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- 1 General
- 1.1 **SUMMARY**
- .1 Section Includes
- .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- 1.2 **CODES, PERMITS AND INSPECTIONS**
- .1 Applicable Codes
- .1 Ontario Electrical Safety Code
- .2 Ontario Building Code
- .3 Ontario Fire Code
- .2 Comply with Ontario Electrical Safety Code, all local, provincial and federal laws, where applicable and with authorities having jurisdiction. Make any changes or alterations required by authorized inspector of authority having jurisdiction.
- .3 Equipment and material must be acceptable to Electrical Safety Authority.
- .4 Where materials are specified which require special inspection and approval, obtain such approval for the particular installation with the cooperation of the material Supplier.
- .5 Obtain and pay for permits and inspections required for work performed.
- .6 Supply and install warning signs, nameplates and glass covered single line diagrams as required by Electrical Safety Authority.
- .7 Submit required documents and Shop Drawings to authorities having jurisdiction in order to obtain approval for the Work. Copies of Contract Drawings and Specifications may be used for this purpose.
- 1.3 **REFERENCE STANDARDS**
- .1 These Specifications supplement the referenced standards.
- .2 Where standards differ between authorities, the most rigid apply.
- .3 Where requirements of the Specifications exceed referenced standards, the Specifications apply.
- 1.4 **COORDINATION**
- .1 Refer to and comply with Section 01 10 00.
- .2 Carefully examine Work and Drawings of all related trades and thoroughly plan the Work so as to avoid interferences. Report defects which would adversely affect the Work. Do not commence installation until such defects have been corrected.
- .3 Coordinate Work of this division such that items will properly interface with Work of other divisions.
- .4 Architectural Drawings, or in the absence of Architectural Drawings, Mechanical Drawings govern all locations.
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- .5 Coordinate work of this division with Division 21 to ensure that damage does not occur to the fireproofing work of Division 21.

1.5 **SUBSTITUTIONS**

- .1 When only one manufacturer's catalogued trade name is specified, provide only that catalogued trade name, material or Product.
- .2 When more than one manufacturer's trade name is specified for a material or Product, the choice is the bidders.
- .3 No substitution is allowed upon award of Contract.

1.6 **DIMENSIONS AND QUANTITIES**

- .1 Dimensions shown on Drawings are approximate. Verify dimensions by reference to Shop Drawings and field measurement.
- .2 Quantities or lengths indicated in Contract Documents are approximate only and shall not be held to gauge or limit the Work.
- .3 Make necessary changes or additions to routing of conduit, cables, cable trays, and the like to accommodate structural, mechanical and architectural conditions. Where raceways are shown diagrammatically run them parallel to building column lines.

1.7 **EQUIPMENT LOCATIONS**

- .1 Devices, fixtures and outlets may be relocated, prior to installation, from the location shown on the Contract Drawings, to a maximum distance of 3 m, without adjustment to Contract Price.
- .2 Switch, control device and outlet locations are shown diagrammatically.

1.8 **INSTALLATION DRAWINGS**

- .1 Prepare Installation Drawings for equipment, based upon approved Vendor Drawings, to check required code clearances, raceway, busway and cable entries, sizing of housekeeping pads and structure openings. Submit Installation Drawings to Consultant for review.

1.9 **"AS BUILT" RECORD DRAWINGS**

- .1 (Refer to and comply with Section 01 33 00.) Maintain a set of Contract Drawings on site and record all deviations from the Contract Documents. **As a mandatory requirement, recording must be done on the same day deviation is made. Be responsible for full compliance with this requirement.**
- .2 Mark locations of feeder conduits, junction and terminal boxes and ducts or conduits run underground either below the building or outside the building.
- .3 Where conduit and wiring are underground or underfloor, furnish field dimension with respect to building column lines and inverts with respect to finished floor levels or grades.
- .4 Record deviations from branch circuit numbers shown on Drawings.
- .5 Prepare diagrams of interconnecting wiring between items of equipment including equipment supplied by Owner and under other Specification sections.

1.10 **SINGLE LINE DIAGRAM**

- .1 Reproduce this diagram in drawing form under glazed frame and mount in main switchgear room. Provide a copy of this diagram to the Consultant and include in the Maintenance Manuals.

1.11 **TEST REPORTS**

- .1 For each check and test performed prepare and submit a test report, signed by the Test Engineer, and where witnessed, by the Consultant.
- .2 Include record of all tests performed, methods of calculation, date and time of test, ambient conditions, names of testing company, Test Engineer, witnesses; also calibration record of all test instruments used together with manufacturers name, serial number and model number.
- .3 Include calibration record, percentage error and applicable correction factors.
- .4 Submit a certified test report from each manufacturer, signed by the certifying inspector, confirming correct installation and operation of each Product and part of Work. Include name of certifying inspector, date and times of inspection, ambient conditions.

1.12 **SHOP (VENDOR) DRAWINGS AND PARTS LISTS**

- .1 Refer to and comply with Section 01 33 00.
- .2 Submit for review, manufacturer's or vendor's drawings for all Products being furnished except cable (up to 1000V), wire and conduit. Include rating, performance, specification sheets, descriptive literature, schematic and wiring diagrams, dimensional layouts and weights of components as well as complete assembly.
- .3 Drawings for equipment assemblies, such as switchgear and unit substations, must include the entire assembly on a single drawing having a minimum size of 420 mm x 594 mm.

1.13 **FACTORY WITNESS TESTS**

- .1 Prior to Consultant attendance at factory for witness testing, perform the following:
  - .1 Successfully conduct test to be witnessed.
  - .2 Following successful testing, inform the Consultant, in writing, that tests to be witnessed have been successfully performed.

1.14 **OPERATING AND MAINTENANCE MANUALS**

- .1 Refer to and comply with Section 01 33 00 and related sections.

1.15 **AREA CLASSIFICATION**

- .1 \_\_\_\_\_

2 Products

2.1 **APPROVALS AND QUALITY**

- .1 Provide new materials bearing certification marks or labels acceptable under Ontario Electrical Safety Code.

- .2 Equipment must bear, on manufacturer's label, certification mark or label acceptable under Electrical Safety Authority.
- .3 Provide units of same manufacture where two or more units of same class or type of equipment are required.
- .4 Manufacturer's names are stated in this Specification to establish a definite basis for tender submission and to clearly describe the quality of Product that is desired for the Work.

## 2.2 **STANDARD SPECIFICATIONS**

- .1 Ensure that the chemical and physical properties, design, performance characteristics and methods of construction of all Products provided comply with latest issue of applicable standard Specifications issued by authorities having jurisdiction, but such standard Specifications shall not be applied to decrease the quality of workmanship, Products and services required by the Contract Documents.

## 2.3 **SPRINKLER PROOF EQUIPMENT**

- .1 Ensure that electrical equipment installed in electrical rooms and other areas containing sprinklers is constructed such that exposure to water from the sprinkler heads does not impair the effectiveness of the enclosed equipment.
- .2 Provide a separate cover or roof on all 2285 mm high equipment. Provide an overhang at the front, rear and sides to effectively prevent the entrance of water either at the top or through projecting faceplates, meters, etc.
- .3 Where penetrations are made in drip shields, flash and seal using manufacturer's approved caulking to maintain drip shield integrity.
- .4 Ensure that enclosure louvres are of outdoor design such that falling water or water running down the sides will not enter the enclosure.
- .5 Where enclosure openings in the top or sides are required for outgoing conduits, provide waterproof conduit fittings.
- .6 Provide panels and transformers with hoods.
- .7 Provide sprinkler proof busways.
- .8 In electrical rooms containing sprinklers provide wall mounted equipment such as pull boxes, junction boxes, splitter troughs, wireways, auxiliary gutters, cable troughs and disconnect switches located below the level of the sprinkler heads with the following accessories:
  - .1 Gaskets on doors and drip shields on equipment, panelboards, panels and enclosures.
  - .2 Louvres facing outward and downward where openings are required for heat dissipation. Expanded metal screening is not acceptable.

## 2.4 **HOUSEKEEPING PADS**

- .1 Provide 100 mm high concrete pads under floor mounted electrical equipment. Extend pads 50 mm outside the equipment perimeter.

**2.5 FIRE BARRIERS**

- .1 Where electrical material or devices pass through fire rated separations, make penetrations and provide fire barrier seals with a fire resistance rating equivalent to the rating of the separation.
- .2 Prior to installation, submit for review, proposed fire barrier seal materials, method of installation and ULC system number.
- .3 Acceptable Manufacturers:
  - .1 A/D Fire Protection Systems
  - .2 Dow Corning
  - .3 Fire Stop Systems
  - .4 IPC Flamesafe Firestop
  - .5 Nelson Electric
  - .6 3M
  - .7 Tremco

**2.6 MISCELLANEOUS METAL FABRICATIONS**

- .1 Provide miscellaneous structural supports, platforms, braces, brackets and preformed channel struts necessary for suspension, attachment or support of electrical equipment in accordance with Section 05 50 00.

**2.7 SILICONE**

- .1 Products and materials containing silicone are not permitted.
- .2 Refer to and comply with Section 01 61 05.

**2.8 EQUIPMENT COLOUR CODING**

- .1 Exterior finish paint colour for switchgear, control panels, panelboards and devices on emergency and UPS systems:
  - .1 Emergency systems: Red
  - .2 UPS systems: Blue

**2.9 PRODUCTS FURNISHED BY OWNER**

- .1 Refer to Sections 00 21 00, 00 41 13, and 01 10 00.
- .2 Carefully examine the Vendor or Manufacturers' Drawings and provide any incidental and miscellaneous materials, mounting hardware and supports required for complete systems.

**3 Execution**

**3.1 MANUFACTURER'S ATTENDANCE**

- .1 Provide manufacturer's representatives to initially start-up each part of the Work, as specified, to check, adjust, calibrate and balance as applicable all components including controls and field wiring. Provide these services for such period and for as many visits as necessary to achieve complete working order in the subject Work.
- 3.2 **FIELD INSPECTION**
  - .1 Provide Field Engineer for inspection and certification of equipment during installation, testing and commissioning as required.
- 3.3 **PAINTING**
  - .1 Touch up finishes on electrical equipment found to be marred on completion of the Work using same colour and type of finish as originally used.
  - .2 Prime paint field fabricated metalwork.
  - .3 Other painting will be provided under Section 09 91 00.
- 3.4 **CORE DRILLING**
  - .1 Core Drilling Procedure
    - .1 Examine locations to be core drilled where:
      - .1 Diameter is greater than 25 mm
      - .2 Multiple drillings required and where the distance between centres is less than ten times the diameter of the hole
    - .2 Examine by most suitable method including:
      - .1 X-ray
      - .2 Ferro scan
      - .3 Cable detection
    - .3 Examine from both sides of the structure to be drilled.
    - .4 Examine proposed core drilling locations to determine:
      - .1 Possible interference with
        - .1 Services
        - .2 Structural components
      - .2 Possible presence of asbestos tile or other asbestos based material. Report any occurrence or suspected occurrence to the Consultant immediately.
    - .5 Select locations as suitable for core drilling and label them:
      - .1 Uniquely number each drilling location and core so that markings will be legible after drilling
      - .2 Mark each core with a north pointing arrow where drilling a slab or upward pointing arrow where drilling a wall

- .6 Without interfering with or damaging any services or structural elements, drill pilot holes sufficient to verify location of potential obstructions or for alignment purposes.
- .7 Use impact drill when drilling holes of 25 mm diameter or less. For holes of greater diameter use core drill.
- .8 Prepare report showing intended core drill locations including printouts and X-ray images. Prior to drilling submit the report to Consultant for approval.
- .9 Proceed with core drilling only after approval has been received from Consultant.
- .10 Confine drilling operation to time-of-day as stipulated by Consultant.
- .11 Position suitable warning notices of a type acceptable to Consultant and exercise caution to ensure safety and protection of personnel and property during drilling especially from effects of water, dust damage, or falling objects below the slab or behind the wall being drilled.
- .12 Stop drilling immediately, and report to Consultant, if contact is made with foreign objects such as reinforcing steel (rebar), electrical conduit, water pipes, drainage pipes.
- .13 Cover open holes with secured covers to guard against fall through of objects.
- .14 Provide necessary firestopping, temporary or otherwise, sufficient to firestop holes that would be otherwise open during hours that the location is unattended. Coordinate placement of firestopping with Consultant.
- .15 Store all cores or core fragments on site and make them available for inspection by Consultant. Dispose of the cores or core fragments after permission is received from Consultant.

End of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

.1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to latest issues, amendments and supplements of following standards:

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|-----|------------------------|--|
| .1  | CISC/CPMA 2.75         | - Canadian Institute of Steel Construction/<br>Canadian Paint Manufacturers Association, A<br>Quick Drying Primer For Use on Structural<br>Steel |
| .2  | CAN/CGSB-1.40-M        | - Primer, Structural Steel, Oil Alkyd Type   |
| .3  | CAN3-C21.1-M           | - Control Cable - 600V   |
| .4  | CAN3-C21.2-M           | - Control Cable for Low Energy Circuits 150V<br>and 300V   |
| .5  | CAN/CSA C22.2 No. 18   | - Outlet Boxes, Conduit Boxes, and Fittings  |
| .6  | CAN/C22.2 No. 26       | - Wireways, Auxiliary Gutters and Associated<br>Fittings   |
| .7  | CSA C22.2 No. 30-M     | - Explosion-Proof Enclosures for Use in Class I<br>Hazardous Locations   |
| .8  | CSA C22.2 No. 38-M     | - Thermoset Insulated Wires and Cables   |
| .9  | CSA C22.2 No. 40-M     | - Cutout, Junction and Pull Boxes  |
| .10 | CSA C22.2 No. 42-M     | - General Use Receptacles, Attachment Plugs<br>and Similar Wiring Devices  |
| .11 | CSA C22.2 No. 45-M     | - Rigid Metal Conduit  |
| .12 | CSA C22.2 No. 49       | - Flexible Cords and Cables  |
| .13 | CAN/CSA C22.2 No. 51-M | - Armoured Cables  |
| .14 | CSA C22.2 No. 52-M     | - Service-Entrance Cables  |
| .15 | CSA C22.2 No. 56       | - Flexible Metal Conduit and Liquid-Tight<br>Flexible Metal Conduit  |
| .16 | CSA C22.2 No. 62       | - Surface Raceway Systems  |
| .17 | CSA C22.2 No. 65       | - Wire Connectors  |
| .18 | CSA C22.2 No. 75-M     | - Thermoplastic Insulated Wires and Cables   |
| .19 | CSA C22.2 No. 76-M     | - Splitters  |

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.20	CSA C22.2 No. 79	- Cellular Metal and Cellular Concrete Floor Raceways and Fittings
.21	CSA C22.2 No. 80	- Underfloor Raceways and Fittings
.22	CSA C22.2 No. 83-M	- Electrical Metallic Tubing
.23	CAN/CSA-C22.2 No. 85-M	- Rigid PVC Boxes and Fittings
.24	CAN/CSA C22.2 No. 94-M	- Special Purpose Enclosures
.25	CSA C22.2 No. 123-M	- Aluminum Sheathed Cables
.26	CSA C22.2 No. 124-M	- Mineral-Insulated Cables
.27	CSA C22.2 No. 126-M	- Cable Tray Systems
.28	CSA C22.2 No. 127	- Equipment Wires
.29	CAN/CSA-C22.2 No. 131-M	- Type Teck 90 Cable
.30	CSA C22.2 No. 138-M	- Heat Tracing Cable and Cable Sets for Use in Hazardous Locations
.31	CSA C22.2 No. 159-M	- Attachment Plugs, Receptacles and Similar Wiring Devices for Use in Hazardous Locations: Class I, Groups A, B, C, and D; Class II, Group G, in Coal or Coke Dust, and in Gaseous Mines
.32	CSA C22.2 No. 174-M	- Cable and Cable Glands for Use in Hazardous Locations
.33	CSA C22.2 No. 182.1	- Industrial Type, Special Use Attachment Plugs, Receptacles, and Connectors
.34	CSA C22.2 No. 182.2-M	- Industrial Locking Type, Special Use Attachment Plugs, Receptacles, and Connectors
.35	CSA C22.2 No. 182.3-M	- Special Use Attachment Plugs, Receptacles, and Connectors
.36	CSA C22.2 No. 208-M	- Fire Alarm and Signal Cable
.37	CSA C22.2 No. 211.2-M	- Rigid PVC (Unplasticized) Conduit
.38	CSA C22.2 No. 211.3	- Rigid Fiberglass Reinforced Epoxy (RE) Conduit and Associated Fittings
.39	CSA C22.2 No. 214-M	- Communications Cables
.40	CSA C22.2 No. 222-M	- Type FCC Under-Carpet Wiring System
.41	CSA C22.2 No. 227.1	- Electrical Nonmetallic Tubing
.42	CSA C22.2 No. 227.2	- Flexible Liquid-Tight Nonmetallic Conduit
.43	CSA C22.2 No. 227.3-M	- Flexible Nonmetallic Tubing

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- .44 CSA C22.2 No. 230-M - Tray Cables
- .45 CSA C22.2 No. 232-M - Optical Fiber Cables
- .46 SSPC - Steel Structures Painting Council, "Steel Structures Painting Manual, Vol. 2"

1.3 **SUBMITTALS**

- .1 Consultant reserves the right to require Contractor to submit samples of any materials to be used in this Project.

2 Products

2.1 **WIRE - LOW VOLTAGE UP TO 1000V SERVICE**

.1 Conductors

- .1 ASTM Class B, soft drawn, electrolytic copper
- .2 Stranded

.2 Insulation

- .1 CSA type RW90 XLPE (-40°C)
  - .1 Heat and moisture resistant
  - .2 Low temperature, chemically cross-linked thermosetting polyethylene material
  - .3 600 V rated
  - .4 For maximum 90°C (194°F) conductor temperature
  - .5 For installation at minimum -40°C (-40°F) temperature
  - .6 To CSA C22.2 No. 38
- .2 CSA type RWU90 XLPE (-40°C):
  - .1 Heat and moisture resistant
  - .2 Low temperature, chemically cross-linked thermosetting polyethylene material
  - .3 1000 V rated
  - .4 For maximum 90°C (194°F) conductor temperature
  - .5 For installation at minimum -40°C (-40°F)
  - .6 To CSA C22.2 No. 38
- .3 CSA type T90 NYLON (-10°C):
  - .1 Heat resistant
  - .2 Flame retardant

- .3 Thermoplastic PVC material with extruded nylon cover
  - .4 600 V rated
  - .5 For maximum 90°C (194°F) conductor temperature dry and 75°C in wet locations
  - .6 For installation at minimum -10°C (14°F)
  - .7 To CSA C22.2 No. 75-M
- .4 CSA type TEW:
  - .1 Heat resistant
  - .2 600 V rated
  - .3 For maximum 105°C (221°F) conductor temperature
  - .4 To CSA C22.2 No. 127
- .5 CSA type SEW-2
  - .1 Heat resistant
  - .2 600 V rated
  - .3 For maximum 200°C (392°F) conductor temperature
  - .4 To CSA C22.2 No. 127
- .3 Acceptable Manufacturers
  - .1 Alcan Cable
  - .2 Alcatel Canada Wire
  - .3 Pirelli Cables
- 2.2 **CABLE - LOW VOLTAGE UP TO 1000V SERVICE**
  - .1 CSA Type AC90 XLPE (-40°C)
    - .1 Conductors
      - .1 ASTM Class B, soft drawn, electrolytic copper
      - .2 Solid for sizes #10 AWG and smaller
      - .3 Stranded for sizes #8 AWG and larger
    - .2 Insulation
      - .1 Heat and moisture resistant
      - .2 Low temperature, chemically cross-linked thermosetting polyethylene material
      - .3 600 V rated for sizes #10 AWG and smaller

- .4 1000 V rated for sizes #8 AWG and larger
- .5 For maximum 90°C (194°F) conductor temperature
- .6 For installation at minimum -40°C (-40°F) temperature
- .7 To CSA C22.2 No. 38
- .3 Construction
  - .1 Two, three or four insulated conductors
  - .2 Bare ground conductor
  - .3 Overall interlocking aluminum armour
  - .4 To CSA C22.2 No. 51
- .4 Acceptable Manufacturers
  - .1 Alcan Cable
  - .2 Alcatel Canada Wire
  - .3 Pirelli Cables
- .2 CSA Type TECK90 (-40°C)
  - .1 Conductors
    - .1 ASTM Class B, soft drawn, electrolytic copper
    - .2 Stranded
  - .2 Insulation
    - .1 Heat and moisture resistant
    - .2 Low temperature, chemically cross-linked thermosetting polyethylene material
    - .3 600 V or 1000 V rated
    - .4 For maximum 90°C (194°F) conductor temperature
    - .5 For installation at minimum -40°C (-40°F) temperature
    - .6 CSA type RW90 XLPE
    - .7 To CSA C22.2 No. 38
  - .3 Construction
    - .1 One or more insulated conductors
    - .2 Bare, stranded, copper ground conductor for multi-conductor cables
    - .3 Bare, solid, served copper ground conductors for single conductor cables

- .4 Fillers with binder tape to produce a circular cross-section for multi-conductor cables
- .5 Power cables
  - .1 One, two, three or four conductors
  - .2 Conductors 1000 V rated
- .6 Control cables
  - .1 Two or more conductors
  - .2 Conductors 600 V rated
- .7 Composite cables
  - .1 Three power conductors
  - .2 Three #14 AWG control conductors
  - .3 Conductors 600V rated
- .8 Extruded PVC inner jacket over conductor assembly
- .9 Interlocking aluminum armour over inner jacket
- .10 Extruded PVC overall jacket over armour
  - .1 FT4 flame test rated
  - .2 Colour black unless otherwise indicated
- .11 Cable assembly for installation at minimum -40°C (-40°F) temperature
- .12 To CSA C22.2 No. 131 and CSA C22.2 No. 174
- .4 Acceptable Manufacturers
  - .1 Alcan Cable
  - .2 Alcatel Canada Wire
  - .3 BICC Phillips
  - .4 Pirelli Cables
- .3 CSA Type RA90 XLPE (-40°C)
  - .1 Conductors
    - .1 ASTM Class B, soft drawn, electrolytic copper
    - OR
    - .2 CSA type ACM aluminum alloy
    - .3 Stranded

- .2 Insulation
  - .1 Heat and moisture resistant
  - .2 Low temperature, chemically cross-linked thermosetting polyethylene material
  - .3 600 V rated
  - .4 For maximum 90°C (194°F) conductor temperature
  - .5 For installation at minimum -40°C (-40°F) temperature
  - .6 CSA type RW90 XLPE
  - .7 To CSA C22.2 No. 38
- .3 Construction
  - .1 Single conductor
  - .2 Continuous, corrugated aluminum sheath of minimum cross-sectional area to comply with electrical code table 16
  - .3 Extruded PVC overall jacket over armour
    - .1 FT4 flame test rated
    - .2 Colour black unless otherwise indicated
  - .4 Cable assembly for installation at minimum -40°C (-40°F) temperature
  - .5 To CSA C22.2 No. 123 and CSA C22.2 No. 174
- .4 Acceptable Manufacturers
  - .1 Alcan Cable
  - .2 Alcatel Canada Wire
  - .3 BICC Phillips
- .4 CSA Type TC, Tray Cable (-40°C)
  - .1 Conductors
    - .1 ASTM Class B, soft drawn, electrolytic copper
    - .2 Stranded
  - .2 Insulation
    - .1 Heat and moisture resistant
    - .2 Low temperature, chemically cross-linked thermosetting polyethylene material
    - .3 600 V rated
    - .4 For maximum 90°C (194°F) conductor temperature

- .5 For installation at minimum -40°C (-40°F) temperature
- .6 CSA type RW90 XLPE to CSA C22.2 No. 38
- .3 Construction
  - .1 Two or more insulated conductors
  - .2 Bare, stranded, copper ground conductor
  - .3 Fillers with binder tape to produce a circular cross-section
  - .4 Jacket
    - .1 PVC
    - .2 FT4 flame test rated
    - .3 Low acid gas rated to CSA C22.2 No. 0.3
    - .4 Black colour
  - .5 To CSA C22.2 No. 230
- .4 Acceptable Manufacturers
  - .1 Alcatel Canada Wire
  - .2 BICC Phillips
  - .3 Pirelli Cables
- .5 CSA Type MI
  - .1 Conductors
    - .1 ASTM Class B, soft drawn, electrolytic copper
    - .2 Solid
  - .2 Insulation
    - .1 Powdered magnesium oxide
    - .2 600 V rated
  - .3 Construction
    - .1 Solid conductor
    - .2 Insulation around the conductor compressed to form a solid, homogeneous mass between the conductor and the metal sheath throughout the entire length of cable
    - .3 Soft annealed seamless copper sheath over insulation
    - .4 Extruded PVC overall jacket over sheath
      - .1 FT4 flame test rated



- .2 Colour black unless otherwise indicated
- .5 To CSA C22.1 No. 124-M
- .4 Acceptable Manufacturer
  - .1 Pyrotenax
- .6 EMF-Free Power Cable
  - .1 Conductors
    - .1 ASTM Class B, soft drawn, electrolytic copper
    - .2 Stranded central conductor
    - .3 Solid, served concentric return conductors, equivalent to central conductor
    - .4 Conductor size and number of runs to suit feeder ratings as shown on drawings
  - .2 Insulation
    - .1 Heat and moisture resistant
    - .2 Ethylene propylene rubber (EPR)
    - .3 Minimum 600 V rated
    - .4 For maximum 90°C (194°F) conductor temperature
    - .5 For installation at minimum -40°C (-40°F) temperature
    - .6 To CSA C22.2 No. 38
  - .3 Construction
    - .1 Single conductor with served wire return conductor (coaxial)
    - .2 PVC inner-jacket over return conductor
    - .3 Interlocking aluminum over inner jacket
    - .4 Overall PVC jacket
  - .4 Power filters
    - .1 Filter parameters to suit the feeder characteristics (rating, length, etc.)
    - .2 EEMAC type 1 enclosure
  - .5 Engineered system
    - .1 Provide EMF-free power cables and power filters as a complete engineered system from the manufacturer
  - .6 Acceptable Manufacturer
    - .1 United Wire & Cable (ZeroFlux® Power Cable)

## 2.3 **MODULAR WIRING (LIGHTING SYSTEMS)**

### .1 Distribution Boxes

- .1 Steel, EEMAC 1 enclosure, minimum size 300 mm x 300 mm x 100 mm
- .2 Modular connectors, five-wire, female
- .3 Terminal block for incoming wiring
- .4 Stranded copper wiring between terminal block and modular connectors

### .2 Extension/Tap Cables

- .1 Armoured type cable, #10 or #12 AWG, copper conductors rated 600 V, 90°C (194°F) insulation
- .2 Modular connectors, five-wire, one male at one end and twin female at other end or splitters to maintain circuit continuity on removal of luminaire drop cable

### .3 Luminaire Drop Cables

- .1 Service cord, type SEO or armoured cable, three-wire, stranded copper conductors rated 600V, 105°C (221°F) insulation, colour phase identification on jacket (phase A, red; phase B, black; phase C, blue)
- .2 Modular connector, male
- .3 Prewired to luminaires

### .4 Modular Connectors

- .1 Rated 347 V, 20 A
- .2 Rated to connect or disconnect an individual luminaire under load

### .5 Acceptable Manufacturers

- .1 Flex Systems (Flex) 3+
- .2 Lithonia Reloc
- .3 Holophane Holoflex
- .4 Cooper MWS

## 2.4 **CABLE CONNECTORS**

### .1 Connectors for Type AC90 Cable

- .1 Steel or malleable iron
- .2 Insulated throat
- .3 Acceptable manufacturers
  - .1 Efcor 1000B series
  - .2 Elliott 65200 series

- .3 Thomas & Betts 3110 series
- .2 Connectors for Type TECK90 Cable
  - .1 Copper free aluminum body
  - .2 Steel or copper free aluminum fittings and locknut
  - .3 Certified for use in hazardous locations Classes I, II, and III
  - .4 Class I hazardous location sealing fitting
  - .5 Acceptable manufacturers
    - .1 Thomas & Betts "STE" series
    - .2 Crouse-Hinds type TMC
    - .3 Commander/Iberville type TEK
- .3 Connectors for Type RA90 Cable
  - .1 Copper free aluminum body
  - .2 Steel or copper free aluminum fittings
  - .3 Acceptable manufacturers
    - .1 Alcatel Canada Wire
    - .2 Crouse-Hinds, type TMC
- .4 Connectors for Type TC, Tray Cable
  - .1 Copper free aluminum body
  - .2 Steel or copper free aluminum fittings and locknut
  - .3 Acceptable manufacturers
    - .1 Thomas & Betts, Tray-Star, HLT series
    - .2 Crouse-Hinds, type TMC
- 2.5 **WIRE AND CABLE CONNECTORS**
  - .1 Copper compression type wire and cable terminations for #8 AWG and larger conductors, colour keyed, sized to suit. Long barrel NEMA 2 hole lugs for sizes #1/0 AWG and larger.
    - .1 Acceptable Manufacturers
      - .1 Thomas & Betts series 54000
      - .2 Ideal Powr-Connect
      - .3 Burndy Hylug
  - .2 Twist type splicing connectors, copper, sized to suit, with nylon or plastic shroud for tee connections in #10 AWG and smaller conductors.

- .1 Acceptable Manufacturers
    - .1 Thomas & Betts spring type
    - .2 Ideal Twister
    - .3 Marr Marrette
  - .3 Conductor compression splice for #10 AWG or smaller.
    - .1 Acceptable Manufacturers
      - .1 Thomas & Betts STA-Kon series
      - .2 Ideal Splices
      - .3 Burndy
  - 2.6 **HEAT SHRINKABLE TUBING INSULATION, HEAVY WALL**
    - .1 Acceptable Manufacturers
      - .1 Thomas & Betts, Shrink-Kon series
      - .2 Ideal Thermo-Shrink, TS-46
      - .3 Raychem tubing WCSM
      - .4 3M cable sleeve ITCSN
  - 2.7 **MOTOR LEAD CONNECTION KITS, 600 VOLT**
    - .1 Connection kits for low voltage motors.
    - .2 Acceptable Manufacturers
      - .1 3M, motor lead splice kit, pigtail, 5300 series
      - .2 Raychem, motor connection kit, MCK, type V
  - 2.8 **MOTOR LEAD CONNECTION KITS, 5000 VOLT**
    - .1 Connection kits for 4000 V motors.
    - .2 Acceptable Manufacturers
      - .1 3M, motor lead splice kit, pigtail, 5320 series
      - .2 Raychem, motor connection kit, MCK-5, type V
  - 2.9 **CONDUIT AND FITTINGS**
    - .1 Rigid Steel Conduit
      - .1 To CSA C22.2 No. 45-M
      - .2 Rigid thickwall galvanized steel threaded conduit
    - .2 Coated Steel Conduit
      - .1 Corrosive resistant coated rigid thickwall steel threaded conduit, CSA approved.
-

- .2 Acceptable Manufacturers
  - .1 Rob Roy Plastibond PVC coated
  - .2 Columbex Green Guard II epoxy polyester coated
- .3 Rigid PVC Conduit
  - .1 To CSA C22.2 No. 211.2-M
  - .2 Rigid PVC conduit
- .4 Flexible Steel Conduit
  - .1 To CSA 22.2 No. 56
  - .2 Liquid-tight flexible steel conduit with PVC cover
- .5 Non-Metallic Flexible Conduit
  - .1 Non-metallic extra flexible PVC conduit
  - .2 Acceptable Manufacturers
    - .1 Carlon, Carflex X-Flex
    - .2 Hubbell, Polytuff Black
- .6 Rigid Steel Conduit Fittings
  - .1 To CAN/CSA C22.2 No. 18
  - .2 Galvanized or polymer coated cast steel fittings
  - .3 Expansion fittings, watertight with integral bonding jumper suitable for linear expansion and 19 mm deflection in all directions
  - .4 Sealing condulets for hazardous areas
  - .5 Corrosive resistant coated cast steel fittings for corrosive resistant conduit
- .7 Rigid PVC Conduit Fittings
  - .1 To CSA C22.2 No. 85-M
  - .2 Rigid PVC fittings of same manufacture as rigid PVC conduit
- .8 Liquid Tight Flexible Steel Conduit Fittings
  - .1 Watertight connectors with nylon insulated throat
    - .1 Acceptable Manufacturers:
      - .1 T & B Series 5331 with Sealing O-ring Series 5262
      - .2 Commander/Iberville Series 6300-IT with nitrile O-ring

2.10 **EMT AND FITTINGS**

- .1 EMT

- .1 To CSA C22.2 No. 83-M
- .2 EMT galvanized cold rolled steel tubing
- .2 EMT Fittings
  - .1 Compression type, steel
    - .1 Gland compression connectors with insulated throats
    - .2 Compression couplings
    - .3 Acceptable manufacturers:
      - .1 T & B Series 5123 & 5120
      - .2 O-Z/Gedney type ZTC series
      - .3 Commander/Iberville Series 5600-IT and 5700
  - .2 Set screw type, steel, concrete-tight
    - .1 Connectors with insulated throats
    - .2 Couplings
    - .3 Acceptable manufacturers
      - .1 Commander/Iberville Series 5400 and 5500

2.11 **CABLE TRAY**

- .1 Cable Trays and Fittings
  - .1 To EEMAC F5-1
  - .2 To CAN/CSA C22.2 No. 126-M
- .2 Ladder Type
  - .1 Class C1
  - .2 Aluminum (Steel, hot dip galvanized after fabrication)
  - .3 Side height, 100 mm(150 mm)
  - .4 Rung spacing, 300 mm
- .3 Ventilated Type
  - .1 Class C1
  - .2 Aluminum (Steel, hot dip galvanized after fabrication)
  - .3 Side height, 100 mm(150 mm)
- .4 Solid Type
  - .1 Class C1
  - .2 Aluminum (Steel, hot dip galvanized after fabrication)

- .3 Side height, 100 mm(150 mm)
- .5 Centre Rail Type
  - .1 Class C1
  - .2 Aluminum
  - .3 Rung spacing 150 mm, 225 mm, 300 mm
  - .4 Loading depth 75 mm, 100 mm, 150 mm
  - .5 Rung width 25 mm minimum
- .6 Acceptable manufacturers for ladder, ventilated and solid types:
  - .1 B-Line
  - .2 Canadian Electrical Raceways
  - .3 Canstrut
  - .4 Electrotray
  - .5 Pilgrim
  - .6 Pursley
  - .7 Unistrut
- .7 Acceptable manufacturers for centre rail type:
  - .1 Wiremold, Spec Mate CA series
  - .2 B-Line, Cent-R-Rail
- 2.12 **WIREWAY**
  - .1 To CSA C22.1 No. 94-M.
  - .2 Steel with hinged cover to give uninterrupted access.
  - .3 Elbows, tees, couplings and hanger fittings manufactured as accessories for wireway supplied.
  - .4 Acceptable Manufacturers:
    - .1 Amalgamated Electric
    - .2 Canadian Electrical Raceways
    - .3 Schneider Square D
    - .4 Pilgrim
    - .5 Pursley

2.13 **SURFACE RACEWAY**

- .1 Surface metal raceway, snap-in divider to form two compartments for power and voice/data, with removable cover.
- .2 Elbows, couplings, end caps, device brackets and faceplates for power, data and voice, and fittings manufactured as accessories for wireway supplied. 120 V power receptacles and mounting only for voice/data.
- .3 Acceptable manufacturer:
  - .1 Wiremold with following components:
    - .1 4000 series, ivory colour
    - .2 Device mounting plate, V4049-G and faceplate 5507-G colour grey
    - .3 Duplex receptacles, 120V, 15A, Leviton Decora plus, colour grey 16262-GY
    - .4 Duplex receptacle, 120V, 20A, P & S Sierraplex, colour grey, 26342-GRY

2.14 **CELLULAR FLOOR SYSTEM**

- .1 Standards
  - .1 Raceways and fittings to CSA C22.2 No. 79.
  - .2 Activation kits and components CSA approved.
- .2 Trench duct: Steel construction, intermittent bottom, adjustable compartment dividers, removable covers, external levelling screws, void closures, coupling mechanisms, end closures, elbows and coverplate lifting device.
- .3 Preset inserts: Steel construction, triple service access with grommetted openings for access to low tension and power cells.
- .4 Activation kits: Pedestal fitting, multiplex service, two duplex power convenience receptacles, two data receptacles, two telephone jack outlets, and fittings to connect to preset inserts.
- .5 Acceptable Manufacturer
  - .1 Walker: Trenchduct type VA, preset inserts NRG-Bloc series and activation kits M6 series

2.15 **FASTENINGS, SUPPORTS AND SLEEVES**

- .1 Fastenings
  - .1 Galvanized steel straps, beam clamps and threaded rods
- .2 Sleeves
  - .1 Schedule 40 steel pipe, minimum I.D. 13 mm larger than outside diameter of conduit or cable passing through.



- .3 Strut
    - .1 Continuous slotted channel
    - .2 Twelve gauge pre-galvanized steel
    - .3 41.2 mm x 41.2 mm minimum
    - .4 Acceptable manufacturers:
      - .1 B-Line
      - .2 Pilgrim
      - .3 Pursley
      - .4 Unistrut
  
  - 2.16 **SPLITTER BOXES**
    - .1 Code gauge (galvanized) sheet steel enclosure EEMAC Type (1) (4) (12) welded corners and formed hinged cover suitable for locking in closed position.
    - .2 Cast steel enclosure EEMAC 7 (9) with gasketed bolt on cover for hazardous locations.
    - .3 Copper (aluminum) main and branch lugs to match required size and number of incoming and outgoing conductors.
    - .4 At least three spare terminals on each set of lugs in splitters less than 400 A.
  
  - 2.17 **JUNCTION BOXES**
    - .1 Galvanized steel EEMAC Type 1 (4) (12) size as required by code for number and size of conduits, conductors and devices, complete with covers, corrosion resistant screws, terminal blocks and mounting rails.
    - .2 Screw-on sheet steel covers to match enclosure for surface mounting boxes.
    - .3 Covers with 25 mm minimum extension around for flush-mounted junction boxes.
    - .4 Galvanized steel barriers as required.
  
  - 2.18 **TERMINAL BLOCKS - SURGE PROTECTION**
    - .1 Terminal blocks, rail mounted, with surge voltage protection, rated for circuit voltage.
    - .2 Acceptable Manufacturers
      - .1 Phoenix Contact Termitrab SLKK5 (Termitrab SLKK5-F) (TT-SLKK5-S).
  
  - 2.19 **PULL BOXES**
    - .1 Galvanized sheet steel welded construction, EEMAC Type 1, (4) (12).
    - .2 Screw-on galvanized sheet steel covers for surface mounting boxes.
    - .3 Covers with 25 mm minimum extension around, for flush mounted pull boxes.
    - .4 Galvanized steel barriers as required.
-

2.20           **CONDUIT BOXES - GENERAL**

- .1           Boxes for EMT
  - .1           Galvanized pressed steel
- .2           Boxes for Rigid Steel Conduit
  - .1           Galvanized cast iron alloy FS boxes with mounting feet for surface mounted switches and receptacles
  - .2           Gasketted cover plate for exterior location
  - .3           For corrosive resistant coated conduit: Cast boxes with same finish as conduit
- .3           Boxes for Rigid PVC Conduit
  - .1           PVC boxes

2.21           **OUTLET BOXES - SHEET STEEL**

- .1           Pressed steel single and multi-gang flush device boxes, minimum size 100 mm x 50 mm x 38 mm. 100 mm square outlet boxes where more than one conduit enters one side, with extension rings as required.
- .2           100 mm square or octagonal outlet boxes.
- .3           119 mm square outlet boxes with extension and plaster rings as necessary for flush mounting devices in gypsum board, plaster or panelled walls.

