of EIA/TIA Category 5E performance with RJ45 terminations. If the there is category 6 existing in the renovated space, then the location must use the same rating or higher rating and must be the same series of cable i.e. Belden/CDT 2400 series or 4800 Series.

a. The UTP-based cabling system shall have minimum a 160 MHz Channel Bandwidth over a maximum distance of 100m (328 ft) and a positive channel Power Sum Attenuation-to-Crosstalk Ratio (PSACR) at 160 MHz.
b. The UTP-based cabling system shall use matched components from a single manufacturer, and the cabling system shall be certified to deliver system

performance over the lifetime of the applications for which the cabling system was originally designed to support.

c. All components used in the UTP-based cabling system shall be warranted for a period of 25 years from date of installation against defects in materials and/or workmanship.

d. The UTP-based cabling system shall comply with the following standards:
Minimum Enhanced Category 5 – ANSI/TIA/EIA-568-B.1
Class D ISO/IEC 11801 2nd edition
Class D - CENELEC EN50173

e. The UTP-based cabling system shall be capable of supporting the following applications:
Gigabit Ethernet (1000BASE-T)
Power over Ethernet (POE) 802.3af standard minimum
Fast Ethernet (100BASE-TX, 100BASE-T4)
Voice

IBDN System 1200 Paramters (cat 5e)

Parameters	Frequency	Standards*	IBDN Performance
PSNEXT	100 MHz	27.1 dB	32.7 dB
	155 MHz		29.6 dB
	160 MHz		29.4 dB
Attenuation	100 MHz	24.0 dB	22.3 dB
	155 MHz		28.6 dB
	160 MHz		29.1 dB
PSACR	100 MHz	3.1 dB	10.4 dB
	155 MHz		1.0 dB
	160 MHz		0.3 dB**
PSELFEXT	100 MHz	14.4 dB	20.0 dB
	155 MHz		16.2 dB
	160 MHz		15.9 dB
Return Loss	100 MHz	10.0 dB	12.0 dB
	155 MHz		10.1 dB
	160 MHz		10.0 dB
Propagation Delay		555 ns	490 ns
Delay Skew		50 ns	25 ns
Available Bandwidth		100 MHz	160 MHz

Worst case scenario for four-connector topology

*Based on ANSI/TIA/EIA-568-B.1 (May 2002)
ISO/IEC 11801 2nd edition (September 2002)

** Positive PSACR @ 160 MHz

1.1.3 In large campus environments such as civic centers and Metro Hall, connections from hub room to hub room or vertical risers connection should use fiber, unless otherwise stated by IT – Network Services.

1.1.4 100BaseTX and 1000baset switches are used in each hub room or communications room. Cat5E / Cat6 patch cables are used to connect the switches to the building cabling system between the hub room and the servers / end user workstations. At the server/workstation, the appropriate Network Interface Cards (NICs) are incorporated in the workstations.

1.1.5 Servers in the main computer room will be connected to Cat5E patch panels within the cabinet. Cat5E / Cat6 cables will be run from these patch panels to patch panels specified by IT – Network Services Group or Gigabix Frame.

a. Any new server cabling put should be located on a directly installed patch panel within the cabinet of the server.
b. New Cabling infrastructure for computer room environment or where GigE is required cat 6 utilizing 4800LX series Belden cable should be considered mandatory, decision should be decided with direction from IT-network services.

1.1.6 Workstations in office areas will be connected to Cat5E wall jacks or to Cat5E jacks incorporated into modular furniture.
a. If the location is new, or a fully renovated floor or location cat6 cable should be used

1.1.7 Data Jacks are to identified with a separate colour, by default black for voice, white or Blue for data, unless a different scheme is used at the location, or aesthetic reasons the jack is in furniture and is limited available colours. Any differences should be approved by IT - Network Services,

1.1.8 Every effort should be used to support the Belden IBDN product line, this will keep the parts standardized and are readily available to the current cabling supplier used by the City of Toronto. Any changes should be a provided by IT -Network Services. Also a proper end to end solution for Cat5e / Cat6 will be certified by one vendor using all the same components from one vendor.

1.2 Cabling Standards (COT – Information Technology (IT))

Corporate standards address the design aspects of CITYNET that comply with industry practices but may be unique to the corporation. These specifications deal with the current environment and the variety of methods used to accommodate the varied computing platforms of the corporation.

There are a variety of methods used to cable LAN's and terminal equipment. The City has adopted the following corporate standards that address the methods for the implementation of cabling to serve a variety of equipment:

1.2.1 A central hub room for each Civic location for the city of Toronto shall be established. This must be located within the City of Toronto space and should be monitored by Corporate security. Access arrangements through Corporate Security for IT must be available 7x24. If any location through this central hub room is monitored by security or any department use is required beyond normal business hours.

1.2.2 A main secure hub room will be established on each floor, This must be located in the City of Toronto Space, all voice and data cabling should terminate here. **This is important for UC environment and -911 Enhanced service.** For Small locations, the equipment will generated some heat and noise. The main hub room should not be in an office where people are occupying.

1.2.3 Where the floor area is extensive, multiple hub rooms will be created

1.2.4 All hub rooms to house voice connections, network patch panels, concentrator equipment, terminal servers and all other network termination equipment. All units will be rack mounted. Rack mounted shelves can be used for equipment that does not provide rack mounts. (For Rack details please see section 1.3.0 Cabinet / Rack Standards) See Appendix A for examples of configurations.

1.2.5 All hub rooms should connect back to the central hub room via a **direct** back bone fibre and/or Copper multi pair riser cable. If security requirements are required, then all backbone cabling shall be placed in conduit. No Daisy chaining fiber cables from floor to floor.

1.2.6 The room should be located in an area that is not obtrusive to staff and sufficient room to house the shelf or rack.

1.2.7 Hub rooms are for Voice/network and communications and related computer equipment only and should **not** be used for storage space. Especially chemicals for cleaning etc.

1.2.8 Floors should **not** be carpeted; a bare concrete or vinyl floor is acceptable.

1.2.9 There must be sufficient room in the hub room to allow access around all the racks installed in the room. 10 Feet by 10feet minimum in room containing only one rack

1.2.10 Sufficient cooling / ventilation should be provided into the hub room for the expected equipment to be installed and also have room for adequate growth.

1.2.11 Water Valves or water dripping hazards etc should not be above equipment.

1.2.12 Enough electrical should be installed to service the rack(s) power strip(s) as well as additional equipment required by the client (local servers – not sanctioned by Network services, expected to follow IT server standards)

1.2.13 Plywood for any other communications should be fire rated or painted with fire retardant paint.

1.2.14 If systems, terminals, printers, etc. require special cable an exception from standard must be requested before installation.

1.2.15 The unshielded twisted pair will be terminated on RJ45 Cat5e patch panels. The four pair cables will be terminated (ISDN format) on the patch panels, all excess will be trimmed and cables will be tied back appropriately. Cables will then be labeled on the cable at the connection point on the back of the patch panel and on the front of the patch panel above each port.

1.2.16 Patch cables running from the patch panel to the network equipment will adhere to the same UTP standard as above and will be labeled before installation.

1.2.17 Patch panel ports will be labeled following the corporate standard see section 1.4.0 Cabling Procedures (COT-IT)

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1.3 Cabinet / Rack Standards (COT-IT)

This standard specifies installation of racks and cabinets in the various buildings throughout the city. Each location has its uniqueness therefore local knowledge should be part of the design process for the layout of the cabinet and/or rack. Also larger locations or locations with a proper raised floor computer room environment have different standards than most other buildings. Most wiring locations, racks are adequate, but some locations, such raised floors areas and proper computer rooms should contain cabinets

1.3.1 All racks and cabinet Z-rails, must have threaded holes for 10/32 screws, no punch rails with separate bolt inserts.

1.3.2 All racks should have a 2 vertical cable managers at least 5” Wide and the height of the rack and should be attached to each side of the rack, the manger should be metal and have a hinged cover. If only one side can be attached or where two racks a placed in a row a 9” wide cable manger should be used.

1.3.3 All racks should be mounted securely to the floor.

1.3.4 Each rack should have a power strip (12 pos) attached to the side of the rack, with a minimum of a 15 foot cord attached to the strip, terminated with standard 125V 15A blade connector. If the cabinet is going on a raised floor. The power bar should have a twist lock on the end of the cable with the appropriate rated connector.

1.3.5 For some small wiring closets where there is no room for a rack or growth is not expected to be more than 24 ports, A wall mount 19” frame (11 RU) can be used in place of a rack. The frame should have a 2 RU metal hinged horizontal cable manager installed under the patch panel and room for at minimum 2RU switch and one shelf to hold non-rack mountable equipment and a 19” rack mountable 6 pos power bar. This rack should be installed at 48 – 60 inches above the floor so that it is accessible without a use of a ladder. IT staff are not certified via health and safety to be on ladders.

1.3.6 A duplex 125V 15A electrical outlet on an independent circuit should be installed within 10 feet of the rack, so that the power cord from the power strip will not cross any open areas. For the wall mounted racks the duplex outlet should be installed in the cabinet. For computer rooms in a raised floor environment a twist lock connector should be provided under the raised floor for the cabinet. Ensure the rating matches the power bar/strip. Within the city, currently there 15A 125V twist locks and 20A 125V twist Locks on cabinets. All power for cabinets and equipment should be verified in computer room environments with IT - Network Services.

1.3.7 If emergency power is available at the location then power for network equipment should be on the emergency power.

1.3.8 UPS requirements are based on the clients requirements. Not IT Network Services. unless specified.

1.3.9 When a cabinet is used, the cabinet type and style should be specified by IT - Network Services, each location is different.

1.3.10 In general for cabinets the should be 30” wide cabinets with 19” Z rails front and back to allow for 19” rack mounted equipment. But should be confirmed depending on the location.

1.3.11 For cabinets, vertical cable managers should be used at the front corners, for every 48 patch ports a 2 RU horizontal cable manager should be used. All cable managers should be metal with hinged doors.

1.3.12 In the cabinets a 19” front mounted shelf should be installed in every cabinet.

1.3.13 For cabinets the patch panel layouts and locations must be approved by IT - Network Services.

1.3.14 For cabinets electrical requirements are specific to the location and equipment within the cabinets and should be specified by IT - Network Services.

1.4 Cabling Procedures (COT-IT)

These procedures will provide a common implementation method for all LAN installations and the appropriate relativity to the Cable/Configuration management system.

In an effort to have common cabling practices across CITYNET the following procedures have been developed to detail exact cable placement and installation procedures:

1.4.1 Cables will be labeled using the corporate standard. For horizontal data cables use Dxxxyyy. Where xxx is the building floor number and yyy is the cable number on that floor. For example cable 17 on floor 12 would be D012017. Where there is more than one Hub Room on a floor a direction indicator will be used (i.e. N,E,W,S). For example, the first cable on the 3rd floor terminated in the north Hub Room will be labeled D03N001. If an existing cabling scheme exists, that is different, continue to follow the existing cabling scheme or contact IT -Network Services for clarification. Computer room wiring labeling should always be confirmed with IT - Network Services. Be aware of older exiting cabling and wire scheme so that numbering is not overlapped. If this occurs and is difficult to continue, then wiring can continue from next hundred higher , for example if the wires end at D021162 then continue d021200

1.4.2 The patch panels ports will be labeled with the above standard numbering system.

1.4.3 For non standard office devices on utilizing IP and cat5/6 cabling, patch panels should be grouped for services separately and indentified jacks such as IP security cameras or intercom systems etc. Enough room should be allocated for expansion and layout of all patch panels included regular office jacks should be documented in a design and approved by IT - network services.

1.4.4 All cables should be terminated on the patch Panel then Patch cables will be utilized to connect into the switch, unless a gigabix IDC type solution is used, Then Pigtails from the switch to the IDC Block is acceptable.

1.4.5 Cables from the office terminated on the patch panel should be attached to the outside rear of the cable manger, not run inside the cable manager.

1.4.6 Any vertical backbone copper cables will be labeled aaa-bbb where aaa is the destination floor and bbb is a consecutive number within the group running to a given floor. For example, if you are looking at the patch panel on the 12th floor, the first vertical cable running to the 11th floor will be labeled 11-1 the second 11-2, the first cable running to the 13th floor will be labeled 13-1 and so on.

1.4.7 When there are more than 24 cables on the floor, additional patch panels will be added and manufacture's port numbering will begin again at 1 and continue consecutively. City standard labeling of these ports will continue consecutively from the panel above. For example port 4 on the second patch panel will have a cable number of D12028 and on the third patch panel port 3 will be cable number D12051. Always use the Dxxxyyy designation when referring to a port, or contact COR I&T – Network Services for clarification

1.4.8 Patch cables will be labeled numbering from 1 to 999 within a single hub room. Straight through cables will have grey jacket colour.

1.4.9 Patch cables must be plugged to the patch panel port within the relative numbering system above. For example cable 9 in port 9 of the first patch panel, cable 34 in port 10 of the second patch panel, cable 55 in port 7 of the third patch panel etc.

1.4.10 Patch cables will be run through vertical and horizontal cable trays where available. Otherwise patch cables will be gathered in groups of 12 at the patch panel and tie wrapped, pulling the cables horizontally across the panel to clear the view of port numbers. Cables 1 through 12 will be gathered, tied and pulled to the left, then tie wrapped again to the rack. Cables 25 through 36 will be gathered, tied and pulled to the right then tie wrapped again to the rack.

1.4.11 Patch cables that are run vertically between patch panels and concentrator equipment, without cable management trays, will be grouped as above and tie wrapped periodically along the outside of the rack, neatly with sufficient tension to form a straight line of cable down the side of the rack.

1.4.12 Clusters of concentrators/switches will be connected to a master hub. The master hub/switch will be connected to the backbone network.

1.4.13 When daisy chaining is required, use the first port(s) of the master hub/switch to connect to the other hubs/switches. Be sure to set the MDI/MDIX switch to MDI or use a cross over cable. Cross over cables will have orange or red jacket colour or proprietary stack cable can be used.

1.4.14 Complete all connectivity cabling of routers, connections between groups of concentrators/switches, etc. before beginning the user equipment cabling.

1.4.15 All cables will be connected to the hubs/switches in order. For example patch cable 1 in the first available user port of first concentrator followed by cable 2 and so on.