2.22           **MASONRY BOXES**

- .1           Pressed steel masonry single and multi-gang boxes for devices flush mounted in exposed masonry walls with extension and plaster rings as required.

2.23           **CONCRETE BOXES**

- .1           Pressed steel concrete type boxes for flush mount in concrete with extension and plaster rings as required.

2.24           **OUTLET BOXES - FITTINGS**

- .1           Bushings and connectors with nylon insulated throats.
- .2           Knock-out fillers to prevent entry of foreign materials.
- .3           Double locknuts and insulated bushings for sheet steel metal boxes.

2.25           **WIRING DEVICES - SWITCHES**

- .1           Specification grade, general purpose AC switches, manual toggle operated, (white), (ivory) and (brown) colour, 15 A, 20 A, 120-277 V, 347 V, single pole, double pole, three-way, four-way switches as required.
- .2           Acceptable Manufacturers:
  - .1           Hubbell - HBL1201 Series: HBL1221 Series: HBL18201 Series: HBL 18221 Series

- .2 P & S - 15AC Series: 20AC Series: 370000 Series
- .3 Arrow Hart - 1891 Series: 1991 Series: 18201 Series: 18221 Series
- .3 Specification grade, general purpose AC switches, manual rocker operated, (white), (ivory) colour, 15 A, 20 A, 120-277 V, 347 V, single pole, double pole, three-way, four-way switches as required.
- .4 Acceptable Manufacturers
  - .1 Bryant, 120-277V, Fashion Series 9000
  - .2 Hubbell, 120-277V, Style Line 2100 Series
  - .3 Leviton, 120-277V and 347V, Decora Plus 5600 Series
  - .4 Pass & Seymour, 120-277V and 347V, Sierraplex Decorator, 2600 and 2600000 Series

## 2.26 **WIRING DEVICES - DIMMER SWITCHES**

- .1 Dimmer switches: solid state, full range with slider type handle on-off switch, (white), (ivory) rated to suit circuit load, 1000 watts minimum, 120 volts.
- .2 Acceptable Manufacturers:
  - .1 P & S
  - .2 Lutron

## 2.27 **WIRING DEVICES - OCCUPANCY SENSORS**

- .1 W1 Automatic wall switch, passive infrared, (120V) (277V) (347V), adjustable time delay thirty seconds to thirty minutes, 180 degrees coverage, minimum 300 sq.ft. hand motion at desktop, adjustable light sensor (21-2150 lux), white.
  - .1 Wattstopper WS-250 Series
- .2 W2 Automatic wall switch, passive infrared, (120V) (277V) (347V), adjustable time delay five minutes to thirty minutes, manual or auto on, 180 degrees coverage, minimum 300 sq.ft. hand motion at desktop, white.
  - .1 Wattstopper PW-100 Series
- .3 W2B Automatic wall switch, passive infrared, (120V) (277V) (347V), adjustable time delay five minutes to thirty minutes, manual or auto on, dimmer, 180 degrees coverage, minimum 300 sq.ft. hand motion at desktop, white.
  - .1 Wattstopper PW-100D-I-U
- .4 W3 Automatic wall switch, dual technology, (120V) (277V) (347V), adjustable time delay five minutes to thirty minutes, manual or auto on, 180 degrees coverage, minimum 300 sq.ft. hand motion at desktop, white.
  - .1 Wattstopper DW-100
- .5 W4 Outdoor PIR Occupancy sensor lighting control to mount internal to task lighting fixtures. 360 degree High Bay lens (20'-40'), 7.5' wire lead length, 24VDC; IP65.

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.1		Leviton OSF20-ILW
.6	DT1	Ceiling mounted dual technology, 2000 sq.ft. coverage at 180 degrees, corner mounting bracket, adjustable time delay, adjustable sensitivity, built-in light level sensor (20 to 2150 lux), (120V/20A) (277V/20A) (347V/15A) power packs/slave packs as required, white.
	.1	Wattstopper DT-200
.7	DT2	Ceiling mounted dual technology, 1000 sq.ft. coverage at 360 degrees, adjustable time delay, adjustable sensitivity, built-in light level sensor (100 to 3200 lux), (120V/20A) (277V/20A) (347V/15A) power packs/slave packs as required, white.
	.1	Wattstopper DT-300
.8	C1	Ceiling mounted ultrasonic, 2000 sq.ft. coverage at 360 degrees, temperature and humidity resistant receivers, logic key/on bypass, adjustable time delay fifteen seconds to fifteen minutes, (120V/20A) (277V/20A) (347V/15A) power packs/slave packs as required, white.
	.1	Wattstopper W-2000A
.9	C2	Ceiling mounted ultrasonic, 1000 sq.ft. coverage at 360 degrees, temperature and humidity resistant receivers, logic key/on bypass, adjustable time delay fifteen seconds to fifteen minutes, (120V/20A) (277V/20A) (347V/15A) power packs/slave packs as required, white.
	.1	Wattstopper W-1000A
.10	C3	Ceiling mounted ultrasonic, 500 sq.ft. coverage at 360 degrees, temperature and humidity resistant receivers, logic key/on bypass, adjustable time delay fifteen seconds to fifteen minutes, (120V/20A) (277V/20A) (347V/15A) power packs/slave packs as required, white.
	.1	Wattstopper W-500A
.11	C4	Ceiling mounted passive infrared, 300 sq.ft coverage, corner mounted, optional ON override through logic key/ON bypass, adjustable time delay thirty seconds to thirty minutes, (120V/20A) (277V/20A) (347V/15A) power packs/slave packs as required, white.
	.1	Wattstopper WPIR
.12	CH	Ceiling mounted ultrasonic, 90 lin.ft. hallway coverage, temperature and humidity resistant receivers, logic key/on bypass, adjustable time delay fifteen seconds to fifteen minutes, (120V/20A) (277V/20A) (347V/15A) power packs/slave packs as required, white.
	.1	Wattstopper W-2000H
2.28		<b>WIRING DEVICES – TIME SWITCHES</b>
.1	T1	(120V) (277V) digital time switch, zero crossing, pushbutton programming, adjustable time-out setting five minutes to twelve hours, flash and beep warnings, time scroll for temporary override of pre-set time-out, reset feature to return to pre-set timeout setting, electroluminescent, white.

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- .1 Wattstopper TS-400
- .2 T2 24 V low voltage digital time switch, local power packs as required to suit load, zero crossing, pushbutton programming, adjustable time-out setting five minutes to twelve hours, flash and beep warnings, time scroll for temporary override of pre-set time-out, reset feature to return to pre-set timeout setting, electroluminescent, white
- .1 Wattstopper TS-400-24.

2.29 **WIRING DEVICES - RECEPTACLES FOR GENERAL SERVICE**

- .1 Receptacles: Specification grade suitable for back and side wiring, complete with grounding terminal. Colour as required for type of area for straight blade devices and black colour for twistlock devices.
- .2 Receptacles of one manufacturer.
- .3 Acceptable Manufacturers:
  - .1 15A, 125V, (5-15R) Single Straight Blade
    - Arrow Hart 5261
    - Leviton 5261
    - Hubbell 5261
    - Pass & Seymour 5261
  - .2 15A, 125V, (5-15R) Duplex Straight Blade
    - Arrow Hart 5262
    - Leviton 5262
    - Hubbell 5262
    - Pass & Seymour 5262
  - .3 20A, 125V, (5-20R) Single Straight Blade
    - Arrow Hart 5361
    - Leviton 5361
    - Hubbell 6331
    - Pass & Seymour 5361
  - .4 20A, 125V, (5-20R) Duplex Straight Blade
    - Arrow Hart 5392
    - Leviton 5362
    - Hubbell 5392
    - Pass & Seymour 5362
  - .5 15A, 125V, (5-15R) Duplex GFCI, Straight Blade
    - Arrow Hart GF5242AH
    - Leviton 6599-W
    - Hubbell GF-5252
    - Pass & Seymour 1591
  - .6 15A, 125V, (5-15R) Duplex Isolated Ground, Straight Blade
    - Arrow Hart IG5262AH
    - Leviton 5262-IG
    - Hubbell IG-5262
    - Pass & Seymour IG6200
  - .7 20A, 125V, (L5-20R) Single locking, 2 pole, 3 wire, grounding
    - Arrow Hart 6200
    - Leviton 2310
    - Hubbell 2310ACN
    - Pass & Seymour L520-RCN
  - .8 20A, 250V, (L6-20R) Single locking, 2 pole, 3 wire,
    - Arrow Hart 6210
    - Leviton 2320

	grounding	-	Hubbell 2320ACN
		-	Pass & Seymour L620-RCN
.9	30A, 250V, (L6-30R) Single locking, 2 pole, 3 wire, grounding	-	Arrow Hart 6340
		-	Leviton 70630-FR
		-	Hubbell 2620CAN
		-	Pass & Seymour L630RCN
.10	30A, 250V, (L15-30R) Single locking, 3 pole, 4 wire, 3 phase, grounding	-	Arrow Hart 6520
		-	Leviton 2720
		-	Hubbell 2720ACN
		-	Pass & Seymour L1530-RCN
.11	20A, 277V, (L7-20R) Single locking, 2 pole, 3 wire, grounding	-	Arrow Hart 6220
		-	Leviton 2331
		-	Hubbell 2330ACN
		-	Pass & Seymour L720R
.12	20A, 347V (L24-20R) Single locking, 2 pole, 3 wire, grounding	-	Leviton 3721
		-	Pass & Seymour L3720-RCN
.13	15A, 125V (5-15R) Quad straight blade, 2 pole, 3 wire grounding	-	Bryant 1254
		-	Hubbell 415 series
		-	Pass & Seymour 1254
.14	15A, 347V, (24-15R) Quad straight blade, 2 pole, 3 wire grounding	-	Bryant 3474W
		-	Hubbell 415347WC
		-	Pass & Seymour 3474W
.15	15A, 125V, (5-15R) Duplex straight blade	-	Arrow Hart 26262
		-	Leviton Decora Plus
		-	Hubbell 2152 series
		-	Pass & Seymour 885
.16	15A, 125V (5-15R) Duplex straight blade, 2 pole, 3 wire grounding, surge suppression, indicator light, blue (ivory) colour	-	Arrow Hart 5250
		-	Hubbell 5260
.17	15A, 125V (5-15R) Duplex straight blade, 2 pole, 3 wire grounding, isolated ground, surge suppression, indicator light, blue (ivory) colour	-	Arrow Hart IG5250
		-	Hubbell IG5262

2.30 **WIRING DEVICES - COVER PLATES**

- .1 Stainless steel Type 302 alloy, vertically brushed, 0.8 mm thick cover plates.
- .2 Nylon, smooth, high impact strength.
- .3 Pressed steel, galvanized.
- .4 Cast covers for cast boxes with gaskets.
- .5 Cover plates of same manufacture as devices.

2.31      **WELDING RECEPTACLES**

.1      Circuit Breaking Receptacle

.1      Receptacle and back box assembly, 600 volt, 60 amp, three-wire, four-pole, weatherproof, aluminum housing.

.2      Acceptable Manufacturers

.1      Appleton Powertite, AJA mounting box and spring door

.2      Crouse-Hinds, Arktite AREA 6000 series, AJ back box, angle adaptor and spring door

.3      Russellstoll, type JRFA, twenty degree angle adaptor and spring door

.2      Interlocked Receptacle and Switch

.1      Receptacle interlocked with unfused disconnect switch, 600 volt, 60 amp, three-wire, four-pole. Receptacle with aluminum housing and spring door. Disconnect switch with NEMA 12 sheet steel enclosure.

.2      Acceptable Manufacturers

.1      Appleton WSRD interlocked receptacle

.2      Crouse-Hinds Arktite receptacle with WSRD disconnect switch

.3      Schneider Square D with Crouse-Hinds Arktite receptacle and class 3110 disconnect switch

.3      Compact Interlocked Receptacle and Switch

.1      Compact unit, receptacle interlocked with unfused disconnect switch, 600 volt, 60 amp, three-wire, four-pole, watertight, NEMA 4X non-metallic enclosure.

.2      Acceptable Manufacturers

.1      Bryant, 460SM series

.2      Crouse-Hinds, Arktite CSR Series

.3      Hubbell, Circuit-Lock

2.32      **SNOW MELTING SYSTEM (SELF-REGULATING CABLE)**

.1      Copper heating cables with semi-conductive core fluoropolymer jacket, copper shield and polyolefin outer jacket. Cold leads of adequate length for each cable set so entire heated length is in concrete section to be heated. Raychem Electromelt EM2-XR.

.2      Automatic snow detector, controller, and contactors to switch cable sets, also air temperature thermostat, and "test/off/auto" switch to control each system. Complete with kits of same manufacture for splices, seals and power connections.

.3      Cast junction boxes for connection of heating cables to power supply from panel. Heat shrink sleeves for watertight connections.

- .4 Thermostat: Rated 20 A, 120 V, suitable for outdoor ambient monitoring. Enclosure die-cast aluminum EEMAC 4, watertight and dusttight with threaded conduit hub. Set point +3°C with a minimum adjustment of 6°C above and 3°C below setpoint.
- .5 Snow sensor, 20 A, 120 V with EEMAC 4 enclosure for electrical wiring and relay, arranged for mounting on vertical conduit.
- .6 Acceptable Manufacturer:
  - .1 Raychem, Electromelt System

2.33 **SNOW MELTING SYSTEM (MI CABLE)**

- .1 Heating cables type MI with polyethylene jacket. Cold leads, jacketed, of adequate length for each cable set so entire heated length is in concrete section to be heated.
- .2 Control panel: 120 V AC supply, two-pole contactor, hold-on timer, bypass switch for manual control and status indicators.
- .3 Heat shrink sleeves for watertight connections.
- .4 Slab sensing thermostat.
- .5 Snow sensor arranged for mounting on vertical conduit with integral ambient thermostat.
- .6 Acceptable Manufacturer
  - .1 Pyrotanax: Slab sensing thermostat model 4688-WP, control panel model APS-3 and slab sensing thermostat model 4688-WP.

2.34 **ICE MELTING CABLE SYSTEM**

- .1 System comprises ice melting cable, junction boxes, downspout hangers, heat shrinkable tubes, end seals and thermostat.
- .2 Ice melting cable: Self regulating cable rated ten watts per foot when it contacts ice and five watts per foot in air, 120 volt power supply.
- .3 Junction boxes: Steel, EEMAC type 4 or cast steel fittings.
- .4 Thermostat: 4.5°F (40°F) setpoint, rated 120V, 22A, EEMAC 4x enclosure, three foot capillary tube.
- .5 Acceptable Manufacturers
  - .1 Ice melting cable: Raychem type GM-1X
  - .2 Downspout hangers: Raychem type GMK-DH
  - .3 Thermostat: Raychem type AMC-F5

2.35 **HEAT TRACING CABLE**

- .1 120 volt copper heat tracing cables for installation (inside) (and) (on exterior of) pipes complete with line voltage thermostat with remote sensor and capillary.
- .2 Acceptable Manufacturers:
  - .1 Thermon



- .2 Raychem
- .3 Pyrotenax

2.36 **PLYWOOD BACKBOARDS**

- .1 Plywood backboards, good one side, 1220 mm x 2440 mm x 19 mm unless indicated otherwise. Treat with primer and two coats of fire retardant paint.
- .2 Mount plywood on vertical strapping, on 40 mm centres to provide 10 mm clearance between wall and rear of plywood. Treat strapping similar to plywood.

2.37 **FINISH**

- .1 Equipment enclosure finish: Baked grey enamel, ANSI 49 or ANSI 61.

3 Execution

3.1 **WIRE AND CABLE**

- .1 Install wiring in raceways unless noted otherwise.
- .2 Minimum wire sizes:
  - .1 Power and lighting - No. 12 AWG
  - .2 Control - No. 14 AWG
  - .3 Fire alarm - No. 18 AWG

.3 Wire and cable application and type:

Application	Type
.1 Lighting branch circuit where connection to luminaire is AC90 cable	T90 nylon
.2 Receptacle branch circuit	T90 nylon
.3 Ceiling boxes to luminaires in suspended ceiling	T90 nylon or AC90 cable
.4 Wiring under raised floor used as plenum	AC90 cable or wire in flexible metal conduit
.5 Wiring inside high temperature equipment	TEW or SEW-2
.6 Branch circuits other than those covered above	RW90
.7 Equipment feeders, circuits	RW90
.8 Underground and under slab raceways, duct banks, direct burial	RWU90

.4 Type AC90 cable length limitations:

- .1 Ceiling box to luminaire: 1.2 m maximum in non-accessible ceilings;  
1.8 m in accessible ceilings
- .2 Junction box to outlet: 3.6 m maximum

- .5 Load current limitations:
  - .1 Conductors rated for more than 90°C: 90°C (194°F) code ampacity rating
  - .2 Motor connection: 75°C (167°F) code ampacity rating
- .6 EMF-Free Power Cables
  - .1 Install the EMF-free power cable system in complete accordance with the manufacturer's written instructions.
  - .2 Provide a manufacturer's representative on site during installation of the system.
  - .3 At completion of the work, provide a letter from the manufacturer indicating that the system was installed to the manufacturer's satisfaction and that it is ready for use.
  - .4 Provide manufacturer's commissioning report to include the manufacturer's standard readings and specifically the following readings taken at three locations, determined by the Consultant; 1 m from the feeder and distance from the feeder where the EMF is 0.5 micro Teslas.
    - .1 Background AC and steady state (DC) EMF readings (feeder de-energized)
    - .2 EMF readings at full load, balanced  $\pm 5\%$
    - .3 EMF readings near full load with 20%  $\pm 5\%$  unbalance
  - .5 Acceptance Criterion
    - .1 The installation will be deemed not acceptable if the ac EMF is in excess of 0.5 micro Teslas above the background EMF at any point along the feeder not within 2 m of either end for all load conditions

### 3.2 **MODULAR WIRING**

- .1 Install and connect modular wiring.

### 3.3 **CONNECTORS**

- .1 Install compression terminations and splices in accordance with manufacturer's written instructions.
- .2 Make splices in junction boxes.
- .3 Make connections in lighting circuits with twist type splicing connectors.
- .4 Terminate and splice conductors No. 8 and larger at terminal blocks in junction boxes.
- .5 Seal terminations and splices exposed to moisture, corrosive conditions or mechanical abrasions with heavy wall heat shrinkable insulation.
- .6 Install fixture type connectors and tighten. Replace insulating cap.

### 3.4 **MOTOR LEAD CONNECTION KITS, 600 VOLT**

- .1 Install motor lead connection kits for low voltage motors.

3.5 **MOTOR LEAD CONNECTION KITS, 5000 VOLT**

- .1 Install motor lead connection kits for 4000 V motors.

3.6 **CONDUIT AND EMT - GENERAL**

- .1 Run parallel or perpendicular to building lines.
- .2 Group raceways wherever possible. Support on channels.
- .3 Install expansion joints as required.
- .4 Run raceways in web portion of structural steel columns and beams.
- .5 Do not drill structural members to pass through.
- .6 Locate raceways behind infrared or unit heaters with 1.5 m clearance.
- .7 Locate raceways not less than 125 mm clear where parallel to steam or hot water lines with a minimum of 75 mm at crossovers.
- .8 Do not install horizontal runs in masonry walls.
- .9 Use metallic raceway where temperatures exceed 75°C (167°F) or where enclosed in thermal insulation.
- .10 EMT and non-metallic conduits to contain insulated green ground wire.
- .11 Install 6 mm diameter nylon pull cord in empty raceways.

3.7 **CONDUIT AND FITTINGS**

- .1 Minimum conduit sizes:

.1	Surface installation	21 trade size conduit
.2	Embedded in concrete	27 trade size conduit
.3	Directly buried	53 trade size conduit

- .2 Conduit application and type:

	Application	Type
.1	Corrosive areas	rigid steel corrosion resistant coated
.2	Hazardous areas	rigid steel
.3	Outdoor areas	rigid steel
.4	Embedded in concrete, other than grade slab	rigid steel (PVC)
.5	In or below grade slab	PVC
.6	Exposed in unfinished areas up to 3 m above finished floor. Use EMT above 3 m	rigid steel

- .7 Connection to motors and equipment subject to vibration liquid tight flexible steel conduit
- .8 Final connection to dry type transformer flexible steel conduit
- .9 Whip connection to modular furniture non-metallic extra flexible PVC
- .3 Use field threads on rigid conduit of sufficient length to draw conduits up tight.
- .4 Do not bend coated steel conduit. Use elbows for deflections.
- .5 Do not install conduit in or under slab.
- .6 Use factory "ells" where ninety degree bends are required for 27 trade size and larger conduits.
- .7 Bend conduit offsets cold. Do not install crushed or deformed conduits and avoid trapped runs in damp or wet locations. Prevent the entrance of water and lodging of concrete, plaster, dirt, or trash in conduit, boxes, fittings, and equipment during course of construction.
- .8 Where conduit joints occur in damp or wet locations, make joints watertight by applying an approved compound on the entire thread area before assembling. Draw up all conduit joints as tightly as possible.
- .9 Cap exposed empty conduits which do not terminate in outlets, panels, cabinets, etc., with standard galvanized plumber's pipe caps.
- .10 Plug empty conduits which terminate flush with floors or walls with flush coupling and brass plug.
- .11 Install conduit sleeves for all exposed conduits and cables passing through walls, ceilings, or floors, and fill void between sleeve and conduit with caulking. If fire-rated caulking is required by code, use same class as walls, ceilings or floors.
- .12 Terminate conduit stubbed up through concrete floor for connection to free standing equipment with a coupling flush with finish floor, and extend rigid conduit to equipment, except where required, use flexible conduit from a point 150 mm above floor.
- .13 Install double locknuts and bushings on all rigid conduit terminations into threadless openings. Increase length of conduit threads at terminations sufficiently to permit bushing to be fully seated against end of conduit.
- .14 Mechanically bend steel conduit.
- .15 Install sealing condulets in conduits at hazardous area boundaries.
- .16 Conduits in Poured Concrete
  - .1 Locate to suit reinforcing steel. Secure firmly to prevent movement during pour.
  - .2 Clear each conduit with mandrel and brush before concrete sets.
  - .3 Protect conduits from damage where they stub out of concrete.
  - .4 Install sleeves where conduits pass through slab or wall.
  - .5 Provide oversized sleeve before membrane is installed where conduits pass through waterproof membrane. Use cold mastic between sleeve and conduit.

- .6 Encase conduits completely in concrete; provide 50 mm minimum concrete cover.
- .7 Replace with exposed conduit, any conduit run found to be obstructed after concrete sets.

### 3.8 **EMT AND FITTINGS**

- .1 Minimum EMT size: 21 trade size conduit.
- .2 EMT Application
  - .1 Exposed in unfinished areas, above truss level and for drops in column web to 3 m above finished floor. Use rigid steel conduit below 3 m.
  - .2 In block walls and stud partitions.

### 3.9 **CABLE TRAY**

- .1 Install cable tray systems.
- .2 Provide barriers where required by code.
- .3 Support cable trays from structural members. Support cable tray on both sides or on cantilever brackets to provide continuous open access to one side of the tray as required. Coordinate support locations and weight per support with building structure. Provide any additional support fastenings required.
- .4 Provide the following minimum clearances:
  - .1 300 mm vertical between top of tray and equipment or structure above.
  - .2 300 mm vertical between trays.
  - .3 600 mm horizontal on access side of tray.
- .5 Ensure that sharp burrs or projections are removed to prevent damage to cables and injury to personnel.
- .6 Install cables individually.
- .7 Lay cables into cable tray. Use rollers where necessary, to pull cables.
- .8 For maintained spacing, secure cables in cable tray at 3 m centers for horizontal runs with black coloured tie wraps and at 1.5 m centres for vertical runs with aluminum clamps supplied by tray manufacturer.
- .9 Maintain power cables greater than one diameter minimum spacing unless shown otherwise.
- .10 Firestop Fire Barriers (Refer to Section 26 05 01).
  - .1 Frame openings in walls, and floors for width and depth required for cable tray to run through with 50 mm clear all around.

### 3.10 **WIREWAYS**

- .1 Install per manufacturer's recommendations.

- .2 Keep number of elbows, offsets and connections to a minimum.
- .3 Install barriers where required by code.
- .4 Install gutters to full length of equipment.

3.11 **SURFACE RACEWAYS**

- .1 Install per manufacturer's recommendations.

3.12 **CELLULAR FLOOR SYSTEM**

- .1 Install trench duct, preset inserts and activation kits including activation power and data receptacles and telephone jack outlets.
- .2 Tack weld trench duct to non-cellular decking, and tack weld trench duct void closures.
- .3 Seal voids at preset inserts, cellular raceway butt joints and void closures with sealing compound.

3.13 **FASTENINGS AND SUPPORTS**

- .1 Provide supports and fastenings for the Work of this division. Do not use supports or equipment provided by other trades.
- .2 Equipment fastenings and supports shall conform to manufacturers recommendations.
- .3 Do not attach to, or suspend any electrical Product or service from the roof deck, mechanical ductwork or piping.
- .4 Do not use wire lashing or perforated strap to support or secure raceways or cable.
- .5 Support rods for any suspended item must not be attached to or extended through steel pan type roofs or through concrete slab roofs.
- .6 For surface mounting of two or more raceways or cables use channels.
- .7 Where there is no wall support for raceways and cables dropped vertically to equipment, provide channel properly secured to floor and structure.
- .8 Hang supports from structural members. Where location does not permit direct support from structure provide necessary brackets, frames, channels secured to structural members.
- .9 Fasten exposed conduit and cables to building construction or support systems using straps. Use beam clamps on exposed steelwork.
- .10 Masonry, tile and plaster surfaces: Use lead anchors.
- .11 Poured concrete: Use expandable inserts. Low velocity powder activated fastenings may be used only in poured concrete.
- .12 Steel structures: Use clips, spring loaded bolts, cable clamps, designed as accessories to basic channel members.
- .13 Do not use powder activated fasteners in, tile, precast concrete or steel structure.
- .14 Do not install conduits or cables on the bottom chord of joists or trusses.

- .15 Use beam clamps of the two-bolt design and of such type that the rod load is transmitted only concentrically to the beam web centreline. The use of "C" and "I" beam side clamps will not be allowed.
  - .16 Where the roof or floor framing consists of open web or long span steel joists and/or trusses, ensure that hangers are located at or within 150 mm of the joist or truss top or bottom chord panel points, otherwise provide additional structural steel as required where hanger spacing does not coincide with joist or truss spacing. Design suspension assembly such that the hanger load is transmitted only concentrically to the supporting joist or truss. The use of "C" and "I" beam clamps, brackets, etc., will not be allowed.
  - .17 Locate secondary structural steel members between joists or trusses at or within 150 mm of top or bottom chord panel points. Where the secondary structural steel member cannot be located at or near a joist or truss panel point, provide additional diagonal structural steel web member/members designed for the applicable load to the nearest panel point in the opposite chord member. Diagonal hangers which will induce lateral stresses in the chord members of the joist will not be permitted. Submit Shop Drawings of the suspension assembly indicating the location of suspension or support points, the maximum load at each suspension point, location and size of hangers, brackets and intermediate framing members when required, and also details of connection to building structure.
- 3.14 **SPLITTER BOXES**
- .1 Install splitters as indicated and mount plumb, true and square to the building lines.
  - .2 Extend splitters full length of equipment arrangement.
- 3.15 **JUNCTION BOXES**
- .1 Install junction boxes in inconspicuous but accessible locations. Secure to structure.
  - .2 Install terminal blocks on mounting rails, for termination of each wire and cable regardless of size.
  - .3 Only one voltage source is permitted in a junction box.
  - .4 Install barriers to separate different auxiliary systems.
- 3.16 **TERMINAL BLOCKS - SURGE SUPPRESSION**
- .1 Install surge suppression terminal blocks.
- 3.17 **PULL BOXES**
- .1 Install pull boxes in inconspicuous but accessible locations. Secure to structure.
  - .2 Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.
  - .3 Only one voltage source is permitted in a pull box.
  - .4 Install barriers to separate different auxiliary systems.
- 3.18 **OUTLET AND CONDUIT BOXES**
- .1 Install conduit outlet boxes for conduit up to 32 mm and pull boxes for larger conduits.
  - .2 Support boxes independently of connecting conduits.

- .3 Seal boxes during construction to prevent entry of debris, dust and dirt.
- .4 For flush installations mount plaster rings to box, flush with wall surface to permit wall finish to come within 6 mm of opening.
- .5 Provide correct size of openings in boxes for conduit, armoured cable connections. Reducing washers will not be acceptable.
- .6 Install switches and other controls close to door lock or latch jambs and other openings, maintaining a minimum of 100 mm from trims of doors (except where installed in door frames of metal partitions) check door swings.
- .7 Install 100 mm square or octagonal outlet boxes for lighting fixture outlets.

### 3.19 **MASONRY BOXES**

- .1 In block walls use deep boxes to provide clear space around knockout for AC90 cable entry.

### 3.20 **WIRING DEVICES - SWITCHES**

- .1 Install single throw switches with handle in up position when switch is closed.
- .2 Install switches in gang type outlet box when more than one switch is required in a location.
- .3 Mount toggle switches at height indicated.
- .4 Install switch colours as follows:

	Area	Colour
.1	Gypsum board, plaster or panelled	(white) (ivory) (brown)
.2	Office	(white) (ivory) (brown)
.3	Factory, service	brown (ivory)

### 3.21 **WIRING DEVICES - DIMMER SWITCHES**

- .1 Install each dimmer switch in outlet box at locations indicated.
- .2 Mount dimmer switches at height indicated.

### 3.22 **WIRING DEVICES - RECEPTACLES**

- .1 Install receptacles vertically, use gang type outlet box where more than one receptacle is required in a location.
- .2 Where split receptacle has a portion switched, mount vertically and switch upper portion.
- .3 Coordinate with architectural and interior design drawings for final positioning and mounting heights of power and voice/data receptacles. Where there is disagreement between electrical and architectural drawings, take the architectural drawings as correct.
- .4 Maintain clearances between receptacle outlet boxes and millwork as stipulated on the drawings.
- .5 Align and evenly space outlet boxes that are mounted as a group.



.6	Install receptacle colours as follows:	
	Area	Colour
.1	Gypsum board, plaster or panelled	(white) (ivory) (brown)
.2	Office	(white) (ivory) (brown)
.3	Factory, service, exterior	brown

**3.23 WIRING DEVICES - 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 designed for flush outlet boxes on surface-mounted boxes.
- .4 Provide plaster ring where necessary.
- .5 Install cover plates as follows:

	Area	Cover Plate Type
.1	Gypsum board, plaster or panelled	stainless steel (nylon) (white) (ivory)
.2	Factory, service	galvanized steel
.3	Exterior	cast cover

**3.24 WELDING RECEPTACLES**

- .1 Install welding receptacles.
- .2 Ensure that phase rotation is similar for all receptacles.

**3.25 CONTROL DEVICES**

- .1 Install as indicated.

**3.26 SNOW MELTING SYSTEM (SELF-REGULATING CABLE OR MI CABLE)**

- .1 Install cables.
- .2 Where not embedded in concrete, waterproof in-line splices may be used for connections to cold leads. Use heat shrink sleeves or other appropriate method to waterproof splices. Where cables are embedded in concrete, extend heating cables from slab to junction box. Splice to cold leads in junction boxes.
- .3 Secure cables in place with cable straps supplied by cable manufacturer. Maintain indicated spacing.
- .4 Install thermostat sensor, clear of cable, to sense slab temperature.
- .5 Install snow sensor in exposed location on roof well clear of any projection which could obstruct deposit of snow in collector. Mount sensor 600 mm above roof deck.

**3.27 ICE MELTING CABLE SYSTEM**

- .1 Install junction boxes, in suitable protected location, adjacent to start of each ice melting cable installation. Install ice melting cables along complete length of roof drains and downspouts. Install cable end seals at cable terminations at bottom of downspouts. Install downspout hangers where cable enters downspouts and roof drains.
- .2 Install thermostat in electrical room. Extend capillary through exterior wall, provide clamp on outside wall surface to hold coiled capillary with probe clear of wall. Seal wall penetration.

3.28 **HEAT TRACING CABLES**

- .1 Install heat tracing cables where indicated. Measure pipes at site for exact length and verify sizes.
- .2 Secure cable and remote sensor to pipe in accordance with cable manufacturer's recommendation keeping bulb clear of heating cable.
- .3 Install heating cable as per manufacturer's recommendations.
- .4 Wire to thermostat and heater cable in conduit. Provide watertight coupling at heater cable.
- .5 Coordinate with mechanical and sprinkler pipe trades. For exterior applied cable do not energize until insulation has been applied over cable.
- .6 Where installed inside pipes provide watertight gland for installation by pipe fitters.
- .7 Megger test insulation resistance before installation, before addition of thermal insulation and after addition of thermal insulation in accordance with manufacturer's recommendations.
- .8 Install and commission heat tracing system under supervision of manufacturer's representative.

3.29 **PLYWOOD BACKBOARDS**

- .1 Install plywood backboards.

3.30 **FIELD FABRICATED METAL WORK**

- .1 Clean and prime paint field fabricated metal work.
- .2 After fabrication deburr, scrape, grind smooth, wire brush with power brush and degrease metal work.
- .3 Prime paint steel with one coat of CISC/CPMA 2.75 oil alkyd primer.
- .4 Prime paint aluminum as follows: Wash with detergent solution and wipe down with SSPC-SP1 solvent. Apply Glidden #Y-5229 primer to 1.5 mils DFT.
- .5 For brass and bronze alloy materials, prepare as for aluminum but apply one coat of CAN/CGSB-1.40-M zinc chromate primer.

End of Section

- 1 General
- 1.1 **SUMMARY**
  - .1 Section Includes
    - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- 1.2 **GENERAL**
  - .1 Modifications, demolition and installation of services within this building require utmost care due to vital operation of systems involved. Removal and installation of systems require constant communication with Consultant.
- 1.3 **CO-ORDINATION BETWEEN NEW AND EXISTING INSTALLATIONS**
  - .1 Provide interfacing components between new and existing systems as necessary for proper performance and operation.
- 1.4 **EXISTING SERVICES**
  - .1 Ensure existing services remain undisturbed and energized except where indicated to be disconnected.
  - .2 Disconnect and remove abandoned wiring materials and devices.
  - .3 Cut raceways flush where embedded in structure.
  - .4 Retain abandoned embedded outlet boxes and close with pressed steel cover plates.
  - .5 Make safe all circuit wiring left for future use.
- 1.5 **INTERRUPTION OF SERVICES**
  - .1 Obtain Consultant's written approval before interrupting any service. Long outages are not acceptable.
  - .2 Provide temporary services to maintain continuity in the event that services must be interrupted.
- 1.6 **PREMIUM TIME**
  - .1 Include cost of premium time in Tender Price for work during nights, weekends or other time outside normal working hours necessary to do the Work and maintain electrical services in operation.
- 2 Products
- 2.1 **USE OF EXISTING MATERIAL AND EQUIPMENT**
  - .1 Unless noted otherwise, existing panels, boxes and wiring materials may be reused if acceptable to inspection authority.
  - .2 Unless noted otherwise, provide additional equipment of same type and manufacture to supplement existing equipment.
  - .3 Reused luminaires: Furnish new lamps.

- 3 Execution
- 3.1 **EXISTING MATERIAL AND EQUIPMENT**
  - .1 Equipment to be reused or relocated: Test for proper operation, and repair as necessary.
  - .2 Repair or replace existing equipment which is damaged in process of relocation.
  - .3 Reused luminaires: Install lamps, clean fixtures and touch up damaged finish.
  - .4 Relocate existing junction, pull or terminal boxes which become inaccessible due to new mechanical ductwork or equipment.
- 3.2 **DEMOLITION**
  - .1 Demolish existing work, where indicated, and remove from site.
  - .2 Execute all demolition work so as to create minimum vibration or dust within and outside the building. Obtain Consultant's approval of methods before proceeding.
- 3.3 **WORK IN EXISTING TENANT FACILITIES**
  - .1 Coordinate Work in tenant facilities with tenant. Ensure that no interruptions and/or interferences occur with tenant's normal operation.
  - .2 Be responsible for any damage created in existing tenant facilities when installing equipment and materials.
- 3.4 **PENETRATIONS IN EXISTING STRUCTURE**
  - .1 Perform cutting, patching and repairing. Before proceeding obtain Consultant's approval.
  - .2 Where necessary to penetrate existing floors, walls, ceiling, roof or structural members provide sleeve and follow Consultant's instructions.
  - .3 Restore surfaces to same finish and condition as existed prior to penetration.
  - .4 Core Drilling Procedure
    - .1 Examine locations to be core drilled where:
      - .1 Diameter is greater than 25 mm
      - .2 Multiple drillings required and where the distance between centres is less than ten times the diameter of the hole
    - .2 Examine by most suitable method including:
      - .1 X-ray
      - .2 Ferro scan
      - .3 Cable detection
    - .3 Examine from both sides of the structure to be drilled.
    - .4 Examine proposed core drilling locations to determine:
      - .1 Possible interference with

- .1 Services
- .2 Structural components
- .2 Possible presence of asbestos tile or other asbestos based material. Report any occurrence or suspected occurrence to the Consultant immediately.
- .5 Select locations as suitable for core drilling and label them:
  - .1 Uniquely number each drilling location and core so that markings will be legible after drilling
  - .2 Mark each core with a north pointing arrow where drilling a slab or upward pointing arrow where drilling a wall
- .6 Without interfering with or damaging any services or structural elements, drill pilot holes sufficient to verify location of potential obstructions or for alignment purposes.
- .7 Use impact drill when drilling holes of 25 mm diameter or less. For holes of greater diameter use core drill.
- .8 Prepare report showing intended core drill locations including printouts, X-ray images. Submit the report for approval, to Consultant, prior to drilling.
- .9 Proceed with core drilling only after approval has been received from Consultant.
- .10 Confine drilling operation to time-of-day as stipulated by Consultant.
- .11 Position suitable warning notices of a type acceptable to Consultant and exercise caution to ensure safety and protection of personnel and property during drilling especially from effects of water, dust damage, or falling objects below the slab or behind the wall being drilled.
- .12 Stop drilling immediately, and report to Consultant, if contact is made with foreign objects such as reinforcing steel (rebar), electrical conduit, water pipes, drainage pipes.
- .13 Cover open holes with secured covers to guard against fall through of objects.
- .14 Provide necessary firestopping, temporary or otherwise, sufficient to firestop holes that would be otherwise open during hours that the location is unattended. Coordinate placement of firestopping with Consultant.
- .15 Store all cores or core fragments on site and make them available for inspection by Consultant. Dispose of the cores or core fragments after permission is received from Consultant.

### 3.5 **SALVAGE MATERIALS**

- .1 Remove from site materials in renovated areas that are not to remain or be reused, unless noted as remaining property of Owner.

End Of Section

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- 1 General
- 1.1 **SUMMARY**
  - .1 Section Includes
    - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- 1.2 **APPROVALS**
  - .1 Identification subject to prior approval of Consultant.
- 2 Products
- 2.1 **WIRE AND CABLE MARKERS**
  - .1 Wire and Cable Diameter Less Than 13 mm
    - .1 Acceptable manufacturer
      - .1 Wieland Z type
  - .2 Cable Diameter 13 mm and Larger
    - .1 Acceptable manufacturer
      - .1 Wieland K type
  - .3 Non-Circular Wire
    - .1 Acceptable manufacturer
      - .1 Raychem Shrinkmark sleeves
- 2.2 **CONDUIT AND ELECTRICAL METALLIC TUBING MARKERS**
  - .1 Stick-On Marker

	Raceway Size	Minimum Character Height
.1	¾" - 1¼"	15 mm
.2	1½" - 2"	19 mm
.3	Over 2"	32 mm
  - .2 Acceptable Manufacturers
    - .1 Brady, vinyl cloth, black on orange, type B-500
    - .2 Panduit, vinyl cloth, black on yellow, type PCL
    - .3 Wieland, mylar, black on yellow, type NL
- 2.3 **CABLE TRAY MARKERS**
  - .1 Stick-On Marker
    - .1 Acceptable Manufacturers

- .1 Brady, vinyl cloth, black on orange, 48 mm character height, type B-500
- .2 Safety Supply Canada, conduit and voltage markers, style A, 48 mm character height
- .3 Panduit, vinyl indoor/outdoor, black on yellow, 50 mm character height, type PVL
- .4 Wieland, black on yellow, 50 mm character height, Electrocode NL

## 2.4 **BUSWAY MARKERS**

- .1 Stick-On Marker
  - .1 Acceptable Manufacturers
    - .1 Brady, vinyl cloth, black on orange, 48 mm character height, type B-500
    - .2 Safety Supply Canada, conduit and voltage markers, style A, 48 mm character height
    - .3 Panduit, vinyl indoor/outdoor, black on yellow, 50 mm character height, type PVL
    - .4 Wieland, black on yellow, 50 mm character height, Electrocode NL
  - .2 Laminated plastic, black letters on white background, 75 mm character height.
  - .3 Suspended sign, rigid vinyl, black on yellow, 75 mm character height.
    - .1 Acceptable Manufacturers
      - .1 Panduit
      - .2 Safety Supply Canada
  - .4 Typical identification: "12-1-1, 600A, 3P, 4W".

## 2.5 **PANELBOARD IDENTIFICATION**

- .1 Engraved laminated plastic, black lettering on white background, 6 mm character height.
- .2 Typical two-line identification for lighting panel:
  - "Lighting Panel C, 120/208V, 3 ph, 4W"
  - "Supplied from panel BB"
- .3 Directories: Typewritten identification of breaker number, ampere rating and connected equipment.

## 2.6 **SWITCHBOARD IDENTIFICATION**

- .1 Engraved laminated plastic, black lettering on white background, 15 mm minimum character height.
- .2 Typical identification: "Switchboard AAA, 347/600V, 3 ph, 4 w"; for branch feeders "Power Panel B.



2.7 **MOTOR STARTER, CONTACTOR AND DISCONNECT SWITCH IDENTIFICATION**

- .1 Engraved laminated plastic, black lettering on white background, 6 mm character height.
- .2 Typical identification: "Pump S4, 208V, 3 ph".

2.8 **MAGLOCK/FIRE ALARM PULL STATIONS IDENTIFICATION**

- .1 Engraved laminated plastic, red lettering on white background, 25 mm character height.
- .2 Identification: "EMERGENCY EXIT UNLOCKED BY FIRE ALARM OR BY SECURITY SYSTEM".

2.9 **WARNING SIGNS**

- .1 Outdoor: Metal, porcelain enamel finish. Indoor: Rigid vinyl.
- .2 Typical identification: "Danger - High Voltage".
- .3 Acceptable Manufacturers
  - .1 Outdoor: Safety Supply Canada
  - .2 Indoor: Safety Supply Canada, Panduit

2.10 **MARKER TAPE, SERVICE AND PHASE IDENTIFICATION**

- .1 Acceptable Manufacturer
  - .1 3M, Scotch Code Tape, type STD with SDR colour refills or 3M Scotch 35 colour tape.

3 Execution

3.1 **SYSTEMS IDENTIFICATION**

- .1 Identify outlet boxes for various systems with distinctive paint colour. Apply a small area of paint to inside of outlet, junction and pull boxes and panels. In suspended ceiling areas, apply paint to inside and outside of junction boxes. System colours:

System	Normal	Emergency	UPS
120/208 volt	black	black/red	black/blue
347/600 volt	orange	orange/red	orange/blue
Fire alarm	red		
Intercom	brown		
Low voltage control	black		
PA and sound	light green		

3.2 **POWER COMPANY SERVICE IDENTIFICATION**

- .1 Identify service conductors with coloured marker tape as follows:
  - .1 Phase A - red
  - .2 Phase B - black
  - .3 Phase C - blue
  - .4 Neutral - white

.5 Ground - green

3.3 **WIRE AND CABLE IDENTIFICATION**

.1 Identify power, control, lighting and receptacle wires with continuous colouring as follows:

- .1 Phase A - red
- .2 Phase B - black
- .3 Phase C - blue
- .4 Neutral - white
- .5 Ground - green
- .6 Isolating ground - green and yellow
- .7 Control - red
- .8 Interlock - yellow
- .9 D.C. - blue

.2 For larger wire sizes available only in black, install coloured wire marker tape in accordance with above coding.

3.4 **WIRE AND CABLE IDENTIFICATION**

.1 Cables Bearing Identification Numbers on the Drawings

.1 Install identification markers at each end of cable run.

.2 Control/Indication Conductors

- .1 Install conductor identification markers at switchgear, motor control centres and motor starter terminal blocks and at remote devices.
- .2 Identification in accordance with the Drawings and reviewed Shop Drawings.

.3 Lighting and Receptacle Branch Circuits

- .1 Install conductor identification markers at panel, outlet box connections to lighting fixtures and device outlet boxes.
- .2 Typical identification if fixture or device is connected to panel A, circuit 5: A-5.

.4 Low Voltage Lighting Control

- .1 Install conductor identification marker at relay phase conductors. Typical identification if connected to panel A, circuit 5: A-5.
- .2 Install conductor identification marker on conductors between control locations and relay panels. Identify in accordance with reviewed Shop Drawings.

.5 Data, Voice and Fibre Optic Cables

- .1 Label horizontally distributed cabling at the following locations:
  - .1 Both ends of cable run

- .2 Entrance and exit of cable pathway (i.e. cable trays, zone conduits, etc.)
- .2 Label riser/backbone distribution cables at the following locations:
  - .1 Both ends of cable run
  - .2 Entrance and exit of cable pathway (i.e. cable trays, zone conduits, etc.)
  - .3 1.5 m above finished floor in communication closets and equipment rooms
  - .4 At entrance and exit of a sleeve or slot in communication closets and equipment rooms

- .3 Use the following colour codes for labels:

Function	Colour
Auxiliary and miscellaneous circuits	Yellow
Common equipment	Purple
Customer side of network interface	Green
First level backbone	White
Horizontal cabling to workstations	Blue
Interbuilding backbone	Brown
Key telephone systems	Red
Network side of network interface	Orange
Second level backbone	Gray

Note: Common equipment refers to PBX equipment, host computer, LANs and multiplexer. Miscellaneous refers to maintenance alarms, security, paging systems, and other system and circuits not an integral part of common equipment. Colour codes to ANSI/TIA/EIA-606.

- .6 Fire Alarm and Miscellaneous Systems
  - .1 Install identification on conductors at panels, remote devices and system connections. Identify in accordance with reviewed Shop Drawings.
  - .2 Install maglock/fire alarm pull station identification adjacent to each door equipped with a maglock.

### 3.5 **CONDUIT AND ELECTRICAL METALLIC TUBING (EMT) IDENTIFICATION**

- .1 Where Drawings indicate conduit and EMT identification numbers/letters, install identification markers at each end of run and at pull box locations.

### 3.6 **CABLE TRAY IDENTIFICATION**

- .1 Install markers indicating system, voltage, or voltages for trays with barriers, and identification number at intervals of 20 m maximum, at branches and termination locations.

### 3.7 **BUSWAY IDENTIFICATION**

- .1 Install stick-on markers indicating busway identification number and rating at cable tap boxes and thereafter at intervals of 30 m maximum.
- .2 Install suspended identification signs at start of run and at intervals of 30 m maximum.

**3.8 PANELBOARD IDENTIFICATION**

- .1 Install identification plates, using adhesive, on outside of panel.
- .2 Install directory.
- .3 Identify main bus as follows:
  - .1 Phase A - red
  - .2 Phase B - black
  - .3 Phase C - blue
  - .4 Neutral - white
  - .5 Ground - green

**3.9 SWITCHBOARD IDENTIFICATION**

- .1 Install identification plates for panel and branch feeders.

**3.10 MOTOR STARTER, CONTACTOR AND DISCONNECT SWITCH IDENTIFICATION**

- .1 Install identification plates using self-tapping screws.

**3.11 IDENTIFICATION AFTER FINISH PAINTING**

- .1 Behind access doors at shaft plenums: identify busways, feeder cables and feeder conduits.

**3.12 EQUIPMENT WARNING SIGNS**

- .1 Install "Danger - High Voltage" signs.
- .2 When equipment is supplied from more than one source install red warning signs to this effect.

**3.13 PATCH PANEL AND FACEPLATE IDENTIFICATION**

- .1 Identify each jack at each wall or furniture outlet with a label supplied by the faceplate manufacturer. Each jack identification designation to match the respective cable identification designation.
- .2 Identify each jack at each patch panel jack with labels, front and back, supplied by the patch panel manufacturer. Each jack identification designation to match the respective cable identification designation.
- .3 In addition to an alphanumeric label use manufacturer's matching colour coded icons, which conform to ANSI/TIA/EIA-606, to identify individual jacks on faceplate and patch panels.

End of Section

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- 1 General
- 1.1 **SUMMARY**
- .1 Section Includes
- .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- 1.2 **REFERENCES**
- .1 Canadian Standards Association: CSA
- .2 C22.3 No. 1
- .3 C22.2 No. 0.3-M
- .4 C22.3 No. 2
- .5 C22.2 No. 04-M
- .6 C22.2. No. 41
- .7 American Society for Testing and Materials: ASTM
- .8 National Electric Testing Association Inc.: NETA
- 1.3 **SUBMITTALS**
- .1 Submit certified test reports in accordance with Section 26 05 01.
- 2 Products
- 2.1 **MATERIALS**
- .1 Furnish all materials, instrumentation, etc. required to execute testing and commissioning as specified, including manufacturers testing and commissioning.
- .2 Calibrate test instruments and for each instrument record identifying numbers, date of calibration and percentage of error (if any) on appropriate test reports.
- .3 Furnish megger test instruments as follows:
- | Megger Voltage | System Voltage                |
|----------------|-------------------------------|
| 500 V          | up to 250 V (low voltage)     |
| 1000 V         | 277 V to 1000 V (low voltage) |
- 3 Execution
- 3.1 **CO-ORDINATION OF ELECTRICAL PROTECTIVE DEVICES**
- .1 Following receipt of Shop Drawings, obtain from manufacturers time-current curves of all protective devices.
- .2 Coordinate setting of relays, rating of fuses and trip elements of circuit breakers, so that the protective device immediately ahead of any fault operates before any upstream protection and establish selective coordination throughout the system.
-

- .3 Prepare a complete set of curves showing time current characteristics for all breakers and fuses from main switchboard main circuit down to 208/120 V panels.

### 3.2 **PRE-TEST INSPECTION AND CLEANING**

- .1 Check that all dust, debris, surplus materials and tools, have been removed from equipment.
- .2 Inspect all parts of the power distribution systems at each voltage level for completeness, check and set circuit protective devices, fuses, breaker relays, trips, and all ancillary devices in accordance with the reviewed coordination studies, approved drawings and manufacturer's instructions.
- .3 Check phase sequence throughout the systems and application of colour codes to equipment and cables.
- .4 Verify all cable sizes, equipment ratings, trip settings conform to Specifications and coordination study.

### 3.3 **TESTING GENERAL**

- .1 Test the electrical installation including all safety devices as the Work progresses and on completion.
- .2 Without adjustment to the Contract Price:
  - .1 Repair, rework or replace any equipment, material or workmanship which fails specified tests.
  - .2 Perform such additional tests and re-tests as may be directed by the Consultant and/or Owner's Representative.
- .3 Energize each voltage level of the system immediately after testing is complete.
- .4 In case this is not feasible verify all fuse sizes and trip settings and repeat megger tests of each feeder and equipment with circuit breakers and switches open, immediately before energization.
- .5 Distribution Panels and Panelboards
  - .1 Check bolted connections bus to bus, and bus to cable lug with torque wrench, to manufacturer's values. Mark with adhesive tape or label when satisfactory.
  - .2 Measure contact resistance on low voltage fusible and non fusible switches, circuit breakers, contactors and auxiliary equipment. Acceptable values:

	Microhms
Low voltage - up to 250 V	500
Low voltage - 277V to 1000V	500
  - .3 Megger test insulation resistance phase to phase and phase to ground of fusible switches, circuit breakers, contactors, buswork, auxiliary equipment. Acceptable values:

	Megohms
Low voltage, up to 250V	1
Low voltage, 277V to 1000 V	50

Duration of each test: one (1) minute

- .4 Check ground bus and ground path for continuity, and connection to all non-current carrying metalwork. Maximum acceptable reading 0.1 ohms.
- .5 Check for physical faults: Damaged or dirty insulators, alignment of contacts, switchblades, operating mechanism, clearances, barriers, mounting.
- .6 Operate circuit breakers, switches, contactors, three times.
- .7 Operate equipment through design functions, including remote control operation, actuation of alarm and indication devices, mechanical and electrical operation and operation from protective relays.
- .8 Check 600V circuit breakers for trip and target operation. Test long time, short time, instantaneous and ground fault trips. Trip settings shall conform to values selected in the coordination study. Verify pickup and time values. Compare actual trip time with manufacturer's specifications and present in tabular form.
- .9 Balance loads on all panelboards. Use Shop Drawing information for all equipment loads.

3.4 **LOW VOLTAGE SWITCHBOARDS UP TO 1000 VOLT SERVICE**

- .1 Visually inspect components and complete assembly, check wiring and interconnections.

3.5 **LOW VOLTAGE STARTERS, CONTACTORS UP TO 1000 VOLT SERVICE**

- .1 Visually inspect components and the complete assembly.
- .2 Check each contactor and starter for switch or breaker operation, fuse or breaker rating, contactor size and operation, auxiliary contact operation.
- .3 Check starter overloads with motor nameplate ratings.
- .4 Check controls and starters and contactors operation on load.
- .5 Check motor rotation.

3.6 **DISTRIBUTION TRANSFORMERS UP TO 1000 VOLT SERVICE**

- .1 Set taps for nominal voltage output from secondary with initial loads applied.
- .2 Check for clear airflow through enclosure.
- .3 Check that connections are not stressed.

End of Section

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1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to latest issues, amendments and supplements of following standards:

- |     |                                      |   |  |
|-----|--------------------------------------|---|--|
| .1  | CAN3-C155-M                          | - | Shunt Capacitors for AC Power Systems  |
| .2  | CSA C9-M                             | - | Dry-Type Transformers  |
| .3  | CSA C22.2 No. 4-M                    | - | Enclosed Switches  |
| .4  | CSA C22.2 No. 5.1M                   | - | Moulded Case Circuit Breakers  |
| .5  | CSA C22.2 No. 27                     | - | Busways  |
| .6  | CSA C22.2 No. 31-M                   | - | Switchgear Assemblies  |
| .7  | CSA C22.2 No. 39                     | - | Fuseholder Assemblies  |
| .8  | CSA C22.2 No. 47                     | - | Air-Cooled Transformers (Dry Type)   |
| .9  | CSA C22.2 No. 106-M                  | - | HRC Fuses  |
| .10 | NEMA BU1.1                           | - | General Instructions for Proper Handling, Installation, Operation, and Maintenance of Busway Rated 600 Volts or Less |
| .11 | ANSI/UL 1449 4 <sup>th</sup> edition | - | Surge Protective Devices   |
| .12 | ANSI/UL 1283 5 <sup>th</sup> edition | - | Electromagnetic Interference Filters   |
| .13 | ANSI/IEEE C62.41                     | - | Surge Voltages in LowVoltage AC Power Circuits   |

2 Products

2.1 **DISTRIBUTION PANELS**

.1 Description

- .1 Distribution panel comprising two basic units: Main circuit breaker and distribution circuit breakers.

.2 Construction

- .1 Steel, indoor, sprinkler proof enclosure, type as specified in Section 26 05 02, dead front, free standing. Suitable for mounting against a wall. Facilities for lifting into position and bolting to floor.
- .2 Provisions for addition of future sections at both ends.

.3 Bus

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- 
- .1 All bus, copper.
  - .2 Neutral bus, full capacity where indicated.
  - .3 Bus short circuit rating: 65 kA, 3 phase, rms, symmetrical, unless indicated on Drawings.
  - .4 Ground bus, 6 mm x 25 mm extending full length of switchboard, solderless connector at each end suitable for No. 2/0 AWG copper grounding cable.
  - .4 Main Circuit Breaker
    - .1 Circuit breaker, electronic trip, molded case, full function 100% rated where indicated, three-pole, quick make, quick break, trip free, provision for padlocking in off position.
  - .5 Distribution Unit
    - .1 Circuit breakers, molded case, standard function 80% rated, three-pole, quick make, quick break, trip free, thermal magnetic or solid state trip elements. Provision for padlocking in "off" position.
    - .2 Spaces to be fully bussed for addition of future breakers.
  - .6 Cable Entry
    - .1 Top cable entry through removable aluminum plates.
  - .7 Surge protective Device (SPD)
    - .1 SPD with connection to switchboard bus via circuit breaker with features as follows:
      - .1 Hybrid filter consisting of thermally protected metal oxide varistors and a parallel filter circuit.
      - .2 High energy transient voltage suppression, surge current diversion and high frequency attenuation of wave shapes in Category C environment as defined in ANSI/IEEE C62.41.
      - .3 Surge current rating, based on 8 x 20 $\mu$ s wave shape, as follows:
        - .1 Per mode: 125 kA minimum
        - .2 Per phase: 250 kA minimum
      - .4 Filter noise attenuation: 50 dB minimum, normal mode, from 10 kHz to 100 MHz.
      - .5 Normal protection modes: line to line (and line to neutral for four-wire systems). Common protection modes: line to ground (and neutral to ground for four-wire systems).
      - .6 Fusing for each protection mode.
      - .7 Status LED indication of each phase.
      - .8 Trouble light.
-

- .9 Auxiliary contact for remote annunciation of system integrity.
  - .10 Transient surge counter.
  - .11 UL1449 4<sup>th</sup> edition and UL1283 5<sup>th</sup> edition listed, CSA or CUL approved.
  - .12 Acceptable manufacturers for SPD
    - .1 Eaton
    - .2 Schneider
    - .3 Siemens
  - .13 Electrical parameter monitoring system:
    - .1 Refer to Section 26 09 13.
  - .8 Sub-metering system
    - .1 Refer to Section 26 09 13.
  - .9 Nameplate
    - .1 Nameplate, engraved laminated plastic, black lettering on white background as follows:
      - .1 Switchboard identification, 15 mm minimum character height
  - .10 Finish
    - .1 ANSI 49 light grey enamel finish.
  - .11 Acceptable Manufacturers
    - .1 Schneider
    - .2 Siemens
    - .3 Eaton
  - 2.2 **PANELBOARDS - CIRCUIT BREAKER TYPE**
    - .1 Panelboards to be product of one manufacturer.
    - .2 Enclosures: Steel, type as specified in Section 26 05 01.
    - .3 Bus: Copper, half capacity ground bar and full or double capacity neutral bar as indicated, braced for interrupting capacity as indicated.
    - .4 Circuit breakers: Bolt-on, quick-make, quick-break, thermal and magnetic trips, trip indicating, trip free handle. Common operating handle on multipole breaker.
    - .5 Integral surge protective device, where indicated, with features as follows:
      - .1 Connection to panelboard bus via circuit breaker.
      - .2 Hybrid filter consisting of thermally protected metal oxide varistors and a parallel filter circuit.
-

- .3 High energy transient voltage suppression, surge current diversion and high frequency attenuation of wave shapes in Category B environment as defined in ANSI/IEEE C62.41.
- .4 Surge current rating, based on 8 x 20µs wave shape, as follows:
  - .1 Per mode: 80 kA minimum
  - .2 Per phase: 160 kA minimum
- .5 Filter noise attenuation: 50 dB minimum, normal mode, from 10 kHz to 100 MHz.
- .6 Normal protection modes: Line to line (and line to neutral for four-wire system). Common protection modes: Line to ground (and neutral to ground for four-wire system)
- .7 Fusing for each protection mode.
- .8 Status LED indication of each phase.
- .9 UL1449 4<sup>th</sup> edition and UL1283 5<sup>th</sup> edition listed, CSA or CUL approved.
- .6 Door: Hinged lockable door.
- .7 Keys: Two keys per panelboard; key panelboards alike.
- .8 In addition to CSA requirements, manufacturer's nameplate to indicate panel withstand fault current.
- .9 Lock-on devices: For circuits supplying continuously operating equipment. Minimum quantity 10% of 15A, 20A and 30A rated breakers.
- .10 Spaces: Fully bussed for future breakers with removable filler plates.
- .11 Breaker arrangement: Locate breakers at specific circuit number locations shown on panelboard schedule sheet.
- .12 Acceptable Manufacturers
  - .1 Schneider
  - .2 Eaton
  - .3 Siemens

2.3 **DRY TYPE TRANSFORMERS - UP TO 600V**

- .1 Dry-type transformers: Type ANN, copper windings, insulation Class H, 150°C rise.
  - .2 Enclosure: Steel, sprinkler proof enclosure type as specified in Section 26 05 01.
  - .3 Taps: Full capacity four – 2½%, two above and two below normal.
  - .4 Impedance: Minimum 3% and maximum 6%.
  - .5 Vibration isolators: Internal noise and vibration isolating pads.
  - .6 Mounting brackets: Floor and wall standard.
  - .7 Acceptable Manufacturers:
-

- .1 Eaton
- .2 Hammond
- .3 Schneider

2.4 **MANUAL MOTOR STARTERS**

- .1 Enclosure: Steel, sprinkler proof enclosure type as specified in Section 26 05 01.
- .2 Overload relay and heater element in each phase, manual reset.
- .3 Heavy duty type single phase toggle switch, and three phase pushbutton type, quick-make quick-break switching mechanism.
- .4 Pilot light: Heavy duty, transformer, push to test, red.
- .5 Provision for padlocking in OFF position.
- .6 Acceptable Manufacturers:
  - .1 Allen-Bradley
  - .2 Eaton
  - .3 Schneider
  - .4 Siemens

2.5 **MAGNETIC MOTOR STARTERS**

- .1 Enclosure: Steel, sprinkler proof enclosure type as specified in Section 26 05 01.
  - .2 NEMA type combination magnetic motor starters, fusible disconnect type with overload relay and heater element in each phase.
  - .3 Rating: Minimum size-1.
  - .4 Door mounted accessories:
    - .1 Pushbuttons or three-position HOA selector switches, heavy duty oil tight type.
    - .2 Pilot lights: Heavy duty, transformer, press to test, red.
    - .3 Lens colour: Running – red; stopped – green; alarm/malfunction – amber.
  - .5 Control transformer: 120V secondary, fused, sized to suit control circuit load plus 50VA.
  - .6 Auxiliary contacts: Minimum one spare N/C, one spare N/O interchangeable, in addition to seal-in contact.
  - .7 For control voltage from an external source:
    - .1 Provide terminals, covered with hard insulating guard.
    - .2 Apply a lamacoid warning plate on the outside of the starter cover describing the source of outside control power.
  - .8 Acceptable Manufacturers
-

- .1 Allen-Bradley
- .2 Eaton
- .3 Schneider
- .4 Siemens

2.6 **CONTACTORS**

- .1 Enclosure: Steel, sprinkler proof enclosure type as specified in Section 26 05 01.
- .2 NEMA type, heavy duty, designed for the application, e.g. lighting contactors for lighting circuits.
- .3 Auxiliary contacts, minimum two N/O and two N/C.
- .4 Control transformer, fused primary and secondary, 120 volt output.
- .5 Hand/Off/Auto (HOA) control selector switch and red pilot light, "press to test" type.
- .6 Acceptable Manufacturers:
  - .1 Allen-Bradley
  - .2 Eaton
  - .3 Schneider
  - .4 Siemens

2.7 **CONTROL STATIONS**

- .1 Pushbutton and selector switches: heavy duty, oiltight.

2.8 **FUSIBLE AND NON FUSIBLE DISCONNECT SWITCHES**

- .1 Enclosure: Steel, sprinkler proof enclosure type as specified in Section 26 05 01.
- .2 Switches: Quick-make, quick-break, heavy duty, short circuit rating 100,000A rms sym. Provision for locking in off position with up to three padlocks.
- .3 Viewing window: For viewing blades.
- .4 Electrical interlock: Mechanically operated from switch mechanism, rated 120 VAC, 15A, one N/O and one N/C contact at non-fusible switches local to motors
- .5 Except as noted otherwise, furnish and install non-fusible safety switches on all electrically powered equipment to isolate equipment from power supply.
- .6 Acceptable Manufacturers:
  - .1 Schneider
  - .2 Eaton
  - .3 Siemens

2.9 **FUSES**

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- 
- .1 HRC fuses to CSA C22.2 No. 106-M.
  - .2 Time delay fuses as follows:
    - .1 Fuses up to 600V, up to 600A HRCI-J, Form I: Class J Bussman JHC, Gould Shawmut AJT.
    - .2 Fuses above 600A HRC-L, Form I: Class L Bussman KLU, Gould Shawmut A4BT.
  - .3 Provide spare fuses of each type and size in use as follows:
    - .1 600A and below: Six.
    - .2 Above 600A: Three.
  - .4 Submit a list of spare fuses to Consultant for approval.
- 2.10 **METERING CABINET**
- .1 Steel enclosure NEMA 1, sprinkler proof, sized 900 mm x 900 mm x 300 mm deep. Code gauge steel complete with hinged door, lock and latch and removable back plate to meet utility requirements.
  - .2 Acceptable Manufacturers:
    - .1 Hammond
- 2.11 **RELAYS**
- .1 Totally enclosed plug-in type relay with four form-C contacts, operating coil to suit required voltage. Complete with mounting socket.
  - .2 Acceptable Manufacturers
    - .1 Allen-Bradley
    - .2 Schneider
    - .3 Eaton
- 2.12 **AC INVERTER SYSTEM**
- .1 Description: Inverter, batteries, battery charger, contactors and controls for supply of emergency AC power to a normally energized load of circuit breaker controls.
  - .2 References
    - .1 Comply with:
      - .1 CSA C22.2 No. 107.1-M – Commercial and Industrial Power Supplies
      - .2 ANSI/UL924 – Emergency Lighting and Power Equipment
  - .3 Enclosure
    - .1 Steel enclosure type to comply with Section 26 05 01, floor mounting, front lockable doors. Common enclosure for inverter, battery, charger and controls.
    - .2 Finish ASA 61 grey.
-

- 
- .4 Rating
    - .1 Input: 120 V, single phase, 60 Hz
    - .2 Normal output: 120 V, single phase, 60 Hz
    - .3 Load: facility for normally on loads, size to suit circuit breaker control transformer in main switchboard.
    - .4 Operating time: Thirty minutes with full nameplate capacity rating at end of thirty minutes continuous operation up to end of ten year battery design life expectancy.
    - .5 Features
      - .1 Input failure sensing
      - .2 Auto test
      - .3 Contactors to transfer from normal to inverter power
      - .4 Automatic battery disconnection at low battery voltage
      - .5 AC output circuit breaker
      - .6 Output voltmeter
      - .7 Inverter on/off control switch
      - .8 Inverter trip LED
      - .9 Manual bypass pushbutton
    - .6 Inverter
      - .1 Frequency regulation:  $\pm 1\%$
      - .2 Voltage regulation:  $\pm 10\%$  for 10-100% load
      - .3 Output: sinusoidal wave form with total harmonic distortion of less than 10%.
    - .7 Battery: Sealed, lead calcium gas recombination type, ten year design life expectancy
    - .8 Battery charger:
      - .1 Capable of full battery recharge within twenty-four hours of full discharge.
      - .2 Automatic equalize cycle, constant trickle charge
      - .3 Regulation:  $\pm 0.5\%$  output for  $\pm 10\%$  input variation
      - .4 DC voltmeter and charge rate ammeter.
      - .5 LED indicators for "ON" float and high charge modes.
      - .6 LED indicators common alarm with cut-off switch for AC failure, high battery voltage, low battery voltage and charger failure.
-



- .9 System Diagnostics
    - .1 Diagnostics to provide report to satisfy Ontario Building Code test requirements.
    - .2 Communication port RS485 and interface to provide monthly diagnostic report to Owner's computer.
  - .10 Acceptable Manufacturers
    - .1 Lumacell
    - .2 Or accepted equal
  - 3 Execution
  - 3.1 **GENERAL**
    - .1 Protect equipment from dust, debris, moisture, and physical damage, with sealed envelope of plastic or other impervious material until building is enclosed and cleaned and equipment is energized.
    - .2 Protect from condensation by maintaining at suitable temperature above 0°C.
    - .3 Finish equipment enclosures to ANSI 49 or ANSI 61, baked grey enamel.
  - 3.2 **PANELBOARDS**
    - .1 Locate panelboards, secure, plumb true and square to structure.
    - .2 Mounting Methods
      - .1 Exterior walls and interior combustible walls: mount on continuous slotted channel strut with 41 mm clear between back of panel and wall. Where practical, group panelboards on common frame.
      - .2 Interior non-combustible walls: mount against wall.
    - .3 Where panelboards are flush mounted, provide three 25 mm empty conduits from each panelboard into ceiling space above.
    - .4 Identify load circuits on panel directory complete with name and location.
    - .5 Where panelboards are equipped with fused switches, install fuses immediately prior to energization. Record fuse rating on breaker or switch cover.
  - 3.3 **DISTRIBUTION TRANSFORMERS**
    - .1 Support from building structure on trapezes or L brackets. Locate to provide free flow of cooling air.
    - .2 Loosen isolation pads until no compression is visible.
    - .3 Make final connection with flexible metal conduit.
    - .4 Leave slack in cables and flexible conduit, to avoid stress on connections.
  - 3.4 **MOTOR CONTROL EQUIPMENT**
-

- .1 Secure equipment plumb true and square to structure.
- .2 Check nameplate rating of motor to select overload relay heater elements; install heater elements.
- .3 Check operation of starters and correct motor rotation. Coordinate with Mechanical Division.
- .4 Provide plastic covers to exclude dirt and dust until starters are energized.

3.5 **DISCONNECT SWITCHES**

- .1 Install local to equipment on adjacent wall, column, or other suitable mounting surface. Where necessary provide free standing rigid continuous slotted channel strut frame.
- .2 Where mounted on masonry walls, allow minimum of 6 mm clear space between enclosure and masonry wall.

3.6 **FUSES**

- .1 Store fuses in a moisture free location until ready to energize.
- .2 Install fuses immediately prior to energization.
- .3 Prior to acceptance of the Work, clearly mark manufacturer's labels on inside cover of each fusible unit, with ampere rating and catalogue symbol of replacement fuses to be used.

3.7 **METERING CABINET**

- .1 Install cabinet in accordance with utility requirements.

3.8 **AC INVERTER SYSTEM**

- .1 Install AC inverter system
- .2 Commission inverter system under supervision of inverter system and battery system manufacturer's representatives.

End Of Section

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- 1 General
- 1.1 **SUMMARY**
  - .1 Section Includes
    - .1 Labour, Products, equipment and services necessary to complete the Work of this section including, but not limited to, the following:
      - .1 Lighting equipment as per the luminaire schedule and as specified herein.
    - .2 Refer to architectural reflected ceiling plans for exact location of luminaires.
    - .3 Check latest ceiling finish schedule in areas where recessed luminaires are specified to ensure that luminaires have suitable ceiling trim for particular ceiling finish.
- 1.2 **SUBMITTALS**
  - .1 Submit Shop Drawings in accordance with Section 01 33 00.
  - .2 Submit certified copies of photometric test data, for each luminaire type, prepared by independent testing laboratory. Photometric data to include total input watts, candlepower summary, candlepower distribution, zonal lumen summary, luminaire efficiency, coefficient of utilization table, lamp type, ballast type and manufacturer, and lumen rating in accordance with IESNA testing procedures.
  - .3 Submit samples as directed by Consultant for the following luminaire types:
- 1.3 **REFERENCES**
  - .1 Refer to the latest issue of the following standards:
    - .1 CSA C22.2 No. 9-M - General Requirements for Luminaires
    - .2 CSA C22.2 No. 34-M - Electrode Receptacles, Fittings, and Connectors for Gas Tubes
    - .3 CSA C22.2 No. 43-M - Lampholders
    - .4 CSA C22.2 No. 66 - Specialty Transformers
    - .5 CSA C22.2 No. 74 - Equipment for Use with Electric Discharge Lamps
    - .6 CSA C22.2 No. 141-M - Unit Equipment for Emergency Lighting
    - .7 ANSI/IEEE C62.41 - IEEE Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits
    - .8 CSA C860 - Performance of Internally Lighted Exit Signs
- 1.4 **CODES AND STANDARDS**
  - .1 All wiring to be in accordance with the Ontario Electrical Safety Code.
  - .2 Provide only equipment bearing a label acceptable to the Electrical Safety Authority (ESA) to indicate that the equipment has been tested to applicable CSA standards.
- 2 Products

2.1 **LUMINAIRES**

.1 General

- .1 Furnish luminaires in accordance with CSA C22.2 No. 9.
- .2 Furnish medium screw base lampholders of nickel or brass in accordance with CSA C22.2 No. 43.
- .3 Furnish mogul screw base lampholders of porcelain and nickel in accordance with CSA C22.2 No. 43.
- .4 Furnish lamp bases for gas tube lamps in accordance with CSA C22.2 No. 34.
- .5 Luminaire finishes shall resist chipping, crazing, discolouration.
- .6 Luminaires to contain no asbestos.
- .7 Furnish luminaires with flanges and gaskets to eliminate light leaks.

.2 Incandescent Luminaires

- .1 Furnish luminaires with all mounting and installation hardware.
- .2 Furnish accessories (guards, shields, reflectors, etc.) of the same manufacture as the luminaire.

.3 Fluorescent Luminaires

- .1 Fabricate steel luminaires from minimum 22 gauge mild sheet steel with joints securely fastened.
- .2 Do not use pre-painted steel.
- .3 Remove sharp edges.
- .4 Phosphate dip, prime and paint luminaire body, hardware and accessories with two coats of baked enamel, or other finish where indicated, after fabrication.
- .5 Interior baked enamel finish to have a minimum 88% reflectance and a minimum thickness of 1.2 mils.
- .6 Where two-level switching is indicated, furnish two ballasts, separately switched, with one ballast connected to the outer lamps and the other ballast connected to the inner lamp(s).
- .7 Acrylic lens, 100% virgin acrylic, 0.125" nominal thickness, extruded aluminum hinged frame.

.4 HID Luminaires

- .1 Rated for operation over a -30°C to +40°C (-22°F to +104°F) ambient temperature range unless otherwise noted in luminaire schedule.

.5 Exit Light Luminaires

- .1 Aluminum housing, stencil face, knock-out chevrons, unless otherwise noted in luminaire schedule.

- .2 150 mm high red letters.
- .3 Universal ceiling, end-to-wall, surface back-to-wall mounting or recessed mounting if indicated.
- .4 Connection for emergency 12 V source where indicated.
- .5 LED type with diffusing lens.

## 2.2

### **BALLASTS**

- .1 Fluorescent
  - .1 To CSA C22.2 No. 74.
  - .2 Electronic, to operate one or two lamps, integrally mounted in luminaire unless otherwise indicated.
  - .3 Rapid start type for normal output lamps unless otherwise indicated.
  - .4 Instant start type for high output lamps.
  - .5 Totally enclosed containing no polychlorinated biphenyls.
  - .6 Rated 60 Hz, voltage as indicated.
  - .7 Rated for operation over an ambient temperature range of 10°C to 40°C (50°F to 104°F).
  - .8 Maximum case temperature not greater than 25°C (77°F) above ambient temperature.
  - .9 Operate at in a frequency range of 25 kHz to 40 kHz.
  - .10 Produce no visible flicker.
  - .11 Minimum sound rating of Class A.
  - .12 Minimum ballast factor of 0.9 unless otherwise noted in luminaire schedule.
  - .13 Minimum power factor of 0.95.
  - .14 Maximum crest factor of 1.5.
  - .15 Maximum input current total harmonic distortion of 15% measured at rated output.
  - .16 To withstand line transients as defined by ANSI/IEEE C62.41, Category A.
  - .17 Acceptable manufacturers (unless otherwise specified in luminaire schedule):
    - .1 Advance
    - .2 Osram Sylvania
    - .3 Universal
- .2 Metal Halide
  - .1 To CSA C22.2 No. 66 and CSA C22.2 No. 74.

- .2 Integrally mounted in luminaire unless otherwise indicated.
- .3 Rated 60 Hz, voltage as indicated.
- .4 Two-winding constant wattage isolated winding (CWI) or three-winding magnetic regulator (Mag Reg) type ballast unless otherwise specified in luminaire schedule.
- .5 Lamp wattage regulation to be  $\pm 10\%$  maximum for a line voltage variation of  $\pm 10\%$  from rated voltage.
- .6 Totally enclosed containing no polychlorinated biphenyls.
- .7 Class 180 insulation.
- .8 Minimum ballast factor of 0.95.
- .9 Minimum power factor of 0.95.
- .10 Maximum crest factor of 1.65 for metal halide and 1.80 for mercury.
- .11 Maximum input current total harmonic distortion of 20% measured at rated output.
- .12 Ballast UL bench top rise temperature code to be suitable for the luminaire in which it is installed.
- .13 Minimum  $-30^{\circ}\text{C}$  ( $-22^{\circ}\text{F}$ ) starting temperature.
- .14 Acceptable manufacturers:
  - .1 General Electric
  - .2 Holophane
  - .3 Universal
  - .4 Advance
- .3 High Pressure Sodium
  - .1 To CSA C22.2 No. 66 and CSA C22.2 No. 74.
  - .2 Integrally mounted in luminaire unless otherwise indicated.
  - .3 Rated 60 Hz, voltage as indicated.
  - .4 Two-winding constant wattage isolated winding (CWI) or three-winding magnetic regulator (Mag Reg) type ballast unless otherwise specified in luminaire schedule.
  - .5 Lamp wattage regulation to be  $\pm 10\%$  maximum for a line voltage variation of  $\pm 10\%$  from rated voltage.
  - .6 Totally enclosed containing no polychlorinated biphenyls.
  - .7 Class 180 insulation.
  - .8 Minimum ballast factor of 0.95.