1.4.16 Where cable mgt. trays are not used, cables will run down both sides of the cabinet or relay rack and concentrator equipment will be mounted directly below the patch panels. All cables must be connected to the concentrator in order working from the left plugging the cables running down the left side of the rack ending at the middle of the concentrator. Cables running down the right side of the rack will begin in the center port and plug across to the right of the concentrator. This process will be repeated on consecutive concentrators until all connections are completed.

1.4.17 All cables at the concentrator must be pulled and tied to provide a clear view of the port numbers on the concentrators.

1.4.18 Patch cable lengths,

a. For wall mount racks used in small site 2ft patch cord should be used.
b. For standard 2 post racks default should be 7ft. but should be verified with IT-network services staff assigned to project.
c. Other configuration should be designed as part of the project.

2.0 Installation Procedures and Prerequisites.

Data cabling requests and services should be issued from an authorized person within the client department (preferred Telecom Coordinator or IT staff) or the project leader from Facilities and real estate, with the cost centre and site contact or alternative contact and/or numbers.

For Bell services for network connectivity to new locations, the call should be initiated from an authorized person from the client department to the IT Service desk.

This section for planning, please ensure that information is review before placing in a tender document.

2.1 Internal cabling.

2.1.1 The cable vendor (Currently Bell Canada under communications Tender ITI Agreement) should be a good standing member in BICSI. The product managers should be accredited RCDD, the technicians installing the cable should have training credits pertaining the product they are installing.

2.1.2 Current base costs of the cabling are for different types of buildings. Bell must follow the standard city pricing where applicable. This is based that all pathways are in place. For example Zone Conduit from the hub room and box and conduit on the wall from the ceiling space. Ceiling height is nominal 10ft.

2.1.3 Extra costs per tech/hr could be incurred for work not covered under the contract. All time and material work details have to be reviewed by network services, approval request from the account holder (i.e. department supervisor or telecom coordinator.

2.1.4 Extra high ceilings must taken into special considerations for workplace safety reason, extra equipment such as sky lifts must be brought for the cable to be installed properly and provide a safe work area for the contractors. All this will cost will be funded from the department requesting the work.

2.1.5 Pathways **must be provided for the cable contractor** unless request for cable contractor to install /create the pathways. Extra charges will apply for this work. All conduits must have proper bend radius for type of cable used in the conduit, special consideration for fiber. Pull boxes should be placed after two 90 degree bends. No LB joints to be used. Pathways should be designed for installation of network cable standards.

2.1.6 For open areas, where there are no conduits, Cable tray should be utilized to allow installation of the cable and pathway back to the hub room.

2.1.7 Any Conduits from from wall boxes, must extend up to the ceiling and flow into a cable tray.

2.1.8 Extensive pathways floor ducts should have pull strings and old cabling should be removed.. Access points and pull boxes should accessible to ease in the installation, should not covered up with carpet and/or furniture. This will incur extra costs.

2.1.9 For general work on buildings the following practices must be used, or verified with the building supervisor.

All wiring to be installed in conduit 90 degrees to building grid fastened to the upper slab.

No free run wiring greater than 10' (should the free run be in a space deemed a plenum, the wiring shall be appropriately fire rated FT6).

All wiring made obsolete/ non-functional shall be removed as part of the installation process.

Cable tray systems can be used if appropriately sized & fire rated cabling is used, these are not preferred since they can eventually overflow and become unmanageable.

J-hooks can be used under the direction of the building supervisor and installation of the system recommended of the manufacturer and approved by IT-network services. Cable Tray is preferred.

2.1.10 Attachment to existing sprinklers, or duct work is not permitted.

2.1.11 Loop extra slack should be built in for relocation or retermination of the cable.

2.1.12 Major renovations cabling should be brought up to current standard, It is easier to remove all the old cable and pull in new cable. Rerouting large quantities of existing cables and installing around existing cable can cause damage to the existing cable. Some locations are still at category/level 3 or level 4 communications cable.

2.1.13 Old cables that do not meet current standard and are removed should be removed back to the patch panel.

2.1.14 New cables should be terminated on patch panels, that are current cat 5e/VCat6 standard and match the current IBDN system in place (currently Belden IBDN)

2.1.15 System furniture where the data jack is integrated, if the jack cannot be placed in securely and reliably than a surface mount jack should be used secured on the surface in the furniture. The contractor is expected to replace this, if this identified as deficiency. Also is should also be confirmed the requirements with designer what is preferred.

2.1.16 Installation for Wall Jacks

a. if system furniture is being placed, then jacks are to be wired into the system furniture, walls jacks must not be covered up.
b. Any special requirements for the systems furniture jacks should be identified by the manufacturer/Furniture re back to the cable contractor.
c. For wall mount jacks the height of Voice/Data Jacks should be placed for accessible standards, such that a person in a wheel chair can access the phones. Must be verified by the client and/or Public Health or accessibility standards
d. All wall plates should have a covered plate with the Jack installed, if a UC phone is to be placed on this jack then a secure wall mount bracket with Key lock must be placed around this jack. Like wise for any other specialized device such as intercoms and wall clocks etc. Should also be identified any special mounting during the design and marked on the drawings.

2.1.17 Installation of Jacks for specialized devices

a. Wireless Access points Jacks should be install so that they can be moved in both directions to adjust the wireless access point

b. Wireless access point should be mounted on the T-Bar ceiling with approved hardware If not T-Bar then approved method must be agreed with IT Network Services.
c. Other Devices, such as time clocks security cameras must be identified on any drawings and mounting must be agreed and to the manufacturers standards and department standards (ie Corporate Security or Toronto Water etc.)
d.

2.2 External Cabling for Bell Services

2.2.1 For current data services via ITI/Bell Canada allow Minimum 45 to 85 business days for installation. Determine by presales check. Any escalation will result in extra fees

2.2.2 The move in date should be planned for 1 week after the Bell due date to ensure any issues with installation are accounted for.

2.2.3 All pathways from the street line must be provided by the City of Toronto (Department requesting the work) or General Contractor associated with the project with adequate space for the cabling required for the services and growth. Follows the same requirements as internal cable. If this is not provided extra fees could be charged.

2.2.4 For services required far from the main DMARC of the building extra charges may apply. This cannot be determined until after the order is places and Bell performs site visits from the BND (Building Network Design) and access networks groups.

2.2.5 In order for data service to be on time and reduce billing charges due to an early installation. The custom must provide a date they want the activation of the service to happen. Otherwise the order will be placed and bell will provide due date. Please allow minimum times.

2.2.6 Under certain circumstances where a delay will be longer thank anticipated, the install can be placed on hold, but will require at least 2 to 3 weeks to continue and reschedule the installation.

2.2.7 Any moves of an existing service within the building may be subject to a moving charge.

2.2.8 Any relocation of services from outside the build, charges may apply.

2.2.9 For extended runs of cable inside a building any outdoor cable that is not fire rated must be placed in conduit of fire rated inner duct.

2.2.10 Bell owns the cable to the DMARC point and must be Bell Canada owned fibre pulled in by their contractor (separate from local Voice and Data Contractor) Usually done by Expertech, Aecon and internal Cable Ready etc, but arranged by Bell Access networks. **Warning: These contractors attend unannounced before the due date. They may require clean dust free environment to complete fiber splicing reliably. Therefore trades may have to work somewhere else. The impact of not allowing them when the show up is that the installation of the service will more than likely be delay.**

2.3 External Cabling - Private Cable and Property

2.3.1 Cabling between buildings on City of Toronto property where there are no issues with right of way crossing of streets etc. This is private cable that the City of Toronto owns and will and the department that requests will be responsible for all installations and future repair costs not associated with warranty on materials or workmanship. There are no guaranteed service levels for repair of this cable and is best effort.

2.3.2 All pathways must be defined, either Conduit under ground, trenching or above ground on along a series of poles.

2.3.3 Similar rules for pathways for section 2.2 and 2.1 apply, Pathways can be supplied by outside source which is preferred, otherwise cable installers will have additional costs and subject to review by IT network services against the cabling agreement.

2.3.4 Safety devices utilized for environmental protections such as lightening should be used.

2.3.5 Tracing wire must be placed for cables installed in the ground.

2.3.6 For aerial cable ensure the height is adequate for any vehicles traveling below the cable.

3.0 Working with GC/Landlords and Clarification of Projects and Timelines.

3.1 Summary.

3.1.1 City current standard is cat 5e based on Belden 1200 series cable and former CDT/NORDX IBDN standards

3.1.2 Current the cabling Vendor of record is to be used for Voice and Data cabling and associated racks, contact to be provided by IT Voice or Data group.

3.1.3 All pathways are to be provided for communication services and voice and data cabling.

a. These are considered construction expect to be completed, by Facilities or the landlord, or the department. The cabling vendor of record can do these as requested, but this should follow standard purchasing polices, since conduit work and electrical work is not included in the ITI agreement.

3.1.4 For orders as part of tenders/landlord agreements, a scope of work/requirements (SOW) must to be stated clearly to the cabling vendor, this should included in the front any cabling specification, and/or indicated clearly in the drawings the expectations from the cabling vendor. A sign-off of the SOW between the GC/Landlord and cabling vendor of record must be included in the response package.

3.1.5 For service installations, voice or data, the department is responsible for this cost, The order must be placed though COT- Information technology (IT) processes and procedures.

Clarification and permissions can be exempted, but must be approved at supervisor level in IT. Cabling infrastructure for these services required to be installed in parallel with the construction, since the cabling is a service, the installation is the responsibility of the vendor, but all pathways as per the service provider specification must be provided by COT, GC/Landlord contracted to do this.

3.1.6 Service orders, especially for data services can be a lengthy process, since outside infrastructure may require building. For typical office buildings where there are tenants, a minimum of 8 weeks sis required and should be sufficient, where the locations are new city property or city leased property in obscure areas, longer timelines may be required for the fibre build. This is can only be determined at the time of order.

3.1.7 GC/Landlords must allow access for service providers and COT- IT Staff during the construction phase to implement the service for time of completion as requested by the department. A local contact/Supervisor cell phone and email must be provided. City IT staff and the service provider are expected to follow health and safety requirements and direction from the GC/Landlord during the construction.

3.2 Project related scheduling.

3.2.1 A GANTT chart or time line must be provided and update accordingly, This must be provided and reviewed by IT Voice and Data groups to ensure the site is prepared for the service provider implementation and IT change management processed to interface to the new location.

3.2.2 Certain milestones are require for the service provider to implement service on time as required by the client and/or COT (i.e. security). This includes the communications racks and associated power.

3.2.3 Site meetings, the IT Voice and Data rep should receive minutes of the site meetings and be allowed to attend when required pertaining any issues to IT communication requirements. All communication for changes and issues should be communicated through the COT project manager assign to this project through Facilities Management.

Appendix A

Examples of rack configurations

Small Locations with HDSL

Currently the HDSL was not moved over from other location. This is the High Park supervisors house. Issue here, rack was larger than expected by the client, so it should have been placed in the basement out of the way. That is why the closet now has doors. Rack is 11U Rack. There is about 12 connections in Total.

The HDSL circuit installed in this rack at the Fire Hall, 280 Burnhamthorpe. This is a little smaller than above. Only issue Patch cords should have been smaller, 2ft to hide in the cable manager. Almost 22 Connections. This room has enough space for a 2-post rack if required.

Larger sites

Typically Fibre locations, where there is more than 1 switch or multiple buildings connecting into the main building.

Below is new location Public Health 44 Victoria, with a 2 post rack, to vertical cable managers and 12 port power strip. Total 3 switches, Issues with this is the room, it was nice size but the air conditioning unit took up more space than anticipated. Therefore only room for growth is the one rack. This floor is at maximum capacity. The rack can be passed to maintain the AC unit.

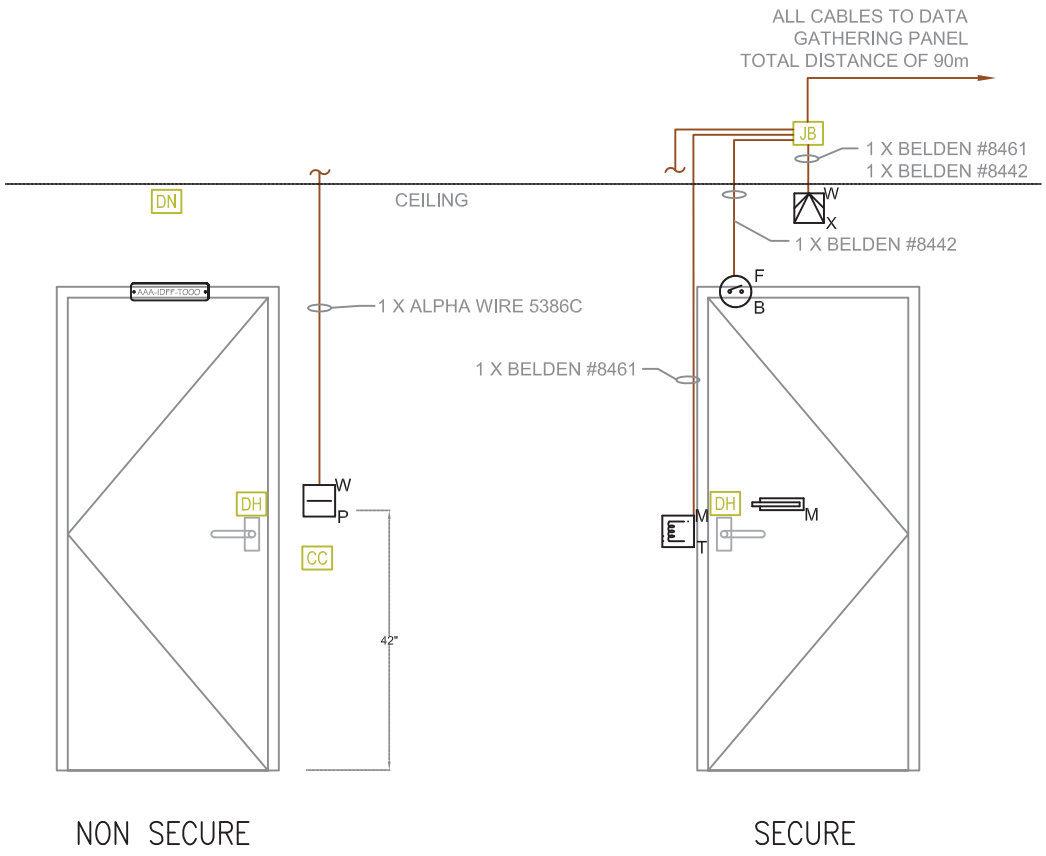

CableTalk

APPENDIX E2
CITY OF TORONTO FACILITIES AND REAL ESTATE
DRAWING CS-ACS-DOOR-0001
DOOR TYPICAL DETAIL: SINGLE DOOR COMPLETE WITH23
2009-APR-25