- .9 Minimum power factor of 0.95.
- .10 Maximum crest factor of 1.65.
- .11 Maximum input current total harmonic distortion of 20% measured at rated output.
- .12 Ballast UL bench top rise temperature code to be suitable for the luminaire in which it is installed.
- .13 Minimum -40°C (-40°F) starting temperature.
- .14 Igniter with an automatic shutdown circuit to de-energize the high voltage pulses when an inoperative or missing lamp is detected.
- .15 Acceptable manufacturers:
  - .1 General Electric
  - .2 Holophane
  - .3 Universal
  - .4 Advance

**2.3 LAMPS**

.1 Compact Fluorescent

watts	type	base	colour temp (K)	hrs life @ 3hrs per start	initial lumens	CRI
9	twin	single end 2-pin	2700/3500/4100	10,000	580	82
13	twin	single end 2-pin	2700/3500/4100	10,000	800	82
13	twin	single end 2-pin	5000	10,000	785	80
9	dbt twin	single end 2-pin	2700/4100	10,000	525	82
13	dbt twin	single end 2-pin	2700/3000/3500/4100	10,000	810	82
13	dbt twin	single end 4-pin	2700/3000/3500/4100	12,000	900	82
18	dbt twin	single end 2-pin	2700/3000/3500/4100	10,000	1150	82
18	dbt twin	single end 4-pin	2700/3000/3500/4100	12,000	1150	82
26	dbt twin	single end 2-pin	2700/3000/3500/4100	10,000	1710	82
26	dbt twin	single end 4-pin	2700/3000/3500/4100	12,000	1710	82
13	triple	single end 4-pin	2700/3000/3500/4100	12,000	900	82
18	triple	single end 4-pin	2700/3000/3500/4100	12,000	1200	82
26	triple	single end 4-pin	2700/3000/3500/4100	12,000	1710	82
32	triple	single end 4-pin	2700/3000/3500/4100	12,000	2200	82
42	triple	single end 4-pin	2700/3000/3500/4100	12,000	3200	82
57	triple	single end 4-pin	2700/3000/3500/4100/5000	12,000	4300	82
70	triple	single end 4-pin	2700/3000/3500/4100	12,000	5200	82

.2 Fluorescent

watts	type	base	colour temp (K)	hrs life @ 3hrs per start	initial lumens	CRI	length (ins.)	length (mm)
14	T5	Miniature bi-pin	3000/3500/4100/6500	20,000	1350	85	21.6	548

21	T5	Miniature bi-pin	3000/3500/4100/6500	20,000	2100	85	33.4	848
28	T5	Miniature bi-pin	3000/3500/4100/6500	20,000	2900	85	45.2	1148
35	T5	Miniature bi-pin	3000/3500/4100/6500	20,000	3650	85	57.1	1450
24	T5HO	Miniature bi-pin	3000/3500/4100/6500	20,000	2000	85	21.6	548
39	T5HO	Miniature bi-pin	3000/3500/4100/6500	20,000	3500	85	33.4	848
54	T5HO	Miniature bi-pin	3000/3500/4100/6500	25,000	5000	85	45.2	1148
80	T5HO	Miniature bi-pin	3000/3500/4100/6500	20,000	7000	85	57.1	1450
17	T8	medium bi-pin	3000/3500/4100	20,000	1300	75	24	610
17	T8	medium bi-pin	3000/3500/4100	24,000	1350	85	24	610
25	T8	medium bi-pin	3000/3500/4100	20,000	1950	75	36	915
25	T8	medium bi-pin	3000/3500/4100	20,000	2150	85	36	915
28	T8/ES	medium bi-pin	3000/3500	24,000	2725	85	48	1219
28	T8/ES	medium bi-pin	4100/5000	24,000	2750	82	48	1219
32	T8	medium bi-pin	3000/3500/4100	20,000	2800	78	48	1219
32	T8	medium bi-pin	3000/3500/4100	20,000	2950	85	48	1219
32	T8	medium bi-pin	5000	20,000	2650	78	48	1219
32	T8	medium bi-pin	5000	20,000	2800	85	48	1219
32	T8	medium bi-pin	6500	20,000	2700	78	48	1219

.3 Incandescent

watts	type	base	Volts	hrs life	initial lumens
250	T4	Mini-can	130	2,000	5000

.4 Metal Halide Pulse Start

watts	type*	base/burn pos.	clear/coated colour temp.	hrs life @ 10hrs per start	initial lumens	CRI	protected*
32	ED17-P.S.	Medium base down	coated-3200K	10,000	2400	70	yes
32	ED17-P.S.	Medium base up	coated-3200K	10,000	2400	70	yes
50	BD17-P.S.	Medium universal	clear-3200K	5,000	3900	70	no
50	BD17-P.S.	Medium universal	coated-3200K	5,000	3500	70	no
50	BD17-P.S.	Medium universal	clear-4000K	5,000	3100	75	no
50	BD17-P.S.	Medium universal	coated-4000K	5,000	2900	75	no
50	ED17-P.S.	Medium universal	clear-3500K	10,000	3400	70	yes
50	ED17-P.S.	Medium universal	coated-3500K	10,000	3200	70	yes
70	BD17-P.S.	Medium universal	clear-3200K	12,000	5500	70	no
70	BD17-P.S.	Medium universal	coated-3200K	12,000	5300	70	no
70	BD17-P.S.	Medium universal	clear-4000K	12,000	4700	75	no



70	BD17-P.S.	Medium universal	coated-4000K	12,000	4500	75	no
70	ED17-P.S.	Medium universal	clear-3200K	12,000	5500	70	yes
70	ED17-P.S.	Medium universal	coated-3200K	12,000	5300	70	yes
100	BD17-P.S.	Medium universal	clear-3200K	15,000	9000	70	no
100	BD17-P.S.	Medium universal	coated-3200K	15,000	8500	70	no
100	BD17-P.S.	Medium universal	clear-4000K	15,000	8100	75	no
100	BD17-P.S.	Medium universal	coated-4000K	15,000	7600	75	no
100	ED17-P.S.	Medium universal	clear-3200K	15,000	9000	70	yes
100	ED17-P.S.	Medium universal	coated-3200K	15,000	8500	70	yes
150	BD17-P.S.	Medium universal	clear-3200K	15,000	12500	70	no
150	BD17-P.S.	Medium universal	coated-3200K	15,000	12000	70	no
150	BD17-P.S.	Medium universal	clear-4000K	15,000	11700	75	no
150	BD17-P.S.	Medium universal	coated-4000K	15,000	11200	75	no
150	ED17-P.S.	Medium universal	clear-3500K	15,000	12500	70	yes
150	ED17-P.S.	Medium universal	coated-3500K	15,000	12000	70	yes
175	BD17-P.S.	Medium base up	clear-4000K	15,000	17500	75	no
175	BD17-P.S.	Medium base up	coated-4000K	15,000	16500	75	no
175	BT28-P.S.	EX39 (keyed) base up	clear-4000K	10,000	14400	65	yes
175	ED23.5-P.S.	Mogul base up	clear-3200K	15,000	17000	65	no
175	ED23.5-P.S.	Mogul base up	coated-3200K	15,000	16,000	65	no
175	ED23.5-P.S.	Mogul base up	clear-4000K	15,000	17500	75	no
175	ED23.5-P.S.	Mogul base up	coated-4000K	15,000	16500	75	no
250	BT28-P.S.	EX39 (keyed) base up	clear-4000K	10,000	23000	65	yes
250	ED28-P.S.	Mogul base up	clear-4200K	15,000	23000	65	no
250	ED28-P.S.	Mogul base up	coated-3900K	15,000	21500	65	no
320	ED28-P.S.	Mogul base up	clear-4000K	20,000	31000	65	no
320	ED28-P.S.	Mogul base up	coated-3700K	20,000	30000	70	no
320	ED28-P.S.	Mogul base up	clear-4000K	20,000	34000	65	no
320	ED28-P.S.	Mogul base up	coated-3700K	20,000	33000	70	no
320	ED28-P.S.	EX39 (keyed) base up	coated-3700K	20,000	30600	70	yes
320	ED37-P.S.	EX39 (keyed) base up	clear-4000K	20,000	32000	65	yes
320	ED37-P.S.	EX39 (keyed)	coated-3700K	20,000	30500	70	yes

		base up					
400	ED28-P.S.	Mogul base up	clear-4200K	20,000	44000	65	no
400	ED28-P.S.	Mogul base up	coated-3700K	20,000	42000	70	no
400	ED37-P.S.	Mogul base up	clear-4000K	20,000	41000	65	no
400	ED37-P.S.	Mogul base up	coated-3700K	20,000	40000	70	no
400	ED37-P.S.	Mogul base up	clear-4000K	20,000	44000	65	no
400	ED37-P.S.	Mogul base up	coated-3700K	20,000	42000	70	no
400	ED37-P.S.	Mogul base down	clear-4000K	20,000	44000	65	no
400	ED37-P.S.	EX39 (keyed) base up	clear-4000K	20,000	42000	65	yes
400	ED37-P.S.	EX39 (keyed) base up	coated-3700K	20,000	40000	70	yes
750	BT37-P.S.	Mogul base up	clear-4000K	16,000	82000	65	no
750	BT37-P.S.	Mogul base up	coated-3700K	16,000	72000	70	no
1000	BT37-P.S.	Mogul universal-vert.	clear-3900K	12,000	115000	65	no
1000	BT37-P.S.	Mogul universal-horiz.	clear-3900K	9,000	105000	65	no

.5 Metal Halide MR16 Ceramic Lamps

watts	type	base/burn pos.	clear/coated colour temp.	hrs life	initial lumens	CRI	protected
20	MR16	GX10	3000K	12,000	1000	83	yes
35	MR16	GX10	3000K/4000K	10,000/12,000	2200	83/93	yes

.6 Metal Halide "T" Shape Ceramic Lamps

watts	type	base/burn pos.	clear/coated colour temp.	hrs life	initial lumens	CRI	protected
39	T4.5	Bi-Pin G12	3000K	10,000	3400	82	no
70	T6	Bi-Pin G12	3000K	15,000	6200	83	no
70	T6	Bi-Pin G12	4200K	15,000	6400	93	no
150	T6	Bi-Pin G12	3000K	12,000	14000	82	no
150	T6	Bi-Pin G12	4200K	12,000	13000	94	no

.7 High Pressure Sodium Lamps

watts	type	base/burn pos.	clear/coated colour temp.	hrs life	initial lumens	CRI
35	B17	Medium universal	clear-1900K	16,000	2250	22
35	B17	Medium universal	diffuse-1900K	16,000	2150	22
50	B17	Medium universal	clear-1900K	24,000	4000	22
50	B17	Medium universal	diffuse-1900K	24,000	3800	22
50	ED23.5	Mogul universal	clear-1900K	24,000	4000	22
50	ED23.5	Mogul universal	diffuse-1900K	24,000	3800	22
70	B17	Medium universal	clear-1900K	24,000	6400	22
70	B17	Medium universal	diffuse-1900K	24,000	5950	22
70	ED23.5	Mogul universal	clear-1900K	24,000	6400	22
70	ED23.5	Mogul universal	diffuse-1900K	24,000	5950	22
100	B17	Medium universal	clear-2000K	24,000	9500	22

100	B17	Medium universal	diffuse-2000K	24,000	8800	22
100	ED23.5	Mogul universal	clear-2000K	24,000	9500	22
100	ED23.5	Mogul universal	diffuse-2000K	24,000	8800	22

.8 Acceptable lamp manufacturers unless otherwise specified in luminaire schedule:

- .1 General Electric
- .2 Osram Sylvania
- .3 Philips

## 2.4 LIGHTING POLES

- .1 Design poles and arms to withstand wind loading of 160 km/h and gusts of 1.3, without deformation, with designated luminaires installed.
- .2 Furnish poles (square) (round) (octagonal), (tapered) (straight), (steel) (aluminum), finish and colour as shown, designed for mounting on concrete base, height as indicated, complete with base bolt covers, grounding lug, handhole and flush weatherproof cover at base housing fuses and terminal strip.
- .3 Fuseholder, in-line, waterproof, breakaway type with 10 A fuse.
  - .1 Acceptable fuseholder manufacturers:
    - .1 Bussman, Tron fuseholder, HEB series with insulation boot
    - .2 Buchanan/Elastimold, Style 65
    - .3 Gould Shawmut, GEB series with insulating boots

## 2.5 EMERGENCY BATTERY UNITS

- .1 Supply voltage 120 (277) (347) V ac.
- .2 Output voltage 12 V dc.
- .3 Batteries: Sealed lead acid calcium alloy grid type sized to operate the lamp load to 91% of initial voltage for thirty minutes unless otherwise specified in luminaire schedule.
- .4 Battery charger: Solid state, multi-rate, voltage/current regulated, sized to restore battery to full charge in twelve hours.
- .5 Low voltage disconnect: Solid state, modular, operates at 80% battery voltage.
- .6 EEMAC 1 code gauge steel housing unless otherwise specified in luminaire schedule.
- .7 Auxiliary equipment:
  - .1 "AC power ON"
  - .2 "Fast charge" pilot light
  - .3 Voltmeter
  - .4 Test switch
  - .5 Five minute time delay relay

- .6 Cord and plug (120 V only)
  - .8 Lamp heads: Mounted as indicated, 360 degree horizontal and 180 degree vertical adjustment, type and wattage as specified in luminaire schedule.
  - .9 Acceptable manufacturers: As specified in luminaire schedule.
- 3 Execution
- 3.1 **INSTALLATION - GENERAL**
- .1 Provide supports for luminaires. Support single units from luminaire studs in outlet boxes. For continuous row fluorescent type, provide support for each end plus at least one for each channel section, or additional as required. Swivel mount stems. Provide concrete inserts at points of luminaire support in unfinished areas where a concrete slab serves as ceiling. Provide support from concrete floor and roof steel above ceiling as applicable.
  - .2 Align luminaires in rows, maintain required heights, and install luminaires clear of other work.
  - .3 Clean and relamp existing luminaires being removed and installed in new locations.
  - .4 Keep luminaires covered and protected from construction dust and debris until building is broom clean and free of suspended dust clouds.
  - .5 Do not lamp luminaires until ready for testing and use. Obtain Owner's approval before lamping. Install lamps in lampholders.
  - .6 When installation is complete, demonstrate operation to satisfaction of Owner.
  - .7 Standard octagonal boxes may be supplied where conduits feeding luminaires in finished areas are exposed on ceiling if hanger canopies entirely cover outlet boxes and are neatly notched for conduit. Otherwise, provide cast conduit outlet boxes with a diameter larger than canopies.
  - .8 Attach boxes or hickeyes directly to poured concrete with 6 mm minimum diameter bolts and lead expansion anchors where luminaires are suspended directly from concrete slabs. Use 8 mm minimum bolts through precast slabs, welded to 100 mm x 100 mm minimum, 3.5 mm plate above slabs.
  - .9 Do not mount luminaires above pipes, ducts or equipment. In event of unavoidable tight locations, provide hangers to clear obstructions. Check layouts of other trades on job and plan cooperatively. Luminaires in any room shall hang at one height. Obtain approval before any changes are made to layouts shown.
  - .10 Provide continuous 12 mm x 38 mm channel above ceiling, where luminaires are suspended or mounted on furred ceilings. Fasten luminaires to channel with two 6 mm minimum diameter studs with minimum 1220 mm on centre.
  - .11 Where two 1220 mm surface or suspended fluorescent luminaires occur in tandem, an 2440 mm body may be used. Where two single lamp luminaires occur in tandem, a common lamp ballast may be used.
  - .12 Verify catalogue number of luminaires with description prior to ordering, and check for final ceiling finish in areas where recessed luminaires are called for in order to provide ceiling trim, flanges and mounting brackets to suit particular construction used where luminaires are installed.

- .13 Support luminaires in an approved manner to comply with the Ontario Electrical Safety Code and the Ontario Building Code.
- .14 Provide steel luminaire studs, brackets and hangers. Where luminaires are hung on chain hangers, provide chain of closed link type capable of supporting ten times luminaire weight. Use U-bolts for chain ends; S-hooks are not acceptable.

### 3.2 **INSTALLATION - INDUSTRIAL**

- .1 For industrial luminaires suspended from ceiling outlet boxes, provide 13 mm rigid combination conduit stems, luminaire stud, and self-aligning hangers. In other locations, except as otherwise detailed or required, provide ceiling or wall outlet boxes with 9.5 mm, no-bolt luminaire studs. Provide special hangers for support of any luminaire which weighs more than 23 kg.
- .2 In high vibration areas, mount luminaires with cushion hangers.
- .3 Where specified, provide safety restraint device (safety chain or safety cord) of minimum length as recommended by the manufacturer.
- .4 The manufacturer to certify that the safety restraint device has been drop tested for the actual luminaire and restraint length.

### 3.3 **INSTALLATION - EMERGENCY AND EXIT LIGHTS**

- .1 Exit sign installation shall meet all requirements of the authorities having jurisdiction.
- .2 Install emergency battery units where shown. Support on brackets supplied by manufacturer.
- .3 Aim heads to properly illuminate exit path.

### 3.4 **INSTALLATION - CEILINGS**

- .1 Suspend luminaires mounted from or in a suspended T-bar ceiling directly from building structure, independent of the T-bar system, to ULC, Local Fire Marshal's Office, Ontario Building Code, Electrical Safety Authority (ESA) and Consultant's approval.
- .2 In non-accessible ceilings wire with not more than 1200 mm of AC90 or RW90 XLPE wire in flexible conduit to adjacent outlet boxes placed above finished ceiling within reach of the luminaire openings.
- .3 In accessible ceilings wire with not more than 1.8 m of AC90 or RW90 XLPE wire in flexible conduit to adjacent outlet boxes, locations as shown on the Drawings.
- .4 Provide suitable trim for all luminaires installed in drywall ceilings or within lay-in or snap-in tiles.

### 3.5 **INSTALLATION - POLES**

- .1 Wire down inside of lighting poles with No. 10 AWG RW90 plus No. 10 AWG insulated ground wire and secure to clips. Provide strain relief at the top of the pole so that the weight of the wiring down to the bottom of the pole does not place a strain on the wiring terminations. Install fuse holders and fuses.
- .2 Assemble arms and luminaires securely to pole. Provide lamps in lampholders.

- .3 Erect pole plumb and true on base. Along roadways, orient pole handhole on the side opposite the roadway unless otherwise indicated.
- .4 Connect underground ground wire and pole ground wire at ground lug in pole.
- .5 Leave slack in wires to allow connector and ground wire to be pulled out of handhole 150 mm clear of pole without disconnecting.

3.6 **FLOODLIGHTS**

- .1 Aim floodlights at night to satisfaction of Consultant.
- .2 Provide support from the building structure where floodlights are supported from buildings. Make support and wiring penetrations of the building envelope waterproof.

End Of Section

## 265000\_LUMINAIRE SCHEDULE

TYPE	VOLTS	LAMP (QTY)	DESCRIPTION	MFR.TYPE/SERIES
L01	120	LED 3500K, MINIMUM 80 CRI	2' x 4' LED Recessed Ceiling Panel, 4000lm	Peer Lux PNLV Lithonia EPanel Metalux 22FP
L02	120	LED 3500K, MINIMUM 80 CRI	4' LED Wall mount strip light, 160w/lm, 4000lm	Metalux SNLED or equivalent
L03	120	LED 3500K, MINIMUM 80 CRI	1' x 4' LED Recessed Ceiling Panel, 3000lm	Peer Lux PNLV Lithonia EPanel Metalux 22FP
L04	120	LED 3500K, MINIMUM 80 CRI	4 inch LED Recessed Round Downlight, 2000lm, 40 deg	EcoNU4RD-SW-20-35K-80-HE40-120-NC-WH- WH or equivalent
L05	120	LED 3500K, MINIMUM 80 CRI	8' LED Surface Mount strip light, 9600lm, round,clear lens	Metalux SNLED or equivalent
L06	120	LED 3500K, MINIMUM 80 CRI	4' Surface Mount strip light, 2200lm, round, semi frost lens, narrow	Metalux SNLED or equivalent
X01	120	LED	Exit Sign, Aluminum Housing, LED, Single Or Double Face, Back-to-Wall, End-to-Wall, pendant or Ceiling Mounted As Shown on Drawings, Green Running Man Pictogram, White Housing	Lumacell LA Series Beghelli Micra RM Series Aimlite RPALW Series
X02	120	LED	Exit Sign, Aluminum Housing, LED, Single Or Double Face, Back-to-Wall, End-to-Wall, pendant or Ceiling Mounted As Shown on Drawings, Green Running Man Pictogram, White Housing, C/W battery pack and remote heads	Lumacell LA Series Beghelli Micra RM Series Aimlite RPALW Series
B01	120	6W LED MR16	Emergency Battery Unit, 120 Volt Input, 12 Volt Output, Minimum 100 Watt Capacity For 30 minute for connected load, Enclosed In EEMAC 1 Code Gauge Steel Housing, 10 Year Life, Time Delay Relay, Voltmeter, Two Integral 6 Watt LED MR16 Heads	Lumacell Signature Series LD10 Heads, Lumacell RG12S Series or approved equal

1 General

1.1 **SUMMARY**

.1 Labour, Products, equipment and services necessary to complete the Work of this section including, but not limited to, the following:

.1 Control Devices

- .1 Distributed dimming control systems
- .2 Central dimming control system

.2 Input Devices

- .1 Occupancy, vacancy sensors
- .2 Sensor power packs
- .3 Daylight sensors
- .4 Multi Sensors
- .5 Touchscreens
- .6 Wallstations

.3 End Devices

- .1 Relays
- .2 Digital to Analog converters
- .3 0-10V to Reverse phase converters
- .4 LED drivers

.4 Software and Integration

- .1 BMS integration
- .2 LAN/VLAN integration
- .3 Partition controls
- .4 DMX integration
- .5 ASCII integration
- .6 Programming software
- .7 Emergency lighting control (if applicable)

1.2 **REFERENCES**

.1 American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)

- .1 C62.41-1991 – Recommended Practice for Surge Voltages in Low-Voltage AC Power Circuits.
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- .2 ASTM International (ASTM)
  - .1 D4674 -02a Standard Test Method for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Fluorescent Lighting and Window-Filtered Daylight.
- .3 Canadian Standards Association (CSA).
  - .1 CSA C22.2 # 14 Industrial Control Equipment
  - .2 CSA C22.2 # 184 Solid-State Lighting Controls
  - .3 CSA C22.2 # 156 Solid-State Speed Controls
- .4 International Electrotechnical Commission.
  - .1 (IEC) 801-2 Electrostatic Discharge Testing Standard.
  - .2 IEC/EN 60669-2-1 Switches for household and similar fixed electrical installations - electronic switches.
- .5 International Organization for Standardization (ISO)
  - .1 9001:2000 – Quality Management Systems.
- .6 National Electrical Manufacturers Association (NEMA)
  - .1 WD1 (R2005) - General Color Requirements for Wiring Devices.
- .7 Underwriters Laboratories, Inc. (UL):
  - .1 489 (2002) - Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
  - .2 508 (1999) - Standard for Industrial Control Equipment.
  - .3 1472 (1996) - Solid-State Dimming Controls.
  - .4 924 (2003) - Emergency Lighting and Power Equipment.
- .8 National Fire Protection Association (NFPA)
  - .1 701 (2004) Standard Methods of Fire Tests for Flame Propagation

1.3 **COORDINATION REQUIREMENTS**

- .1 Coordination
    - .1 Coordinate the placement of lighting control panels
    - .2 Coordinate the placement of sensors, wallstations and other user input devices
    - .3 Coordinate the placement of daylight sensors to achieve optimal daylight dimming
  - .2 Prewire meeting: Conducted on-site with lighting control system manufacturers or designated representative prior to commencing work as part of the manufacturer's standard practice and startup services. Manufacturer to review with the installer:
    - .1 Installation of lighting control panels and locations
-

- .2 Lighting control network wiring
- .3 Network IT requirements
- .4 Low voltage wiring requirements
- .5 Lighting control integration requirements
- .6 Lighting control system integration network wiring and connectivity
- .7 Installer responsibilities
- .8 Startup and training schedule and actions

#### 1.4 **SUBMITTALS**

- .1 Submit under provisions of Section 013300.
- .2 Specification Conformance Document: Indicate whether the submitted equipment:
  - .1 Meets specification exactly as stated.
  - .2 Meets specification via an alternate means and indicate the specific methodology used.
- .3 Shop Drawings; include:
  - .1 Load schedule indicating actual connected load, load type, and voltage per circuit, circuits and their respective control zones, circuits that are on emergency, and capacity, phase, and corresponding circuit numbers.
  - .2 Schematic of system.
- .4 Product Data: Catalog specification sheets with performance specifications demonstrating compliance with specified requirements.
- .5 Project Record Documents: Installer to record actual installation location and settings of lighting control panels and components.

#### 1.5 **QUALITY ASSURANCE**

- .1 Manufacturer: Minimum 10 years experience in manufacture of architectural lighting controls.
- .2 Manufacturer's Quality System: Registered to ISO 9001:2000 Quality Standard, including in-house engineering for product design activities.
- .3 Central dimming control system:
  - .1 Meets UL, cUL, and/or CSA Standards specifically for the required loads. Provide evidence of compliance upon request.

#### 1.6 **PROJECT CONDITIONS**

- .1 Do not install equipment until following conditions can be maintained in spaces to receive equipment:
  - .1 Ambient temperature: 0° to 40° C (32° to 104° F).

- .2 Relative humidity: Maximum 90 percent, non-condensing.
- .3 Lighting control system must be protected from dust and sprays during installation.

1.7 **WARRANTY**

- .1 Provide manufacturer's warranty covering 5 year 100 percent parts to repair and replace defective equipment.
  - .1 Systems that do not provide 100 percent parts at no extra charge for the first 5 years of installation shall not be acceptable.
- .2 Provide manufacturer's additional warranty options to customer where required.
  - .1 Provide warranty options beyond initial 5 year period as an additional purchased service.

1.8 **COMMISSIONING**

- .1 Provide factory-certified field service engineer to a site visit to ensure proper system installation and operation under following parameters:
  - .1 Qualifications for factory-certified field service engineer:
    - .1 Certified by the equipment manufacturer on the system installed.
  - .2 Make a visit upon completion of installation of central dimming control system:
    - .1 Verify connection of power feeds and load circuits.
    - .2 Verify connection Wallstation controls.
    - .3 Verify proper connection iCAN link.
    - .4 Download system panel data to dimming panels.
    - .5 Check dimming panel load types and currents and remove by-pass jumpers.
    - .6 Verify system operation control by control, circuit by circuit.
    - .7 Obtain sign-off on system functions.
    - .8 User to be trained on system operation

1.9 **MAINTENANCE**

- .1 Make ordering spare parts available to end user.
  - .2 Make new replacement parts available for minimum of ten years from date of manufacture.
  - .3 Provide factory direct technical support hotline.
  - .4 Provide on-site service support where required.
  - .5 Offer renewable service contract on yearly basis, to include parts, factory labor, and annual training visits to customer if desired.
-

1.10 **DELIVERY, STORAGE AND FIELD CONDITIONS**

- .1 Ensure products are delivered as shipped, including pallet assembly and packaging has not been damaged in shipment.
- .2 Store products in a clean, dry location in manufacturers original packaging.
- .3 Store products in an environment that meets products ambient and storage temperature per products specification sheets.
- .4 Store products in an environment that meets products relative humidity of less than 90 percent, non-condensing as outlined on the product specification sheets.

1.11 **SYSTEM DESCRIPTION AND OPERATION**

- .1 The Lighting Control and Automation system as defined under this section covers the following equipment:
    - .1 Distributed dimming control system – Simplified factory assembled dimming and switching solutions that meet typical applications and simplify low voltage wiring to help a space meet the latest IECC, ASHRAE and Title 24 energy codes.
    - .2 Centralized dimming control system – Factory assembled dimming and switching solutions that allow for applications to scale from small to enterprise while providing simplified low voltage wiring to allow for system completion faster. This system includes third party integration and features to simplify complex application designs.
    - .3 Occupancy Sensors – PIR, DT and ULT Auto adjusting, NEMA WD7 compliant occupancy or vacancy sensors.
    - .4 Wallstations – Smart device that are fully programmable, pre-engraved digital pushbutton wallstations and dimmers.
    - .5 Scene Wallstation – Smart device that are fully programmable, pre-engraved digital pushbutton scene wallstations, dimmers and programmable scene buttons.
    - .6 Daylight Photosensor – Smart device that is a multi-zone open loop daylight sensor with two-way active infrared (IR) communications, which can provide dimming control for daylight harvesting.
    - .7 Touchscreens – Full color touchscreen that can be programmed to control any area on the lighting control network. Shall include multiple screens with templates for simplified programming as well as password protected screen locking features.
    - .8 3rd Party Integration – Interface shall be provided to allows for 3rd party integration via serial or Ethernet into the iLumin Plus lighting system using standard ASCII commands
    - .9 BAS Integration – BACnet interface shall be available to allow BAS systems to detect and control area status.
    - .10 Demand Response – OpenADR or other demand response input shall be connected to one or more iLumin Plus panels. The DR signal will trigger a
-

- response to the lighting and is fully programmable based on a single area or the entire network.
- .11 iLumin Plus communication network – iCANnet CANbus wiring using Belden 1502 or 1502P network wire to create the iLumin Plus system lighting control network.
  - .12 2 wire topology free polarity free low voltage network – 18AWG or 14AWG twisted pair wire (purple and purple) is preferred for connecting user interface devices to the iLumin Plus lighting control panels. This simplifies the design, installation and controls allowing the installer and designer to get off the job faster.
- .2 Minimum lighting control performance required, unless local energy code is more stringent.
- .1 Occupancy/vacancy requirements – Provide occupancy/vacancy sensors as indicated on drawings and sequence of operation.
  - .2 Daylight Zones – Primary sidelit or toplit areas within an enclosed space shall be controlled separately and automatically by a multi-level photocontrol device.
  - .3 Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to dim electric light to the lowest light level.
  - .4 Provide the ability to adjust the high end and low end trim of the dimmers to ensure the lighting automatically provides energy saving even when daylighting calls for full illumination.
  - .5 Provide the ability for the dimmers and the relays to function separately. Systems where the 0-10V dimmers and relays are tied together reduce design capabilities and shall not be acceptable.
  - .6 Provide the ability to provide occupancy status to a Building Automation System.
  - .7 Shall be capable of automatically responding to a Demand Response Signal and adjusting the lighting level. (Required for California Title 24 2013)
- 2 Products
- 2.1 **MANUFACTURERS**
- .1 Acceptable Manufacturers:
    - .1 Cooper Lighting Solutions
    - .2 Douglas Controls
  - .2 Basis of design product: Cooper iLumin Plus system or subject to compliance and prior approval with specified requirements of this section, one of the following:
    - .1 Cooper iLumin Plus system
    - .2 Douglas Controls
  - .3 Substitutions:
-

- .1 No substitution will be accepted prior to award of Contract.
- .2 All proposed substitutions (clearly delineated as such) must be submitted in writing for approval by the design professional
- .3 Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
- .4 Provide complete engineered shop drawings (including power wiring) with deviations for the original design highlighted in an alternate color to the engineer for review and approval prior to rough-in.

## 2.2 **GENERAL**

- .1 Provide system hardware that is designed, tested, manufactured, and warranted by a single manufacturer.
- .2 Architectural Lighting Controls: Ten-year operational life while operating continually at any temperature in an ambient temperature range of 0° C (32°F) to 40° C (104°F) and 90 percent non-condensing relative humidity.
- .3 Designed and tested to withstand electrostatic discharges up to 12,000 V without impairment per IEC 801-2.

## 2.3 **ILUMIN PLUS PANELS**

- .1 Mechanical:
    - .1 Meets UL, cUL, and/or CSA Standards specifically for the required loads. Provide evidence of compliance upon request.
    - .2 Delivered and installed as a factory assembled panel listed to UL508.
    - .3 Field wiring accessible from front of panel without need to remove dimmer or relay assemblies or other components.
    - .4 Panels passively cooled via free-convection, unaided by fans or other means.
  - .2 Electrical:
    - .1 Electrolytic capacitors to operate under the component manufacturer's maximum temperature rating when device is under fully-loaded conditions in 40° C (104° F) ambient temperature.
    - .2 Design and test dimmers/relays to withstand line-side surges without impairment to performance.
      - .1 Panels: Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 3,000 amps per ANSI/IEEE C62.41 and per IEC 61000-4-5 surge requirements.
      - .2 Other power handling devices: Withstand surges without impairment of performance when subjected to surges of 6,000 volts, 200 amps per ANSI/IEEE C62.41.
    - .3 Utilize air gap off, activated when user selects "off" at any control to disconnect the load from line supply.
-

- .4 Power failure memory and dimmer/relay recovery:
  - .5 When power is interrupted and subsequently returned, lights will automatically return to same levels (dimmed setting, full on, or off) prior to power interruption.
  - .6 In 3 phase panels loss of power to any phase should not effect operation or control dimmers on any other phase.
  - .3 Performance:
    - .1 Shall be UL listed to relevant standards (UL508A, UL916, cULus)
    - .2 Shall be capable of mixed voltages 120/277VAC 50/60Hz
    - .3 Shall be capable of mixed sources including normal and emergency power
    - .4 Shall include a panel SCCR rating of 25kA
    - .5 Shall be capable of providing a mixed module solution panel including relays, dimmers and DALI controls.
    - .6 Shall be capable of meeting the latest IECC, ASHRAE and Title 24 energy codes
    - .7 Shall support three enclosure sizes
      - .1 Small Enclosure
        - .1 Shall support up to two modules
      - .2 Medium Enclosure
        - .1 Shall support up to four modules and PC connection module
        - .2 Shall include configurations with Ethernet connection to building LAN or VLAN
      - .3 Large Enclosure
        - .1 Shall support up to eight modules and PC connection module
        - .2 Shall include configurations with Ethernet connection to building LAN or VLAN
    - .4 Relay Module: (SCMR1220)
      - .1 Up to 48 relays in large enclosure
      - .2 Each relay module shall support up to twelve 20A fully rated relays
        - .1 Shall include heavy duty 20A @40C relays
      - .3 Rated life of relay: Minimum 1,000,000 cycles.
      - .4 Load switched in manner so that there is no arcing at mechanical contacts when power is applied to and removed from load circuits.
-

- .5 Fully rated output continuous duty for inductive, capacitive, and resistive loads.
  - .6 Relay controller shall include the capability for DMX input control with base address
  - .7 Relay controller shall include the capability for DALI input control
  - .8 Relay controller shall include alert dry contact input for hardware override of all relays
  - .5 Dimmer Module: (SCMH1200)
    - .1 Up to 48 Low Voltage Dimming (0-10V) channels in large enclosure
    - .2 Each dimmer module shall support up to twelve 0-10V channels; Meet following requirements:
    - .3 Capable of controlling any 0-10V source.
    - .4 0-10V dimmers shall include a fail to full output safety feature by default
    - .5 Provide isolated 0-10V output signal conforming to IEC 60929.
      - .1 50mA sink current per channel via IEC 60929.
      - .2 50mA source current per channel
    - .6 0-10V controller shall include the capability for DALI input control
  - .6 DALI: (SCMD4)
    - .1 Up to 16 DALI buses in medium enclosure
    - .2 Each DALI module shall support up to four DALI buses
    - .3 Shall include dedicated test/override buttons for each DALI bus
    - .4 Shall include a separate power supply for each DALI bus
      - .1 Shall provide 16V nominal, 250mA max current per bus
      - .2 Shall support 64 standard DALI devices per bus
    - .5 DALI controller shall include the capability for DMX input control with base address
    - .6 DALI controller shall include the capability for DALI input control
    - .7 DALI controller shall include alert dry contact input for hardware override of all relays
  - .7 Ethernet: (EG2)
    - .1 Shall provide a single ethernet port for connection to the building LAN or VLAN
-



- .2 Shall be capable of facilitating a LAN or Wi-Fi connection to the iLumin Plus system
- .3 Shall include an integral web server
- .4 Shall provide the capability for mobile devices to override the lighting system via scene or channel slider commands
- .5 Shall provide the capability for 3rd party integration via ASCII control strings
- .6 Shall provide the capability for bridging the iLumin Plus network across LAN or VLAN connections

## 2.4 INPUT DEVICES

### .1 WALLSTATIONS & TOUCHSCREENS

#### .1 Product: DALI Wallstation

##### .1 Electronics:

- .1 Use 18AWG – 14AWG wiring for low voltage communication to SCMD4 module

##### .2 Functionality:

- .1 Upon button press, LEDs to immediately illuminate.
- .2 Each button shall be programmable to control any area, scene, channel

##### .3 Color: White

- .4 Provide color matching faceplates with concealed mounting hardware where specified.

- .5 Engrave wall stations with appropriate button, zone, and scene descriptions as specified.

#### .2 Product: Ineo Wallstation

##### .1 Electronics:

- .1 Use iCANnet wiring for low voltage communication to ensure reliable data communication in high electrical noise environments.

##### .2 Functionality:

- .1 Upon button press, LEDs to immediately illuminate.
- .2 Each button shall be programmable to control any area, scene, channel

##### .3 Color: White

- .4 Provide color matching faceplates with concealed mounting hardware where specified.
-

- .5 Engrave wall stations with appropriate button, zone, and scene descriptions as specified.
  - .3 Product: [TSC-30]
    - .1 Communication: iCANnet protocol.
    - .2 Power: From the 9V external power supply (included)
    - .3 Connections: Five (5) wires Belden 1502 or 1502P
    - .4 Mounting: Wallbox (included)
    - .5 VGA 320x240 pixel resolution, 65,000 colors available
    - .6 3.5" diagonal backlit LCD touchscreen
    - .7 Shall allow up to 250 pages to be stored in memory
    - .8 Groups: The set of fixtures controlled by a given touchscreen shall be completely configurable through software and can span entire iLumin Plus network.
    - .9 Shall support individual zone level adjustment and save scene controls
  - .2 ADDRESSABLE MULTI-SENSOR
    - .1 Product: [MST-6], [MTS-12],
      - .1 Communication: DALI protocol.
      - .2 Power: From the DALI bus.
      - .3 Maximum Current Draw: 3.75 mA.
      - .4 Connections: Two (2) wires (16/18AWG, FT6, non-twisted, non-shielded, non-polarized and plenum rated) connected to the DALI communication bus.
      - .5 Sensing Technologies: Occupancy, daylight and temperature.
      - .6 Daylight Sensing Range: 0-400 lux.
      - .7 Daylight Sensing Coverage: Light input within 60° cone.
      - .8 Occupancy Detection Technology: Passive infrared.
      - .9 Occupancy Detection Coverage Area: 600 sq. ft. or 1,200 sq. ft.
      - .10 Occupancy Detection Angle: 360°.
      - .11 Mounting: Junction box or ceiling tile.
      - .12 Groups: The set of fixtures controlled by a given multi-sensor shall be completely configurable through software and can span iLumin Plus network..
-

- .13 Timers: All times shall be configurable through the web software and shall not require any manual configuration of settings prior to installation. Timer values can range from 1 second to 24 hours
  - .14 Shall be capable of occupancy forwarding to send occupancy status to other areas within the system
  - .2 Product: [NC3-C]
    - .1 Communication: iCANnet protocol.
    - .2 Power: From the iCANnet bus.
    - .3 Connections: Five (5) wires Belden 1502 or 1502P
    - .4 Sensing Technologies: Occupancy, daylight
    - .5 Daylight Sensing Range: 0-400 lux.
    - .6 Daylight Sensing Coverage: Light input within 60° cone.
    - .7 Occupancy Detection Technology: Passive infrared.
    - .8 Occupancy Detection Coverage Area: 250 sq. ft.
    - .9 Occupancy Detection Angle: 360°.
    - .10 Mounting: ceiling tile.
    - .11 Groups: The set of fixtures controlled by a given multi-sensor shall be completely configurable through software and can span entire iLumin Plus network.
    - .12 Timers: All times shall be configurable through the web software and shall not require any manual configuration of settings prior to installation. Timer values can range from 1 second to 24 hours
    - .13 Shall be capable of occupancy forwarding to send occupancy status to other areas within the system
    - .14 Capable of sending a command to turn HVAC on and off
  - .3 ADDRESSABLE SENSOR POWERPACK
    - .1 Product: [FLT-SP-MV-DC2], [FLT-SP-MV-DC1], [FLT-SP-347-DC2], [FLT-SP-347-DC1], [FLT-SP-240-DC2], [FLT-SP-24-DC1]
      - .1 Communication: DALI protocol.
      - .2 Power: 347VAC.
      - .3 Maximum Current Draw: 2 mA.
      - .4 Maximum number of sensors: Up to five (5) PIR or DT sensors are connected and report to the system as a single addresss.
      - .5 Connections: Two (2) wires (16/18AWG, FT6, non-twisted, non-shielded, non-polarized and plenum rated) connected to the DALI communication bus.
-

- .6 Sensor connections: Five (5) wires (16/18AWG, FT6, non-twisted, non-shielded, non-polarized and plenum rated) connected to sensor for controls and addressing

#### .4 CEILING MOUNTED SENSORS

- .1 Product: [OAC-DT-2000-R], [OAC-DT-1000-R], [OAC-P-1500-R], [OAC-U-2000-R]

- .1 Provide all necessary mounting hardware and instructions.
  - .2 Sensors shall be Class 2 devices.
  - .3 Connect up to five (5) sensor to the DALI Powerpack for power and signal back to the iLumin Plus system
  - .4 Device calibration and features:
    - .1 Sensitivity – 0-100% in 10% increments.
    - .2 Time delay – 1-30, self-adjusts to 10 min based on room occupancy.
    - .3 Test mode – Fifteen second time delay.
    - .4 Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.
    - .5 Walk-through mode.
    - .6 Ultrasonic and Dual Technology Sensors utilize two independent sensor detection circuits simultaneously to ensure optimum performance, regardless of location or proximity to walls and structures.
    - .7 Ultrasonic and Dual Technology Sensors utilize Variable Drive Circuitry (VDC) in cases of over saturation from misapplication, which automatically adjusts the volumetric output without reducing detection capability. Systems that reduce detection coverage area shall not be acceptable.
    - .8 Automatically and continually self-adjust ultrasonic frequency to ignore specific frequency, continuous noise from airflow to prevent detuning which can lead to inadvertent lights out. Sensors that require detuning shall not be acceptable.
  - .5 Device Status LEDs including:
    - .1 PIR Detection
    - .2 Ultrasonic detection
  - .6 Manual override of controlled loads.
-

.7 Where specified, sensor packaging shall be 100% recycled [made entirely from post-consumer waste (100% post-consumer fiber content) as well as, 100% recyclable].

.8 Sensors shall be RoHS compliant.

.5 **WALL/CORNER MOUNTED SENSORS**

.1 Product: [OAWC-P-120W-R], [OAWC-P-009L-H-R], [OAWC-DT-120W-R],

.1 Provide all necessary mounting hardware and instructions.

.2 Sensors shall be Class 2 devices.

.3 Connect up to five (5) sensor to the DALI Powerpack for power and signal back to the iLumin Plus system

.4 Device calibration and features:

.1 Sensitivity – 0-100% in 10% increments.

.2 Time delay – 1-30, self-adjusts to 10 min. based on room occupancy.

.3 Test Mode – Fifteen second time delay.

.4 Detection technology – PIR, Ultrasonic or Dual Technology activation and/or re-activation.

.5 Walk-Through Mode.

.6 Automatically and continually self-adjust ultrasonic frequency to ignore specific frequency continuous noise from airflow to prevent detuning which can lead to inadvertent lights out. Sensors that require detuning shall not be acceptable.

.5 Device Status LEDs including:

.1 PIR Detection

.2 Ultrasonic detection

.6 Manual override of controlled loads.

.7 Where specified, sensor packaging shall be 100% recycled [made entirely from post-consumer waste (100% post-consumer fiber content) as well as, 100% recyclable].

.8 Sensors shall be RoHS compliant.

2.5 **END DEVICES**

.1 **ADDRESSABLE RELAYS AND DRIVERS**

.1 Product: [FLT-DAC-DALI-DC1], [FLT-DAC-DALI-DC2]

.1 0-10V Addressable Dimming Modules

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- .2 Communication: DALI protocol.
  - .3 Power: From the DALI bus.
  - .4 Maximum Current Draw: 3.75 mA.
  - .5 Communication Connections: Two wires (16/18AWG, FT6, non-twisted, non-shielded, non-polarized and plenum rated) connected to the DALI communication bus.
  - .6 Power Ratings: Up to 4A Ballast 120/277/347 VAC.
  - .7 Dimming Control: 0-10V, 50 mA max current sink.
  - .8 Mounting: Fixture or conduit (90° elbow and mounting clips included).
  - .9 UL 924 Listed component.
- .2 Product: [FLT-HPRS-DALI]
- .1 Communication: DALI protocol.
  - .2 Power: From the DALI bus.
  - .3 Maximum Current Draw: 3.75 mA.
  - .4 Enclosure: Standard outlet box or NEMA 250, Type 1, unless otherwise indicated.
  - .5 Communication Connections: Two (2) wires (16/18AWG, FT6, non-twisted,
  - .6 non-shielded, non-polarized and plenum rated) connected to the DALI communication bus.
  - .7 Power Ratings: Up to 20 A at 347 VAC.
  - .8 Field relays shall be capable of controlling plug loads.
  - .9 Mounting: Junction box.

## 2.6 **INTEGRATION AND ACCESSORIES**

### .1 **BAS INTEGRATION**

- .1 Product: [FPA-W34-1130] BMSPro 2 - BACnet Interface
    - .1 The iLumin Plus network shall permit data protocol translation through a building automation interface Gateway. The BACnet Gateway shall permit BACnet communication protocol to operate individual areas, scenes or channels and read the status. The iLumin Plus network shall respond efficiently to the requested information from the BACnet network.
    - .2 The BMSPro2 provides up to 10,000 points of control and can communicate to multiple panel types.
    - .3 The BMSPro 2 requires a dedicated EG2 interface for connectivity either installed in an iLumin Plus panel or as a separate accessory.
-

- .4 Provide PIC list definition and object model to other system manufacturers.
  - .2 LAN/VLAN INTEGRATION
    - .1 Product: [EG2-NA] Ethernet Gateway
      - .1 Shall provide a single ethernet port for connection to the building LAN or VLAN
      - .2 Shall be capable of facilitating a LAN or Wi-Fi connection to the iLumin Plus system
      - .3 Shall include an integral web server
      - .4 Shall provide the capability for mobile devices to override the lighting system via scene or channel slider commands
      - .5 Shall provide the capability for 3rd party integration via ASCII control strings
      - .6 Shall provide the capability for bridging the iLumin Plus network across LAN or VLAN connections
      - .7 Provide ability for bi-direction communication by means of Ethernet communication to system by means of user-supplied PC, digital audiovisual, or BAS equipment. Control to be located on the same Local Area Network.
      - .8 Allow for custom communication command strings to be entered in to software to allow lighting control system to control other devices
  - .3 SERIAL INTEGRATION
    - .1 Product: [SI-2-NA] RS232 Interface
      - .1 Communication: iCANnet protocol.
      - .2 Power: From the iCANnet bus.
      - .3 Connections: Five (5) wires Belden 1502 or 1502P
      - .4 Mounting: Junction box
      - .5 Provide ability for bi-direction communication by means of RS232 serial communication to system by means of user-supplied PC, digital audiovisual, or BMS equipment. Control to be located within 50 feet (15 meters) of RS232 source.
      - .6 Allow for custom RS-232 command strings to be entered in to software to allow lighting control system to control any other device
  - .4 PARTITION CONTROL;
    - .1 Product: [UIG-NA], [UIM-NA]
      - .1 Communication: iCANnet protocol.
      - .2 Power: From the iCANnet bus.
-

- .3 Connections: Five (5) wires Belden 1502 or 1502P
  - .4 Inputs: Four (4) digitally optically isolated inputs
  - .5 Mounting: Junction box
  - .6 Partitioning: Shall provide partitioning and room join capabilities using either a button press, input, or IR wall partition sensors
  - .7 Low Voltage Input: Shall provide the capability for contact closures to integrate between lighting controls and other systems.
    - .1 The contact closure input device will accept both momentary and maintained contact closures.
  - .2 Product: [IRTR]
    - .1 Infrared Transmitter & Receiver
    - .2 Provide the ability to sense the presence or absence of partitions.
    - .3 Requires the connection to a UIG-2-NA or UIM-NA
  - .5 **NETWORK ACCESSORIES**
    - .1 Product: [LCNJ]
      - .1 Communication: iCANnet protocol.
      - .2 Power: From the iCANnet bus.
      - .3 Connections: Five (5) wires Belden 1502 or 1502P
      - .4 Mounting: Junction box
      - .5 Shall allow direct access to the iLumin lighting control network while in the space being modified.
    - .2 Product: [BN-2-NA]
      - .1 Network Bridge
      - .2 Communication: iCANnet protocol.
      - .3 Power: From the iCANnet bus.
      - .4 Connections: Five (5) wires Belden 1502 or 1502P
      - .5 Mounting: Junction box
      - .6 Shall allow the network to extend more than 1000m/3200 feet.
      - .7 Shall permit the connection of multiple networks allowing up to 65,000 devices on one system.
  - 2.7 **SOFTWARE**
    - .1 ICANsoft Suite
      - .1 Product: [SW-2]
-



- .1 Software shall support multiple functions to setup entire enterprise iLumin Plus system
  - .1 DALI addressing tool
  - .2 Device editor for system programming and scheduling
  - .3 iCANsoft editor for system programming and scheduling
  - .4 Smartphone configuration tool for mobile applications
  - .5 Touchscreen configuration tool
  - .6 Panel editor for floor plan control
- .2 Software shall support multiple diagnostic tools for troubleshooting the iLumin Plus system
  - .1 Network monitor
  - .2 Flash tool for updating system device firmware
  - .3 Device simulator
- .3 Shall include with user-friendly software suitable for operation on computer workstations which serve as central control stations for the selection and operation of lighting scenes
- .4 Clients shall interface with the software via Eaton Lighting Systems iCANsoft application

3 Execution

3.1 **INSTALLATION**

- .1 Install equipment in accordance with manufacturer's installation instructions.
  - .2 Provide complete installation of system in accordance with Contract Documents.
  - .3 Define each dimmer's/relay's load type, assign each load to a zone, and set control functions.
  - .4 Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.
  - .5 100 digital devices (Source Controllers, User Interfaces, etc) may reside on a single network segment with a network length not to exceed 3000 feet. Additional network segments shall be accomplished by the employment of a network bridge up to 65000 devices. Network segments shall be terminated at the end of each segment.
  - .6 Devices to be connected via Daisy Chain topology.
  - .7 Network wire recommended is Belden#1502R or 1502P (plenum) or similar. Wire shall meet color code requirements to insure proper installation of the network polarity.
  - .8 All panels are "masters" and may be added to the network in any location and any amount as long as network installation guidelines are met.
  - .9 Panels are designed to function independently from external control devices.
-

End of Section



IDEN. No	AREA	CONTROLS	SEQUENCE
1	Corridors	Local low voltage switches Occupancy sensors Low voltage relays Time of day schedule	ON: 50% by time of day schedule; remaining 50% by occupancy sensor when space is occupied  ADJUST: Reduced to 50% when space is not occupied, increased to 100% when occupied  OFF: by time of day schedule  OVERRIDE: local manual switches to override ON when scheduled OFF
2	Washrooms; Janitor Room	Local low voltage switches Low voltage relays Vacancy sensors	ON: manual by local switches  OFF: vacancy sensors
3	Private Offices	Local dimming type wall switch sensor or vacancy sensor & dimming switch as indicated on drawings Photocells where Primary and/or Secondary sidelighting is available Low voltage relay	ON: 100% manual by local wall dimmers/dimming sensor  ADJUST: Local dimmer; photocell where daylighting is available  OFF: vacancy sensor
4	Open Offices; Copy/Print Rooms	Local dimming switches preset for 50% ON, 100% ON, OFF (no additional manual adjustment) Photocells where Primary and/or Secondary sidelighting is available Vacancy sensor Low voltage relays	ON: manual by local dimming switches  ADJUST: Local dimmer (2 levels only); photocell where daylighting is available  OFF: by switch or vacancy sensor
5	Meeting Rooms, Conference Rooms, Multipurpose rooms	Local dimming switches Photocells where Primary and/or Secondary sidelighting is available Vacancy sensor Low voltage relays	ON: manual by local dimmer switches  ADJUST: Local dimmers; photocell where daylighting is available  OFF: vacancy sensor, and manual override by local dimmer switches
6	Mechanical, Electrical, Comms. Rooms	Local low voltage switch Low voltage relay	ON: Manual by local control  OFF: Manual by local control or schedule
7	Lobby, Vestibule	Local low voltage switch Occupancy sensor Photocell where daylighting is available Low voltage relays Time of day schedule	ON: 50% Auto on by schedule; remaining 50% by occupancy sensor when space is occupied  ADJUST: Dimmed to 50% by occupancy sensor when not occupied; dimmed by photocell in response to daylighting  OFF: time of day schedule  OVERRIDE: local manual switch to override ON when scheduled OFF
8	Storage up to 1000 sq ft	Local wall switch or sensor switch Vacancy sensors Low voltage relays	ON: Manual on using local switch;  OFF: Auto off using vacancy sensors when space is not occupied
9	Exterior	photocell Low voltage relays time-of-day schedule	ON/OFF: by time of day schedule and photocell  REDUCE: dimmed by time of day schedule

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- 1 General
- 1.1 **SUMMARY**
  - .1 Section Includes
    - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- 1.2 **ALTERNATE PRODUCTS**
  - .1 Submit a Tender Bid based on the use of Products indicated as base system Products.
  - .2 Voluntarily submit an alternative Bid based on the use of Products indicated as alternative Products. Indicate in the Bid Form, the change in Bid Price by the use of alternative Products. By submitting a Bid based on alternative Products the Bidder accepts responsibility for coordination and interferences that may arise from their use.
- 1.3 **SYSTEM DESCRIPTION**
  - .1 Pathways – Hangers and Supports
    - .1 Supports for structured cabling to segregate cabling from electrical and mechanical sources of interference or sources of potential damage.
    - .2 Open Hook Hangers
      - .1 Open hook hangers (J hooks) permitted only where expressly indicated.
      - .2 Open hook hangers (J hooks) only of the type expressly indicated.
    - .3 Cable Retention Wraps
      - .1 Cable retention wraps permitted only of the type and where expressly indicated.
      - .2 Cable retention wraps permitted only of the type indicated.
      - .3 Hard nylon cable retention wraps (Tiewrap™) or like Products not permitted as communications cable retainers nor permitted to be in direct contact with cable jacket.
  - .4 Pathways – Conduits
    - .1 Comply with Section 26 05 00.
    - .2 Metallic and non-metallic conduit and cable tray to TIA 569.
    - .3 Flexible conduits at building expansion joints, connections from overhead pull-boxes to furniture access poles, and between wall pass-through boxes and modular systems furniture assemblies.
    - .4 Flexible liquid-tight metallic conduit for isolation and protection of communications cables between outlet boxes and enclosed raceways installed below access floors in areas not designated as a computer room.
  - .5 Pathways – Conduit Device Boxes
    - .1 Comply with Section 26 05 00.
    - .2 Metallic and non-metallic device boxes to TIA 569.
    - .3 Device boxes of sufficient depth and width to prevent cable curvature in breach of manufacturer's specification for bending radius.
    - .4 Device boxes of sufficient capacity to permit storage of cable working allowance without interference to outlets and terminations.

- .6 Pathways – Cable Tray and Cable Runway
  - .1 Overhead cable tray in telecommunications rooms and computer rooms where indicated.
  - .2 Overhead cable runway in finished and unfinished areas where indicated.
  - .3 Under floor cable tray in finished areas with access floor where indicated.
- .7 Pathways – Ducts
  - .1 Comply with Section 26 05 53.
  - .2 Underground and buried duct conduit and services to TIA 569.
  - .3 Ducts installed complete with flexible inner-duct sleeving and marked mule tape.
- .8 Grounding and Bonding
  - .1 Comply with CSA C22.1.
  - .2 Grounding and bonding to TIA 607.
  - .3 Comply with Telcordia GR-295-CORE
  - .4 Provide technical single point ground as telecommunications systems ground reference.
    - .1 Grounding and bonding system for telecommunications to achieve an independent electrical grounding and bonding scheme separate and isolated from other grounds including building ground, lightning ground, process and controls ground or grounds, with exception that technical ground and electrical safety ground bonded at single point only, being closest to the source of incoming electrical power or as indicated.
    - .2 Technical grounding bus bars in telecommunications rooms, computer equipment rooms, telecommunications carrier building entrance and service rooms.
    - .3 Main technical grounding bus bar(s).
    - .4 Bonding conductors between technical grounding bus bars and main technical grounding bus bar as indicated using conductor of size whichever is greater of #6 AWG or as required by electrical safety code or as indicated on the Contract Drawings.
    - .5 Bonding between main technical grounding bus bar and electrical safety ground.
    - .6 Computer and communications equipment cabinets bonded to technical ground.
  - .5 Common Electrical Ground
    - .1 Overvoltage protection building entrance devices bonded to electrical power safety ground.
    - .2 Communications metallic conduits, cable trays, cable runways, electrical enclosures, raceways bonded to electrical power safety ground.
    - .3 Electrical enclosures with the exception of computer and communications equipment cabinets bonded to electrical safety ground
    - .4 Grounding conductors in buried telecommunications ducts bonded to electrical safety ground.

- .6 Pathways
  - .1 Communications cable tray, cable runway, bonded to electrical safety ground through continuous minimum 10 AWG copper conductor. Bonding at intervals of 2440 mm or less.
- .9 Submittals
  - .1 Comply with Section 01 33 00.
  - .2 Affix Engineer's seal or RCDD stamp of qualified persons identified herein to all submissions tendered under this division of the work to indicate work submitted has been reviewed by the qualified person. The indicated engineer seal or RCDD stamp in addition to seal or stamp required under provincial law.
  - .3 Submit the following:
    - .1 Prepare and submit detailed and dimensioned drawings to describe and illustrate coordination of overhead communications systems, including but not limited to:
      - .1 Overhead support grid and suspension.
      - .2 Overhead cable tray.
      - .3 Overhead cable runway.
      - .4 Insulators.
      - .5 Top of equipment cabinets, frames and racks.
      - .6 Exhaust air containment ducts, flexible and rigid.
      - .7 Ceiling mounted AC units.
      - .8 Lighting fixtures.
      - .9 Overhead power distribution cables.
      - .10 Overhead power distribution busway.
      - .11 Overhead power tap boxes.
      - .12 Overhead optical fibre cable troughs and down drops.
      - .13 Overhead patch panels.
      - .14 Cable entry cable chimney to equipment cabinets.
    - .2 Shop Drawings
      - .1 Submit Shop Drawings for all component types prior to their use on site.
      - .2 Drawing illustrating front elevation of rack layouts prior to assembling said equipment.
      - .3 Drawing illustrating equipment room layouts where different from Contract Drawings. Identify dimensions of clearances to front, rear and sides of floor mounted components.
      - .4 Drawings illustrating cabling identification scheme prior to use on site.
  - .4 Working, progress and constructed drawings
    - .1 Site maintained working progress drawings for Consultant's review when requested. Site maintained copy of site instructions, Change Orders,

Change Directives, minutes of site and trades coordination meetings for Consultant's review when requested.

- .2 "As-Constructed" Record Drawings.
  - .1 Prepare and submit drawings in hard copy format and in electronic machine readable Computer Aided Drafting (CAD) format describing the work as completed. Submit drawings in AUTOCAD format of release level no older than two versions prior to current release. Request copy of standards and conventions for use when creating and maintaining CAD files. Comply with layer conventions as indicated in CAD standards and practices documentation, or use existing layering conventions in existing files when machine readable files are available.
  - .2 Where wires or communications raceways are underground or under floor or below finished grade, furnish field dimension with respect to building column lines and inverts with respect to finished floor levels or grades. Indicate inverts at point of penetration of conduits into below-grade hand wells, or below-grade maintenance chambers.
  - .3 Record deviations from cable numbers shown on the Contract Drawings.
  - .4 Prepare records of interconnecting and cross-connecting wiring between items of equipment including equipment supplied by Owner and under other Specification sections. Provide the records loaded into a data base. Select the data base by mutual agreement with the Consultant.
  - .5 Approved data base Products
    - .1 Microsoft Access
    - .2 Microsoft Excel
    - .3 Flat ASCII text file in CSV format
  - .6 Prepare drawings clearly identifying routes taken by cable where the cable is not supported along its length by an approved electrical raceway.
  - .7 Submit Record Drawings no later than ten days following submitting a claim for Substantial Performance.
- .5 Test reports
  - .1 Submit test reports within three days of testing.
- .6 Manuals
  - .1 Submit Operating and Maintenance Manuals.

#### 1.4 **TENDER SUBMISSIONS**

- .1 Tender submissions from pre-qualified bidders
  - .1 Submit a Tender to undertake work described under this division only if pre-qualified by the Owner.
  - .2 Tenders to undertake this work will be accepted from other bidders only if accompanied by written approval from the Owner to have Tender Bid considered.



- .2 Tender submissions from bidders at large
  - .1 Submit a Tender to undertake work described under this division only if:
    - .1 Fully qualified and certified to undertake the work by the manufacturer(s) of the Product(s) proposed in the Tender;
    - .2 Compliant with bidder qualifications required and outlined herein below.

1.5 **PRE-AWARD SUBMISSIONS**

- .1 On request of the Owner submit the items listed herein before award of Contract as a condition of award. Failure to comply will be justifiable grounds for cancelling the Contract or disqualification of the bid at the sole discretion of the Owner.
- .2 Submit the following items prior to, or no later than ten working days following, the award of Contract.
  - .1 Personnel
    - .1 Submit a list of personnel who will be directly involved in overseeing the technical interpretation of the work described in the Contract Documents.
    - .2 Submit a list of personnel who will be directly involved in assessing the quality of the work during execution and in ensuring quality standards are upheld.
    - .3 Submit a statement indicating that the Bidder maintains the minimum number of trained installation technicians to comply with the structured cabling system manufacturer's business partner or certified partner program. Provide information on the manufacturer's requirements.
    - .4 Submit a list of trained personnel who will or may be assigned to the Project. Indicate the degree of training each technician has received and whether training was factory training or in-field. Submit for each person named, a record of factory training credentials issued by the named manufacturer(s) stating training curriculum and date of training applicable to the Products identified.
    - .5 Submit for each person named, professional and/or industry recognized credentials endorsing the ability and competency to undertake quality assurance, overseeing and technical guidance of the work.
  - .2 Corporate
    - .1 Submit a list to identify five or more like-sized systems undertaken by the Bidder. Identify the completion date of each. Provide on demand a reference who can and is willing to attest to the quality of the work results for each named project.
  - .3 Manufacturer
    - .1 Submit a statement from the manufacturer of the cabling Products proposed for use in this Contract indicating the Bidder's good standing with the manufacturer and the manufacturer's willingness and agreement to underwrite the performance warranty on the final installation.
    - .2 Failure to comply within ten working day following award may result in the disqualification of the bid at the sole discretion of the Owner.

1.6 **CONTRACTOR QUALIFICATIONS**

- .1 At any time before date of award or within ten business days following the date of award of Contract, submit the name of one or more persons who are qualified to undertake the

- work to implement and oversee the work of this division and described in the Contract Documents.
- .2 Identify one or more persons to fulfil two identified roles. Acceptable for both roles to be fulfilled by one person.
    - .1 Technical design supervisor
    - .2 Site work supervisor
  - .3 Acceptable qualifications are:
    - .1 Active member of BICSI and currently registered under BICSI RCDD program. Acceptable form of statement is RCDD certificate expiring no sooner than the date of substantial completion or one full year following the date of award whichever is the later.
    - .2 Active individual member or corporate member of BICSI and licensed within Canada as Professional Engineer with ten years demonstrated practice in the field of design and installation of communications infrastructure. Acceptable form of statement is an image of the signed Professional Engineer seal as cover to a history of work undertaken similar in nature and scope to the work described in the Contract Documents.
  - .4 Provide commitment to maintain same personnel or direct and immediate replacements through period of Contract. Acceptable replacements include personnel possessing like credentials for term including construction period.
  - .5 Provide commitment that qualified personnel will execute a tenure of commitment expiring no less than one year from the date of award, or a period conterminal with the final completion of the work whichever is the sooner.
  - .6 Quality assurance.
  - .7 Pre-Installation Meetings
    - .1 Arrange for and attend pre-installation design and construction meetings. Attendees at meetings to include site work supervisor and technical design supervisor.
      - .1 Minimum of one meeting to review the Contract scope of work.
      - .2 Minimum of one meeting to review the proposed execution of the work.
  - .8 Site Meetings
    - .1 Arrange for and attend construction progress meetings. Attendees at meetings to include site work supervisor and technical design supervisor.
      - .1 Minimum of two site meetings per month commencing on day of mobilization and running until four weeks after site work completion.
    - .2 These Specifications supplement the Electrical and Electronic Manufacturers Association of Canada, Canadian Standards Association Standards, Electronic Industries Association, Telecommunications Industries Association standards and recommendations. Conditions of the EEMAC, CSA, EIA, TIA and ISO/IEC standards and recommendations apply unless superseded or modified by this Specification.
    - .3 Where requirements of the Specifications exceed referenced standards, the Specifications apply. Where standards differ between authorities, the most stringent applies.

- .4 Requirements of the Specifications that are substandard to referenced standards should be brought to the attention of Consultant during bidding period in sufficient time to allow suitable action to be taken and addenda issued as necessary.
- .5 Equipment must be acceptable to electrical inspection authorities.
- .6 Where any part of the Work fails tests, on approval of the manufacturer repair the fault in a manner to prevent recurrence and re-test.
- .7 Where any part of the Work fails tests and that Work is to be built without physical discontinuity, remove the offending material and install new without increase in cost to the Contract.
- .9 Area Classification
  - .1 No area in the Work is classified as hazardous.
- .10 Warranty
  - .1 Comply with the terms of the warranty described in the Contract Documents.
  - .2 All components comprising the structured cabling channel as defined by TIA 568 by one manufacturer only and under the protection of a single installation and performance warranty.
  - .3 Provide Products protected under a single warranty where providing such is of benefit to the Owner. Provide evidence of this benefit.
  - .4 Assemble the cabling system using Products protected by a single warranty of minimum twenty-five years.
  - .5 Warranty to include protection against defective manufacture of Products and guarantee of fit for purpose for present and future uses for cable of stated performance level. Warranty to protect the Owner from defects in Product made evident by long term exposure to operating environment for which the Product is specified.
  - .6 Do not propose the use of Products or to provide contracting services if the manufacturer of the Products proposed will not warrant the Work to the best warranty most beneficial to the Owner.
- 2 Products
  - 2.1 **MANUFACTURERS**
    - .1 Use Products manufactured by stipulated manufacturer where identified.
    - .2 Use Products manufactured by the identified preferred manufacturer as the basis of the Base Bid.
    - .3 Use Products manufactured by identified alternative manufacturers as the basis of voluntary alternative bids. Provide justification for the use of alternative Products.
    - .4 Avoid substitution of Products that are not beneficial to the Contract. Demonstrate benefit to the Contract and obtain approval prior to use of Products not identified in the Contract Drawings.
  - 2.2 **ACCEPTABLE MANUFACTURERS**
    - .1 Submit a Tender that includes only those Products identified in this and related sections in this division of the Specification.
    - .2 All components comprising the structured cabling channel as defined by TIA 568 by one or more manufacturers and under protection of a single installation and performance warranty.

**2.3 PRODUCT VENDORS**

- .1 Provide Products by a sole stipulated manufacturer where indicated.
- .2 Provide Products by listed alternative manufacturers where indicated for voluntarily proposed alternates. Acceptable alternative Products are listed within this and other sections comprising this division of the Work.
- .3 Use of Products not identified in this division as substitutes for stipulated or preferred Products is at the risk of the Contractor. At the discretion of the Owner, the Contractor may be called to replace the substituted Products at no cost to the Owner. A claim by the Contractor for a time delay caused by the need to replace substituted Products will be rejected.
- .4 For each alternative Product submit justification for use as alternates indicating benefits to the Owner. Identify if benefits are based on price, delivery, or performance.

**2.4 COMMUNICATIONS GROUNDING AND BONDING**

- .1 Pre-drilled Copper Bus Bar
  - .1 Telecommunications Grounding Busbar (TGB)
    - .1 Type T-250
      - .1 250 mm TGB telecommunications grounding bus bar, 6.5 x 50 x 250 mm, tin plated; four sets holes 6 mm diameter, spaced 16 mm; three sets of 10 mm holes spaced 25 mm, standoff insulators and mounting brackets.
    - .2 Type T-300
      - .1 300 mm TGB telecommunications grounding bus bar, 6.5 x 50 x 305 mm, tin plated; six sets holes 6 mm diameter, spaced 16 mm; three sets of 10 mm holes spaced 25 mm, standoff insulators and mounting brackets.
    - .3 Type T-500
      - .1 500 mm TGB telecommunications grounding bus bar, 6.5 x 50 x 508 mm, tin plated; twelve sets holes 6 mm diameter, spaced 16 mm; three sets of 10 mm holes spaced 25 mm, standoff insulators and mounting brackets.

Table 1 - Telecommunications ground bus bar - by manufacturer

Type	Panduit		
T-250	GB2B0304TPI-1		
T-300	GB2B0306TPI-1		
T-500	GB2B0312TPI-1		

- .2 Telecommunications Main Grounding Bus Bar (TMGB)
  - .1 Type TM-300
    - .1 300 mm TMGB telecommunications main grounding bus bar, 6.5 x 100 x 305 mm, tin plated; twelve sets holes 6 mm25 diameter, spaced 16 mm; six sets of 10 mm holes spaced 25 mm, standoff insulators and mounting brackets.
  - .2 Type TM-500
    - .1 500 mm TMGB telecommunications main grounding bus bar, 6.5 x 100 x 508 mm, tin plated; twenty-four sets holes 6 mm diameter,

spaced 16 mm; six sets of 10 mm holes spaced 25 mm, standoff insulators and mounting brackets.

Table 2 - Communications main ground bus bar - by manufacturer

Type	Panduit		
TM-300	GB4B0612TPI-1		
TM-500	GB4B0624TPI-1		

- .3 Two-hole long barrel lug
  - .1 Comply with BICSI/J-STD-607A.
  - .2 Tin plated long barrel with inspection window to confirm cable insertion; two holes according to NEMA size and spacing.

2.5 **PATHWAYS FOR COMMUNICATIONS SYSTEMS**

- .1 General
  - .1 Comply with Section 27 11 00 for overhead cable runway.
  - .2 Comply with Section 26 05 00 for rigid overhead cable tray.
  - .3 Supplement approved electrical raceways with items described herein.
- .2 Cable Hangers and Supports
  - .1 Use only where expressly indicated as permitted.
  - .2 Cable supports of open hook construction (J hooks) with 54 mm wide cable bearing surface curved with radius greater than minimum required by supported cable.
  - .3 Listed manufacturers and Products:
    - .1 Panduit: JM2H-X
    - .2 Ideal
  - .4 Cable retention wraps, soft, reusable hook-and-loop tie, coloured to match colour code indicated. Plenum rated.
    - .1 Panduit: HLTP and HLSP series
  - .5 Nylon cable retention wraps (Tiewraps™) not permitted.
- .3 Conduit Guard
  - .1 Plastic protection press-on bushings to suit EMT and rigid galvanized steel conduit; size to suit conduit to maximum 103 diameter. Suitable for use in air supply or return plenum spaces.
- .4 Flexible Corrugated Non-metallic Conduit
  - .1 Nominal inside diameters 25 mm, 32 mm.
  - .2 Fire ratings FT4, FT6.
  - .3 Manufacturer:
    - .1 Arlington
- .5 Flexible Fabric Thin Wall Inner Duct Sleeve
  - .1 White with colour identification stripe including pull tape in one-, two-, three-cell on micro-cell format.
  - .2 Fire ratings of normal, riser and plenum with optional copper 18 gauge tracing strips.

- .3 Listed manufacturer and Products:
  - .1 Max cell
    - .1 Three-cell: 103 mm MXC4003XX series
    - .2 Three-cell: 78 mm MXC3456XX series
    - .3 Two-cell: 53 mm MXC2002XX series
    - .4 Micro two-cell: 27 mm MXCM3302XX series
- .6 Flexible Liquid-tight Metallic Conduit
  - .1 Corrugated heavy gauge electro galvanized flexible steel strip helically wound conduit with integral copper bonding wire and PVC jacket, colour blue or grey in nominal inside diameter sizes 21 mm, 25 mm, 32 mm, with fire ratings FT4, FT6, to CSA C22.2 No. 0.3.
  - .2 Manufacturers:
    - .1 Delikon, Type YF-604
- .7 Flexible Metallic Conduit
  - .1 Corrugated heavy gauge electro galvanized flexible steel strip helically wound conduit with integral copper bonding wire in nominal inside diameter sizes 21 mm, 25 mm, 32 mm.
  - .2 Manufacturers:
    - .1 Delikon, Type YF-504
- .8 Cable Trays for Communications Systems
  - .1 Rigid ladder tray
    - .1 Comply with Section 26 05 00 and Section 26 05 33.
  - .2 Rigid solid bottom cable tray
    - .1 Comply with Section 26 05 00 and Section 26 05 53.
  - .3 Open wire mesh cable tray
    - .1 Form
      - .1 Tray formed of circular or ovaloid steel wire welded to form grid pattern of nominal 50 mm x 100 mm
      - .2 Folded sides to provide longitudinal structural support
      - .3 Widths ranging from nominal 200 mm to nominal 600 mm
      - .4 Fixed or snap-on cable retention side wall depths ranging from 50 mm to 150 mm
      - .5 Standard lengths of nominal 3 m
    - .2 Finishes:
      - .1 Painted black, white
      - .2 Zinc electroplated
    - .3 Certifications
      - .1 ULc or UL Canada or Certification acceptable to the AHJ

- .2 CSA 22.2 No 126.1 Metal Cable Tray Systems
- .3 NEMA VE 1
- .4 Accessories
  - .1 Accessories as required
    - .1 Splicing kit
    - .2 Edge hanger
    - .3 Cantilever brackets
    - .4 Underfloor C bracket
    - .5 Split bolt grounding lug and clamp
    - .6 Divider
    - .7 Radius drop
    - .8 Side bracket
    - .9 Radius control side wall brackets
    - .10 Vertical radius bracket
    - .11 Conduit bracket
    - .12 Solid liner insert
    - .13 Side supported cable hanger brackets
- .5 Manufacturer
  - .1 CPI Chatsworth
  - .2 T&B Thomas and Betts
  - .3 Legrand
  - .4 Panduit

2.6 **UNDERGROUND DUCTS AND RACEWAYS FOR COMMUNICATIONS**

- .1 Comply with Section 26 05 00 and Section 26 05 53.
- .2 Rigid PVC Conduit
  - .1 Rigid PVC conduit manufactured to CSA C22.2 No. 211.2
  - .2 Rigid PVC fittings, long sweep bend
- .3 Rigid Ferrous Metal Conduit with PVC Coating
  - .1 Rigid ferrous metal conduit to CSA C22.2 No. 45-M with PVC coating to nominal thickness of 1.02 mm conforming to NEMA publication RN1-1998
  - .2 Matching rigid ferrous metal PVC coated fittings and couplings; matching long sweep bends
- .4 Underground Enclosure
  - .1 Precast polymer concrete underground enclosure
  - .2 Precast polymer concrete enclosure reinforced with glass fibre, to 9072 kg loading application, open base, tamperproof cover locks
  - .3 Width: 305 mm square; depth: 457 mm, 609 mm, 913 mm

- .4 Manufacturers:
  - .1 Synertech

3 Execution

3.1 **DIMENSIONS AND QUANTITIES**

- .1 Dimensions shown on Drawings are approximate. Verify dimensions by reference to Shop Drawings and field measurement.
- .2 Quantities or lengths indicated in any of the Contract Documents are approximate only.
- .3 Make necessary changes to routing of cables and the like to accommodate structural, mechanical, electrical and architectural conditions. Coordinate with other trades and make allowance for conditions that will arise from work in progress under separate contract.
- .4 Plan cable pathway routing to ensure compliance with cable performance specifications, reference standards, and to avoid electromagnetic interference effects.
- .5 Report to the Engineer immediately upon identification of any condition that may result in the performance criteria of the cabling being compromised.
- .6 Install measuring tape for full length of communications pathways in those pathways approaching cable performance distance limits. Measure length and confirm that distance limits are not exceeded.
- .7 Mark up areas on communications rooms backboards to indicate locations for installation and mounting of communications terminal blocks, security related devices and electronic equipment, public address and paging related equipment and terminal blocks and areas allocated for public carrier for overvoltage protection devices, demarcation terminal blocks and CATV distribution and amplification devices. Use removable tape to prepare proposed layout for Consultant's review. Overlay with black permanent marker after review by Engineer.

3.2 **COMMUNICATIONS GROUNDING AND BONDING**

- .1 General
  - .1 Install grounding and bonding to comply with Ontario Electrical Safety Code and all applicable codes.
  - .2 Install inside grounding cables and conductors in electrical raceways, cable trays, cable runways, or in rigid PVC conduits as indicated. Install outside grounding cables and conductors in PVC rigid conduit or direct buried as indicated.
  - .3 Install inside grounding to comply with BICSI/JSTD-607-A, TIA-607 and BICSI published Telecommunications Design Methods Manual.
  - .4 Install outside grounding to comply with BICSI published Customer Owned Outside Plant Manual (latest edition).
- .2 Bus Bars
  - .1 Mount bus bars insulated from building ground and in locations and at elevations indicated.
  - .2 Mount horizontally with fasteners able to resist axial pull of 50 kgf.
  - .3 Ensure clearance of 50 mm from other metallic objects including components of dissimilar grounding systems.
- .3 Enclosures



- .1 Bond communications enclosures only to telecommunications ground bus bar. Do not bond directly to electrical safety ground.
  - .2 For arrays of four or fewer communications cabinets, connect individual #6 grounding cables between technical grounding bus bar and individual communications cabinets.
  - .3 For arrays of five or more communications cabinets, connect individual #6 grounding cables between individual cabinets and a common #2 AWG insulated aisle ground cable using crimp taps. Connect aisle ground cable to technical ground bus bar using two-hole long barrel lug with window.
  - .4 **Communications Shields**
    - .1 Bond communication shields to technical ground at both terminations when sharing a common single point ground system. Bond communications shield to technical ground at termination distant from work area outlets when terminations do not share a common ground system.
    - .2 Make grounding connections to telecommunications cable conductive shields as indicated, using components designed for purpose and following manufacturer's instructions.
    - .3 Protect finished communications grounding against making unwanted connections to dissimilar grounding systems.
  - .5 **Flexible Conduits**
    - .1 Bond armour and bonding wire to ground through manufactured conduit accessories.
- 3.3 **ELECTRICAL SAFETY GROUND**
- .1 Bond electrical conduit for telecommunications, cable trays for telecommunications, cable runways directly to electrical safety ground. Do not bond directly to technical ground.
  - .2 Bond main technical ground bus bar to electrical safety ground.
- 3.4 **PATHWAYS FOR COMMUNICATIONS SYSTEMS**
- .1 **General**
    - .1 Pathways laid out and installed to comply with latest release of ANSI/TIA 569.
    - .2 Pathways run lengths to comply with latest release of ANSI/TIA 568. Notify Engineer in event of any inside path length exceeding 90 m.
    - .3 Inside pathways installed parallel or perpendicular to building lines.
    - .4 Submit drawings of proposed installation, and indicating deviation from cable routing shown on drawings to the Engineer for review prior to commencing installation.
    - .5 Maintain minimum clearances measured from any point of the communications system to any point on the outer container of electrical and heat sources.
      - .1 Unit substations
        - 10 mPower transformers enclosure (greater than 30 kVA)
        - 10 mTransformers enclosures (up to 30 kVA)
        - 1.2 mMotors casings (greater than 1 HP)
        - 10 mMotors casings (up to 1 HP)
        - 1.2 mSwitch gear enclosures (greater than 600V)
        - 10 mFeeder cable / conduit (600V and above)
        - 1 mDistribution cable / conduit (less than 600V)
        - 750 mmEMT conduit (enclosing 30A branch circuits)

- 300 mmENT conduit (enclosing 30A branch circuits)
- 450 mmAC90 cable (enclosing 30A branch circuits)
- 450 mmEMT conduit (enclosing 20A branch circuits)
- 75 mmENT conduit (enclosing 20A branch circuits)
- 150 mmAC90 cable (enclosing 20A branch circuits)
- 150 mmEMT conduit (enclosing 15A branch circuits)
- 65 mmENT conduit (enclosing 15A branch circuits)
- 100 mmAC90 cable (enclosing 15A branch circuits)
- 100 mmControl cabling (in separate conduit)  
zero
- .19 Control cabling (exposed) 100 mmClass 2 wiring (in separate conduit)  
zero
- .21 Class 2 wiring (exposed) 100 mmConduit (all others)  
75 mmFluorescent luminaires  
600 mmPipes (gas, oil, water, etc.)  
300 mmHVAC (equipment, ducts, etc.)  
150 mmCable Protection
- .1 Provide protective cable sleeving to prevent damage to cables at transition from cable tray, conduit, pull box, junction box, maintenance hole, pull point. Provide sleeve to reduce friction, bending and crushing forces. Install split sleeve where impracticable to install solid.
- .3 Cable Hangers and Supports
  - .1 Where expressly indicated, support cables by use of cable hangers. Space hangers at maximum 1 m separation.
  - .2 Limit cables to twenty-four per hanger.
  - .3 Apply cable retention wraps without causing tension, pressure or other deformation of cable and cable bundles. Complete wrap with 100 mm overlap. Spacing between wraps not more than 1.2 m except for cables in horizontal cable tray. Avoid wrapping cables in bundles in horizontal sections of cable tray. Secure cables in bundles in vertical portion of cables tray with supports at spacing of not more than 600 mm. Place and secure cables in tray to prevent edges pressing against cable jacket.
  - .4 Do not use nylon cable retention wraps (Tiewraps™) for cable retention.
- .4 Conduit
  - .1 Extend distribution and backbone conduit to cable tray.
  - .2 Form field-formed raceway to comply with TIA 569 specifications.
  - .3 Fit conduit guard bushings on each exposed entrance to conduit raceway.
  - .4 Field form “gooseneck” bends in conduit where surface run conduit changes direction to penetrate a wall or partition at ninety degrees. Assume the gooseneck bend includes one hundred eighty degrees of bending.
- .5 Innerduct Sleeving
  - .1 Provide and install flexible corrugated non-metallic conduit for protection against abrasion and bending, and as protection of optical fibre cables in open cable tray. Colour: Orange except black or grey where indicated; inside diameter: 25 mm except 32 mm where indicated; fire ratings: FT6 except FT4 where indicated.