LEGEND

SYMBOL	DESCRIPTION
JB	JUNCTION BOX
DN	DOOR NUMBER TYPICAL
CC	CLEAR ACRYLIC COVER
LH	LOCKING HARDWARE
DH	DOOR HARDWARE
AV	AUDIO VISUAL / HORN STROBE
KA	KEY ACCESS

See SIA/IAPSC CAD for Security Symbols



NOTE:

1. ALL CABLE TO BE HOME RUN FROM DEVICE MOUNTING LOCATION TO CONTROL PANEL
2. ALL CABLE TO BE IN EMT CONDUIT FROM EACH DEVICE AND FROM JB TO DGP
3. ALL CABLE TO BE IN PLENUM RATED IF NOT IN CONDUIT, UNLESS OTHERWISE NOTED.
4. ALL CABLE TO BE INDIVIDUALLY LABELLED
5. ALL CONDUIT AND JB TO BE SIZED ACCORDINGLY (MIN 21mm TO CONTROL PANEL, 12mm CONDUIT OK FROM JB TO DEVICE.
6. ALL CONDUIT TO BE ON THE SECURE SIDE OF DOOR AND JB TO BE LOCATED ABOVE DOOR
7. ALL DEVICES TO BE MOUNTED ON SGL-GANG BACKBOX AND WILL BE TERMINATED BY OTHERS (SECURITY CONTRACTOR), UNLESS OTHERWISE NOTED.
8. EXACT DEVICE MOUNTING LOCATION TO BE CONFIRMED ON SITE WITH CITY CORPORATE SECURITY PROJECT MANAGER.
9. COORDINATE ELECTRIC STRIKE WITH DOOR FRAME MANUFACTURER FOR NEW CONSTRUCTION
10. DOOR CONTACT REQUIRES 25mm (1") DIAM. HOLE PREPPED 100mm - 150mm (4"-6") FROM EDGE OF DOOR FRAME.
11. CARD READER HEIGHT IS RECOMMENDED 1.07m (42") C/L AND TO BE MOUNTED ON ACTIVE EDGE OF DOOR.
12. EGRESS MOTION DETECTOR TO BE CENTERED ABOVE DOOR ON SECURE SIDE OF WALL. 2.44m (8') FROM FLOOR (WHERE APPLICABLE)
13. EXIT BUTTON TO BE MOUNTED ON SECURE SIDE OF WALL.
14. EMERGENCY FIRE PULL STATION TO BE WITHIN 600mm OF DOOR.
15. ALL DOOR LOCKING HARDWARE SHOULD BE PASSAGE SET FUNCTION WHERE MAGLOCKS INSTALLED, UNLESS OTHERWISE NOTED.
16. THE THROW/LATCH ON LOCKING HARDWARE MUST BE A MINIMUM OF $\frac{3}{4}$" OR FITTED TO MAKE EFFECTIVE THE LATCH MONITOR (I.E. NOT TO CAUSE NUISANCE ALARMS)
17. ALL CABLE TYPES AND DISTANCES LISTED ARE FOR TYPICAL INSTALLATION STANDARDS AND ARE FOR PRICING PURPOSES, IT IS THE RESPONSIBILITY OF THE SECURITY CONTRACTOR TO FINALIZE THE CABLES REQUIRED FOR THE SPECIFIC EQUIPMENT AND FUNCTIONALITY REQUIRED BY THE CITY.

Door Typical's

SINGLE DOOR COMPLETE WITH PROXIMITY CARD READER AND ELECTRIC STRIKE

Toronto Corporate Security

FACILITIES & REAL ESTATE

CITY OF TORONTO
CORPORATE SECURITY

DESIGN:	MMM GROUP	SCALE:	NTS	DATE:	April 23, 2009	CONTRACT No. N/A
DRAFTING:	L.B., CPO	DRAWING NUMBER:	CS-ACS-DOOR-0001			SHEET No. 1 of 1
CHECK:	Walter Chan, CPP, CSPM					

APPENDIX E3
CITY OF TORONTO CORPORATE SECURITY
ACCESS CONTROL SYSTEM INSTALLATION AND SYSTEM REQUIREMENTS
REVISION 1.2, 2014-AUG-13

City of Toronto Corporate Security Access Control System Installation and System Requirements

Revision 1.2

City of Toronto
8/13/2014

1 GENERAL

1.1 SUMMARY

.1 The intent of the specification is to describe standards for City of Toronto Corporate Security supply and install work. The complete details of the work shall be the responsibility of the Contractor. The Contractor shall furnish all hardware and services that meet the requirements of the specification with regards to performance and functionality.

.2 The Contractor shall be required to supply, install, and program a fully functional integrated Access Control System.

1.2 Reference Documents

.1 City of Toronto Corporate Cabling Standards

.2 City of Toronto Corporate IT Standards

.3 City of Toronto Corporate Security Standards

.4 City of Toronto Video Security Surveillance Policy

.5 City of Toronto Corporate Security Access Control Systems Installation Standards

.6 City of Toronto Corporate Security Intercom System Installation Standards

.7 City of Toronto Corporate Security Access Control and Intercom System Maintenance Standards

.8 City of Toronto C-Cure 9000 Programming Standards

.9 City of Toronto Corporate Security Structured Cabling Standards

.10 City of Toronto, Toronto Water Plant Structured Cabling System Standard

.11 City of Toronto Fair Wage Policy

.12 City of Toronto Acceptable Use Policy

.13 City of Toronto City Internet Acceptable Use Agreement

.14 Transport Canada Reference Manual for Using Closed Circuit Television in Counter-Terrorism Activities.

1.3 Reference Standards

.1 Electrical Standards Authority

.2 Manufacturing: ISO 9003

.3 National Fire Protection Association (NFPA®)

.1 NFPA® pamphlet 51B

.2 NFPA® 70, National Electric Code.

.3 NFPA® 730, Guide for Premises Security 2008 or latest edition

.4 NFPA® 731, Standard for the Installation of Electronic Premises Security Systems, 2008 or latest edition

.4 Ontario Building Code

.5 Ontario Fire Code

1.4 Definitions

.1 ***24/7:*** Twenty four (24) hours, seven (7) days a week, three hundred and sixty five (365) days a year including all holidays.

.2 ***Addenda:*** means additions or changes made by the City to a Request for Quotation before closing the RFQ.

.3 ***Addendum****:* means additions or changes made by the City to a Request for Quotation before closing the RFQ.

.4 ***Agreement:*** means any written contract between the City and a Vendor with respect to any services or deliverables, or both, contemplated by this RFQ, incorporating all provisions of this RFQ.

.5 ***Authority Having Jurisdiction (AHJ):*** An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

.6 ***Backbone Cabling****:* Cabling and connecting hardware that provides interconnections between telecommunications rooms, equipment rooms, and entrance facilities.

.7 ***Backbone****:* A facility (e.g., pathway, cable or conductors) between telecommunications rooms, or floor distribution terminals, the entrance facilities and equipment rooms within or between buildings.

.8 ***Bidder:*** specifies a legal entity, being a person, partnership or firm that submits a quotation in response to a formal Request for Quotation.

.9 ***Bonding Conductor (BC):*** An insulated copper conductor that bonds the TMGB to the Service Equipment (power) Ground.

.10 ***Building Distribution Frame (BDF):*** The BDF is designated as the point where the outside plant cable terminates on the building entrance terminal (first level backbone). These Building entrance terminals include provisions for optical fiber/twisted-pair cabling coming from the campus telephone switch facility where the Main Distribution Frame (MDF) is located.

.11 ***Call Centre:*** specifies the Successful Bidders designated service call receiving centre responsible for administering and dispatching personnel.

.12 ***City***: means the City of Toronto.

.13 ***Connector (Jack):*** A female telecommunications connector that may be keyed or unkeyed and may have six or eight contact connector that may be positions, but not all the positions need to be equipped with jack contacts. Jacks are typically used to terminate cable at the user end and are inserted into faceplates to create a connection point for the user's equipment cord.

.14 ***Constructor:*** means a person who undertakes a project for an owner; also called the general or prime contractor. The Constructor has complete control of the work on behalf of the City, and would have responsibility for regulatory compliance and safe procedures on the job site.

.15 ***Corporate Security****:* means the City of Toronto, Facilities and Real Estate Division, Facilities Operations Section, Security & Life Safety Unit.

.16 ***Council****:* means City Council

.17 ***Electromagnetic Interference – (EMI):*** Radiated or conducted electromagnetic energy that has an undesirable effect on electronic equipment of signal transmission.

.18 ***Equipment Room (ER):*** An environmentally controlled centralized space for telecommunications that houses a main or intermediate cross-connect.

.19 ***Horizontal Cable:*** The cabling between and including the work area telecommunications outlet/connector and the horizontal cross-connect/patch cord in the telecommunications room.

.20 ***Intermediate Distribution Frame (IDF):*** A frame, rack or termination block that connects to the BDF with copper and optical fiber riser cables and distributes horizontal wiring to the rooms (Second Level). In some situations, a BDF may serve this function.

.21 ***MFIPPA:*** means the Municipal Freedom of Information and Protection of Privacy Act, (the Act), provincial legislation that governs access to public information and the protection of personal information and privacy.

.22 ***MSRP:*** Manufacturer Suggested Retail Price

.23 ***Others:*** specifies City divisions and/or City designated and registered Contractors

.24 ***Outside Plant (OSP):*** Telecommunications infrastructure designed for installation exterior to buildings.

.25 ***Owner:*** specifies the City of Toronto as represented by Corporate Security, a unit of the Facilities & Real Estate Division.

.26 ***Power Over Ethernet (POE):*** Power-over-Ethernet (PoE) or "Active Ethernet" eliminates the need to run 110/220 VAC power to Wireless Access Points and other devices on a wired LAN. Using Power-over-Ethernet system installers need to run only a single Ethernet cable that carries both power and data to each device.

.27 ***Project Manager****,* ***Program Manager****,* ***Project Coordinator*** *and* ***City Representative:*** specifies the main contact person at the City for all matters relating to the project. Manager of a team of City staff assigned to the project.

.28 ***Protector:*** A device used to protect facilities from and equipment from abnormally high voltages or currents.

.29 ***Provide****:* The term "provide" shall be synonymous to, and complementary with, "supply", "install", "configure", "make operational", and "warranty", in reference to any and all hardware, equipment and materials, unless explicitly stipulated otherwise.

.30 ***Pull Point:*** A Pull Point is a space use to transition between floors for backbone and horizontal cabling within a building riser system.

.31 ***Quotation:*** means a bid submitted by a Bidder in response to a formal Request for Quotation (RFQ), which includes all of the documentation necessary to satisfy the submission requirements of the RFQ.

.32 ***Repair:*** To furnish and/or restore an equipment module and/or system to its fully functional state without any additional costs to the City. This applies to all warranty and non-warranty equipment.

.33 ***RFQ****:* means this Request for Quotation package in its entirety, inclusive of all Appendices and any bulletins or Addenda that may be issued by the City.

.34 ***Riser Cable:*** Telephone, data, audio, video, coaxial and other structured cabling system cables extending vertically and/or horizontally between the BDF and each area IDF to support low voltage systems.

.35 ***Services:*** specifies all services and deliverables to be provided by a Vendor as described in this RFQ.

.36 ***Shop Drawings****:* specifies drawings, diagrams, illustration, schedules, performance charts, brochures and other data, which are to be provided by the Successful Bidder to illustrate details of the work.

.37 ***Solution****:* specifies a set of goods and services meeting the City's requirements, as set out in this RFQ.

.38 ***Structured Cabling System (SCS):*** The complete collective configuration of a telecommunications cabling and associated hardware at a given location.

.39 ***Successful Bidder****:* means the Bidder which has been awarded a purchase order by the City for the Products and Services under this RFQ in accordance with its Provisions.

.40 ***Telecommunications Bonding Backbone (TBB):*** An insulated copper conductor that bonds all TGB's to the TMGB.

.41 ***Telecommunications Bonding Backbone Interconnecting Bonding Conductor (TBBIBC):*** An insulated copper conductor that bonds two or more TBB's together in a multi-story building.

.42 ***Telecommunications Grounding Busbar (TGB):*** A copper ground busbar installed in every TR and is bonded to the TMGB by the TBB. All metallic items in the TR's are connected to the TGB.

.43 ***Telecommunications Main Grounding Busbar (TMGB):*** A copper ground busbar installed in the BDF or EDF and is bonded to the Service Equipment (power) Ground by the BC. Serves as a dedicated extension of the building grounding electrode system for telecommunications.

.44 ***Telecommunications Outlet (TO):*** A connecting device in the work area on which horizontal cable or outlet cable terminates.

.45 ***Telecommunications Room (TR):*** The TR is the point in the voice and data infrastructure that the backbone and horizontal distribution systems are connected to each other.

.46 ***The Contract Documents****:* documents that consist of the specifications, the general conditions and contract supplement, and all addenda issued prior to and all modifications issued after execution of the contract. The intent of the contract documents is to include all items necessary for proper execution and completion of the work. A modification is a written amendment to the contract signed by both parties, a change order, or a written interpretation issued by the owner.

.47 ***Voice Over Internet Protocol (VoIP):*** VoIP (Voice over Internet Protocol) is the transmission of voice traffic over IP-based networks.

.48 ***Wireless Access Point (WAP or AP):*** Wireless access points are specially

configured nodes on wireless local area networks (WLANs). Access points act as a central transmitter and receiver of WLAN radio signals.

.49 ***Wiring****:* specifies all final and necessary terminations and connections of cable to the equipment, components and devices; including all necessary connectors and fasteners.