- .2 Provide and install flexible fabric low friction pre-lubricated inner duct sleeve in all backbone conduits and in conduits intended to carry backbone cabling, and in all conduits below grade and also where indicated. Colour coded, with pre-installed pulling tape; electrically traceable where indicated.
    - .1 Three-cell construction for installation in 103 conduits
    - .2 Three-cell construction for installation in 78 conduits
    - .3 Two-cell construction for installation in 54 conduits
    - .4 Micro two-cell construction for installation in 27 conduits
  - .6 Flexible Metallic Conduit
    - .1 Flexible non-combustible metallic liquid-tight conduit permitted below access flooring as pathway between communications raceways and individual outlet device boxes.
    - .2 Install conduit of trade size as indicated on the drawings or described in the Specification or 21 mm diameter whichever is the greatest.
  - .7 Flexible Non-metallic Tubing
    - .1 Flexible non-metallic tubing not permitted in damp or wet locations.
    - .2 Flexible non-metallic cable not permitted between locations separated by greater than 150 m.
    - .3 Flexible non-metallic electrical tubing not permitted where aggregated bending exceeds one hundred eighty degrees.
    - .4 Acceptable use of flexible non-metallic tubing as replacement for rigid non-metallic conduit when minimum of one trade size larger than required size of indicated rigid conduit.
    - .5 Flexible non-metallic tubing permitted if maximum permitted pull tension of installed cable is not exceeded. Provide pull tension reports to the Engineer on request.
    - .6 Flexible non-metallic tubing installed complete with colour identified and measured mule tape.
    - .7 Mule tape incorporating copper tracing conductor for use in non-metallic tubing.
- 3.5 **UNDERGROUND DUCTS AND RACEWAYS**
- .1 General
    - .1 Clean out each section of duct by pulling a steel wire brush and mandrel of the correct size through the duct before pulling cables.
    - .2 Notify the Engineer if immovable obstructions are encountered when cleaning existing ducts.
    - .3 Protect cable at entry and exit from ducts by flexible corrugated non-metallic conduit.
    - .4 Install pull string with length markers ("Mule tape") in each duct and in each inner-duct where applicable.
    - .5 Conduit ducts below concrete slab on grade at minimum 300 mm below finished concrete floor or 100 mm below lowest elevation of concrete, whichever dimension is the greater.
  - .2 Cable Placement in Underground Ducts

- .1 Pull cables in underground ducts in continuous length, without splicing.
- .2 Install cables in lower ducts first, leaving upper ducts for future; install cables in inner-ducts where provided.
- .3 Apply only manufacturer recommended or approved lubricant to cables to reduce friction between the cable and the duct.
- .4 Apply cable grips with ball bearing swivel to the cable sheath or strength members to avoid applying tensile force directly to conductors or fibres when pulling cables.
- .5 Station personnel at each access point to observe and lubricate the cables during pull.
- .6 Provide cable slack at manholes for expansion and contraction; mount with clips to prevent sagging.
- .7 Submit tension pulling calculation prior to installation of cables to Consultant for review.
- .8 Monitor cable pull tension during installation. Do not exceed maximum tensile rating of cables.
- .9 Avoid bending cables to a radius less than manufacturer's recommendation, or ten times the cable outside diameter, whichever is the greater.
- .10 Where cable is pulled through a distance of greater than 30 m or through a pathway containing more than one ninety degree bend, use a dynamometer to record installation tension and a tension limiting device to prevent exceeding the maximum pulling tension specification during installation. Set the tension limit at or below the manufacturer's maximum limit. Take up the cable at intermediate pulling points with an intermediate cable take-up device reviewed by the Consultant.
- .11 Make cable pulls continuous and steady between pull points. Avoid interruptions to the pull unless necessitated by excessive tension on the cable.
- .12 Seal duct entrance into buildings with duct sealing compound to prevent the ingress of moisture, foreign materials and rodents.
- .13 Deem exposed any cable portion which is in a buried raceway and extends 1 m or more beyond the building curtain perimeter and provide over-voltage protection at each terminal.

### 3.6 **MANUFACTURER'S ATTENDANCE AND REPORT**

- .1 Provide manufacturer's representatives to verify installation practices for each part of the Work relevant to components including wiring and terminations.
- .2 Provide a construction review report prepared and signed by a representative of the manufacturer of wiring and terminations describing summary assessment for acceptability to meet warranty terms and conditions of work in progress for work described in this section and related sections affecting the Work. Submit a construction review report to accompany the first progress claim to include 50% of the Work by installed value. Submit second report on Substantial Completion of Work.
- .3 Manufacturer's report is an essential component of the Work and must be submitted to the Engineer before Consultant's Project deficiency review.

### 3.7 **FIELD INSPECTION**

- .1 Provide field technician for inspection and certification of cables, connectors, and associated equipment and accessories during installation, testing and commissioning as required. Provide a field technician possessing industry recognized credentials. Submit

the technician's credentials as a Shop Drawing within five days of receiving a request from the Engineer or within five days of award of Contract, whichever is the sooner.

- .2 Acceptable credentials include certificates of qualifications issued or assessed by a registered telecommunications industry association, a registered college or university, a registered training institution, a registered labour union, or a certificate of installer training issued by the manufacturer of the Products in use for the Work.

End of Section

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- 1 General
- 1.1 **SUMMARY**
  - .1 Section Includes
    - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- 1.2 **SYSTEM DESCRIPTION**
  - .1 General
    - .1 Comply with TIA 606.
    - .2 Use identification schema parameters identified on Contract Drawings.
    - .3 Identification of cables, cabinets, electrical raceways, grounding conductors, communications outlets, faceplates, firestops, by use of printed alphanumeric labels and colour coding markers as further described on the Contract Drawings and herein.
  - .2 Standard Colours
    - .1 Coloured marking using standardized colours consisting of the following Pantone reference colours or the indicated commercial equivalent:
      - .1 Red: Pantone 186C or 184C
        - .1 Benjamin Moore: 133-20
        - .2 Armourcoat: Fire Red 98-4748-6
      - .2 Blue: Pantone 300C or 291C
        - .1 Benjamin Moore: 133-33
        - .2 Armourcoat: Commodore Blue 98-4745-2
      - .3 White: Pantone White C
        - .1 Benjamin Moore: 133-01
        - .2 Armourcoat: Gloss White
      - .4 Orange: Pantone 166C or 150C
        - .1 Benjamin Moore: 007
        - .2 Armourcoat: Zesty orange
      - .5 Yellow: Pantone Yellow C or 101C
        - .1 Benjamin Moore: 133-12
        - .2 Armourcoat: Holland Yellow
      - .6 Green: Pantone 336 or 353C

- .1 Benjamin Moore: 133-40
- .2 Armourcoat: Shutter Green
- .7 Brown: Pantone 478C or 465C
  - .1 Benjamin Moore: 133-60
  - .2 Armourcoat: Havana Brown
- .8 Black: Pantone Black C
  - .1 Benjamin Moore: 133-80
  - .2 Armourcoat: Gloss Black
- .9 Purple: Pantone 257C or 264C
  - .1 Benjamin Moore: 1396
  - .2 Armourcoat: N/A
- .10 Grey: Pantone 422C
  - .1 Benjamin Moore: Not specified
  - .2 Armourcoat: Not specified

1.3 **SUBMITTALS**

- .1 Prepare a sample printed copy of the identification labels and submit to the Consultant for review.

2 Products

2.1 **MANUFACTURERS**

- .1 Furnish or install Products manufactured by stipulated manufactures where so indicated on the Contract Documents.

Avoid use of Products by manufacturers not stipulated on the Contract Documents.

Occurrence of Products in these Specifications other than those stipulated for use is not to be interpreted as authorization to use such Products.

2.2 **WRAP-AROUND COLOUR IDENTIFICATION MARKERS**

- .1 Coloured Metallic Cable Ties
  - .1 Coloured aluminum cables ties
    - .1 Width: 8 mm
    - .2 Lengths: 140 mm, 201 mm, 362 mm to suit cable or conduit diameters of 25 mm, 51 mm, 102 mm
    - .3 Colours: Blue, green, red, yellow, black, clear aluminum
  - .2 Listed manufacturers and representative Products:
    - .1 Panduit: MLT1H-LPAL, MLT2H-LPAL, MLT4H-LPAL etc



- .2 Coloured Hook and Loop Non-Metallic Cable Ties
  - .1 Coloured non-metallic cables ties, adjustable and reusable, hook-and-loop material, -18°C to +104°C
    - .1 Widths: 8.4 mm, 13 mm, 19 mm
    - .2 Lengths: 150 mm, 300 mm, 457 mm
    - .3 Colours: Black, red, orange, yellow, green, blue, grey, white
  - .2 Listed manufacturers and representative Products:
    - .1 Panduit: HLT2I-X0 etc
- .3 Electrical Colour Coding Tape
  - .1 PVC backing, 0.178 mm thick indoor outdoor suitable, pressure sensitive rubber adhesive, coloured, fade resistant, abrasion and weather resistant, to CSA C22.2 No 197-M1983
    - .1 Widths: 13 mm, 19 mm
    - .2 Colours: Black, brown, red, orange, yellow, green, blue, grey, white, violet
  - .2 Listed manufacturers and representative Products:
    - .1 Scotch 35 vinyl electrical colour coding tape

## 2.3 LABELS

- .1 General
  - .1 Comply with TIA-606A and CSA-T528.
  - .2 Prepare labels by use of machine printing.
  - .3 Avoid use of handwritten labels.

Manufacturer: Same as original equipment Supplier, otherwise Panduit.

- .2 Cable Labels
  - .1 Self-adhesive, self-laminating material, white engrave area.
  - .2 Minimum two times full wrap-around cable.
- .3 Faceplate Labels
  - .1 Labels to suit selected faceplate.
- .4 Grounding Bus Bars
  - .1 Self-adhesive, white engraved areas, minimum size 25 x 50 mm, characters minimum height 12 mm.
- .5 Patch Panels
  - .1 Self-adhesive, white engraved areas to suit selected patch panel or termination strip.

- .6 Rack and Cabinets
  - .1 Self-adhesive, white engraved areas, minimum size 50 x 75 mm, characters minimum height 12 mm.
- 2.4 **PAINT**
  - .1 Comply with Section 09 91 00; otherwise treat as shop primed ferrous metal - alkyd finish.
    - .1 One coat alkyd, paint code 48, gloss enamel.
    - .2 Paint code: 48 - interior alkyd gloss enamel: Conforming to CAN/CGSB-1.60-M; Benjamin Moore 133, ICI Devoe 4308 Series, Para 400, PPG 6-282, Sherwin Williams B35-200 Series or Sico 888-111.
- 3 Execution
  - 3.1 **COLOURS**
    - .1 Use components in the colour as indicated.
  - 3.2 **LABELLING**
    - .1 General
      - .1 Identify conduits, electrical raceways, pullboxes, junction boxes, for communications according to the colour scheme indicated on the Contract Drawings and herein.
      - .2 Identify cables, outputs, faceplates, jacks, grounding components and cabinets for communications according to the labelling and identification scheme indicated in the Contract Drawings and herein.
      - .3 Use cables, jacks, cords, icons, manufactured in the colours identified in the Contract Drawings and herein.
      - .4 Use the identification scheme as indicated.
      - .5 Apply labels so that the printed information may be read without the need to disturb the cables.
      - .6 Apply labels on cables as close to the end of the cable jacket as practicable, and no closer than 10 mm and not concealed by obstructions.
      - .7 Apply labels on jacks, faceplates and patch panels in the manner prescribed by the original equipment manufacturer.
      - .8 Apply more than one label where immediate obstructions may prevent ease of reading the prescribed label.
      - .9 Apply a label on the inside of the electrical device outlet box corresponding to each cable terminated on the faceplate mounted on the device box.
      - .10 Use only approved cable marking materials.
      - .11 Clearly identify all outlets, patch-panels, patch-cords, cables, racks enclosures, spaces, closets, conduit, and raceways according to the administration system shown on the Contract Drawings.

- .12 Use only machine printed labeling for outlets.
- .13 Use only engraved plastic plates for the labeling of enclosures and racks.

.2 Horizontal Distribution Cabling

- .1 Use the identification scheme as stipulated in the Contract Documents or herein.

.3 Backbone Cabling

- .1 Use the identification scheme as stipulated in the Contract Documents or herein.

3.3 **LABELLING AND IDENTIFICATION SCHEMA**

.1 Schema H: Industrial

.1 General

- .1 Schema applicable to large scale multiple level industrial premises.
- .2 Horizontal distribution cables defined by alpha-numeric full definition of cabling termination hub, followed by cable family, followed by cable medium, followed by cable ordinal.
- .3 Backbone cables defined by alpha-numeric full definition of cabling termination hub of source termination point, followed by destination termination point, followed by cable family, followed by cable medium, followed by cable ordinal.
- .4 Prefix terms omitted where all cables share common term.
- .5 Outlet defined.

.2 Scheme

- .1 Comply with proxy values indicated on the Contract Drawings.
- .2 Scheme consisting of the following terms
  - .1 Region identifier
    - .1 Example: Country
    - .2 Alpha: Two characters
    - .3 Proxy: RR
  - .2 Facility identifier
    - .1 Example: City
    - .2 Alpha: Two characters
    - .3 Proxy: CC
  - .3 Premises / area / building identifier
    - .1 Example: Production plant
    - .2 Alpha-numeric: Two characters

- .3 Proxy: AA
- .4 Floor / level identifier
  - .1 Indicates floor of cabling hub
  - .2 Example: Mezzanine
  - .3 Alpha-numeric: Two characters
  - .4 Proxy: FF
- .5 Cabling hub identifier
  - .1 Example: Telecom enclosure
  - .2 Alpha-numeric: One to six characters
  - .3 Proxy: hhhhhH
- .6 Cable family
  - .1 Example: Production network
  - .2 Alpha: One character
  - .3 Proxy: G
- .7 Medium type
  - .1 Example: Optical fibre
  - .2 Alpha: One character
  - .3 Proxy: M
- .8 Cable ordinal
  - .1 Example: Numeric value
  - .2 Numeric: Four character, zero filled, right justified
  - .3 Proxy: NNNN
- .3 Horizontal distribution format
  - .1 Fully defined form
    - .1 RR-CC-AA-FF-hhhhhH-G-M-NNNN
  - .2 Abbreviated form for cables within a sole region
    - .1 CC-AA-FF-hhhhhH-G-M-NNNN
  - .3 Abbreviated form for cables within a sole facility
    - .1 AA-FF-hhhhhH-G-M-NNNN
  - .4 Abbreviated form for cables within a sole premises
    - .1 FF-hhhhhH-G-M-NNNN

- .5 Abbreviated form for cables within a sole premises and within a sole family
  - .1 FF-hhhhhH-M-NNNN
- .6 Abbreviated form for cables within a sole premises and within a sole family and of a single medium
  - .1 FF-hhhhhH-NNNN
- .4 Horizontal distribution format examples:
  - .1 Administration network copper Category 6 distribution cables on grade level terminating at communications enclosure at grid reference WA/11
    - .1 01-WA/11-A-C-0001.....01-WA/11-A-C-9999
  - .2 Production network copper Category 6 distribution cables on grade level terminating at communications enclosure at grid reference WA/11
    - .1 01-WA/11-P-C-0001....01-WA/11-P-C-9999
  - .3 Production network multimode optical fibre distribution cables on grade level terminating at communications enclosure at grid reference WA/11
    - .1 01-WA/11-P-M-0001....01-WA/11-P-M-9999
  - .4 Administration network copper Category 6 distribution cables on 2<sup>nd</sup> floor terminating at communications enclosure in telecom room 201.
    - .1 02-201-A-C-0001.....02-201-A-C-9999
- .5 Back bone format
  - .1 Fully defined form
    - .1 RR-CC-AA-FF-hhhhhH-AA-FF-hhhhhH-G-M-NNNN
  - .2 Abbreviated form for cables within a sole region
    - .1 CC-AA-FF-hhhhhH-AA-FF-hhhhhH-G-M-NNNN
  - .3 Abbreviated form for cables within a sole facility
    - .1 AA-FF-hhhhhH-AA-FF-hhhhhH-G-M-NNNN
  - .4 Abbreviated form for cables within a sole premises
    - .1 FF-hhhhhH-FF-hhhhhH-G-M-NNNN
- .6 Backbone cabling format examples
  - .1 Administrative network copper multi-pair Category 6 backbone cables originating at second floor main telecom room #201, terminating at equipment enclosure WA/11 on grade level

- .1 02-201-01-WA/11-A-C-0001
- .2 Production network single mode optical fibre multi strand originating at second floor main telecom room #201, terminating at equipment enclosure WA/11 on grade level
  - .1 02-201-01-WA/11-P-S-0001
- .3 Production network single mode optical fibre multi strand originating at grade level equipment enclosure WP/15, terminating at equipment enclosure WA/11 on grade level
  - .1 01-WP/15-01-WA/11-P-S-0001
- .7 Outlet numbering format
  - .1 Fully defined form
    - .1 RR-CC-AA-FF-hhhhhH-G-M-NNNN
  - .2 Typical usage
    - .1 hhhhhH-G-M-NNNN
- .8 Outlet numbering format examples
  - .1 Administration network copper Category 6 distribution cables on grade level terminating at communications enclosure at grid reference WA/11
    - .1 WA/11-A-C-0001
  - .2 Administration network copper Category 6 distribution cables on 2<sup>nd</sup> floor terminating at communications enclosure in telecom room 201.
    - .1 201-A-C-0001
- .2 Scheme A: Consecutive Numbering – Single Data Outlet
  - .1 General
    - .1 Use this scheme where an outlet is indicated on the Contract Drawings as data.
  - .2 Identifier Scheme
    - .1 Scheme template: DxxxTyyy where
      - .1 D (fixed, literal) indicates DATA cable
      - .2 XXX (variable, ordinal) indicates building floor of outlet
      - .3 T (variable) indicates the telecommunication room in which the cable is terminated
      - .4 YYY (variable, ordinal) indicates cable count ordinal
      - .5 Use full scheme for labels affixed to cables and jacks. Do not abbreviate.

- .3 Floor Ordinal
  - .1 Use the numeric value of the floor on which the work area outlet is situated, padded left to three characters using zero as the pad character. Use numbers for floors above grade, prefix floors below grade with B or character to suit local conditions, use M to indicate mezzanine levels. In North America avoid the value "000".
  - .2 Example:
    - .1 Floor 12: 012
    - .2 Basement 3: 0B3
    - .3 Concourse 2: 0C2
    - .4 Mezzanine 2: 0M2
    - .5 Ground floor: 001
- .4 Termination Identifier
  - .1 Use a sequential alphabetic identification character to indicate in which telecommunications room the cable is terminated: Match to existing convention such as N (North), S (South) otherwise use A, B, C etc.
- .5 Telecommunications Room Horizontal Cable Patch Panel Termination
  - .1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification with existing cabling, padded left to three characters using zero and the pad character.
  - .2 Label the data termination field beginning at the upper most and left most jack position, starting with the lowest ordinal, advancing horizontally left to right, and progressing vertically as each row of jacks is completed. Example 001, 002, etc.
  - .3 Label the cable at the patch panel with the same identification as the jack to which the cable is connected.
- .6 Cable Count Ordinals
  - .1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification with existing cabling, padded left to three characters using zero and the pad character.
  - .2 Example: Cable 32: 032.
- .7 Work Area Outlet
  - .1 Label the jacks at the work area outlet faceplate with the same identification as the cable connecting to the jack.
  - .2 Install voice and data jacks with the same numeric ordinal on a common faceplate where local conditions permit.

.3 Scheme B: Basic Numbering

.1 General

.1 Where an outlet is indicated on the Contract Drawings designate each jack as a communications jack suitable for data or voice or other services, with the following exceptions.

.1 Where an outlet is tagged on the Contract Drawings as "T", designate the jack for convenience telephone service.

.2 Where an outlet is tagged on the Contract Drawings as "P" designate the cable for payphone service.

.3 Where an outlet is tagged on the Contract Drawings as "M", designate the cable for monitored line service.

.4 Where an outlet is tagged on the Contract Drawing as "I", designate the cables for intercom service.

.5 Where an outlet is tagged on the Contract Drawing as "C", designate the cables for special communications service.

.2 Facility Prefix

.1 Prefix all identifies with a building identifier. Default this field to blank if there is only one building.

.2 Prefix all identifiers with a numeric value indicating the floor within the premises or facility for the telecommunications room where the cable is terminated.

.1 Example: Floor 2: 02; basement: B1; ground floor: 01

.3 Follow the prefix with a hyphen separator and an alpha character and a hyphen separator to identify the specific telecommunications room where there is more than one to any floor.

.4 Reserve the special value of "Z" to indicate a building entrance service room.

.1 Example: First and only telecom room: -A-; second telecom room on common floor: -B-; building entrance room: -Z-

.3 Numeric Ordinals

.1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification with new or existing cabling.

.4 Communications Cables

.1 Identify cables as nnn where nnn is a unique numeric ordinal beginning at 001 to 999.

.1 Example: Cable #1: 001; cable #50: 050



- .5 Telephone Cables
  - .1 Identify telephone cables as Tnnn where nnn is a unique numeric ordinal beginning at 001 to 999 and T is a literal value.
    - .1 Example: Telephone cable #1: T001; telephone cable #50: T050
- .6 Pay Phone Cables
  - .1 Identify payphone cables as Pnnn where nnn is a unique numeric ordinal beginning at 001 to 999 and P is a literal value.
    - .1 Example: Pay phone cable #1: P001; pay phone cable #2: P002
- .7 Monitored Line Cables
  - .1 Identify monitored line cables as Mnnn where nnn is a unique numeric ordinal beginning at 001 to 999 and M is a literal value.
    - .1 Example: Monitored line cable #1: M001; monitored line cable #2: M002
- .8 Intercom Cables
  - .1 Identify intercom line cables as Innn where nnn is a unique numeric ordinal beginning at 001 to 999 and I is a literal value.
    - .1 Example: Intercom line cable #1: I001; intercom line cable #2: I002
- .9 Work Area Outlet
  - .1 Label the jacks at the work area outlet faceplate with the same identification as the cable connecting to the jack.
- .10 Telecommunications Room Horizontal Cable Patch Panel Termination
  - .1 Label the jacks at the patch panel with the same identification as the cable connecting to the jack.
  - .2 Label the communications cable termination field beginning at the upper most and left most jack position, starting with the lowest ordinal, advancing horizontally, left to right, and progressing vertically as each row of jacks is completed. Example: 001, 002, 003, etc.
    - .1 For each non-generic cable, label the termination field beginning at the upper most and left most jack position, starting with the lowest ordinal, beginning a new row for each non-generic type.
    - .2 Example  
P001, P002, P003, P004 ....  
T001, T002, T003, T004, ....  
M001, M002, M003, M004, ....  
C001, C002, C003, C004, ....
- .11 Cable Identification Examples
  - .1 A-01-A-001: Building A, floor 01, room A, cable 001

- .2 A-B1-Z-P001: Building A, basement B1, room Z (entrance room), pay phone 001
- .4 Scheme M: Modular Numbering
  - .1 General
    - .1 Where an outlet is tagged on the Contract Drawings as “V/2D”, designate one jack as voice, the other two jacks as data.
    - .2 Where an outlet is tagged on the Contract Drawings as “V/D”, designate one jack as voice, the other jack as data.
    - .3 Where an outlet is tagged on the Contract Drawings as “T” or “T1”, designate the jack for convenience telephone service.
    - .4 Where an outlet is tagged on the Contract Drawings as “P” or “P1”, designate the cable for payphone service.
    - .5 Where an outlet is tagged on the Contract Drawings as “M”, designate the cable for monitored line service.
    - .6 Where an outlet is tagged on the Contract Drawing as “I” or “I1”, designate the cables for intercom service.
  - .2 Facility Prefix
    - .1 Prefix all identifiers with a numeric value indicating the floor within the premises or facility for the telecommunications room in which the cable is terminated.
    - .2 Follow the prefix with an alpha character to identify the specific telecommunications room where there is more than one to any floor.
    - .3 Separate the prefix from the alphanumeric identifier with a hyphen separator.
  - .3 Numeric Ordinals
    - .1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification with existing cabling.
  - .4 Voice Cables
    - .1 Identify voice cables as V-rr-pp-jj where
      - .1 “rr” is a unique two character numeric ordinal identifying the rack on which the cable is terminated beginning at 01.
      - .2 “pp” is a consecutive two character numeric ordinal, unique in any rack or cabinet, identifying the patch-panel on which the cable is terminated, commencing at 01 at the uppermost patch panel in the rack.
      - .3 “jj” is a consecutive two character numeric ordinal, unique in any one patch panel, identifying the jack on which the cable is terminated, commencing at 01 at the uppermost, left most jack position in the panel.

- .4 "V" is a literal value.
- .5 Data Cables
  - .1 Identify data cables as D-rr-pp-jj where
    - .1 "rr" is a unique two character numeric ordinal identifying the rack on which the cable is terminated beginning at 01.
    - .2 "pp" is a consecutive two character numeric ordinal, unique in any rack or cabinet, identifying the patch-panel on which the cable is terminated, commencing at 01 at the uppermost patch panel in the rack.
    - .3 "jj" is a consecutive two character numeric ordinal, unique in any one patch panel, identifying the jack on which the cable is terminated, commencing at 01 at the uppermost, left most jack position in the panel.
    - .4 D is a literal value.
- .6 Telephone Cables
  - .1 Identify telephone cables as T-rr-pp-jj where
    - .1 "rr" is a unique two character numeric ordinal identifying the rack on which the cable is terminated beginning at 01.
    - .2 "pp" is a consecutive two character numeric ordinal, unique in any rack or cabinet, identifying the patch-panel on which the cable is terminated, commencing at 01 at the uppermost patch panel in the rack.
    - .3 "jj" is a consecutive two character numeric ordinal, unique in any one patch panel, identifying the jack on which the cable is terminated, commencing at 01 at the uppermost, left most jack position in the panel.
    - .4 T is a literal value.
- .7 Pay Phone Cables
  - .1 Identify payphone cables as Pnnn where nnn is a unique numeric ordinal not occurring in the existing Pay phone cabling beginning at 001 to 999 and P is a literal value.
- .8 Monitored Line Cables
  - .1 Identify monitored line cables as Mnnn where nnn is a unique numeric ordinal not occurring in the existing monitored line cabling beginning at 001 to 999 and M is a literal value.
- .9 Intercom Cables
  - .1 Identify intercom line cables as Innn where nnn is a unique numeric ordinal not occurring in the existing intercom cabling beginning at 001 to 999 and I is a literal value.

- .10 Work Area Outlet
  - .1 Label the jacks at the work area outlet faceplate with the same identification as the cable connecting to the jack.
- .11 Telecommunications Room Horizontal Cable Patch Panel Termination
  - .1 Label the jacks at the patch panel with the same identification as the cable connecting to the jack.
  - .2 Label the voice termination field beginning at the upper most and left most jack position, starting with the lowest ordinal, advancing horizontally, left to right, and progressing vertically as each row of jacks is completed. Example: V001, V002, V003, etc.
  - .3 Label the data termination field beginning at the upper most and left most jack position, starting with the lowest ordinal, advancing horizontally in A and B pairs, left to right, and progressing vertically as each row of jacks is completed. Example D001A, D001B, D002A, D002B, etc.
- .5 Scheme C: Consecutive Numbering
  - .1 General
    - .1 Where an outlet is tagged on the Contract Drawings as “V/2D”, designate one jack as voice, the other two jacks as data A and data B respectively.
    - .2 Where an outlet is tagged on the Contract Drawings as “V/D”, designate one jack as voice, the other jacks as data A.
    - .3 Where an outlet is tagged on the Contract Drawings as “T” or “T1”, designate the jack for convenience telephone service.
    - .4 Where an outlet is tagged on the Contract Drawings as “P” or “P1”, designate the cable for payphone service.
    - .5 Where an outlet is tagged on the Contract Drawings as “M”, designate the cable for monitored line service.
    - .6 Where an outlet is tagged on the Contract Drawing as “I” or “I1”, designate the cables for intercom service.
  - .2 Facility Prefix
    - .1 Prefix all identifiers with a numeric value indicating the floor within the premises or facility for the telecommunications room where the cable is terminated.
    - .2 Follow the prefix with an alpha character to identify the specific telecommunications room where there is more than one to any floor.
    - .3 Separate the prefix from the alphanumeric identifier with a hyphen separator.
  - .3 Numeric Ordinals
    - .1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification with existing cabling.

- .4 Voice Cables
  - .1 Identify voice cables as Vnnn where nnn is a unique numeric ordinal beginning at 001 to 999 and V is a literal value.
- .5 Data Cables
  - .1 Identify one data cable to an outlet as DnnnA where nnn is a unique numeric ordinal beginning at 001 to 999 and D and A are literal values.
  - .2 Identify the second data cable to an outlet as DnnnB where nnn is a unique numeric ordinal beginning at 001 to 999 and D and B are literal values.
- .6 Telephone Cables
  - .1 Identify telephone cables as Tnnn where nnn is a unique numeric ordinal beginning at 001 to 999 and T is a literal value.
- .7 Pay Phone Cables
  - .1 Identify payphone cables as Pnnn where nnn is a unique numeric ordinal beginning at 001 to 999 and P is a literal value.
- .8 Monitored Line Cables
  - .1 Identify monitored line cables as Mnnn where nnn is a unique numeric ordinal beginning at 001 to 999 and M is a literal value.
- .9 Intercom Cables
  - .1 Identify intercom line cables as Innn where nnn is a unique numeric ordinal beginning at 001 to 999 and I is a literal value.
- .10 Work Area Outlet
  - .1 Label the jacks at the work area outlet faceplate with the same identification as the cable connecting to the jack.
  - .2 Install voice and data jacks with the same numeric ordinal on a common faceplate.
- .11 Telecommunications Room Horizontal Cable Patch Panel Termination
  - .1 Label the jacks at the patch panel with the same identification as the cable connecting to the jack.
  - .2 Label the voice termination field beginning at the upper most and left most jack position, starting with the lowest ordinal, advancing horizontally, left to right, and progressing vertically as each row of jacks is completed. Example: V001, V002, V003, etc.
  - .3 Label the data termination field beginning at the upper most and left most jack position, starting with the lowest ordinal, advancing horizontally in A and B pairs, left to right, and progressing vertically as each row of jacks is completed. Example D001A, D001B, D002A, D002B, etc.

.6 Scheme D: Ottawa City

.1 General

- .1 Where an outlet is tagged on the Contract Drawings as “VV/DD”, the outlet is served by two cables; cable A dedicated to a data jack, designated as DATA 1; cable B split between three jacks, designated as VOICE 1, VOICE 2, DATA 2.
- .2 Where an outlet is tagged on the Contract Drawings as “T”, the outlet is served by one cable and is for convenience telephone service.
- .3 Where an outlet is tagged on the Contract Drawings as “P”, the outlet is served by one cable and is for payphone service.
- .4 Where an outlet is tagged on the Contract Drawings as “M”, the outlet is served by one cable and is for monitored line service.
- .5 Where an outlet is tagged on the Contract Drawing as “I”, the outlet is served by one cable and is for intercom service.

.2 Jack Colours

- .1 Jack colours and position in faceplate:
  - .1 Data 1 colour: Grey: Position - lower left
  - .2 Voice 1 colour: Blue: Position - upper left
  - .3 Voice 2 colour: Beige: Position - upper right
  - .4 Data 2 colour: Orange: Position - lower right

.3 Facility Prefix

- .1 Maintain records in an electronic data file. Prefix all alpha-numeric identifiers with an alpha-numeric character string indicating the site reference.
- .2 For city of Ottawa sites, use the following site identifiers:
  - .1 Dispatch building: D
  - .2 Garage: G
  - .3 Bylaw building: B

.4 Termination Room Identifiers

- .1 Use a room identifier to identify the telecommunications rooms as follows:
  - .1 “1”: Telecom room, dispatch building, 2<sup>nd</sup> floor
  - .2 “2”: Telecom and equipment room, garage
  - .3 “3”: Telecom enclosure, office mezzanine
  - .4 “4”: Telecom room, garage, tire bay

- .5 "5": Telecom room, garage entrance
  - .6 "6": Telecom enclosure, garage mezzanine
  - .7 "9": Telecom room, bylaw building
- .5 Distribution Cable Identifications
- .1 Label each end of every distribution cable. Label each cable with a unique identifier. Use the same identifier at each end of each respective cable.
  - .2 Use a cable identifier to identify the various distribution cable purposes as follows:
    - .1 Data jack (D1): Cable type A
    - .2 Hybrid (V1 V2 D2): Cable type B
    - .3 Voice only (V): Cable type V
    - .4 Wireless access: Cable type W
    - .5 Express POTS: Cable type P
    - .6 Building ECMS: Cable type E
  - .3 Identify the cables comprising the pair of cables to a MIXED USE outlet as follows, where "b" is facility prefix, "n" is terminating room identifier, "xxx" is the cable ordinal, and "A" or "B" to identify the respective cables. Use the same cable ordinal for the two cables terminating at a common outlet.
    - .1 Cable to data 1: b-n-A-xxx
    - .2 Cable to voice 1, voice 2, data 2: b-n-B-xxx
  - .4 Identify the cable to a single use outlet as follows, where "b" is facility prefix, "n" is terminating room identifier, "xxx" is the cable ordinal, and "C" or "D" or "E" or "F" to identify the respective cables.
    - .1 Cable to voice: b-n-V-xxx
    - .2 Cable Wireless Access Point (WAP): b-n-W-xxx
    - .3 Cable to POTS outlet: b-n-P-xxx
    - .4 Cable to building EMCS: b-n-E-xxx
- .6 Numeric Ordinals
- .1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification with existing cabling.
  - .2 Two cables terminating at a common faceplate to carry the same ordinal.
  - .3 Cable ordinals for all cables types to begin at 001, restarting at 001 for each cable type at each telecom room.

- .7 Telephone Cables
  - .1 Treat telephone cables as single purpose voice cables (above).
- .8 Payphone Cables
  - .1 Treat pay telephone cables as single purpose (POTS) cables (above).
- .9 Monitored Line Cables
  - .1 Treat power utility monitoring cables as single purpose (POTS) cables (above).
- .10 Intercom Cables
  - .1 Not specified
- .11 Work Area Outlet
  - .1 Label single use and mixed use outlets according to the respective schemes described below.
  - .2 Label the faceplate at a mixed use outlet as follows where “b” is facility prefix, “n” is terminating room identifier, “xxx” is the cable ordinal of the two cables terminating at the outlet
    - .1 b-n-xxx
  - .3 Label the jacks at the MIXED USE work area outlet faceplate
    - .1 Upper left: Voice 1
    - .2 Upper right: Voice 2
    - .3 Lower left: Data 1
    - .4 Lower right: Data 2
  - .4 Install voice (V1, V2) and data (D1, D2) jacks with the same numeric ordinal on a common faceplate.
  - .5 Label the faceplate at a single use outlet as follows where “b” is facility prefix, “n” is terminating room identifier, “X” is replaced with “V” or “W” or “P” or “E” to identify the respective cables type and “xxx” is the cable ordinal of the cable terminating at the outlet.
    - .1 b-n-X-xxx
- .12 Telecommunications Room Horizontal Cable Patch Panel Termination
  - .1 Label each patch panel with facility prefix and room identifier as indicated above, where “b” is facility prefix, “n” is terminating room identifier
    - .1 b-n
  - .2 Label the jacks at the patch panel with the same identification as the cable connecting to the jack
    - .1 Jack connected to Cable A:A-xxx



- .13 Telecommunications Room Horizontal Cable Wall Mounted Panel Termination
  - .1 Label each wall mounted panel with facility prefix and room identifier as indicated above, where "b" is facility prefix, "n" is terminating room identifier
    - .1 b-n
  - .2 Label the terminations at the termination panel with the same identification as the cable connecting to the termination
    - .1 Termination for Cable B: B-xxx
    - .2 Termination for Cable V: V-xxx
    - .3 Termination for Cable W: W-xxx
    - .4 Termination for Cable P: P-xxx
    - .5 Termination for Cable E: E-xxx
  - .3 Label terminations beginning at the upper most and left most position, starting with the lowest ordinal, advancing horizontally, left to right, and progressing vertically as each row of jacks is completed. Example: B-001, B-002, B-003, etc.
  - .4 Terminate cables of only a single type on a termination block.
- .7 Scheme E
  - .1 Generic Horizontal Cabling
    - .1 Use this scheme for converged horizontal systems with separate CCTV.
    - .2 Identifier scheme template: ITx-nnn or ITx-Cppp
      - .1 IT: Literal to indicate IT room or enclosure.
      - .2 X: Ordinal from 0 through 6 to indicate different communication wiring hubs as shown on the layout drawings.
      - .3 Nnn: Consecutive cable ordinals to identify each cable with a unique identifier. Series resets to 001 at each IT room or enclosure.
      - .4 C: Identifier to distinguish cables for CCTV camera connections.
      - .5 Ppp: Three digit identifier to uniquely distinguish each camera. Same ordinal used to identify cable to the camera.
    - .3 Telecommunications Room Horizontal Cable Patch Panel Termination
      - .1 Label the data termination field beginning at the upper most and left most jack position, starting with the lowest ordinal, advancing horizontally left to right, and progressing vertically as each row of jacks is completed.
      - .2 Repeat for CCTV. Segregate CCTV cables from other cables.