.50 ***Work:*** The term "work" includes all labour, materials, equipment and services required and implied as shown and described in the contract documents, supplied and installed or erected, complete at the designated place, in compliance with the laws and regulations of the locality.

1.5 **Acronyms**

.1	**ACS**	Access Control System
.2	**AED**	Automated External Defibrillator
.3	**AFF**	Above the Finished Floor
.4	**AMPE**:	Architectural, Mechanical, Plumbing, Electric
.5	**CAT**	Category
.6	**CATV**	Community Antenna Television (cable television)
.7	**CCTV**	Closed Circuit Television
.8	**DCU**	Door Control Unit
.9	**DGP**	Data Gathering Point
.10	**DPU**	Distributed Processing Unit
.11	**DVR**	Digital Video Recorder
.12	**EMI:**	Electromagnetic Interference
.13	**EOC**	Emergency Operations Center
.14	**ER:**	Equipment Room
.15	**GUI**	Graphical User Interface
.16	**HH**	Handhole
.17	**IPS**	Images Per Second
.18	**JB**	Junction Box

.19	**KVM**	Keyboard, Video, Mouse console
.20	**LAN**	Local Area Network
.21	**MH**	Maintenances Hole
.22	**PB**	Pull Box
.23	**PBX:**	Private Branch Exchange (Phone Switch)
.24	**PP**	Pull Point
.25	**RAM**	Random Access Memory
.26	**REX**	Request to Exit Motion Detector
.27	**RXP**	Request to Exit Push Button
.28	**SCC**	Security Control Center
.29	**SCS**	Structured Cabling System
.30	**SOC**	Security Operations Center
.31	**SPOC**	Single point of Contact
.32	**TGB**	Telecommunications Grounding Busbar
.33	**TMGB**	Main Telecommunications Grounding Busbar
.34	**TO**	Telecommunications Outlet
.35	**TR**	Telecommunications Room
.36	**UPS**	Uninterruptible Power Supply
.37	**UTP**	Unshielded Twisted Pair
.38	**VDU**	Visual Display Unit
.39	**VSS**	Video Surveillance System
.40	**W/O**	City of Toronto Work Order Number
.41	**WAP**	Wireless Access Point

1.6 Design Performance Requirements

.1 General

.1 The Security Contractor will be required to supply and install a fully functional integrated access control system.

.2 The Access Control System shall have the capability to fully integrate with the Closed Circuit Television System, Digital Storage System, and Intercom System to the maximum level supported by the systems manufacturers.

.3 The Contractor shall be responsible for a complete functioning system. This work may include, design, procurement, installation, programming, integration, testing and commissioning.

.4 The Contractor shall supply and install all required cabling, connectors, hardware, software, hardware and software updates, hardware and software upgrades and licenses to allow for the required functionality under this specification.

.5 This Access Control System shall be based on the Software House manufactured C-Cure 9000 system. Alternative architectures and solutions are not acceptable.

.6 The products and performance levels specified are those that have been standardized by the City of Toronto and are intended as mandatory performance levels for the system. Alternative architectures and solutions are not acceptable.

.7 The Contractor shall review the current site conditions and existing system configurations.

.8 The Contractor shall provide at all times sufficient competent labor, materials, and equipment to properly carry on construction work and insure completion of each part in accordance with the Work Schedule and within the Contract time period.

.9 Provide necessary labour and material to comply with manufacturer's requirements and applicable standards and codes for grounding of devices supplied through this Contract.

.10 Equipment shall be installed as per manufacturer recommendations or as otherwise noted in this specification and specification drawings.

.11 The Contractor shall secure and be responsible for the safe keeping and protection of the system equipment until the system is fully accepted by the City of Toronto after the commissioning process.

.12 The Contractor shall coordinate all Work with applicable trade contractors on site.

.13 The Contractor shall coordinate all Work regarding network with City of Toronto IT Services group.

.14 Equipment and material provided for this Contract shall be CSA/ULC certified. Where there is no existing rating to equipment specified, the Contractor shall obtain special prior written approvals from Electrical Inspection Department.

.15 The Contractor shall warrant the completed Access Control system including all equipment/hardware, software and documentation. Maintain the Access Control System in compliance with manufacturer specified preventative maintenance schedule during the project installation period.

.16 Preventive and corrective maintenance performed by another maintenance provider other than the Contractor after / during warranty period shall not void warranty on labour, hardware and software provided by Contractor.

.17 All system testing shall follow the City testing, commissioning and acceptance process.

.2 Operational Systems

.1 Locations where there are both existing City systems along with multiple existing tenant systems that share doors, these doors contain separate card readers for each system. On such doors the Contractor shall be required to maintain the exiting functionality and not disrupted, disconnect, or impact the other connected systems.

.2 Work shall be executed to minimize the impact or the disruption of the existing, operational, systems and terminal operations. At any time during the performance of the work, if the existing, operational, systems are affected beyond the expectation approved through the Implementation Plan or there is an imminent danger to be affected beyond the approved expectation, the Contractor shall stop work and minimize the impact on the operational systems. The Contractor shall immediately inform the Owner or Owners representative. On the owner's request, the Contractor shall perform all Work to implement a temporary solution to enable the functionality for the operational systems. The Contractor is to proceed with permanent Work only after a solution is approved by the Manufacturers Engineer and City of Toronto.

.3 Failure to fully comply with the above paragraph will make the Contractor directly responsible for all damages and all costs required to respond to the incident and to remedy the failure.

.3 Heritage

.1 The City of Toronto may need to request and approval from Heritage AHJ to proceed with the necessary work to enhance the premises for security purposes. Retrofitting of security devices into buildings can be one of the biggest challenges of some projects.

.2 The Successful Bidder shall survey the site and examine all available drawings and specifications and reference documentation to determine the extent of the work. The Successful Bidder shall take necessary precautions to avoid damage to existing historic items that are to remain in place, to be reused, or to remain the property of the Government. Items damaged by the Successful Bidder shall be repaired and restored to original condition, or replaced, as approved by the Heritage AHJ.

.4 System Description

.1 The access control system shall consist of City of Toronto acceptable readers, and monitoring devices, door hardware, electronic locking devices all necessary to provide a fully automated system to control authorized traffic in and out of controlled areas of the facility.

.2 The access control system shall be designed on a distributed processing architecture employing remote DGP's (Data Gathering Points) and operator workstations connected to a redundant central server solution.

.3 The Contractor shall connect all doors and devices to centrally located iStar Panels located in communications rooms as detailed in the specification drawings.

.4 Connectivity from the iStar panels to the system front end will be based on Ethernet IP based protocols over a City supplied network communicating back to the Security Operations Center (SOC) Communications Room.

.5 The conduit/cable path installation from the doors to the communications rooms shall be consistent with the specification drawings and all norms and regulations applicable. In the event the proposed pathway becomes infeasible the Contractor shall source an alternative route and propose to the Owner or Owners representative for approval. Alternative routing of pathways shall not incur any additional costs to the project.

.6 The Contractor shall provide detailed door wiring diagrams to City of Toronto standards to the Owner or Owners representative. It is the responsibility of Contractor to finalize the wiring diagrams to meet any site specific conditions and provide a fully functional system. The Contractor shall submit the finalized drawings for approval to the Owner or Owners representative in RAW editable format.

.7 The Access Control System shall be comprised of the devices specified in

the security drawings and door schedule.

.8 The Contractor shall be expected to provide an Integrated C-Cure 9000 Access Control System that is a scalable enterprise solution. This system shall be a complete solution that is scalable from the existing scope of this project to several hundreds of doors which can be added on a unit-by-unit basis. This future expansion capacity shall not require significant replacement or upgrading of equipment provided as part of the initial solution.

.9 The ACS shall use multi-user, multi tasking standard operating software and shall provide an integrated imaging system. The use of any operating system that will not provide such capabilities in the Access Control System software is not acceptable.

.10 The access control system host shall be used for the following purposes

.1 Maintain the user database.

.2 Configure DGPs.

.3 Provide monitoring capabilities at the workstation.

.4 Store activity logs journals and audits.

.11 Provide additional functionality by integrating with the other security sub systems through the system management host.

.12 The system shall be capable of operating even in the event that the system management server is unavailable.

.13 Following a power failure and the restoration of main or backup power, the ACS shall revert automatically, within 3.5 minutes, to normal service status without the need for operator intervention. The system shall restart in the same state as existed before the power interruption with no loss of functionality or transaction data.

.14 In the event that communication between the DGP and access control server is unavailable, the functionality of the DPG shall be preserved such that door functionality at every door shall not be affected.

.1 This will apply for all card records that were recorded in the access control system database prior to the loss of communication between the DGP and access control system server.

.15 The ACS shall provide continuous unattended access control and alarm monitoring at specified locations while meeting the technical, operational

and feature requirements of the specification.

.16 The ACS shall grant or deny access within one (1) second of an access attempt. Alarms shall be fully displayed on the Visual Display Unit (VDU) within one second of origination.

.17 The ACS shall allow no more than one (1) false reject per 1000 read attempts. A "miss" is an incorrect read of an otherwise valid card.

.18 Under no circumstances shall a false acceptance be allowed.

.19 New Doors

.1 Where new door installation is required, the door to be supplied by the Contractor must match the original appearance of the area. All new doors to be installed must be approved by the City prior to installation.

.2 Where a new lock is required on a new door, this must be done by a Unionized Carpenter.

.20 Emergency Building Lockdown

.1 The Contractor shall provide programming and system functionality such that in an emergency situation, Operator performance of a single action (card swipe, macro, etc.) will result in immediate lock down of various layers/areas of the building to be defined by the Owner during programming meetings. Access for visitors and/or cardholders during emergencies shall also change to reflect the situation.

.2 An Emergency lockdown shall be able to be initiated from the security desk or from a remote location.

.1 Emergency Lockdown Levels

.1 Full Lockdown

.1 In Full Lockdown situations, all access control doors are in the secured/locked mode. All access system points are monitored for activity. Visitor and Contractor badges shall be disabled.

.2 Interior Lockdown

.1 Emergency situation where the emergency is in a specific area of the building (ie: Arrivals, departures, etc).

.1 Segregates general public away from the danger.

.2 Ensuring that no unauthorized individuals enter the area.

.3 Exterior Lockdown

.1 Emergency situation where the emergency exists immediately outside the building.

.1 Segregates general public away from the danger.

.2 Security personnel will also secure the building entrances, ensuring that no unauthorized individuals leave or enter the building

.21 Portal Definition

.1 Common Portal Functions

.1 The below functions are general to all portal's where applicable, and unless otherwise stated within the respective portal sub-sections.

.1 Valid Access Trigger – The following are valid triggers which shunt the door alarms, and allow proper access through the respective portal.

.1 Valid Access Card swiped

.2 Valid Pinpad input

.3 Request to Exit Motion Detector or Pushbutton

.4 Remote access granted.

.2 Loss of Power Operation

.1 The doors shall be arranged to lock on loss of power to the sensor.

.3 Intercom

.1 An Intercom icon will be displayed in the SOC Control room upon alarm, if an intercom station is installed at alarm location.

.4 CCTV

.1 Upon alarm event e.g. Door Forced Open, or Door Held Open, designated camera(s) adjacent immediately pan, tilt, and zoom to the appropriate pre-set (position pre-programmed), and record the sequence.

.2 When the operator acknowledges the alarm, the CCTV workstation monitor shall be automatically switched to the appropriate camera(s).

.5 Invalid Card Reader Swipe

.1 Upon presentation of an invalid access card, the card reader shall provide an audio/visual indication of the invalid access attempt.

.6 Door Forced Open Alarm

.1 In the event that the Door Position Switch or Lock Status Switch activate without a Valid Access Trigger, generate a “Door Forced Open” alarm at the SOC Control room, and activate the local annunciator.

.2 Local annunciator, shall remain active until door is closed and a valid access card is swiped. Alarm can also be reset by the operator in the SOC Control room.

.3 Door Held Open Alarm - Door not closed during shunt time will activate “Door Held Open” indication in the SOC Control room and activate local annunciator. The system should have the ability to keep the local annunciator active until door is closed and a valid card is swiped. Alarm can also be reset by the operator in the SOC Control room.

.4 Interlocking Functions - Where required, it is necessary that the functions of one portal be interlocked with the status of another door. For

example, Door ‘a’ and door ‘b’ should be interlockable such that when ‘a’ is open, ‘b’ is closed. If door ‘b’ is open, then the Valid Access Triggers for door ‘a’ should be disabled, while its alarm reporting remains functional as usual. Refer to the “Portal Summary” documents for the doors which have interlocking requirements, and confirm the specific interlocking requirement with the Owners Representative.

.2 Type “A” – Staff Monitored / Free Egress Portal

.1 Doors are used exclusively for keyed access.

.2 These doors are typically equipped with a door position switch for constant monitoring.

.3 Type “A-2” – Staff Monitored / Free Egress Portal

.1 Doors are used exclusively for keyed access.

.2 These doors are typically equipped with a door position switch for constant monitoring.

.4 Type “B & B-2” – Staff Monitored Service Portals

.1 When a user presents an access card to a card reader, the ACS shall read the card information. If the card is valid, the ACS shall:

.1 Display the card reader’s “valid” indicator;

.2 Release the electric door strike latch for a short period of time as determined by the Lock Release Timer. If the door returns to the closed position before the Lock Release Timer has expired, de-energize the electric door strike and begin monitoring the door contact immediately;

.3 Record the valid access attempt in the event logger;

.4 Begin a Door Held Open timer (duration adjustable by the system administrator);

.5 Shunt the door contact for the duration of the timer cycle;

.6 If the door does not return to the closed position before the Door Held Open timer expires, a door held open alarm shall be generated at the operator workstation and the local audible alarm shall be activated.

.7 When the door returns to the closed position secure the Electric Strike.

.2 If the card is not valid, the ACS shall:

.1 Display the reader's "invalid" indicator;

.2 Maintain the electric door strike in the locked position;

.3 Generate an invalid access attempt alarm at the operator work station;

.4 Record the invalid access attempt in the event logger.

.3 Egress operation upon activation of REX:

.1 Record the valid egress attempt in the event logger;

.2 Begin a Door Held Open timer (duration adjustable by the system administrator);

.3 Shunt the door contact for the duration of the timer cycle;

.4 If the door does not return to the closed position before the Door Held Open timer expires, a door held open alarm shall be generated at the operator workstation and the local audible alarm shall be activated.

.5 These doors shall be equipped with fail secure locking devices, on the non-secure side of the door.

.5 "C" – Staff Controlled Speed Door

.1 When a user presents an access card to a card reader, the ACS shall read the card information. If the card is valid, the ACS shall:

.1 Display the card reader's "valid" indicator;

.2 Activate the Speed Door controller which shall in turn cause the door to automatically open allowing a vehicle to pass through. If the door returns to the closed position before the Lock Release Timer has expired, monitoring the door contact immediately;

.3 Record the valid access attempt in the event logger;

.4 Begin a Door Held Open timer (duration adjustable by the system administrator);

.5 Shunt the door contact for the duration of the timer cycle;

.6 If the door does not return to the closed position before the Door Held Open timer expires, a door held open alarm shall be generated at the operator workstation and the local audible alarm shall be activated.

.2 If the card is not valid, the ACS shall:

.1 Display the reader's "invalid" indicator;

.2 Maintain the Speed Door in the locked/Closed position;

.3 Generate an invalid access attempt alarm at the operator work station;

.4 Record the invalid access attempt in the event logger.

.3 Egress operation upon activation of Egress Induction Loop:

.1 Record the valid egress attempt in the event logger;

.2 Begin a Door Held Open timer (duration adjustable by the system administrator);

.3 Shunt the door contact for the duration of the timer cycle;

.4 If the door does not return to the closed position before the Door Held Open timer expires, a door held open alarm shall be generated at the operator

workstation and the local audible alarm shall be activated.

.6 .6 Type “D” – Staff Controlled Sliding Door

.7 Type “D-2” – Staff Monitored Service Portals

.1 When a user presents an access card to a card reader, the ACS shall read the card information. If the card is valid, the ACS shall:

.1 Display the card reader’s “valid” indicator;

.2 .2 Activate the Automatic Door Opener which shall in turn cause the doors to automatically to slide open. If the door returns to the closed position before the Lock Release Timer has expired, monitoring the door contact immediately

.3 Release the electric door strike latch for a short period of time as determined by the Lock Release Timer. If the door returns to the closed position before the Lock Release Timer has expired, de-energize the electric door strike and begin monitoring the door contact immediately;

.4 Record the valid access attempt in the event logger;

.5 Begin a Door Held Open timer (duration adjustable by the system administrator);

.6 Shunt the door contact for the duration of the timer cycle;

.7 Door shall open automatically via the power operator and then close automatically after a period of time. Under no circumstances shall the automatic opener activate with the locking devices engaged.

.8 If the door does not return to the closed position before the Door Held Open timer expires, a door held open alarm shall be generated at the operator workstation and the local audible alarm shall be activated.

.9 When the door returns to the closed position secure

the Electric Strike.

.2 If the card is not valid, the ACS shall:

.1 Display the reader's "invalid" indicator;

.2 Maintain the electric door strike in the locked position;

.3 Generate an invalid access attempt alarm at the operator work station;

.4 Record the invalid access attempt in the event logger.

.3 Egress operation upon activation of REX:

.1 Release the Electric Strike for a short period of time as determined by the Lock Release Timer;

.2 Record the valid egress attempt in the event logger;

.3 Begin a Door Held Open timer (duration adjustable by the system administrator);

.4 Shunt the door contact for the duration of the timer cycle;

.5 Door shall open automatically via the power operator and then close automatically after a period of time;

.6 If the door does not return to the closed position before the Door Held Open timer expires, a door held open alarm shall be generated at the operator workstation and the local audible alarm shall be activated;

.7 When the door is in the closed position secure the Electric Strike and monitor the door contact.

.8 .7 Staff Controlled Elevators

.9 Type "E" - Staff Controlled Elevators

.1 When a user presents an access card to a card reader, the ACS shall read the card information. If the card is valid, the ACS shall:

.1 Display the card reader's "valid" indicator;

.2 Enable all floors/buttons to which the user has been assigned access. (Floor Control)

.3 Record the valid access attempt in the event logger;

.4 Record the all elevator call buttons activated by the user. (Floor Monitoring)

.2 If the card is not valid, the ACS shall:

.1 Display the reader's "invalid" indicator;

.2 Maintain the disabling of elevator floor call buttons;

.3 Generate an invalid access attempt alarm at the operator work station;

.4 Record the invalid access attempt in the event logger.

.3 Activation of Fireman's Key switch:

.1 Deactivate all security equipment interfaced with the elevator and allow the elevator to respond normally to floor calls and other requests as generated by the elevator system and controls.

.5 Conduits, Boxes and Raceways

.1 The Contractor shall be responsible for providing all cable, conduits, boxes, and raceways as called for in the specification, or deemed necessary to provide a quality installation.

.2 All electronics modules shall be properly housed in steel enclosures or junction boxes as required.

.1 The Contractor shall be responsible for providing these enclosures or boxes where necessary.

.2 The Contractor shall be responsible for ensuring that all backboxes, conduit, and raceways meet equipment and wiring requirements for the system.

.3 The Contractor shall inspect the raceway system during construction and shall notify the City of any problems found, prior

to the finishing of the wall, ceiling, or floor surface.

.4 All junction boxes are to be accessible.

.5 Location of all boxes and access panels are to be approved by the City.

.6 No access panels may be located where they will affect the finished appearance of the surrounding area.

.6 Communications Rooms

.1 Provide cable troughs, conduit, and emergency power circuits for DGP configurations. Cable troughs shall be grounded to earth ground.

.2 All Equipment mounted in each DGP configuration shall be mounted on fire rated plywood supplied and installed by this Contractor.

.3 Access Control equipment, cable troughs, conduit, and emergency power circuits, and CCTV power supplies shall be wall mounted as per specification drawings and manufacturer's specifications. In the event the proposed layout becomes physically or technically infeasible the Contractor shall propose an alternative layout to the Owner or Owners representative and architect for approval. Alternate DGP equipment layout, cabling, and conduit shall not incur any additional costs to the project.

.7 Security Network

.1 Connectivity from the panels to the system front end will be based on Ethernet IP based protocols over a City supplied network. The Contractor shall connect Access Control equipment to communication rooms containing City network devices and connect to associated network patch panels.

.2 The Access Control Systems shall be configured to communicate with full functionality via the City local and or wide area networks.

.3 The Contractor shall coordinate and facilitate all connections of both networks with the City of Toronto IT department.

.8 City of Toronto Network

.1 This Contractor shall ensure all IP addressing schemes used on the security network are coordinated and approved by the City of Toronto IT department.

.9 Monitoring & Control Locations

.1 City, SCC/SOC/EOC and Breakout Rooms

.1 Supply and install all necessary C-Cure Client licenses for City console workstations.

.10 Interface with Other Systems

.1 Elevators

.1 Where elevators require card access, the card reader shall be mounted inside the cab and shall provide for floor by floor control. The elevator on a valid card read shall unlock all floors pertain to the cardholders access rights. Once a floor is chosen the elevators shall be directed to the restricted floor. The system shall capture information as to the floor that was chosen by the card holder.

.2 The Contractor shall be responsible for coordinating and identifying all installation requirements to the elevator company.

.3 The Contractor shall connected all equipment to the Access Control system and shall restrict and track access of card holders to each elevator floor.

.2 Network Time Protocol

.1 The Access Control System shall be maintained with NTP time. The NTP master clock shall provide by City of Toronto.

.3 Parking Garage Entrances, Gates and Exit Overhead Doors

.1 This Contractor shall be responsible for coordination, supply, installation and integration of access control and intercom system components and cabling to all locations where required.

.2 All doors and gates shall integrate to the access control system to open on a valid card read or remote operator action.

.3 This Contractor shall provide for all entrance and exit gates to have an override option for remote open and close of gates via the access control system software.

.4 703 Don Mills (SCC)

.1 Supply and install all required C-Cure client licenses on City of Toronto provided workstations at the 703 Don Mills security consoles to allow operators to view all alarms.

.2 Provide all required coordination, network appliances and infrastructure, programming, and configuration required to allow communication between sites.

.5 Photo badge and Verification

.1 The system shall be capable of integrating a photo-badge and verification application into the access control system. This application shall have dual functionality: design photo badge templates and draw floor maps.

.2 The operator shall have the ability to capture a photo. The photo capture of a cardholder shall be done by any Twain compatible device, i.e. video capture card, scanner, digital camera, or other. The system shall also provide for importing existing JPEG or Bitmap images of cardholders.

.3 The application shall allow a photo to be displayed when viewing cardholder records or online transactions from either the Client module or the guard monitoring application.

.4 The photo badge and verification application shall provide a suite of tools to draw objects, edit text, and insert database fields to create or modify badge templates.

.5 The application shall provide an interface for a card printer and be capable of printing cards on one or both sides at any given time.

.6 The system will allow photo verification when a token is read by the reader displaying the cardholder photo in a separate window. The operator shall be able to set the window to show photos of the last 10 cardholders whose activity produced a transaction.

.7 The Maps function shall allow the operator to either import basic AutoCAD® drawings (.dxf) or draw original floor maps and insert icons representing doors and supervised and auxiliary input device locations.

.8 The operator shall have the option to display a map from a specified access control interface screen to assist in locating the source of the alarm event.

.11 Power Requirements

.1 120 VAC power (on UPS/generator back-up if available) shall be provided for the security system at each location required. This includes all modifications to existing systems required to accomplish this task.

.2 The power solution shall comprise of CSA listed power supplies and transformers to distribute low voltage power to system components.

.3 The power solution shall include lockable, hinged covered, terminal cabinets for all power supplies, transformers, and power distribution terminal strips. The Contractor shall provide all conduit and wiring from the 120 VAC facilities to the terminal cabinets.

.4 The power solution shall provide protection against surges, spikes, noise, and other line problems for all system equipment and their components. In addition to generator support, all power sources shall be equipped with uninterrupted power supply capable of supporting all attached equipment for a period of 20 minutes.

.5 All equipment and system components which are powered by more than 48 volts AC or DC shall be ULC listed for safety. This includes equipment or system components classified as non-power limited.

.6 All system power supplies shall be monitored, by the Access Control System, for line failure on a dedicated monitoring input point. Therefore, when an AC line fails, a unique alarm condition will be caused.

.12 Labelled Fire Doors and Frames

.1 In no instance shall any labelled fire door or frame be cut, penetrated, drilled or modified in any way that has not been designated as requiring such in the security drawings.

.2 Any labelled fire door or frame which will require modification to meet the system specifications must be immediately brought to the attention of the City.

.3 The Contractor shall be responsible for replacing any labeled fire door or frame that is modified, by the Contractor, without written approval from the City.

.13 System Operable

.1 The security system shall be complete and capable of operation upon City acceptance of the system. The Contractor shall be responsible for preparing all systems for user operation.

.2 The Contractor shall be responsible to load the entire site specific database into the security system up to the inaugural day of City controlled use. The City will assist in establishing procedural guidelines, terminology, and conditions unique to the City's facility and facility needs.

.3 The Contractor shall ensure all controls and devices are labelled, in a

manner that is self-explanatory, to agree with their proper function and in accordance with provided labeling/naming conventions.

.4 The Contractor shall ensure duress buttons, intercom stations, pull stations, card readers, and other devices normally operated by end users shall remain covered until commissioned, to prevent attempted usage of a partially completed installation.

2 PRODUCTS

2.1 General Requirements

.1 The Contractor shall be fully responsible for the ultimate design and implementation of the system topology (physical and logical) best suited for the project, given identified and recognized physical infrastructure and constraints.

2.2 Technical Requirements – Field Devices

.1 Electric Strike Locks

.1 In locations requiring electric strikes these units shall be supplied and installed as noted in the door hardware schedules by the Contractor.

.2 Operation of these devices shall be verified by the Contractor.

.3 Each electric strike shall provide for latch bolt and locking cam monitoring. These shall be wired in series with a door position switch and be connected to a single unique monitoring input point.

.4 Doors with card readers/electric strikes will use a Request-To-Exit PIR, which is programmed only to shunt the door contact alarm, not to unlock the door.

.2 Door Position Switches

.1 The Contractor is responsible for and shall install appropriate models and types necessary for a fully functional system.

.2 Door position switches shall be concealed discrete devices unless otherwise noted and shall not be integral to other devices such as strikes, maglocks, etc.

.3 All E.O.L. resistors shall be installed at the door contact.

.3 Perimeter Doors

.1 Each perimeter door secured with a magnetic lock shall have a separate addressable monitoring input point for lock status and door position.

.2 Door position switches shall not be a component of the magnetic lock.

.3 Each doorway's locking arrangement shall be connected through an individually dedicated addressable system output for remote unlocking.

.4 Electromagnetic Locks

.1 Each card reader controlled magnetic lock shall have a magnetic bond sensor wired in series to a door position switch (which may be a component of the lock if not used in a perimeter location). These switches shall be connected to the door's "Door Monitor" point.

.2 Instruction for 500 ms MBS delay will be given on site. Power connections shall have a metal oxide varistor connected at the lock termination point.

.3 A fire alarm pull station, mounted on the egress side, supplied and installed by the Contractor, shall also be provided where new maglocks are installed.

.4 Applicable permits, inspections, and testing shall be the Contractor's responsibility at the contractor's expense.

.5 Door Release Push Buttons (Security Push Buttons to Exit)

.1 For use only on maglock doors, each door release push button shall provide double pole, double throw configuration.

.2 One pole is to request exit from the system, the other shall redundantly release the magnetic lock by power interruption.

.3 The exit pushbuttons shall be totally fail-safe, to release the doors in the event of a failure of the exit control circuitry within the reader interface module.

.4 All exit pushbuttons shall be labelled to meet local codes.

.6 Card Readers

.1 All new installs shall utilize HID RP40 or RPK40 multiclass readers. "Slim" (mullion) readers may be required for specific installations, as specified by the City.

.2 Vehicle gate readers should be "Mid-range" or "Long-range" type, as specified by the City.

.3 The City's normal colour of these reader covers is black; however, these reader covers are available in several colours to match existing interiors.

.1 The City will specify reader cover colour for each individual job.

.4 Elevator readers are to be recessed when possible.

.5 Card readers shall read the encoded data from the credential and transmit the data to the host panel. The card reader shall also present audio and visual feedback to the user that a card read operation is either "valid" or "invalid".