- .3 Label the cable at the patch panel with the same identification as the jack to which the cable is connected.
- .4 Cable Count Ordinals
  - .1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification with existing cabling, padded left to three characters using zero and the pad character.
- .5 Work Area Outlet
  - .1 Label the jacks at the work area outlet faceplate with the same identification as the cable connecting to the jack.
- .2 Presto horizontal cabling
  - .1 Use this scheme for cables specific to Presto systems
  - .2 Identifier scheme template:
    - .1 Label each cable as indicated on the riser diagram and layout drawings.
    - .2 Cable identification strings:  
SPAAC  
TPT-P  
DRD-P  
SPOS-P  
DSC-P  
SPOS-T1 through SPOS-T2  
WP-1 through WP-9
    - .3 Cabinet identification strings:  
CC-P1 through CC-P3  
DC-P  
CC-T
    - .4 Telecommunications room horizontal cable patch panel termination.
    - .5 Label the data termination field beginning at the upper most and left most jack position.
    - .6 Label the cable at the patch panel with the same identification as the jack to which the cable is connected.
  - .3 Work Area Outlet
    - .1 Label the jacks at the work area outlet faceplate with the same identification as the cable connecting to the jack.
- .8 Scheme U: Unified Numbering – Single Outlet
  - .1 General
    - .1 Use this scheme where an outlet is indicated on the Contract Drawings as data, or IP phone, or POTS, or red phone.

- .2 Identifier Scheme
  - .1 Scheme template: DxxxTTTTTcccYYY where
    - .1 D (literal) indicates DATA cable; P (literal) indicates POTS telephone.
    - .2 XXX (variable, ordinal) indicates building floor of outlet.
    - .3 TTTTT (variable) indicates the telecommunication room in which the cable is terminated.
    - .4 Ccc (variable, ordinal) indicates cabinet/panel identification.
    - .5 YYY (variable, ordinal) indicates cable count ordinal.
    - .6 Use full scheme for labels affixed to cables and jacks. Do not abbreviate.
  - .3 Floor Ordinal
    - .1 Use the numeric value of the floor on which the Work area outlet is situated, padded left to three characters using zero as the pad character. Use numbers for floors above grade, prefix floors below grade with B or character to suit local conditions, use M to indicate mezzanine levels. In North America avoid the value "000".
    - .2 Example:
      - .1 Floor main at grade: 001
      - .2 Floor 2 above grade: 002
      - .3 Mechanical mezzanine: BM1
      - .4 Mechanical main: B01
      - .5 Transformer level: B02
      - .6 Cabling level: B03
  - .4 Termination Identifier
    - .1 Use a sequential alphanumeric identification to indicate which telecommunications room the cable is terminated: Use full room number.
    - .2 Example:
  - .5 Telecommunications Cabinet/Panel
    - .1 Use a sequential alphanumeric identification to indicate which telecommunications cabinet/panel the cable is terminated.
    - .2 Example
  - .6 Telecommunications Room Horizontal Cable Patch Panel Termination
    - .1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification with existing cabling, padded left to three characters using zero and the pad character.

- .2 Label the data termination field beginning at the upper most and left most jack position, starting with the lowest ordinal, advancing horizontally left to right, and progressing vertically as each row of jacks is completed.
- .3 Example 001, 002, etc.
- .4 Label the cable at the patch panel with the same identification as the jack to which the cable is connected.
- .7 Cable Count Ordinals
  - .1 Select the lowest numeric value as the starting value in an ordinal series to avoid duplication of identification with existing cabling, padded left to three characters using zero and the pad character.
  - .2 Example: Cable 32: 032.
- .8 Work Area Outlet
  - .1 Label the jacks at the Work area outlet faceplate with the same identification as the cable connecting to the jack.
- .9 Backbone Cabling
  - .1 General Scheme
    - .1 Designate backbone multi-pair copper cables as MC//01//02//nnn, where 01 designates the terminal in or nearest to the building entrance room, 02 designates the next telecommunications room and nnn is a unique numeric ordinal beginning at 001 to 999. The ordinal is maintained unique throughout this cable type; it does not revert to 001.
      - .1 Example  
MC/A-B1-Z/A-01-A/001  
Multi-pair copper cable, from: building A, basement B1, entrance room (Z); to building A, floor 01, room A; cable number 001
    - .2 Designate backbone optical fibre multimode cable as OM-01-02-nnn where 01 designates the terminal in or nearest to the building entrance room, 02 designates the next telecommunications room and nnn is a unique numeric ordinal beginning at 001 to 999. The ordinal is maintained unique throughout this cable type; it does not revert to 001.
    - .3 Designate backbone optical fibre single mode cable as OS-01-02-nnn where 01 designates the terminal in or nearest to the building entrance room, 02 designates the next telecommunications room and nnn is a unique numeric ordinal beginning at 001 to 999. The ordinal is maintained unique throughout this cable type; it does not revert to 001.
    - .4 Designate backbone crossover copper 4-pair cable as Xnnn where nnn is a unique numeric ordinal beginning at 001 to 999 and X is a literal value. The ordinal is maintained unique throughout this cable type; it does not revert to 001.
  - .2 Multi-Pair Copper Backbone Cables
    - .1 Label the termination field with the identification of the cable that terminates thereon.

- .3 Optical Fibre Backbone Cables
  - .1 Label the optical fibre termination patch field with the identification of the cable that terminates thereon.
- .4 Backbone Crossover Cables
  - .1 Label the crossover termination field beginning at the upper most and left most jack position, starting with the lowest ordinal, advancing horizontally, left to right, and progressing vertically as each row of jacks is completed. Example: X001, X002, X003, etc.
- .5 Scheme D: Ottawa City
  - .1 Use “facility prefix” and “termination room identifiers” as indicated above for horizontal distribution cabling.
  - .2 Identify backbone cables as lying between the far-end facility and near-end facility where the near-end is closest to the work area.
  - .3 Label each end of every backbone cable. Label each cable with a unique identifier. Use the same identifier at each end of each respective cable.
  - .4 Label each cable within each pull box or maintenance hole.
  - .5 Identify each cable indicating the media type, shown below as “MMM”, as follows:
    - .1 Optical fibre: Multi mode: OM1
    - .2 Optical fibre: Multi mode: OM2
    - .3 Optical fibre: Multi mode: OM3
    - .4 Optical fibre: Single mode: OS1
    - .5 Copper unshielded: Cat 1: UT1
    - .6 Copper unshielded: Cat 3: UT3
    - .7 Copper unshielded: Cat 5e: UT5
    - .8 Copper shielded: Cat 1: ST1
    - .9 Copper shielded: Cat 3: ST3
    - .10 Copper shielded: Cat 5e: ST5
    - .11 Copper armoured: Cat 1: AT1
    - .12 Copper armoured: Cat 1: AT3
    - .13 Copper armoured: Cat 5e: AT5
  - .6 Multi-pair backbone copper cables
    - .1 Label the termination field with the identification of the cable that terminates thereon.

- .2 Identify each cable as follows, where “F” facility prefix for far-end facility, “f” is terminating room identifier at the far end, “N” is the facility prefix for the near end, “n” is the termination room identifier at the near end, “MMM” indicates the media type, indicates “ppp” indicates the number of pairs, left padded with zero, “xxx” is the cable ordinal, left padded with zero
  - .1 F-f -N-n-MMM-ppp-xxx
- .7 Multi-strand optical fibre cables
  - .1 Label the optical fibre termination patch field with the identification of the cable that terminates thereon.
  - .2 Identify each cable as follows, where “F” facility prefix for far-end facility, “f” is terminating room identifier at the far end, “N” is the facility prefix for the near end, “n” is the termination room identifier at the near end, “MMM” indicates the media type, indicates “ppp” indicates the number of strands, left padded with zero, “xxx” is the cable ordinal, left padded with zero
    - .1 F-f -N-n-MMM-ppp-xxx
- .8 Backbone ordinals
  - .1 Number all copper cables with a common far-end identifier using unique consecutive ordinals beginning at 001.
  - .2 Number all optical fibre cables with a common far-end identifier using unique consecutive ordinals beginning at 001.
- .6 Scheme E:
  - .1 Generic backbone cabling
    - .1 Identifier scheme template: ITx-ITy-M-nnn
      - .1 IT: Literal to indicate IT room or enclosure.
      - .2 X: Ordinal from zero through six to indicate different communication wiring hubs as shown on the layout drawings. (x) is always numerically less than (y).
      - .3 M: Identification of medium:
        - O to indicate optical fibre,
        - C to indicate copper
      - .4 Nnn: Consecutive cable ordinals to identify each cable with a unique identifier.
    - .2 Presto optical fibre backbone cabling
      - .1 Identifier scheme template: DCP-Px-M-nnn
        - .1 DCP: Literal to indicate main Presto panel
        - .2 P: Literal to indicate Presto panel

- .3 X: Ordinal from one through three to indicate different Presto panels
- .4 M: Identification of medium:  
O to indicate optical fibre,  
C to indicate copper
- .5 Nnn: Consecutive cable ordinals to identify each cable with a unique identifier.

.10 Connecting Cords

- .1 Do not label connecting cords.
- .2 Identify each connecting cord with a label affixed at each end within 50 mm of the jack
  - .1 Label each cable as follows where "LL" is length expressed in meters, left padded with zero, "xxx" is cord ordinal, left padded with zero, beginning at 001. Ordinal does not reset for different values of LL
    - .1 LL-xxx

3.4 **COMMUNICATIONS PATHWAY IDENTIFICATION**

- .1 General
  - .1 Identify only those communications conduits used for backbone cabling.
  - .2 Identify communications ducts.
- .2 Mark surface mounted metallic or non-metallic conduit raceways by use of combination of coloured couplers and painted stripes, electrical identification plastic tape, or wrap-around markers.
- .3 Do not identify surface raceways mounted below ceiling line in finished areas. Do not apply colour code identifier markings to outlet faceplates.
- .4 Identify raceways at termination of raceway and transition to other raceways or enclosures. Apply markings on each side of transit through architectural partitions or floors or ceilings.
- .5 Employ system colours as indicated in table below.
- .6 Apply a small area of paint to inside of outlet, junction and pull boxes.
- .7 Apply identifying mark as paint to full surface of junction box and pull box cover panels for boxes of 150 mm x 150 mm or smaller.
- .8 Apply identifying mark as stripe for junction and pull boxes greater than 150 mm x 150 mm.
- .9 Use wrap around identification bands to identify conduit where painting is impracticable or prohibited or has potential to damage cabling or adjacent materials. Avoid obscuring labels. Avoid obscuring inspection windows.
- .10 Use wraparound identification bands to identify exposed communications cabling according to system where indicated on the Drawings.

- .11 Apply one or more markings per the table below as indicated in the Contract Drawings. Refer also to Section 25 05 54. Where the Specifications differ, Section 25 05 54 will prevail.
- .12 Apply a base mark of minimum 19 mm wide. Where indicated, apply stripes of minimum 8 mm maximum 12 mm each. Apply marking with separation of 12 mm to 20 mm between adjacent bands. Apply the base marking band nearest to the junction of the conduit with the junction box, outlet box or pull box.

- .13 Use the following system colours

System	base colour	1 <sup>st</sup> stripe	2 <sup>nd</sup> stripe
Communications	blue		
Communications – backbone	blue	blue	
Communications – backbone – copper (public)	blue	blue	green
Communications – backbone – copper (private)	blue	blue	blue
Communications – backbone – fibre (public)	blue	blue	orange
Communications – backbone – fibre (private)	blue	blue	yellow
Communications – distribution	blue	green	
Communications – distribution – copper	blue	green	green
Communications – distribution – fibre	blue	green	orange
Security	green		
Security – access control	green	yellow	
Security – intrusion detection	green	yellow	green
Security – CCTV	green	blue	
Security – magnetic locks	green	red	
Security – duress alarms	green	red	green
Fire alarm	red		
Fire alarm – speakers	red	white	
Fire alarm – telephone	red	blue	
Distributed communications	white		
Distributed communications – intercom	white	brown	
Distributed communications – PA	white	white	
Distributed communications – AV	white	white	green
Distributed communications – radio	white	green	
Distributed communications – CATV	white	blue	



End of Section

- 1 General
- 1.1 **SUMMARY**
  - .1 Section Includes
    - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
- 1.2 **REFERENCES**
  - .1 Telecommunications Industry Association ([www.tiaonline.org](http://www.tiaonline.org))
  - .2 Building Industry Consulting Services International (BICSI) ([www.bicsi.com](http://www.bicsi.com))
  - .3 International Electrical Testing Association Inc. ([www.netaworld.org](http://www.netaworld.org))
- 1.3 **SUBMITTALS**
  - .1 Submit test reports for review by Consultant. Include in Operating and Maintenance Manual. Comply with Section 01 33 00.
  - .2 Submit test data in a machine readable format approved by the Consultant. Submit a "reader" program designed and as required for use with the test data file.
  - .3 Submit a hard copy version of each test report. Use two-sided printing where practicable.
  - .4 Submit a PDF® (portable document format) version of each test report.
  - .5 Submit a summary report for each copper cable indicating pass/fail and length for each cable tabulating each result by cable number.
  - .6 Submit a summary report for each optical fibre strand indicating insertion loss for each strand tabulating each result by cable sheath and strand number.
  - .7 Submit detailed test results for all copper and optical fibre cables including backbone and distribution communications cables.
  - .8 Deliver the reports in a media format selected from the following:
    - .1 CD-ROM
    - .2 DVD/R-RW
  - .9 Within thirty days of award of Contract but no later than ten days before site mobilization of forces, submit evidence from each third party warranting performance guarantees of any part of the cabling system of their agreement that testing and site inspection procedures are fit for the purpose of upholding the warranty.
  - .10 Submit test and field reports before submitting claim for Substantial Performance.
- 1.4 **TEST REPORTS**
  - .1 For each check and test performed prepare and submit a test report, signed by the test Engineer, and where witnessed, by the Consultant.
  - .2 Test reports to include a record of all tests performed, methods of calculation, date and time of test, ambient conditions, names of testing company, test Engineer and witnesses,

also calibration record of all test instruments used together with manufacturers name, serial number and model number.

- .3 Calibration record to include performance level of test equipment.
- .4 Tests performed with instruments that have not been calibrated or certified as Fit For Purpose within twelve months preceding the date of use may be rejected at sole discretion of the Owner.
- .5 Undertake either full or sample testing daily and have reports available for review by the Consultant as an assurance that standards of working practices are being maintained.
- .6 Complete test records and certification of such records prior to Project cutover or beneficial use of the facility by Owner.
- .7 Configure the test equipment according to the cable under test. Install Product specific parameters.

#### 1.5 **MANUFACTURER'S ATTENDANCE**

- .1 Provide manufacturer's representatives to verify installation practices for each part of the Work as may be relevant to all components including wiring and terminations.

#### 1.6 **FIELD INSPECTION**

- .1 Provide field Engineer for inspection and certification of facilities during installation, testing and commissioning as required.
- .2 Concurrent with testing, perform visual inspection of all exposed cable to verify compliance with bend radius protection, sheath protection and protection against harsh environment.
- .3 Perform visual verification that all cables, outlets, jacks and patch cords are labelled according to this Specification. Confirm that cable numbers and jack numbers align.
- .4 Prepare and submit to the Consultant, summary report attesting to the findings of the field inspection.

#### 1.7 **QUALITY ASSURANCE**

- .1 These Specifications supplement the Electrical and Electronic Manufacturers Association of Canada, Canadian Standards Association standards, Electronic Industries Association, Telecommunications Industries Association standards and recommendations. Conditions of the EEMAC, CSA, EIA, TIA and ISO/IEC standards and recommendations apply unless superseded or modified by this Specification.
- .2 Where requirements of the Specifications exceed referenced standards, the Specifications apply. Where standards differ between authorities, the most rigid applies.
- .3 Requirements of the Specifications that are substandard to referenced standards should be brought to the attention of Consultant during bidding period.
- .4 Where any part of the Work fails tests or fails visual inspection, replace the defective material.

- .5 Where any part of the Work fails tests and that Work is to be built without physical discontinuity, remove the offending material and install new without increase in cost to the Contract.
- .6 Identify and indicate in the test results, the type/style/category/product number of cables under test.
- .7 At the reasonable discretion of the Engineer, replace cable or cabling components that fail performance tests, or fail to comply with work practices described in TIA and BICSI published standards and with practices published by the vendor of cabling used on the Project. Make these replacements at no cost to the Project, not in material cost, nor labour charges, nor in delays incurred to make such replacements.

## 2 Products

### 2.1 **TEST INSTRUMENTS**

- .1 Use only one style of test instrument for all measurements; use instruments of only one manufacturer for all measurements.
- .2 Use instruments manufactured by one of the following:
  - .1 Agilent
  - .2 Fluke

## 3 Execution

### 3.1 **MATERIAL ACCEPTANCE**

- .1 Before installing any cable on site, perform the following material acceptance tests:
  - .1 Perform OTDR and flux loss measurements on optical fibre cable after delivery to site and before installation. Prepare summary report and submit as a Shop Drawing to the Engineer for review. Reject material which fails performance tests or appears physically damaged.
  - .2 Perform visual inspection tests on communications cables after delivery to site and before installation. Reject material which fails performance tests or appears physically damaged.
  - .3 Perform full performance testing on samples removed from each spool of communications cable after delivery to site and before installation. Submit the test results to the Engineer for review as a Shop Drawing. Record the manufacturer's production data as imprinted on the cable sheath. Use a cable sample of physical length 50 meters  $\pm$  500 mm. Retain sample for further testing until after Shop Drawings are returned as "Reviewed as Submitted".

### 3.2 **VISUAL AND MECHANICAL INSPECTION**

- .1 Immediately following installation of cables and connector hardware, perform the following visual and mechanical inspections:
  - .1 Compare cable, connectors and splice data with Drawings and Specifications.
  - .2 Inspect cable and connectors and connections for physical and mechanical damage.

.3 Verify that all connectors and splices are correctly installed.

.4 Verify colour and marking identification is correctly installed.

### 3.3

#### **ELECTRICAL TESTING**

.1 Test horizontal and backbone copper cables according to the following criteria:

.1 Cable length measurement and construction defect inspections.

.2 Connector integrity tests.

.3 Cable and connector attenuation and performance testing.

.4 For cables up to and including Category 3, test all pairs of each horizontal and backbone cables for continuity, short circuits, open circuits, continuity to ground, correct polarity, length, attenuation and near end crosstalk to a minimum of 16 MHz. Perform tests in accordance with TIA 568B.

.5 For Category 5, and 5e cabling, test all pairs for continuity, short circuits, open circuits, continuity to ground and correct polarity. Test each cable for length, attenuation, near end crosstalk, far end cross talk, delay, delay skew to a minimum of 350 MHz. Perform tests in accordance with TIA 568B.

.6 For Category 6 cabling, test all pairs for continuity, short circuits, open circuits, continuity to ground and correct polarity. Test each cable for length, attenuation, near end crosstalk, far end cross talk, delay, delay skew to a minimum of 650 MHz. Perform tests in accordance with TIA 568B.

.7 For Category 6A cabling, test all pairs for continuity, short circuits, open circuits, continuity to ground and correct polarity. Test each cable for length, attenuation, near end crosstalk, far end cross talk, delay, delay skew to a minimum of 1000 MHz. Perform tests in accordance with TIA 568B.

.8 For Category 6A cabling, and on request of the Engineer, conduct tests to 1000 MHz for alien cross talk measurements on an audit basis as per TIA 568 B2-10 on two samples of six-around-one cable sets selected by the Engineer.

.9 Test coax cabling for center conductor continuity, shield continuity, impedance (75 ohms), attenuation to limits dependent on the application as described in TIA 942-1.

.2 Test optical fibre cable according to the following:

.1 Cable length measurement, fibre fracture inspection and construction defect inspections using an Optical Time Domain Reflectometer (OTDR).

.2 Connector and splice integrity tests using an OTDR.

.3 Cable attenuation and loss measurements using an optical power loss test set.

.4 Test every fibre of each cable with an OTDR for length and attenuation. Include a hard copy chart recording with the test documentation.

.5 Test every fibre of each cable with a power meter/light source combination in both directions. Tabulate and include test results with the test documentation.

.6 Multi Mode Fiber

- .1 Perform factory tests for loss measurements at 850 nm and 1300 nm in both directions using a source and power meter calibrated at these wavelengths. Perform the tests using an LED source. Comply with procedures described in FOTP-171 Methods A1 or D1, or FOTP-34 Method A2. Archive measurement results electronically showing pass/fail results measured using limits provided in TIA 568-C.3 and deliver with viewer/reporting software.
- .2 Perform testing with an optical time domain reflectometer using a launch fiber at both ends. Submit OTDR trace data along with a viewer program. Submit OTDR event table showing reflective events with an absolute value less than 50 dB return loss and non-reflective events with a loss value greater than 0.1 dB.

.7 Single Mode Fiber

- .1 Perform tests for loss measurements at 1310 nm and 1550 nm in both directions using a source and power meter calibrated at these wavelengths. Comply with procedures described in FOTP-171 Methods A3 or D3, or FOTP-34 Method B. Measure against limits provided in TIA-568-C.3. Archive measurement results electronically and show pass/fail results delivered with viewer/reporting software.
- .2 Perform testing with an OTDR using a launch fiber at both ends. Submit OTDR trace data along with a viewer program. Submit OTDR event table showing reflective events with an absolute value less than 50 dB return loss and non-reflective events with a loss value larger than 0.1 dB.
- .3 For single mode fiber runs longer than five km deployed for 10 Gbps or higher rates, measure chromatic dispersion showing absolute dispersion at 1550 nm and polarization mode dispersion. Record and submit results for these fibers in addition to the tests above.

.3 Test Values

- .1 Assemble test results and submit to the Engineer in a timely manner.
- .2 Analyze the results and repair or replace cabling so that the Work results comply with the Specifications.
- .3 Verify that the installed cabling conforms to the manufacture`s Specifications.

3.4 **REPAIRS**

- .1 Replace defective or damaged cables and components and re-execute tests.
- .2 Replace defective cables without splicing where splicing is not permitted.

End of Section

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- 1 General
- 1.1 **SUMMARY**
  - .1 Section Includes
    - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
    - .2 Related Sections
      - .1 Refer to all divisions of Work in the Specifications.
- 1.2 **REFERENCES**
  - .1 Safety
    - .1 National
      - .1 Canadian Standards Association CSA C22.1
    - .2 Provincial
      - .1 Ontario Electrical Safety Code
      - .2 Ontario Building Code
  - .2 Performance
    - .1 International Standards Organization
      - .1 ISO11801 Information technology — Generic cabling for customer premises
    - .2 Telecommunications Industry Association ([www.tiaonline.org](http://www.tiaonline.org))
      - .1 TIA-526-7 measurement of optical power loss of installed single-mode fibre cable plant
      - .2 TIA-526-14 optical power loss measurements of installed multimode fiber cable plant
      - .3 TIA-568 commercial building telecommunications cabling standard
      - .4 TIA-569 telecommunications pathways and spaces
      - .5 TIA-598 optical fiber cable color coding
      - .6 TIA-606 administration standard for telecommunications infrastructure
      - .7 TIA-607 generic telecommunications bonding and grounding (earthing) for customer premises
      - .8 TIA-758 customer-owned outside plant telecommunications infrastructure standard
      - .9 TIA-862 building automation systems cabling standard
      - .10 TIA-942 telecommunications infrastructure standard for data centers
      - .11 TIA-1005 telecommunications infrastructure standard for industrial premises
      - .12 TIA-1152 requirements for field test instruments and measurements for balanced twisted-pair cabling

- .13 TIA-TSB-62 informative test methods (ITMS) for fiber-optic fibers, cables opto-electronic sources and detectors, sensors, connecting and terminating devices and other fiber-optic components
- .14 TIA-TSB-130 generic guidelines for connectorized polarization maintaining fiber and polarizing fiber cable assemblies for use in telecommunications applications
- .15 TIA-TSB-162 telecommunications cabling guidelines for wireless access points
- .16 TIA-TSB-184 guidelines for supporting power delivery over balanced twisted-pair cabling
- .17 TIA-TSB-190 guidelines on shared pathways and shared sheaths
- .3 Building Industry Consulting Services International (BICSI) ([www.bicsi.com](http://www.bicsi.com))
  - .1 ANSI/BICSI 002-2014, Data Center Design and Implementation Best Practices
  - .2 ANSI/NECA/BICSI-568-2006, Standard for Installing Commercial Building Telecommunications Cabling
  - .3 NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
  - .4 Telecommunications Distribution Methods Manual
- .4 International Electrical Testing Association Inc. ([www.netaworld.org](http://www.netaworld.org))

### 1.3

#### **DEFINITIONS**

- .1 Accept the following definitions of terms used within this document
  - .1 Approved sole equivalent. A single Product proposed by the Bidder to displace a named Product as being beneficial to the Contract and which has been reviewed and accepted by the Owner as suitable and acceptable as the only substitute to the named Product.
  - .2 Sole manufacturer: One only manufacturer of indicated Products to the exclusion of all other manufacturers.

### 1.4

#### **ABBREVIATIONS**

- .1 Not specified

### 1.5

#### **SYSTEM DESCRIPTIONS**

- .1 Structured Cabling – Outside Plant
  - .1 Extensions of existing outside plant facilities to new locations in doors.
  - .2 Interception, modification, expansion and improvements to existing incoming carrier pathways where previous pathways exist.
- .2 Structured Cabling – Architecture
  - .1 Organized system of information systems extra low voltage power limited copper cabling arrayed as individual communications channels between end point device connections.
  - .2 Communications channels indicated as *network channels* to operate at 1 Gbps data transfer rate consisting of 8 conductor small gauge copper conductors

- arranged as four-independently twisted pairs in a common unshielded flame spread rated plastic sheath.
- .3 Organized systems of information systems extra low energy optical fibre cabling arrayed as individual communications channels between end point device connections.
  - .4 Communications channels indicated as *network channels* to operate at up to 10 Gbps consisting of two strands of multimode optical fibre in a common sheath sometimes shared with other like fibre strands.
  - .5 Network subscribing field devices arrayed in the work area each attached to a network channel outlet jack by work area equipment patch cord.
  - .6 Network energizing equipment aggregated in centrally located telecommunications spaces.
  - .7 Network energizing equipment attached to network channels by equipment patch cords.
  - .8 Network terminations aggregated on common rack mounted patch panels in centrally located telecommunications spaces.
  - .9 Work area network outlet terminations mounted on work area faceplates individually, or shared with other like outlet terminations.
  - .10 Work area network outlets mounted on faceplates mounted on furniture outlet mounts, electrical conduit wall and surface mounted enclosures.
  - .11 Network channels terminated at each end with a connector firmly attached to the fabric of the premises or firmly attached to a faceplate within furniture and fixed to the premises.
- .3 Communications Pathways
- .1 Comply with TIA 569.
  - .2 Avoid exceeding cable pathway occupancy density of 40% measured by cross section area. Report to the Consultant occurrences where occupancy density exceeds 40% in cable trays or cable runways or optical fibre overhead raceways.
  - .3 Communications pathway infrastructure complying with this document and Division 26 of this Specification.
  - .4 Cables fully enclosed by continuous conduits or continuous cable tray or optical fibre containment raceways or within electrical utility rooms or combination to achieve a fully protected cable distribution system.
  - .5 Optical fibres in medium to large telecommunications rooms or communications equipment rooms in dedicated fibre management raceways with controlled cable entry and descent pathways.
  - .6 Optical fibre cables in cable trays protected by flexible thin wall non-metallic electrical inner duct conduit.
  - .7 Optical fibre cables exposed in cable tray in airborne oil environments installed in protective flexible liquid tight conduit.
  - .8 Communications pathways supplemented with multi-cell pre-lubricated flexible cloth detectable innerduct.
  - .9 Route diversity established by use of two separate and distinct conduits or cable trays or combination within 50 m of distribution point.

- .4 Communications Equipment Room Fittings
  - .1 General
    - .1 Entrance protection devices to reduce damage due to overvoltage and over-current conditions on exposed cabling.
    - .2 Communications cabinets racks, frames and enclosures and overhead supporting structures and associated components.
    - .3 Cabling termination blocks, patch panels, as components of a structured cabling installation.
    - .4 Runway mounted cable management systems.
    - .5 Termination blocks for multi-pair copper cables.
    - .6 Patch panels for 4-pair copper UTP network distribution cables.
    - .7 Termination panels for optical fibre cabling.
    - .8 Rack mounted cable management systems.
  - .2 Cabinets racks, frames and enclosures
    - .1 Cabinets, racks, frames and enclosures as secure and managed spaces to support structured cabling components and network energizing equipment communications equipment, computer equipment, communication cabling terminations and power distribution strips, bars and accessories including inside mounting rails, vertical cable management accessories, air exhaust chimney, doors, side panels, air dams, door locks, with grounding bar securing and bracing brackets all by a sole manufacturer.
    - .2 Communications rack mounted power distribution, protection and power strips.
  - .3 Air management and containment systems
    - .1 Overhead supported air management system of panels and supports and doors as supplement to equipment cabinets to create hot / cold air containment system.
  - .4 Copper medium termination blocks
    - .1 Termination blocks and patch panels for structured cabling systems manufactured by a sole vendor furnished under a single manufacturer's warranty.
  - .5 IDC termination blocks and patch panels
    - .1 IDC termination blocks
      - .1 Wall or backboard mounted insulation displacement wire termination strips in multiples of fifty pins (twenty-five pair) per strip, for 22-26 AWG conductor, inserted in wall mounted panels in assemblies of increments of 300 pairs, in "110" or "BIX" format as indicated; wall or backboard mounted wire management rings, troughs and accessories to match

- .2 Communications patch panels
  - .1 Panels mounted on flat vertical surfaces, or rails within racks or frames supporting individual or modules of multiple cable terminations
  - .2 Panels supporting individual cable termination jacks
  - .3 Panels supporting cassettes of pre-terminated cable jacks
  - .4 Panels supporting individual optical fibre termination connectors
  - .5 Panels supporting cassettes of preterminated optical fibre connectors
- .6 Communications cable management and ladder racking
  - .1 Rack mounted lateral cable retention strips; vertical rack mounted cable troughs; to retain and manage cables within a rack or enclosure.
  - .2 Cable runway supported overhead as open pathway for communications cabling and as support for cable, cable patch panels and power distribution conduits.
  - .3 Cable raceway supported overhead as protected covered pathway for optical fibre cabling, patch cables, providing support and escort into communications racks.
- .7 Communications distributed enclosures
  - .1 Custom surface mounted enclosures to accommodate DIN rail mounted cabling terminations and DIN rail mounted network energizing equipment including DIN rail cabling termination blocks, patch panels, as components of a structured cabling installation, DIN rail mounted termination panels for optical fibre cabling, DIN rail rack mounted cable management systems. Components to support structured cabling components and network energizing equipment.
  - .2 Overhead ladder racking cable runway support including fittings, structural supports, braces, rods and brackets necessary for suspension, attachment or support of communications cabinets, racks, frames and enclosures. Cable management guides and retainers, support brackets, section joining elements, horizontal bends, vertical inside/outside bends, wall support brackets, and ground bonding links all by a sole manufacturer.
  - .3 Rack mounted power distribution and power protection strips for in-rack power distribution, monitoring and control. Mounted vertically and horizontally.
- .5 Communications Copper Backbone Cabling
  - .1 Multi-pair copper pair cabling installed between termination panels within premises and between premises of common owner.
    - .1 Applications
      - .1 Voice frequency band telemetry
      - .2 Voice communications
      - .3 Data network 10 Mbps -100 Mbps,
    - .2 Exposed copper backbone cable protect against overvoltage conditions.

- .6 Communications Copper Backbone Terminations
  - .1 Multipair termination strips, wall or panel or surface mounted.
- .7 Communications Optical Fibre Cabling
  - .1 Multi-strand optical fibre cable.
    - .1 Multi-strand optical fibre of various types as indicated in the contract drawings.
    - .2 Multi-strand optical fibre cables to suit environmental conditions including
      - .1 Physical environments including
        - .1 Indoor,
        - .2 Indoor/outdoor, and
        - .3 Outdoor
      - .2 Chemical / Climate conditions including
        - .1 Indoor – dry
        - .2 Indoor – damp
        - .3 Outdoor – damp
    - .3 Multi-strand optical fibre cables of various forms of construction including combinations of OFNP, OFNR, OFNG, loose tube, loose tube with water blocking barrier, tight buffer, tight buffer with water blocking barrier, steel armour, aluminum armour, steel armour with plastic outer jacket, aluminum armour with plastic outer jacket.
    - .4 Multi-strand field terminated and pre-terminated single mode and multimode optical fibre cable assemblies installed between termination panels within premises and between premises of common owner in support of the following applications:
      - .1 Data networking Ethernet: 1 Gbs, 10 Gbs,
      - .2 Data networking carrier: OC-3, OC-12, OC-48, OC-192
- .8 Communications Optical Fibre Terminations
  - .1 Multi-strand optical fibre terminations and couplers
    - .1 Optical fibre terminations of various types as indicated in the Contract Drawings.
    - .2 Factory terminated factory polished cable multi strand assemblies.
    - .3 Field terminated factory polished mechanical attached single strand connectors.
    - .4 Optical fibre termination adapters.
    - .5 Optical fibre field splicing tray and cassettes.
    - .6 Optical fibre rack mounting accessories.
    - .7 Optical fibre fan out cassettes.
- .9 Communications Optical Fibre Termination Enclosures
  - .1 Rack or wall or surface mounted enclosures or trays to accommodate optical fibre terminations, splice trays, and cable loops

- .2 Accommodation for connector mounting faceplate adapter panels.
- .10 Communications Horizontal Distribution Cabling
  - .1 Four-pair shielded or unshielded copper cabling installed between termination panels and work area outlet in support of the following applications:
    - .1 Voice frequency band telemetry.
    - .2 Voice communications.
    - .3 Data network 10 Mbps, 100 Mbps, 1 Gbps, 10 Gps.
    - .4 Elevator communications intercom.
  - .2 Multiple conductor cabling installed between termination panels or field devices and other field devices in support of the following applications:
    - .1 Building management systems.
    - .2 Premises security systems.
    - .3 Premises access and gate controls.
  - .3 Modular connectors as terminations of horizontal distribution cables.
  - .4 Multi-strand single mode or multimode field terminated or pre-terminated optical fibre cable installed between termination panels and work area terminations in support of the following applications:
    - .1 Data networking Ethernet: 1 Gbs, 10 Gbs, 40 Gpbs, 100 Gbps.
  - .5 Coaxial cables installed between termination panels and work area terminations in support of the following applications:
    - .1 Radio antenna connections.
  - .6 Single pair copper cabling installed between termination panels and field devices in support of the following applications:
    - .1 Public address speaker distribution.
- .11 Work Area Faceplate
  - .1 Modular faceplate adapter for mounting on conduit box enclosures to mount single or multiple fixed or modular work area outlets for copper or optical fibre horizontal distribution cables and for audio / visual cable terminations.
- .12 Communications Connecting Cords, Devices, and Adapters
  - .1 Network cords installed between devices and cabling terminations to form or complete a communications channel:
    - .1 Copper medium
      - .1 Copper four-pair, unshielded patch cords of various lengths and colour
    - .2 Optical medium
      - .1 Optical fibre two-strand optical fibre single and multi-mode patch cords of various lengths; duplex LC to duplex LC connector polarity field adjustable A-A and A-B
      - .2 Optical fibre twelve-strand, single mode and multi-mode patch cords of various length



- .3 Common cord for configuration of 40-GBASE channels using either Method A and Method B or a combination of cabling arrangements compliant with TIA-568-C.0 by manual and non-intervention manipulation of in-field setting of connector pinning polarity and key polarity without need of tools
- .13 Antennas Communications Horizontal Cabling
  - .1 Network wireless access points
    - .1 Horizontal distribution cabling connection from wireless access point to network active device in telecommunications room or enclosure.
    - .2 Wireless access point
      - .1 Comply with Section 27 20 00
- 1.6 **SHOP DRAWINGS SUBMITTALS**
  - .1 General Instructions
    - .1 Comply with Specification Section 01 33 00.
    - .2 Shop Drawings issued and reviewed before construction.
    - .3 Retain the services of a person accredited by BICSI as a Registered Communications Distribution Designer (RCDD) to review and stamp shop drawings submitted under this division of work to attest to compliance with contract specifications.
  - .2 Shop Drawings
    - .1 Submit Shop Drawings for field installations
      - .1 Telecommunications rack equipment elevations for telecommunications rooms, data centre, and AV systems indicating outlet placement and identification of cable terminations by type and by administration labels.
      - .2 Wall elevations for telecommunications rooms, data centre, AV equipment spaces.
      - .3 Wall elevations and floor layout for carrier entrance rooms.
      - .4 Spreadsheet file indicating location on patchpanel the termination of backbone cables and cabling with terminations in the equipment server room and telecom rooms.
    - .2 Submit Shop Drawings for communications systems Products
      - .1 Cables and connectors.
      - .2 Termination panels, patch panels, termination blocks.
      - .3 Work area faceplates and outlet connectors.
      - .4 Manufactured items.
      - .5 Enclosures and panels.
      - .6 Cable runway and racking.
      - .7 Optical fibre raceway systems and accessories
      - .8 Cable management accessories.
    - .3 Submit Shop Drawings to justify and explain proposed deviations from the design depicted in the Contract Documents.

- .4 Submit Shop Drawings for manufactured assemblies
  - .1 Telecommunications industrial wall mount enclosures.
  - .2 Overhead heat containment baffles.
- .3 Samples
  - .1 Submit test results of cable samples.
  - .2 Comply with Specification Section 27 08 00.
- .4 Manufacturer's Field Reports
  - .1 Provide manufacturer's representative to prepare pre-installation report on communications cabling infrastructure as pre-construction condition in support of manufacturer's warranty. Submit copy of report for Owner's review four weeks before installation commences.
  - .2 Obtain statement from manufacturer attesting to fulfillment of terms of manufacturer's warranty. Submit copy of statement for Owner's review four weeks before installation commences.
  - .3 Provide services of manufacturer's representative to conduct periodic site reviews and prepare summary reports of work in progress. Submit each report for Owner's review within two days of observation on site.
- .5 Close Out Submittals
  - .1 Comply with Section 01 10 00.
  - .2 Submit as-constructed drawings indicating any deviation of cabling, cable administration, and routing from as shown on Contract Drawings.

1.7

**QUALITY ASSURANCE**

- .1 Qualifications
  - .1 Comply with requirements of Section 27 05 00.
- .2 Certifications
  - .1 Comply with requirements of Section 27 05 00.
- .3 Field Samples
  - .1 Provide minimum of one field sample of each colour and type of component for use in the Work. Submit samples for Owner's review with sufficient lead time to allow modification of Product at Owner's discretion and with a minimum of two weeks before commencement of installation.
  - .2 Provide representative sample of factory manufactured cable assemblies. Submit samples for Owner's review with sufficient lead time to allow modification of Product at Owner's discretion.
- .4 Pre-Installation Meetings
  - .1 Arrange for and attend pre-installation design and construction meetings. Attendees at meetings to include site work supervisor and technical design supervisor.
    - .1 Minimum of one meeting to review the Contract scope of work.
    - .2 Minimum of one meeting to review the proposed execution of the work.