.6 Card readers shall read the encoded data from the credential and transmit the data to the host panel. The card reader shall also present audio and visual feedback to the user that a card read operation is either "valid" or "invalid".

.7 Visual feedback shall be through the use of LCD displays at doors with Pin pads or other advanced user interaction.

.8 Card readers shall be capable of being flush or surface mounted, and will typically be wall mounted.

.9 Smart Card Readers

.1 Card readers at certain sites shall be multi-technology iCLASS RP40 as manufactured by HID or approved equivalent.

.2 Card reader shall support as a minimum:

.1 HID Prox, iCLASS and MIFARE™ cards

.2 HID multi-technology Prox/iCLASS cards

.3 low-current consumption and operate at 5 or 12 VDC.

.4 Auto tuning for more consistent read ranges

.7 Access Cards

.1 Pre-Numbered Access Cards/Tokens

.1 The City uses Indala ISO30 FPISO 27-bit proximity access cards.

.2 The contractor should never order ISO30 FPISO 27-bit proximity access cards because the City has switched to new card technology. Similarly, the City uses Indala Flexkey ASK-116 FPKEY 27-bit proximity key fob access tokens, in one consecutive range of numbers.

.1 Facility code, offset, and number range to be provided to

the Contractor with each order.

The ordering of uses Indala Flexjey ASK-116 FPKEY 27-bit proximity key fob access tokens is under review.

.2 Access cards shall be highly resistive to wear and environmental deterioration and shall be able to be punched to accept chains or clips.

.3 Smart Cards

.1 The access card shall be an iClass Corporate 1000 “smart” proximity access control card manufactured by HID Corporation.

.2 The access card shall have up to 84 programmable bits of Wiegand formatted information for universal compatibility with all HID’ Wiegand reader applications.

.4 The Contractor shall ensure that the Owner is formally consulted to ensure card format and bit structure conform to their standards and allow for multiple site access capabilities where necessary.

.5 The access card shall be “Passive” (non-battery operated) proximity technology.

.6 The access card shall have a permanently engraved identification number printed onto it.

.7 The card numbering options shall be:

.1 Sequential Matching - The internal identification numbers and the external numbers shall both be sequential and shall match (i.e. internal numbers 1-100, external numbers 1-100).

.8 The access card shall be capable of having a photo or image printed directly onto the surface of the card with a direct print printer. It shall be offered with multicolour custom graphics, and shall have the option of a slot punch on the short edge of the card for a vertical/portrait format.

.9 The access card shall be no larger than 3.375" x 2.125" (8.57 X 5.40 cm), with a maximum thickness of 0.035" (0.09 cm).

.10 The access card shall have an operating temperature of -50 to 160 degrees Fahrenheit (-45 to 70 degrees Celsius), and shall have an operating humidity of 5-95% noncondensing.

.11 The read range of the access card shall be extremely consistent, and not affected by body shielding or variable environmental conditions.

.13 The City uses HID 1431 dual-technology MIFARE/PROX . The card uses the standard mifare S50 1K chip from NXP in addition to HID 125 KHz proximity. This card is used at 60 Tiffield biometric card reader.

.14 The contractor shall ensure that the City is formally consulted to ensure card format and bit structure conform to their standards and allow for multiple site access capabilities where necessary.

.8 .15 The contractor must consult with the City before ordering cards because of card sequential matching, HID card model number and HID iClass facility code numbers.Tamper Alarms

.1 All security equipment cabinets (including CCTV, ACS, intercom and audio/video system power supply cabinets) shall be equipped with sensors, which detect and remotely annunciate their opening.

.2 All AED (Automated External Defibrillator) devices noted on specification drawings shall be equipped with sensors, which detect and remotely annunciate their opening and removal.

.3 All communication and alarm device cabling at the door and between the DGP and the door shall be supervised to detect and remotely annunciate "open", "high impedance", "low impedance", and "short" conditions. The end of line supervision device shall be installed as close as possible to the security device.

.9 Local Enunciator Alarm

.1 All doors shall have a local audio/visual alarm feature. Local audio/visual alarms shall enunciate from either the card reader or Request to Exit Motion Detector at each location.

.2 The objective of the local alarm is to deter unauthorized entry and shall be controllable (On/Off) by the Security Operations Centre (SOC) operator.

.10 Motion Detector

.1 Motion detectors shall be dual technology passive infra-red (PIR) and microwave devices immune to RFI, vibration, static electricity, stray light, rapid temperature changes and other false alarm sources. These devices are to be supplied and installed by this Contractor.

.11 Request to Exit Motion Detector

.1 Request to Exit Motion Detectors shall be the 150i series as manufactured by Detection Systems.

.2 The REX will mask the alarm when a person is using the door for egress from the secure side of the door. REX shall shunt the door contact alarm only, not to unlock the door.

.12 Duress Buttons

.1 The City recommends all emergency (duress/panic) buttons to be HUB 2B type latching buttons, reverse mounted to deter false activation.

.2 Proper shielded wiring must also be installed for these buttons to reliably communicate with the C·Cure system.

.3 Where specified, a latching push button which visually indicates its state at the button, shall be connected to an individually-annunciated C·Cure800 system monitoring input point.

.1 This duress shall be configured as such that when activated, the button stays in a visible, activated mode until properly reset with a special tool. Exact duress placement shall be confirmed by the City prior to installation, according to the needs of the area occupant.

.13 Magnetic Lock Master Reset Switches

.1 The City utilizes the appropriate Locknetics 640 Series magnetic lock reset keyswitch. This switch shall be set-up to “enable” when turned one way and “disable” when turned the other.

.2 This switch should be normally located inside the Fire Panel System Room and shall indicate the lock control system status with red and green LED indicators at the switch.

.14 Field Panels

.1 The City normally utilizes field panels from Software House C·Cure product.

.15 Wiring Techniques

.1 Refer to Corporate Security Structured Cabling Standards

.2 All electrical work shall abide by the Ontario Electrical Code standards.

.3 All wiring shall be run within appropriate conduit. Placement of any exposed wiring in accessible ceilings or floors or within riser closets, etc., shall be submitted to and approved by the City prior to installation.

.4 Plenum type cable (FT6) must be used in all return air plenum spaces

and where required by code.

.5 All cables shall be fastened to the structure at least every ten (10) feet where not in conduit.

.6 Code compliant fireproofing techniques shall be used by the Contractor on all penetrations of fire rated partitions and slabs, where the penetrations are made by or used by the Contractor.

.7 All wires and cables shall be ULC listed for their application and shall conform to manufacturer specifications after installation.

.8 All cable and wiring methods shall meet national, provincial, and local code requirements.

.9 All cable must be properly grounded to meet Codes and provide a trouble free system.

.10 All wire and cable types shall be submitted to the Owner for acceptance prior to installation.

.11 All cables must be whole. Splicing of cable is prohibited.

.12 All cable carrying data or voice transmissions shall be individually shielded twisted pairs.

.1 All other cable shall be shielded where necessary for interference-free signals.

.13 Any splicing of coaxial cable that is required shall only be accomplished by means of video amplifiers. T

.1 The Contractor shall provide the power for the video amplifiers. The exact location of all video amplifiers used must be indicated on the record drawings.

.2 No splicing of communication or point monitoring/control cable will be acceptable.

.14 The existing wiring shall be reused whenever possible.

.15 If there is a need to rewire certain sections, any and all existing redundant wires and equipment shall be removed and the City shall be consulted for final approval.

.16 Cabling

.1 Refer to Corporate Security Structured Cabling Standards

2.3 Technical Requirements – Display and Control Equipment

.1 Distributed Processing Unit (DPU)

.1 General

.1 The DPU shall be the iSTAR control panel as manufactured by Software House. The controller shall be independent and totally self contained, microprocessor controlled field panel with built-in Ethernet connection and backup phone modem used to enhance or control a variety of systems. The panel shall serve as the data collection and communications interface between the System Server and the various field devices. The low battery fault and power fault outputs of the Advanced Power System should be looped together and attached to the power fail input on the panel.

.2 Power Requirements

.1 Each DPU shall accept a regulated DC input voltage and generate appropriate voltage levels for on-board use as required. All power output to external devices shall be current limited by the DPU.

.2 All DPU's shall contain a ULC or CSA approved power supply. In such cases where the DPU does not contain a ULC or CSA rating, a separate lockable and tampered external power supply containing these ratings shall be provided.

.3 All power supplies shall be hard wired into source 110VAC power. Plug in transformers are not acceptable.

.3 System Enclosure

.1 Sheet metal, of the appropriate gauge for the cabinet size per UL 294, shall be utilized. The cabinet shall be beige in color with a matte finish.

.2 The DPU's shall be housed in a locking 18 gauge metal cabinet, suitable for wall mounting. All cabinet locks shall be keyed alike. The cabinet shall be suitably sized to allow installation of the controller and all expansion modules and associated field wiring. The cabinet door shall include illuminated diagnostic indicators, which shall indicate the status of the panel. A single tamper switch shall be incorporated into the door. There shall be at least 4 mounting holes and 12 knockouts on the cabinet.

.4 Regulatory Approvals - UL 1950, UL 294, and UL 1076, ULC, CSA. All power supplies shall be ULC or CSA approved.

.2 General Controller Module

.1 The hardware platform of the controller shall be comprised of several components including the processor, Ethernet port, serial ports, expansion connectors, which can accept at least two Access Control Module (ACM) expansion cards, and a LCD for diagnostics and program verification. The board also includes on-board flash memory and sockets for RAM expansion.

.2 Memory Configurations - The DPU shall support at a minimum 64MB of on-board memory for cardholder and event storage and be capable of being field upgradeable to at least 128MB. There shall be at a minimum 16MB of on-board FLASH that shall be used for boot code and operating system code.

.3 Serial Ports - There shall be an RS-232 serial port that may be used for on-site data-retrieval/programming, troubleshooting, or for dialup communication via an external modem.

.4 Ethernet Port - The General Controller Module (GCM) shall support 10BaseT Ethernet Communication. The interface to the Ethernet services shall be through a standard RJ-45 jack connector.

.5 There shall be expansion connectors which will allow connections of at least two extra ACM's to the DPU.

.6 Indicators/Switches - The DPU shall have several LED indicators that show system and communication status. The DPU shall allow custom configuration of communication and software services through an integrated keypad.

.7 DPU LCD - The DPU shall support an LCD for status and field diagnostic messages. An integrated keypad shall be available to configure the DPU diagnostic modes.

.8 Inputs/Outputs

.1 The DPU shall support dedicated Normally closed (NC) inputs to monitor cabinet tamper, power fail and low battery. The System Administrative Application shall support the configuration of all dedicated inputs connected to the DPU. The Monitoring Application Interface shall provide the status of the inputs and shall log changes in input status. Inputs shall be able to be taken offline for

diagnostic purposes and each input shall support being linked directly to an output or to a system event. All input activations shall be reported to the Monitoring Application and stored in the Event History Database of the System Server.

.2 Cabinet Tamper contacts shall be normally closed and pre-wired to the enclosure door to report opening of the door as a tamper event.

.3 Power fail and low battery inputs shall be normally closed and wired from the battery backup power supply outputs to report main power fail and low batter conditions as required.

.3 Access Control Module

.1 All Access Control functionality shall be contained in the Access Control Module and its accessories. Access Control Modules shall be connected to the System Server through the GCM. Each DPU shall support at least two (2) Access Control Modules and at least 16 readers. The minimum number of supervised inputs per DPU shall be 192. The minimum number of outputs per DPU shall be 176.

.2 Each ACM provides at least 16 supervised inputs, eight (8) relay outputs and shall support at least eight (8) readers. The Access Control Module shall support the option of direct or indirect Wiegand reader connections. Indirect Wiegand readers shall be connected via the Door Control Unit (DCU) to the DGP by a properly wired RS-485 bus. Each DGP shall support up to eight (8) different card formats. Each card format shall support 50 company and site codes. The card formats shall be assigned to any of the card readers.

.3 Power Requirements - Each Access Control Module shall accept a regulated DC input voltage and generate appropriate voltage levels for on-board use as required. The input supply voltage shall be bussed directly to the reader bus connectors to supply operating voltages for reader and input/output modules. All Wiegand readers connected to the Wiegand ports shall have the same power requirements or an external power supply shall be required. All power outputs to external devices shall be power limited via PTCs.

.4 LED Indicators - Each ACM shall provide LED indicators for the following functions:

.1 Power on

.2 Data for the RS-485 communication ports.

.3 On-board relay activation

.5 Connectors - All ACM connectors shall be screw down type and pluggable to facilitate field replacements and simplify testing.

.6 Reader Ports - There shall be multiple RS-485 ports provided, per ACM, for connecting external DCU modules. An end-of-line (EOL) termination resistor shall be provided for each port to satisfy RS-485 multi-drop requirements. The EOL termination for each RS-485 port may be individually disabled.

.7 Supervised Inputs

.1 Class A Supervised optically isolated inputs shall be provided on each ACM. These inputs shall report secure for 100 ohms, alert for 500 or 2000 ohms; and alarm for open or short.

.2 The System Software Administrative Application shall support the configuration of all Supervised inputs connected to the ACM. The Monitoring Application Interface shall provide the current status of the inputs and shall log changes in input status. Supervised inputs shall be able to be taken offline for diagnostic purposes and each input shall support being linked directly to and output or to a system event. All input activations shall be reported to the Monitoring Application and stored in the Event History Database on the System Server.

.8 Outputs

.1 Each ACM shall provide multiple form C, general-purpose, dry contact relay outputs, which are user configurable. These relay contacts shall be rated at 10A at a nominal voltage of 28VDC\24VAC. Each relay contact shall have metal oxide varistors (MOV's), rated at 56V, between the relay's common terminal and the normally open and normally closed contacts to prolong the contact life and protect the ACM from external devices being controlled by the relay.

.2 The System Software Administrative Application shall support the configuration of all outputs connected to the ACM. The Monitoring Application Interface shall provide

the current status of each output and shall allow the manual activation of each output individually or in used defined groups for diagnostic purposes. All output activations shall be reported to the Monitoring Application and stored in the Event History Database on the System Server.

.2 Operator Workstations

.1 Supply and install client application software required for administrative and monitoring functions of the CCTV, Access Control, Intercom, Audio/Video and Video conferencing systems on each workstation shown in the specification drawings.

.2 The configuration should be capable of displaying at a minimum 16 MPEG-4 video streams at 4CIF/30fps at 2 Mbps.

.3 All workstations shall be provided by the City of Toronto IT department.

.4 This Contractor shall provide and coordinate all workstation quantities, requirements, and specifications to the City of Toronto IT department. Requirements shall be provided a minimum of 60 days prior to installation.

.5 Workstation requirements shall include as a minimum the following components. Specifications for these components shall be in compliance with the software developers recommended requirements for all software applications that are installed on the system:

.1 Main Memory

.2 Microprocessor

.3 Hard Disk Drive

.4 2 Accelerated Video Cards

.5 Network Interface Card

.6 Storage Media

.7 Mainboard

.1 Integrated 6-channel soundcard

.2 Integrated USB 2.0 controller with four (4) USB 2.0 ports.

.8 Key board: 101 key enhanced keyboard with USB 2.0 interface.

Keyboard shall incorporate soft touch keys and a retractable cord of not less than 2 m in extended length.

.9 Mouse: Optical mouse with USB 2.0 interface.

.10 Operating System

.6 Main Memory

.1 Architecture shall be based on DDR2 or FBDIMM technology.

.7 Microprocessor

.1 Hardware-enforced data execution disabling technology.

.1 This is a feature built into the microprocessor that can prevent certain classes of malicious buffer overflow attacks.

.2 Data execution disabling technology allows the processor to classify areas in memory by where application code can execute and where it cannot.

.3 When a malicious worm attempts to insert code in the buffer, the processor disables code execution, preventing damage and worm propagation.

.8 Network Interface Card

.1 Provide communication capabilities with the required quantity of CCTV, Access Control System, Intercom System servers over the owner supplied network.

.9 Provide an audible annunciator capability to signal alarm activation to the operator. It shall be possible for the operator to vary the level of the annunciator but not to turn it completely "off". The minimum allowable setting shall be 10 dB.

.10 Provide the capability and program the system to annunciate different alarm signals for the various alarm types.

.11 Invalid entries by the operator shall be annunciated and displayed on the computer monitors with another alternative entry.

.12 Use appropriate common terms when displaying or printing text. The use of uncommon abbreviations is not acceptable.

.13 All SOC workstations shall be configured for dual 20” LCD monitors.

.3 High Resolution Graphic:

.1 The system shall support a minimum of 200 user programmable color graphic map displays capable of showing the floor plan, location of alarm device, and alarm instructions. Floor plans shall be capable of being imported from other systems such as AutoCAD. All of the graphic maps are to be centralized in the system configuration and shall be displayed on the operator's workstations. Systems requiring separate display monitors or PC are not acceptable.

.4 Information Storage:

.1 All programmed information as well as transactional history shall be automatically stored onto the server hard disk for later retrieval. The system shall warn the operator when the disk space allocation approaches maximum capacity. The system shall allow the system administrator to determine at what percentage of capacity the warnings shall be issued. The system shall further allow the system administrator to define the frequency at which the warnings shall be issued.

.5 Rack Mounting:

.1 All equipment to be located within termination equipment cabinets shall be rack mounted.

.6 Equipment Cabinets

.1 Specific to specification

.7 KVM

.1 Refer to specification

.8 Information Backup/Retrieval:

.1 The System Server shall be capable of transferring all programmed data and transactional history to an appropriate archive storage media. All programmed data shall be restorable from the back-up media in case of system hardware failure.

.9 Communication Rates:

.1 The system shall be capable of supporting a minimum communication rate of 19,200 baud to all access control panels and 10MB Ethernet communications rates to client workstations.

.10 Communication Ports:

.1 Network Ports: The System Server shall support the use of Ethernet networks as the communications path between the server and DPU's, Intercoms and CCTV servers. This communications path shall be the same network used for communications between the System Server and the operator workstations. The communications between the System Server and the field devices shall be encapsulated in a TCP/IP network/transport layer.

.2 Port Name: Each communications port shall be addressed with the system by a unique twenty character user defined name. The used of code numbers or mnemonics shall not be accepted.

.3 Port Description: The System Server shall provide the ability to add a communication port description to each port configuration. There shall be no limit to the amount of text that can be used to describe the communications port.

.4 On-line/Off-line: The System Server shall allow the operator to put a communications port on-line or off-line. If the communications port is placed off-line, the System Server shall not use the port to communicate to field devise configured on that port. If the communications port is put on-line, the System Server shall use the port to communicate to field devices configured on that port.

.5 Communications failure:

.1 If the communications port is on a network device, such as a terminal server, the System Server shall indicate if there is a loss of communications to that network address. All field units connected to that network address should also be reported as being in communications failure.

.2 To allow for network delays, the System Server shall allow the system administrator to define a wait time before annunciation of a communications failure.

.3 The System Server shall provide the administrator the ability to set a reconnect retry period. This is the time period the system shall wait before attempting to re-establish communications with a network port which is in communications failure.

.4 Configuration of the remote communications port characteristics, i.e. baud rate, parity, error-checking etc. shall be done either on the network device or through network management tools. The configuration is not required to be executed by the Central Management System.

.5 IP address: For communications ports on a network device, the

System Server shall allow the operator to define the IP address of the device, as well as the local port address, to which the remote field devices are connected.

.11 Encryption:

.1 It shall be possible to configure a system such that the communications between the System Server and the DPU is encrypted.

2.4 Technical Requirements – Software

.1 Distributed Processing Unit (DPU)

.1 General

.1 The Distributed Processing Unit (DPU) serves as the data collection and communications interface between the host and the various field devices such as card readers, alarm inputs and control outputs. Communication between the Server and the DPU shall be asynchronous. The unit will consist of a separate general controller module and one or more access control modules.

.2 The software services are a set of common functions and applications that shall be installed on every DPU to perform system configuration, generic system event handling and communications between the DPU and System Server or other DPUs.

.3 The DPU shall provide for configuration, status and event reporting.

.4 An Access Control System (ACS) selectively allows certain people to enter an area. The DPU shall allow access to identified individuals, shall control entry by time, and shall record entries. The DPU shall also allow a server to control access, or allow an access cycle to be controlled by a request-to-exit input.

.5 The DPU shall perform door and elevator access control. The primary difference between door and elevator is as follows:

.1 For a door, the DPU will operate a single door latch relay (DLR) to unlock the door to allow access.

.2 For an elevator, the DPU operates multiple relays, (usually one per floor) to enable elevator buttons. When pressed, these buttons instruct the elevator to move to a particular floor where access is then allowed.

.3 The DPU will use a door switch monitor to determine door use, while elevator access control may use floor selection inputs to give feedback about which floor was accessed. There are also differences between door and elevator clearance records. Door clearances contain information about the days and times that a cardholder is allowed to access a specific door, while elevator clearances include additional information about the floors that may be accessed from a particular elevator.

.2 Communication Services:

.1 A set of Communications Services shall be provided to facilitate communication between the System Server and DPU, as well as between DPUs. The service shall also allow configuration of communication ports and shall handle all data encryption and communication protocol specifics.

.2 Communications

.1 The ACS shall be designed to support an advanced distributed network architecture, whereas DPU's do not need to be home-run wired back to the System Database Server. Controllers shall be wired at any point on the Local Area Network via industry standard TCP/IP communication protocol. DPUs shall be able to communicate back with the System Database Server through industry standard network switches and routers and shall not be required to reside on the same subnet. Any activity or event within the network can be routed to any client workstation(s) on the network, regardless of the Controller that manages the activity. The System Server shall manage any message routing issues, thus isolating the subsystem applications from network-specific communication details.

.2 The DPU to System Server Communication shall include authentication and a minimum of 128 bit encryption that conform to industry-accepted standards

.3 Upon losing and then restoring communications between a DPU and the System Server, database synchronization between the System Server and the local database in each controller shall be fast and efficient. Every change made to the controller database shall establish a time/date stamp for the change. When communications are restored, database synchronization shall occur immediately and without System Operator intervention. The time-date stamp shall be compared with any changes in the System

Database, hardware configuration, events, or output control commands and the System Server shall log which changes occurred after the off-line event. Any changes made to the System Server Database while the DPU was off-line shall also be simultaneously downloaded to all DPU databases in the System.

.4 Communication between the System Server and the DPU hall be asynchronous. The DPU shall not require any poll messages between the System Server and the DPU. Messages shall only be transmitted when required and messages can be initiated by any DPU or by the System Server. The DPU shall transmit a network heartbeat to the System Server to satisfy UL requirements.

.3 Protocols:

.1 Multiple communication techniques may be utilized between the System Server and DPU. Communication from controller to controller is via TCP/IP Ethernet only.

.2 The DPU shall support Dynamic Host Configuration Protocol) DHCP. Each DPU may be configured to accept IP address and device names from local DHCP, Windows Internet Naming Service (WINS) or Domain Name System (DNS) servers.

.3 The DPU shall have RS232 and Ethernet (RJ-45) ports on-board and shall not require external devices to connect to the network.

.3 Common System Services

.1 Common System Services will include a system watchdog, event handling services, time management services, software update services, database backup services and diagnostic services.

.2 The system shall constantly monitor all internal processes and if it detects a problem it shall reboot the DPU. The DPU shall also reboot automatically if the system software fails to strobe it.

.3 Software Update Service: The system software shall provide the ability to update the flashed software remotely from a host. Two images of the software shall always be stored, a permanent bootable image and an update image. If the update image becomes corrupt the DPU can fall back to the original image and inform the host to re-send the update image. This feature allows the DPU software to be easily upgraded to add new features or

download patches.

.4 Database backup to Flash: In the event of an unexpected power-loss, the system software shall automatically save the system and application databases by copying them to the Flash SIMM, and restoring them to RAM when power is restored.

.4 Event Handling Services

.1 The system software shall provide a service that will serve as a clearinghouse for all activities generated on a DPU. The System Server will upload a list of action definitions and a list of events to each controller. Based on this information, the system shall perform the actions specified for each activity as it is reported. The system software shall provide an interface for reporting activities.

.2 Event Linking: Event linking on the system shall tie an activity on one DPU to the triggering of an action on the same or a different DPU. Any conflict of event link requests shall be resolved in the system by means of a server-assigned priority for each event link. The DPU shall support three types of event linking:

.1 Local Event Linking - When the source device and the target device are linked through an activity on the same DPU, local event linking shall occur.

.2 Peer-to-Peer Event Linking - When the source device and the target device being linked through an activity are on different DPUs in the same peer group, event linking will occur. The transmission of the action request from one DPU to another shall occur with no server intervention.

.3 Global Event Linking - When the source device and the target device being linked through an activity are on different groups, global event linking will occur. This cross-system linking will require that the action request messages be routed through a host for delivery to a separate DPU.

.4 The definitions of the event links shall be created on the server and shall be downloaded to the appropriate controllers. The server shall also insure that the event link definitions are valid and that there are no recursive links.

.3 Action Scheduling - The system software shall provide an action scheduling service that will execute actions on devices residing on the same or other DPUss at a predefined time, frequency and time

interval. The action definitions shall be the same server-defined actions utilized by event linking. The actions and the action schedule shall be defined by a server and shall be downloaded to the appropriate DPUs. The system shall allow a server to manually invoke a predefined action.

.4 Offline / Online Reporting - The system shall provide a mechanism to report activities to a server for display, reporting and archiving. If a server is not currently connected to the cluster of DPUs, the activity reports will be buffered until the server connects to the DPU. Should the server-configured, activity buffer limit be exceeded before a server connects, the first in first out rule shall apply.

.5 Time Management Services - The system shall provide a service to manage user-defined time periods, called Time Specifications. These time specifications shall be defined on the server and downloaded to all DPUs. The time management services shall also ensure that all controllers have a synchronized time clock. All time periods downloaded shall be defined according to Greenwich Mean Time (GMT) by the host.

.6 Input / Output Services

.1 The system software shall allow the configuration and control of inputs and output. The software shall allow the retrieving of the current status of the inputs and shall log changes in input and output status. The software shall allow the control of the output including setting the current state to activated, deactivated or momentarily activated.

.2 Inputs monitored may include: Cabinet tamper, Power fail input, Low battery input.

.3 Input configuration controls the behaviour of the input and includes the following parameters:

.1 Enabled/Disabled – a disabled input is not monitored.

.2 Reversed – whether the input should be treated as reversed – alert report as secure, secure report as alert.

.4 The DPU shall allow the configuration of input events. These events shall include activation outside a specified time specification causes event.

.5 Output configuration controls the behaviour of the Output and includes the following parameters:

.1 Enabled/Disabled – Whether the output is enabled or disabled. Disabled outputs do not react to any output control requests.

.2 Reversed – Whether the output is reversed. At the lowest level of control, a reversed output shall have an activate request changed to deactivate and deactivate changed to activate.

.5 Diagnostic Services

.1 The DPU shall provide real-time status and diagnostic information to system installers, trouble-shooters and tech support personnel. Based on this information, a user should be able to determine the connection status, memory status, time and general condition of the controller. Predefined diagnostic tests may be executed and the results of these tests presented to the user. The following minimal information should be available:

.1 Controller Time/Boot Time

.2 Total/Available Memory

.3 Connection Status

.4 Firmware and OS Versions

.5 Total and Available Memory (RAM)

.6 Current Time Information

.7 Controller Type

.2 The DPU shall provide diagnostic services through either a diagnostic web server, through an RS-232 port supplied by the DPU, and HMI on the controller or any other reasonable method.

.6 Access Control Services:

.1 Door Access Control: The System Server shall allow the DPU to handle door configuration and control.

.2 Panel Wide Door and Reader Configuration: If card readers include keypads used for PINs, the Server may configure the number of digits required in the PIN as well as any other

functionality on a panel wide bases.

.3 Door Configuration: The door configuration defines the behaviour of a door and includes the following parameters:

.1 Inbound and Outbound Access Readers(s) (optional) – which readers are monitored at this door.

.2 Door Switch Monitor (DSM) (optional) – usually a simple switch that changes state when the door is opened or closed. The switch, if enabled, connects to a monitored input. If the DSM input becomes active while not shunted, it will generate a Door Forced Open Alarm.

.3 Door Shunt Time – how long the DSM should be shunted after the door is opened for access. The configuration may also indicate whether the DSM should remain shunted for the full shunt time, instead of clearing when the door closes. If the DSM remains active after the shunt time expires, it shall generate a Door Held Open event.

.4 Request to Exit (RTE) Input (optional) – an input whose activation triggers an access cycle that allows egress through a door. The RTE Input should be placed on the protected side of the door. The configuration may indicate whether the DSM should be shunted as long as the RTE is active, and whether the DLR should be enabled for and RTE access. Request to Exit Push Buttons (RXP) and Request to Exit Motion Detectors (REX) operate maglock and electric strikes respectively.

.1 If an RXP is connected to a RTE input, the DPU signals the Door Control Unit (DCU) to de-energize the maglock to allow free egress open toggling of the RXP.

.2 If an REX is connected to a RTE input, the DPU signals the DCU to energize the electric strike to allow free egress upon detection of a person on the secure side of the door.

.5 Door Latch Relay (DLR) (optional) – the output which controls the strike for the door.

.6 Door Unlock Time – the length of time that the DLR is energized during a valid access cycle. The DLR is normally energized for a valid access, and de-energized as soon as the door opens, but a Re-lock Delay may cause the DLR to

be energized for a number of seconds after the door opens. Access grant decisions based on presented cards, RTE access based on RTE input activation, and host requests for momentary unlock of the door all cause the DPU to perform a valid access cycle at the door.

.7 Continuous Active Mode - a door may be configured for continuous active mode or non-continuous active mode. In non-continuous active mode, each side of the door will process only one card or RTE access cycle at a time – from the time the card is read or the RTE activates, until the door is opened and closed for the access. During this access cycle, all other cars and RTE requests will be ignored. In continuous active mode, cards and RTE requests may be processed at any time during the access cycle.

.8 ADA Output – an output may be configured to activate at 1 second after the door is unlocked for valid access, for a duration of 1 second when the door is being accessed by cardholders with an ADA flag in their personal record.

.9 Expanded Shunt Time – For certain cardholders, a longer shunt time may also be configured.

.4 Door Control: The DPU shall allow door control from a host. The door mode may be set to lock, unlocked momentarily unlocked, or access disabled modes. A momentary unlock request will start a valid access cycle process on the door.

.5 Door Status Reporting: The DPU shall report door alarm status changes including door held open and door forced open.

.6 Door Event Configuration: The DPU shall allow the configuration of events that are activated by certain door event. The supported events shall include:

.1 Door held open causes Event

.2 Door forced causes Event

.3 Duress access causes Event

.4 All admits cause Event

.5 All rejects cause Event

.6 All visitor admits cause Event

.7 All visitor rejects cause Event

.8 All noticed admits cause Event

.9 All noticed rejects cause Event

.7 Door Groups: The DPU shall allow the configuration of door groups by a server. Door groups may then be used in clearances, or to group doors for common control.

.8 Reader Configuration: The DPU shall allow reader configuration from a server. The reader configuration defines the behaviour specific to a reader on a door and includes the following parameters:

.1 Default PIN Mode – If a card reader includes a keypad, it may be configured to require the cardholder to enter a Personal identification Number (PIN), in addition to presenting a card, to gain access at a door. A Time Specification may be entered to control this mode on a time basis.

.2 Card formats – the card formats supported at this reader.

.3 Entry through Pinpads – For card readers with Pinpads, they may be configured to allow the users to enter their pre-programmed pin number through the Pinpad instead of by presenting a card.

.4 Command Entry through Pinpads – Card readers with Pinpads, may be configured to allow the user to enter additional command sequences through the Pinpad during the card transaction process.

.9 Reader Events: The DPU shall allow the configuration of events that are activated by certain reader events.

.1 Reader communication failure causes Event

.2 Reader tamper causes Event

.10 Interface to Reader Hardware

.1 The DPU shall communicate with reader-bus modules to receive card swipe, and to set the reader LED’s and display to communicate access control results to cardholders.

.2 The DPU shall support the user of inputs and outputs on the reader-bus modules and on the DPU expansion card for use as door switch monitors, door latch relays, request to exit inputs and any other access control related purposes.

.7 Elevator Access Control Services

.1 Elevator Configuration: The DPU shall allow the configuration of elevators from a server. The elevator configuration controls the behaviour of the elevator and includes the following parameters.

.1 Reader – The reader assigned to this elevator.

.2 Floor to Output (Elevator Button) mapping – Each floor is mapped to an output which when activated shall enable a floor button in the elevator.

.3 Button activation time – The maximum time that the outputs shall be activated for during an access cycle. Floor selection feedback may shorten this time for a particular access cycle.

.4 Floor selection feedback configuration – An elevator may have on of three types of floor selection feedback.

.5 None – The outputs shall be activated for the full Button activation time and the access report shall not indicate which floor was accessed.

.6 Single Input – The outputs shall be activated for the full Button activation time or until this input activates (whichever comes sooner) and the access report shall not indicate which floor was accessed.

.7 Multiple Input – the outputs shall be activated for the full Button activation time or until one of the multiple floor selection inputs activates (whichever comes sooner) and the access report shall indicate which floor was accessed based on which input activates.

.8 Floor selection input mapping – For the single input floor selection, the input, or for multiple input floor selection the multiple inputs, will be configured.

.2 Elevator Control: The DPU shall allow elevator control from a server controlling and un-controlling individual buttons and requiring or disabling PIN use at the elevator.

.3 Elevator Groups: The DPU shall allow the configuration of elevator groups by a server. Elevator groups may then be used in clearances, control zones, or to group doors for common control.

.4 Floor Groups: The DPU shall allow the configuration of floor groups. Floor groups are primarily used in elevator clearances.

.5 Interface to Reader Hardware

.1 The DPU shall communicate with reader-bus modules to receive card swipe data, and to set the reader LED's and display to communicate elevator access control results to cardholders.

.2 The DPU shall support the user of inputs and outputs on the reader-bus modules and on the DPU expansion card for use as floor-enabled outputs and floor-selection inputs and any other elevator access control related purposes.

.8 Card Formats: The DPU shall allow the configuration of card format records describing data that may be read by the card readers. This includes whether the data read from the card is binary (typically from a Wiegand or proximity reader) or BCD (typically from a magnetic card reader), and the length and position of the card number, issue code, any facility or site codes, or parity bits in the data. The API shall allow for specification of which formats are valid at each card reader.

.9 Anti-passback (APB) and Area Related Features

.1 Anti-passback

.1 The anti-passback feature (sometimes abbreviated APB) prevents cardholders from gaining access at a reader and then passing cards back through the door for other people to use. The ACS accomplishes this by keeping track of the area the cardholder is in. If a cardholder attempts to gain access to an area that he/she already occupies, then the ACS assumes that the cardholder passed the card back for another to use and access will be denied.

.2 The APB feature also includes tests for tailgating – the tailgate rule prevents cardholders without using their own access cards. When the ACS receives a receives a request from a cardholder to enter a new area, it checks which are the cardholder last entered. If the area the cardholder is exiting differs from the area the system last recorded the cardholder as entering, the system assumes the cardholder exited the latter area by following someone

out.

.3 Anti-passback and tailgating are tested for any access that leads to or from an area that is configured for anti-passback.

.4 The system does not change the recorded area that the cardholder is in until it knows that the cardholder has actually passed through a door. If the door does not have a DSM input or some other means of determining entry, or if the door is open, the system will record the area change as soon as the admit decision is made. For the case of a door configured as continuously active, where multiple cards may be presented before the door is opened; all valid cards will be recorded as entering into the area when the door finally opens.

.5 The single-threaded anti-passback role prevents a cardholder from presenting a card at a door and after being admitted, but before opening the door, passes the card to someone else that presents it at an adjacent door and is admitted there. If the system grants access to a cardholder and, before the door is open, detects the same card presented at a second door, the system shall deny the cardholder access at the second door (anti-passback violation), unless all the doors at which the card is presented are configured not to test for any form of anti-passback. The exception to this rule is that if the readers on a particular door are not configured to lead in and out of any area at all, then that door shall not check for single-threaded anti-passback nor shall accesses at that door affect other doors testing for single-threaded anti-passback.

.6 Doors whose readers are not configured as part of any area shall not participate in any anti-passback testing, and accesses at that door shall not cause the cardholders location to change, and these accesses shall not be recorded as part of the accesses recorded for timed anti-passback testing. Normally these would be interior doors inside a controlled area.

.2 Timed Anti-Passback: A simpler form of anti-passback, known as Timed anti-passback, may be configured for a door. Timed anti-passback is useful for locations where other types of anti-passback are not possible. If the system records that a cardholder uses a card to enter an area more than once in a specified time period, the system assumes that a second person used the same

card after the original cardholder entered the area. Timed anti-passback is tested for each access that leads into an area configured for times anti-passback. Due to memory constraints it is not possible to record every access that a cardholder may make within the re-entry time, but the system shall record the last three accesses entered and test against those to determine if the cardholder's card is being used to re-enter the area.

.3 Anti-Passback Grace Flag: The Anti-passback grace flag is an indicator set in a personnel record that allows the cardholder to gain access at a door without being tested for any form of anti-passback. When the cardholder goes through the door, the grace flag is cleared. An API shall be supplied to allow a single or all personnel records to be graced.

.4 Area Events: The DPU shall provide an API to allow the configuration of events that are activated by certain area events. These include:

.1 Entrance – this is activated when a cardholder with an AP Event flag is the personnel record triggers an anti-passback violation while entering the area.

.2 Exit – this is activated when a carholder with an AP Event flag in the personnel record triggers an anti-passback violation while exiting the area.

.10 Input Services

.1 The DPU shall allow the configuration and control of inputs connected to reader-bus modules and inputs connected to the DPU and any logical input that may be maintained by the DPU.

.2 Inputs monitored may include:

.1 The inputs directly connected to the DPU.

.2 The cabinet tamper and power fail inputs.

.3 The inputs connected to readers.

.4 The inputs connected to input boards.

.5 The tamper inputs on the reader, the input boards, and the output boards.

.3 Logical inputs monitored may include:

.1 The on-line/off-line condition of any of the reader-bus modules.

.2 Door force open and door held open on a door.

.3 Input Definition

.4 The DPU shall allow the configuration of inputs. Input configuration controls the behaviour of the input and includes the following parameters:

.1 Enabled/Disabled – a disabled input is not monitored.

.2 Armed/Disarmed – a disarmed input may report secure (or supervision error, if supervised), and armed input may report secure, alert, or supervision error.

.3 Reversed – whether the input should be treated as reversed – alert report as secure, secure report as alert.

.5 Input Control: The DPU shall allow the control if inputs including arming/disarming the input.

.6 Input Status Reporting: The DPU shall allow the retrieving of the current status of inputs and shall log changes in input status.

.7 Input Event Configuration: The DPU shall allow the configuration of input events. The events will include:

.1 Activation during a specified time specification causes Event.

.2 Activation outside a specified time specification causes Event.

.3 Supervision error causes Event.

.4 Tamper on input board or board causes Event.

.5 Communication failure of input board or output board causes Event.

.8 Input Groups: The DPU shall allow the configuration of input groups. Input groups may be referenced by events.

.11 Output Services

.1 The DPU shall allow the configuration and control of outputs

connected to reader-bus modules and of outputs connected directly to the DPU.

.2 Output Definition: The DPU shall allow the configuration of outputs. Output configuration controls the behaviour of the Output and includes the following parameters:

.1 Enabled/Disabled – Whether the output is enabled or disabled. Disabled outputs do not react to any output control requests.

.2 Reversed – Whether the output is reversed. As the lowest level of control, a reversed output will have an activate request changed to deactivate and deactivate changed to activate.

.3 Output Control: The DPU shall allow the control of outputs, including setting the current state to activated, deactivated, or momentarily activated.

.4 Output Groups: The DPU shall allow the configuration of output groups. Output groups are useful for elevator definitions, events or other purposes.

.12 Personnel Database

.1 The DPU shall provide a database to facilitate the storage of personnel data.

.2 In addition to the database manipulation functions described below, the DPU shall supply an API to apply anti-passback grace to one or many personnel records.

.3 Personnel records used for access control may include the following parameters:

.1 Card Number – the number embedded in the access card or otherwise associated with the access request.

.2 Control Flags – such as whether this cardholder may need the ADA output for accesses, or whether the card is currently disabled. These flags include ADA, lost, noticed, AP Event, expired, and disabled.

.3 Issue Code

.4 Personal Identification Number (PIN)

.5 Activation/Deactivation Date – cardholder records typically contain field for an activation and a deactivation date which specify the date/time when the access card becomes valid and invalid, respectively. By setting the activation date, the card can be issued in advance of use; the deactivation date ensures that the card cannot be used after a certain time. The activation date may also be set to after the deactivation date to disable the card for a period of time.

.13 Clearance Database: The DPU shall provide a database to facilitate the storage of regular and elevator clearance data. Clearances describe the locations and times at which an access card is valid. Because people often share the same access privileges, clearances are created separately from personnel records. Clearance records include a varying number of time specification and door group pairs.

3 EXECUTION

3.1 General

.1 Programming

.1 The Contractor shall include all associated costs to program the system and ensure all configuration and naming conventions are approved by the Owner or Owners Representative.

.2 The Contractor shall attend pre-installation meetings as required with the Owner and/or Owners representative and key staff to identify the specifics of the system programming.

.3 The Contractor shall be responsible to document all decided on software configuration parameters and submit for approval.

.4 The Contractor shall include all approved software configuration parameters in final revisions shop drawings.

.5 Building door numbers are not yet final and will change prior to final system programming. The Contractor shall be responsible to ensure final programming configuration and system documentation match this newest set to be provided by the Architect.

.2 For C-Cure programming please refer to document “C-Cure 9000 Programming Lables”

3.2 Mechanical and Electrical Requirements

.1 Refer to specific requirements of the specification.

3.3 **Commissioning**

.1 Refer to specific City requirements of the specification and the NFPA 730 and 731 standards.

3.4 **Training**

.1 Refer to specific requirements of the specification.

3.5 **Documentation**

.1 Refer to specific requirements of the specification.

3.6 **Warranty**

.1 Warranty Period: Two years from date of Substantial Completion

END OF SECTION