- .5 Site Meetings
  - .1 Arrange for and attend construction progress meetings. Attendees at meetings to include site work supervisor and technical design supervisor.
    - .1 Minimum of two site meetings per month commencing on day of mobilization and running until four weeks after site work completion.
- 1.8 **DELIVERY, SHIPPING, HANDLING AND UNLOADING**
  - .1 Acceptance at Site
    - .1 Examine Products delivered to site.
    - .2 Reject Products that appear damaged or unfit for use.
    - .3 Verify quality of components. Comply with requirements of Section 27 08 00.
  - .2 Storage and Disposal
    - .1 Maintain a sufficient supply of components to execute and complete the Work.
    - .2 Store and protect the supply of components against loss or damage.
    - .3 Make good losses or damages without penalty to the Owner.
    - .4 Comply with conditions of site housekeeping and waste removal in the Specifications.
- 1.9 **WARRANTY**
  - .1 General Terms
    - .1 Provide best warranty available from component vendor; provide as a minimum a warranty as described in the Project Specifications.
    - .2 Perform the Work according to the terms dictated by the manufacturer to obtain the best warranty offered by the manufacturer.
    - .3 Submit the manufacturer's warranty declaration to the Owner.
    - .4 Arrange for the Owner to receive documents to support the manufacturer's extended warranty.
- 1.10 **COMMISSIONING**
  - .1 Execute testing and compliance measurements to comply with Section 27 08 00.
  - .2 Submit results to the Owner for review.
- 1.11 **MAINTENANCE**
  - .1 Clean and inspect all optical fibre connections before handing over the installation.
  - .2 Provide inspection reports including photographic images of all optical fibre terminations optical mating surfaces.
- 2 Products
- 2.1 **MANUFACTURERS**
  - .1 Manufacturers – General
    - .1 Manufacturers - Stipulated
      - .1 Products by stipulated manufacturer or manufacturers where identified on the contract drawings without substitution.

- .2 Manufacturers – Equal
  - .1 Products by manufacturer or manufacturers where manufacturer's products are approved as equal and as acceptable substitution expressly by the Owner or Owner's appointed representative.
- .3 Manufacturers- Equivalent
  - .1 Products by manufacturer or manufacturers where manufacturer's products are functionally and materially identical or superior to the specified product.
  - .2 Proof or evidence of equivalence submitted on demand by the Owner.
  - .3 Contractor accepts financial and temporal risks on failure of products to meet conditions of equivalency determined at the sole discretion of the Owner or the Owner's appointed representative.
- .4 Manufacturers - Voluntary
  - .1 In absence of an indicated manufacturer, a sole manufacturer in common with manufacturer of specified copper cabling components.
  - .2 In absence of an indicated manufacturer or manufacturer of specified copper cabling products, a sole manufacturer selected from list of recognized manufacturers listed by class of product.
- .5 Manufacturers – Recognized
  - .1 Manufacturers identified in the sections below by class of product.
- .6 Manufacturers - Substitution
  - .1 Acceptable as substitution of products by a sole manufacturer are products supplied by a business joint venture between a cable manufacturer and component manufacturer represented by either party as a sole provider and furnished under a single manufacturer's warranty where such substitution is of demonstrable material or performance benefit to the Owner. Substitution conditional on express approval by the Owner or Owner representative.
- .2 Communications Equipment Room Fittings
  - .1 Equipment racks – floor mounted
    - .1 Hammond
  - .2 Equipment frames – floor mounted
    - .1 Not specified
  - .3 Equipment cabinets – surface mount
    - .1 Hammond
  - .4 Industrial enclosures – surface mount
    - .1 Hammond
  - .5 Power distribution strips
    - .1 Liebert
  - .6 Termination blocks and patch panels
    - .1 Copper cabling termination blocks

- .1 Belden – BIX series
- .2 Copper cabling patch panels
  - .1 Panduit
- .3 Optical fibre cabling system components
  - .1 Comply with 271000.1
- .7 Overhead cable runway and accessories
  - .1 Chatsworth Products Inc.
  - .2 Cooper Industries
  - .3 Middle Atlantic
- .3 Communications Optical Fiber Cabling
  - .1 Sole manufacturer
    - .1 Optical fibre cabling of double- or multi- strand, single mode or multimode, field terminated or pre-terminated, panel mounted coupling connectors, termination panels, pre-terminated cable assemblies, work area patch cables, telecommunications room equipment patch cables, by a sole manufacturer of optical fibre products.
    - .2 Termination housings and enclosures, work area outlet, work area outlet faceplate compatible with optical fibre products
  - .2 Manufacturers
    - .1 Optical fibre cables, terminations and accessories
      - .1 Corning Cabling
    - .2 Comply with 271000.1
- .4 Communications Copper Backbone Cabling
  - .1 Sole manufacturer
    - .1 Sole manufacturer in common with copper distribution cabling and cabling components
  - .2 Manufacturers
    - .1 Copper – single pair
      - .1 Copper conductor 12 ga to 20 ga insulated to 300 V
        - .1 Comply with Division 26
    - .2 Copper – multiple conductor non-pair
      - .1 Copper conductors 12 ga to 24 ga insulated to 300 V
        - .1 Comply with Division 26
    - .3 Copper – multi pair, with pair count greater than four.
      - .1 General Cable
      - .2 Belden
      - .3 Comply with 271000.1

- .5 Communications Coaxial Cabling
  - .1 Manufacturers
    - .1 Match to existing
- .6 Communications Coaxial Splicing and Terminations
  - .1 Coaxial cable terminations, patch panels
    - .1 Panduit
- .7 Audio-Video Communications Cabling
  - .1 Shielded pair and multi pair
    - .1 Belden
- .8 Paging Communications Cabling
  - .1 Copper one pair 10 ga to 20 ga, insulated 300V
    - .1 Product and manufacturer
      - .1 Not specified
- .9 Antennas Communications Cabling
  - .1 Coaxial type, multi conductor, pre-terminated and connectorized
    - .1 Match to existing
  - .2 Wireless access points cabling and accessories
    - .1 Horizontal cabling to comply with section on communications copper distribution cabling
- .10 Communications Copper Distribution Cabling
  - .1 Copper category four-pair unshielded cable, panel mounted connectors, termination panels, pre-terminated cable assemblies, work area outlet, work area outlet faceplate, work area patch cables, telecommunications room equipment patch cables, all products by a sole manufacturer
    - .1 Manufacturers
      - .1 General Cable
      - .2 Comply with 271000.1
- .11 Communications Faceplates and Connectors
  - .1 Wall faceplates
    - .1 Same manufacturer as specified for horizontal data cabling.
  - .2 Furniture adapter faceplates, system furniture adapters, modular furniture adapters
    - .1 Same manufacturer as specified for modular and systems furniture.
- .12 Communications Connecting Cords, Devices, and Adapters
  - .1 Communications copper patch cords
    - .1 Same manufacturer as specified for copper distribution cabling.

- .2 Communications optical fibre patch cords
  - .1 Same manufacturer as specified for optical fibre distribution or backbone cabling.

## 2.2 **COMPONENTS**

- .1 Communications Equipment Room Fittings
  - .1 Communications cabinets racks frames and enclosures
    - .1 General
      - .1 Cabinets, racks, frames and equipment enclosures consisting of equipment cabinets, inside mounting rails, inside power distribution strips, vertical cable management accessories, air exhaust chimney, doors, side panels, air dams, door locks, securing and bracing brackets all by a sole manufacturer
      - .2 Wall mounted optical fibre termination enclosures
      - .3 Grounding bar and grounding jumpers installed in each
        - .1 Wall mounted open frame
        - .2 Communications cabinet enclosure or
        - .3 Any other form of equipment enclosure
    - .2 Wall, pole and surface mount industrial enclosures
      - .1 Provide enclosure of Type ID indicated on Contract Drawings
      - .2 Comply with 271000.1
    - .3 Network communications / server cabinet enclosure
      - .1 General
        - .1 Provide cabinet enclosure equipment rack of Type ID indicated on drawings possessing characteristics drawn from table below for same Type ID.
        - .2 Comply with 271000.1.
        - .3 Communications floor mounted free standing cabinet for mounting network equipment and cabling terminations on 483 mm panels.
        - .4 Frame grounding lug to CAN/CSA C22.1; grounding connection to frame from grounding lugs on removable elements.
      - .2 Cabinet fixtures
        - .1 Quick release removable side panels; Solid roof plate secured to prevent removal from outside the cabinet.
      - .3 Door style
        - .1 Two sets keys milled to Owner specified combination.
        - .2 Single front ventilated door with reversible hang and
        - .3 Split rear ventilated doors;

- .4 Quick release hinges; opening range greater than 180 degrees;
- .5 Effective ventilation ratio of 85% by area for front, rear and roof;
- .6 Frame grounding lug to CAN/CSA C22.1; grounding connection to frame from grounding lugs on removable elements.
- .7 Metal parts powder coat painted otherwise chrome or cadmium plated.
- .8 Colour: Industrial light grey (RGB 215-215-215) RAL 7035.
- .9 Flammability of plastic components to UL94V-1.
- .10 Safety to IEC 60950.
- .4 Door lock
  - .1 Keyed lock on front and rear keyed alike to side panel release;
  - .2 Two sets keys milled to Owner specified combination.
- .5 Cabinet accessories
  - .1 Levelling feet; four casters.
  - .2 Vertical mounting rails adjustable without use of tools; Front and side mounting flange surface vertical mounting rails machine threaded 10-32 at spacing to EIA-310
  - .3 Front and rear equipment mounting rails adjustable forward and backward for front and optional rear support; minimum setback of 75 mm from inside surface of front door, minimum offset of 38 mm between side rails and side panels; calibrated and marked in units of 44.45 mm.
  - .4 Kit of sixty captive insert cage nuts M6 with washers and mounting bolts.
- .6 Air management
  - .1 Front panel blanking kit; plastic front mounting panels, full height in 1RU increments, black plastic
- .7 Instrumentation
  - .1 SNMP/Ethernet/IP monitor module to measure, report and alarm on open door, high temperature.
  - .2 Mounting for intrusion detector alarm switch.
  - .3 Door open detector switch on front and rear doors.
- .8 Server cabinets attributes
  - .1 Provide cabinets indicated as "SERVER" with components possessing the following change of attributes



- .2 Change: Vertical mounting rails machine threaded 10-32 at spacing to EIA-310  
Replace with: Vertical mounting rails surface square punched at spacing to EIA-310;
- .3 Kit of sixty captive insert cage nuts M6 with washers and mounting bolts.
- .4 Cable management channel - inrack
  - .1 Four vertical cable management channels within equipment enclosures and outside equipment space
  - .2 Inside cable openings of 75 mm diameter minimum and outside cable openings of minimum two 100 mm x 100 mm and three 100 mm x 200 mm openings fitted with grommets on each side.
- .2 Products
  - .1 Provide Products indicated in table below corresponding to Type ID and approved manufacturer.
  - .2 Provide approved equivalent.

Table 1 - Network Communications Cabinet Enclosure – By Properties

Type ID	IP rating	NEMA	Rail width	Width	Depth	RU
E751-44	IP21	1	483mm"	762mm	1067mm	44

Table 2 - Network Communications Cabinet Enclosures - By Manufacturer

Type ID	HP	Panduit	Rittal	WrightLine
E751-44				Paramount-44

- .5 Cable management side plenum chaseway
  - .1 Verical metallic chaseway to complement network rack, side mounted

Table 3 - Enclosure Side Plenum Chase - By Properties

Type ID	IP rating	NEMA	Width	Depth	RU
EC032-44	IP21	1	300mm12in	914mm	44

Table 4 - Enclosure Chase Side Plenum - By Manufacturer

Type ID	HP	Panduit	Rittal	WrightLine
EC032-44				Paramount side cable chase 44RU x 12 x 42

- .6 Rack grounding bar
  - .1 General
    - .1 Grounding bar kit, rack mounted, 483 mm long, tin plated, predrilled to accept twenty thread forming installed 12-24 screws spaced at 15.9 mm, two cage nut bonding screws, four bonding nuts, to C22.2 No 41-13, UL 467, EIA-310.
    - .2 Two bolt grounding jumper kit, #6 AWG ground bonding conductor, compression lug terminated one end.
  - .2 Product
    - .1 Panduit RGRB19CN

- .7 Optical fibre enclosures-Interior
  - .1 Wall or surface mount metallic enclosures identified by Type ID below
  - .2 Accommodate optical fibre termination connector couplers, splice tray, loop storage
  - .3 Provide all accessories to complete fibre splice and connector terminations
  - .4 Swing door, exterior door lock
  - .5 IP / NEMA ratings
    - .1 NEMA 1
  - .6 Independent compartments for optional patch cords
  - .7 Accommodate splice trays by same or other manufacturer
  - .8 Accommodate coupler connectors by same or other manufacturer
  - .9 Styles with capacities of
    - .1 12 to 192 LC terminations in increments of 12
    - .2 Inline splice trays
  - .10 Accessories
    - .1 Splice tray with heatshrink splice protectors
    - .2 Coupler mounting plates
  - .11 Products
    - .1 Products and fibre splice & connector accessories by sole manufacturer
    - .2 Approved Product by sole manufacturer of optical fibre cabling system products.
    - .3 Approved manufacturer identified on contract drawings.
- .8 Optical fibre enclosures – interior/exterior
  - .1 Wall or surface mount metallic enclosures identified by Type ID below
  - .2 Stainless steel construction
  - .3 Accommodate optical fibre termination connector couplers, splice tray, loop storage
  - .4 Provide all accessories to complete fibre splice and connector terminations
  - .5 Swing door, exterior door lock
  - .6 IP / NEMA ratings
    - .1 NEMA 4X
  - .7 Accommodate splice trays by sole manufacturer
  - .8 Styles with capacities of
    - .1 144 inline splices connections

- .9 Accessories
  - .1 Splice tray with heatshrink splice protectors
- .10 Products
  - .1 Products and fibre splice & connector accessories by sole manufacturer
  - .2 Approved Product by sole manufacturer of optical fibre cabling system products.
  - .3 Approved manufacturer identified on contract drawings.

Table 5 - Fibre Splice Enclosures - By Properties

Type ID	Environment	Termination type	Patch cord compartment	Capacity	Rating	Size
OFSE-12	Interior	Splice/coupler	Yes	12	NEMA 1	279 x 330 x 64
OFSE-24	Interior	Splice/coupler	Yes	24	NEMA 1	279 x 330 x 64
OFSE-48	Interior	Splice/coupler	Yes	48	NEMA 1	279 x 330 x 108
OFSE-96	Interior	Splice/coupler	Yes	96	NEMA 1	279 x 330 x 152
OFSE-144E	Interior / exterior	Inline splice	None	144	NEMA 4X	472 x 422 x 262

Table 6 - Fibre Splice Enclosure - By Manufacturer

Type ID	Corning	Commscope		
OFSE-12		WBE-EMT-BK/1P		
OFSE-24		WBE-EMT-BK/2P		
OFSE-48		WBE-EMT-BK/4P		
OFSE-96		WBE-EMT-BK/8P		
OFSE-144E	SSEDC			

- .2 Communications Terminal Blocks, Terminations, Connectors and Patch Panels
  - .1 Copper paired cables termination block strips
    - .1 Termination of unshielded twisted pair copper multipair cables.
    - .2 Termination blocks as fixed wall or surface or rack mounted terminations of backbone or distribution cabling.
    - .3 Insulation displacement terminations for solid copper conductors between 24 AWG – 20 AWG.
    - .4 Termination of shielded twisted pair copper multipair cables with grounding bar.
    - .5 Termination strips or wafers panel mounted in groups of fifty through three hundred terminations in increments of fifty.
    - .6 Strips in industry format “110” type or “BIX” type.
    - .7 Flat wall mount panels for support of multiple BIX wafers; panels in multiples of 250 or 300 terminations; cable dressing spacers between adjacent panels.
    - .8 Flat wall mount support for single or multiple 110 type strips.

.9 Match performance of termination block to performance of cable being terminated.

Table 7 - Termination Block Strips - By Properties

Type ID	U/S	Category	Form	Pin	Ground
B11	U/UTP	1	110	50	
B12	U/UTP	3	110	50	
B13	U/UTP	5e	110	50	
B14	U/UTP	6	110	50	
B15	U/UTP	6A	110	50	
B21	U/UTP	1	BIX	50	
B22	U/UTP	3	BIX	50	
B23	U/UTP	5e	BIX	50	
B24	U/UTP	6	BIX	50	
B25	U/UTP	6A	BIX	50	
B31	S/UTP	1	110	50	Ground
B32	S/UTP	3	110	50	Ground
B33	S/UTP	5e	110	50	Ground
B34	S/UTP	6	110	50	Ground
B35	S/UTP	6A	110	50	Ground
B41	S/UTP	1	BIX	50	Ground
B42	S/UTP	3	BIX	50	Ground
B43	S/UTP	5e	BIX	50	Ground
B44	S/UTP	6	BIX	50	Ground
B45	S/UTP	6A	BIX	50	Ground

Table 8 - Termination Block Strips - By Manufacturer

	Belden	Commscope	Panduit		
B23					
B43					

Table 9 - Vacant (Non-populated) Communications Patch Panel

Type ID	RU	Capacity	F/A/R/W	SNAP IN	Grounding	
V12W1M	1	12	Wall	Module		
V12W6F	1	12	Wall	Faceplate-4		
V24F1	1	24	Flat	Module		
V24F1S	1	24	Flat	Module	Yes	
V24A1	1	24	Angled	Module		
V24A1S	1	24	Angled	Module	Yes	
V24R1	1	24	Recessed	Module		
V24R1S	1	24	Recessed	Module	Yes	
V48F1	2	48	Flat	Module		
V48F1S	2	48	Flat	Module	Yes	
V48A1	2	48	Angled	Module		
V48A1S	2	48	Angled	Module	Yes	
V48R1	2	48	Recessed	Module		
V48R1S	2	48	Recessed	Module	Yes	

V72F1	2	72	Flat	Module		
V72F1S	2	72	Flat	Module	Yes	
V72A1	2	72	Angled	Module		
V72A1S	2	72	Angled	Module	Yes	
V72R1	2	72	Recessed	Module		
V72R1S	2	72	Recessed	Module	Yes	
V24F4	1	24	Flat	Faceplate-4		
V24A4	1	24	Angled	Faceplate-4		
V24R4	1	24	Recessed	Faceplate-4		
V24F6	1	24	Flat	Faceplate-6		
V24A6	1	24	Angled	Faceplate-6		
V24R6	1	24	Recessed	Faceplate-6		
V48F4	2	48	Flat	Faceplate-4		
V48A4	2	48	Angled	Faceplate-4		
V48R4	2	48	Recessed	Faceplate-4		
V48F6	2	48	Flat	Faceplate-6		
V48A6	2	48	Angled	Faceplate-6		
V48R6	2	48	Recessed	Faceplate-6		

Table 10 - Vacant Patch Panel - By Manufacturer

Type ID					Panduit	
V12W1M						
V12W6F						
V24F1						
V24F1S						
V24A1						
V24A1S						
V24R1						
V24R1S						
V48F1						
V48F1S						
V48A1						
V48A1S						
V48R1						
V48R1S						
V72F1						
V72F1S						
V72A1						
V72A1S						
V72R1						
V72R1S						

V24F4					CPP24WBLY	
V24A4						
V24R4						
V24F6						
V24A6						
V24R6						
V48F4					CPP48WBLY	
V48A4						
V48R4						
V48F6						
V48A6						
V48R6						

.2 UTP 4-pair cable termination rack mount patch panels

.1 Patch panels consisting of multiple single position 8P8C (RJ45) jacks or six-position modules of preformed 8P8C (RJ45) jacks, 22-26 AWG IDC connection block for solid or stranded wire to TIA 568B pinning, panel format with lands for individual port identification labels and panel identification label, forming panels of twelve, twenty-four, or forty-eight or seventy-two ports per panel. Cable retention bar and back-of-panel cable support and strain relief bracket to secure cable perpendicular to panel; colour: Black.

.2 Products

.1 Products of the type ID indicated on the Contract Drawings and manufactured by approved manufacturer listed in the table following.

Table 11 - Termination Patch Panels - UTP 8P8C - By Properties

Type ID	Category	U/F/S	Port	RU			
P25	6A	UTP	24	1	Flat		

Table 12 - Termination Patch Panels - UTP 8P8C - By Manufacturer

Type ID	Panduit	Commscope	Tyco	Belden		
P25	DP246X88TGY			AX103254		

.3 UTP 25 pair cable termination rack mount patch panels

.1 Patch panels consisting of twelve or twenty-four single position 8P2C RJ45 jacks pins 4-5 active RJ21 connector panel format with lands for individual port identification labels and panel identification label, colour: Black.

.2 Products

.1 Provide Products of the type ID indicated on the Contract Drawings and manufactured by approved manufacturer listed in the table following.

Table 13 - Termination Patch Panels UTP 8P2C - By Properties

Type ID	Category	U/F/S	Port	RU	Face	Term
V11	1	UTP	12	1	Flat	RJ21
V21	1	UTP	24	1	Flat	RJ21

Table 14 - Termination Patch Panels UTP 8P2C - By Manufacturer

Type ID	Panduit				
V11					
V21	VP24382TV25Y				

.4 Copper medium jacks

.1 UTP and STP 2-pair 4P4C jack – non-keyed

.1 Modular plastic formed telecommunications four-pin four-conductor outlet jack non-keyed, comply with ANSI/TIA/EIA 568 specification and CSA T529, compatible with flush- and surface-mount telecommunications outlet faceplates, modular furniture faceplate adapters, utility service pole adapter plates, floor box adapter plates, conduit poke-through adapter plates for termination of unshielded and shielded twisted pair cables.

.2 Colour: Black or as indicated on the drawings.

Table 15 - Termination Jacks UTP 4P4C - By Properties

Type ID	Category	Pair	Form
J11	1	2	UTP
J12	3	2	UTP
J13	5e	2	UTP
J14	6	2	UTP
J15	6A	2	UTP

Table 16 - Termination Jacks STP 4P4C - By Properties

Type ID	Category	Pair	Form
J21	1	2	S/UTP
J22	3	2	S/UTP
J23	5e	2	S/UTP
J24	6	2	S/UTP
J25	6A	2	S/UTP

.3 Products

.1 Provide Products of the type ID indicated on the Contract Drawings and manufactured by approved manufacturer listed in the table following.

Table 17 - Termination Jacks 4P4C - By Manufacturer

Type ID	Belden	Panduit	
J14			
J15			

.2 UTP 4-Pair 8P8C (RJ45) modular jack – non-keyed

.1 Modular plastic formed telecommunications eight-pin eight-conductor (“RJ45”) outlet jack non-keyed, comply with ANSI/TIA/EIA 568 specification and CSA T529, compatible with flush- and surface-mount telecommunications outlet faceplates, modular furniture faceplate adapters, utility service pole adapter plates, floor box adapter plates, conduit poke-through adapter

plates, rack mount modular patch panels, with colour coded removable identification icon, built in modular cable strain relief for termination for shielded and unshielded twisted pair cables.

- .2 Colour: Black or as indicated on the drawings.

Table 18 - Termination Jacks 8P8C - By Properties

Type ID	Category	Pair	Form
J51	1	4	UTP
J52	3	4	UTP
J53	5e	4	UTP
J54	6	4	UTP
J55	6A	4	UTP

- .3 Products

- .1 Provide Products of the type ID indicated on the Contract Drawings and manufactured by approved manufacturer listed in the table following.

Table 19 - Termination Jacks 8P8C - By Manufacturer

Type ID	Belden	Panduit	
J54			
J64			

- .3 UTP 4-pair 8P8C (RJ45) modular jack – non-keyed – keystone format

- .1 Modular plastic formed telecommunications eight-pin eight-conductor (“RJ45”) outlet keystone jack non-keyed, comply with ANSI/TIA/EIA 568 specification and CSA T529, compatible with flush- and surface-mount telecommunications outlet faceplates, modular furniture faceplate adapters, utility service pole adapter plates, floor box adapter plates, conduit poke-through adapter plates, rack mount modular patch panels, with colour coded removable identification icon, for use with keystone jack.
- .2 Colour: Black or as indicated on the drawings.

Table 20 - Termination Jacks 8P8C Keystone - By Properties

Type ID	Category	Pair	Form
J81	1	4	UTP
J82	3	4	UTP
J83	5e	3	UTP
J84	6	4	UTP
J85	6A	4	UTP

- .3 Products

- .1 Provide Products of the type ID indicated on the Contract Drawings and manufactured by approved manufacturer listed in the table following.

- .2 Comply with 271000.1

- .5 Optical fibre termination connectors

- .1 Field installed discrete connectors as terminations for optical fibre strands in single or multi-stranded cable assemblies
  - .1 For installation on fibres of 250 micron, 900 micron tight buffer, 2 mm jacketed, 3 mm jacketed



- .2 Type LC, LC duplex, SC, SC duplex, and ST
- .3 Multimode OM1, OM2, OM3, OM4 performance: Insertion loss maximum 0.5 dB, typical 0.2 dB, return loss minimum 25 dB
- .4 Single mode OS1, OS2 connectors
  - .1 Finished to UPC (Ultra Physical Contact) with insertion loss maximum 0.5 dB, typical 0.3 dB, return loss minimum 50 dB
  - .2 Finished to APC (Angled Physical Contact) with insertion loss maximum 0.5 dB, typical 0.3 dB, return loss minimum 60 dB
- .2 Field fusion splice connector pigtail assemblies as terminations of single, dual and multi-stranded optical fibre cable assemblies
  - .1 For installation on fibres of 250 micron, 900 micron tight buffer, 2 mm jacketed, 3 mm jacketed
  - .2 Type LC, LC duplex, SC, SC duplex, and ST
  - .3 Multimode OM1, OM2, OM3, OM4 performance: Insertion loss maximum 0.5 dB, typical 0.2 dB, return loss minimum 25 dB
  - .4 Single mode OS1, OS2 connectors
    - .1 Finished to UPC (Ultra Physical Contact) with insertion loss maximum 0.5 dB, typical 0.3 dB, return loss minimum 50 dB
    - .2 Finished to APC (Angled Physical Contact) with insertion loss maximum 0.5 dB, typical 0.3 dB, return loss minimum 60 dB
  - .5 Single pigtails
    - .1 900 micron tight buffered
    - .2 2 mm and 3 mm zip interconnect cable
    - .3 LC terminated in kit of 12 TIA colour coded
  - .6 Duplex pigtail
    - .1 900 micron tight buffered
    - .2 2 mm and 3 mm zip interconnect cable
  - .7 Twelve-fibre ribbon pigtails formed and made ready to mass fusion terminate twelve strand ribbon
    - .1 Jacketed or not jacketed
    - .2 MPO terminated 250 micron loose
    - .3 LC terminated in kit of twelve TIA colour coded
  - .8 Products
    - .1 Provide Products of the type ID indicated on the Contract Drawings and manufactured by approved manufacturer listed in the table following.
    - .2 Comply with 271000.1

Table 21 - Optical Fibre Terminations - Multimode

Type	Strand	Perform	Mech/Fusion
TM011M-xx	1	OM1	M
TM012M-xx	1	OM2	M
TM013M-xx	1	OM3	M
TM014M-xx	1	OM4	M
TM011F-xx	1	OM1	F
TM012F-xx	1	OM2	F
TM013F-xx	1	OM3	F
TM014F-xx	1	OM4	F
TM121M-xx	12	OM1	M
TM122M-xx	12	OM2	M
TM123M-xx	12	OM3	M
TM124M-xx	12	OM4	M
TM121F-xx	12	OM1	F
TM122F-xx	12	OM2	F
TM123F-xx	12	OM3	F
TM124F-xx	12	OM4	F

Table 22 - Optical Fibre Terminations - Single Mode

Type	Strand	Perform	Mech/Fusion
TS011M-XX	1	OS1	M
TS012M-XX	1	OS2	M
TS011F-XX	1	OS1	F
TS012F-XX	1	OS2	F
TS121M-XX	12	OS1	M
TS122M-XX	12	OS2	M
TS121F-XX	12	OS1	F
TS122F-XX	12	OS2	F

Table 23 - Optical Fibre Termination Type Modifier

-xx	LC	SC	MPO	Duplex	AP
01	Yes				
02		Yes			
04			Yes		
09	Yes			Yes	
10		Yes		Yes	
11	Yes				Yes
24		Yes			Yes
26	Yes			Yes	Yes

- .1 Optical Fibre connector adapter mounting panel
  - .1 6-port, 12 port, LC duplex mounting panel
  - .2 Provide Products of the type ID indicated on the Contract Drawings and manufactured by approved manufacturer listed in the table following.
  - .3 Manufacturer
    - .1 Corning:

Table 24 - Optical Fibre Termination Mounting Adapter - By Feature

Type ID	Description	Fibre	Class	Face	Rear
OFMA-6-LD	6-port	12 strand	OM4	LC Duplex	LC Duplex

Table 25 - Optical Fibre Termination Mounting Adapter - By Manufacturer

Type ID	Corning			
OFMA-6-LD	CCH-CP12-E4			

- .2 Optical fibre termination cassette
  - .1 Not specified
- .3 Communications Cable Management and Ladder Rack
  - .1 Rack mounted cable management devices and accessories. High capacity cable managers for horizontal mounting in 483 mm racks, cabinets or frames, complete with removable dual hinged covers, cable management fingers, front and optional rear pathways, suitable for cables of diameter 8.0 mm, manufactured of plastic with optional removable covers of metal or plastic, channel depth greater than 150 mm, colour black
  - .2 Cable managers in modular units of one, two, three or four rack units.

Table 26 - Rack Mount Cable Management - By Properties

Type ID	RU	channel
M11	1	Front
M12	2	Front
M13	3	Front
M14	4	Front
M31	1	Front/rear
M32	2	Front/rear
M33	3	Front/rear
M44	4	Front/rear

- .1 Product
  - .1 Provide cable management accessories of type ID as shown on the Contract Drawings and of same manufacturer as communications terminations patch panels.

Table 27 - Rack Mount Cable Management - By Manufacturer

Type ID	Belden	Panduit	Commscope
M11			
M12		NMF1	
M13			
M14		NMF4	
M31			
M32			
M33			
M44			

- .3 Overhead ladder racking cable runway and accessories
  - .1 Cable runway

- .1 UL classified 38.1 deep tubular side stringer, 25.4 x 12.7 rails, welded, spaced at 230, steel, 300 mm wide.
- .2 Length 2959 mm.
- .3 Radius bend connecting section ninety degrees vertical, external and internal.
- .4 Radius e-bend section ninety degrees horizontal.
- .5 Radius cable drop.
- .6 Radius corner bracket.
- .7 Colour: gold over zinc.
- .2 Cable runway accessories
  - .1 Support "C" clips, couplers, to match and by same manufacturer as runway.
- .3 Products
  - .1 Chatsworth Products: 11275-012
  - .2 Approved sole equivalent

Table 28 - Ladder Racking Runway - By Manufacturer

	CPI	Cooper	Middle Atlantic		
Tubular stringer	11275-012	SB17T			
Solid stringer					

- .4 Racking accessories
  - .1 Front of rack mounted shelving, 380 mm deep, ventilated, support capacity 23 kg one or two rack units high.
  - .2 Products
    - .1 Same manufacture as for equipment cabinets
- .4 Rack Mounted Power Distribution Strip
  - .1 General
    - .1 Power distribution strips fully compatible with equipment cabinets and racking
    - .2 Power strips with flexible connection whips terminated with lockable twist lock plugs of length sufficient to reach power distribution outlets
  - .2 Monitoring
    - .1 Provide distribution strips with integrated power monitoring where indicated
    - .2 Metered units with digital RMS current monitoring, local display, with SNMP reporting and alarm indication
  - .3 Power strips formats
    - .1 30A 230V L6-30P; 42 x IEC C13, Metered

Table 29 - Rack Mounted Power Strips - By Properties

TYPE ID	Voltage	Amp phase	KW	Branch Recept	Type	Branch Recept	Type	Feed Plug	Meter

PDI230SM	230	30	5.5	42	IEC C13			L6-30	Yes
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.4 Products

- .1 Provide power distribution strips of type indicated by listed manufacturers

Table 30 - Rack Mounted Power Strips - By Manufacturer

TYPE ID	Server technology	Geist	APCC	Liebert	
PDI230SM				MPH2	

.5 Communications Copper Backbone Cabling

.1 General

- .1 Provide CMP rated Backbone cables except where expressly indicated otherwise.
- .2 Provide CMP or CMR rated backbone cables where no portion of the entire length of cable is exposed to air contact within an air supply or air return plenum or air within an enclosed space.
- .3 Provide CMP or CMR rated backbone cables where cables are contained within electrical communications utility rooms possessing a fire rating of one-hour or continuous electrical raceway or combination.
- .4 Avoid using cables outdoors if characterized for inside use
- .5 Comply with 271000.1
- .6 Provide cable of the type ID indicated on the Contract Drawings possessing the attributes and characteristics indicated by the table below

.2 Copper backbone cable - Inside

- .1 Multi-pair powersum 24 AWG solid annealed copper twisted pair 100 Ω characteristic impedance cable per ANSI/EIA/TIA 568 in identified binder groups, formed as compact core, covered by dual polyolefin/polyvinyl chloride insulation and an Alplast sheath, cable jacket

.3 Apply the following definitions to the terms appearing in the table:

- .1 Type ID: The cable designation as it appears in the Contract Documents
- .2 Pair: The number of twisted pairs of conductors in a common sheath
- .3 Form:
- .1 U designates unshielded cable;
- .2 S designates cable protected by an overall electromagnetic shield;
- .3 F designates cable or individual pairs protected by individual foil electromagnetic shielding.
- .4 Cat: The performance of the cable further defined within TIA-568 as the performance category of cable
- .5 Outdoor: Indicates the cable construction is suitable for use outdoors
- .6 Armour: The cable is protected by an outer protective armoured casing
- .7 Blocked: The cable is protected against ingress of water
- .8 Bury: The cable is suitable for direct burial applications

- .4 Manufacturer
  - .1 Use products where specifically identified by Manufacturer in the tables below

Table 31- Unshielded Copper Backbone Cabling – By Properties

Type ID	Pair	Form	Cat	Outdoor	Armour	Blocked	Bury
C52	25	U/UTP	3	No	No	No	No

Table 32 - Unshielded Copper Backbone Cabling – By Manufacturer

Type ID	Belden	Panduit	Systemax	General Cable
C52	DPLN25			2131505

- .6 Communications Optical Fibre Backbone Cabling
  - .1 General
    - .1 Cable of type indicated Contract Drawings possessing characteristics identified in tables below.
  - .2 Manufacturer
    - .1 Use products identified by Manufacturer in the tables below
    - .2 Use products manufactured by Corning to exclusion of all others.
  - .3 Fire rating
    - .1 Cable jacket rated OFNP or OFCP.
    - .2 Cable jacket rated OFNR or OFCR or OFNG or OFCG where permitted by local electrical and building safety codes, unless specifically excluded in this contract.
  - .4 Comply with Section 27 10 00.1

Table 33 - Multimode Fibre, Indoor/Outdoor (Service) by Strand Count, Performance

Type ID	Strand	Env	Purpose	Construction	Armor	dia	Core	Perf	Term
MS1241	12	In/out	Backbone	Tight buffer	Yes	250	50	OM4	

Table 34 - Mutlimode (Service) Type Cable - By Manufacturer

Type ID	Belden	Corning	Panduit
MS1241		012T8P-31190-A3	

- .7 Communications Optical Fibre Trunk cabling: modular terminated
  - .1 General
    - .1 Ribbon cable assemblies of twelve or twenty-four strand factory made consisting of multi-strand cable factory terminated with multi-fibre push-on pull-off (MPO) connecto(s) at two ends
    - .2 Pigtail assemblies, saem as ribbon assembly with one end not terminated
    - .3 LC Duplex break out cables, same as Ribbon assemblies with near end MPO termination, far end LC Duplex
  - .2 Cable
    - .1 Ribbon cable
      - .1 Jacket diameter, nominally 2 mm, 3 mm
      - .2 Performance type OM3, OM4, OM5, OS2

- .3 12 or 24 Strand
- .2 Fibre cable assembly with modular connector terminations of type ID indicated in table below
- .3 Terminations
  - .1 MPO style
  - .2 Polished to PC, UPC, APC.
  - .3 Multi strand with Polarity Maintenance
  - .4 Pinned (Male) or Not pinned (Female) and Gender field adjustable
  - .5 Not termination (pigtail)
  - .6 LC Duplex termination
  - .7 Fibre cable assembly terminatison of type modifier indicated in tables below
- .4 Polarity Maintenance
  - .1 Array trunk cabling using Method B polarity maintenance. Comply with TIA 568.0
  - .2 Multimode cable using Type B terminations with UPC polish
    - .1 Couplers using Type B (key up/Key up)
    - .2 Cassettes using Method B (Key up)

Table 35 - Optical Fibre Trunk Cables: Modular Connector Termination

Type ID+MODIFIER	Strand	Near Connector	Far Connector	Fibre Type
MM1204-pppp	12	MPO	MPO	OM4
MN1204-pppp	12	MPO	None	OM4
ML1204-pppp	12	MPO	LC-Duplex	OM4
ML1202-pppp	12	MPO	LC-Duplex	OS2

Table 36 - Optical Fibre Trunk Cables Termination Type Modifier

-pppp	Near Key	Near gender	Far Key	Far gender	Polish
-11	Key UP	Pinned	None	None	UPC
-11-11	Key UP	Pinned	Key UP	Pinned	UPC

- .8 Audio-Visual Communications Horizontal Cabling
  - .1 HDMI extension cabling
    - .1 Cables of length less than 10 m, Factory made cable preterminated HDMI connectors on multi conductor copper cable.
    - .2 Cables of length greater than 10 m, Factory made cable preterminated with active HDMI transducers on optical fibre cable assembly.
- .9 Paging Communications Horizontal Cabling
  - .1 Comply with manufacturer's installation instructions for 70 V PA distribution.
  - .2 2-#12 copper 300V insulated in flexible metallic armour.

.10 Communications Horizontal Distribution Cabling

.1 Cable

- .1 Four-pair twisted copper 24-23 AWG cables of characteristic impedance 100Ω: Fire rating to CMR (FT4) or CMP (FT6); performance to category class defined by TIA 568; additional EMI protection by conductive foil or metallic shield.
- .2 Provide cables of type ID possessing characteristics drawn from the table below
  - .1 Outdoor cables
  - .2 Water blocked cables
  - .3 Armoured
  - .4 Direct bury
  - .5 Other
    - .1 HT: High tensile strength
- .3 Category cables characterized to bandwidths
  - .1 Category 6A: 625 MHz
- .4 Colour
  - .1 Select cable from tables below to qualify performance criteria.
  - .2 Select cable with same performance criteria and with jacket of colour to match requirements indicated in section on Administration and Identification.
  - .3 Where not indicated otherwise, select the following colours
    - .1 CAT-6A general purpose data cabling: BLUE
- .5 Products
  - .1 Provide Products of type ID indicated on the Contract Drawing and by the indicated manufacturer.
  - .2 Provide Products same or better than Products identified below.
- .6 Comply with Section 27 10 00.1A

Table 37 - Copper Horizontal Distribution Cabling - By Properties

Type ID	Form	Cat	EMI	Placement	Waterblock	Armour	Bury	other
C15	U/UTP	6A	No Shield	Indoor	No	No	No	

Table 38 - Copper Horizontal Distribution Cabling - By Manufacturer

Type ID	Amp	Belden	Commscope	Leviton	Panduit	GeneralCable
C15		10GX			PUP6X04BU-	7141819

.2 Modular jacks

- .1 Modular jacks mounted as a component of patch panels located in telecommunications equipment rooms:
  - .1 Comply with section “communications terminal blocks and patch panels”
- .2 Modular jacks mounted on work area faceplate



- .1 Comply with section “communications faceplates and connectors”
- .3 Comply with 271000.1A
- .11 Communications Faceplates and Connectors (Jacks)
  - .1 Wall faceplates
    - .1 Comply with 271000.1
    - .2 Plastic faceplate, as cover to single or multi position electrical conduit outlet box, with capacity of one, two, three, four, six, ten outlets with flat or sloping face, to suit snap-in jack.
      - .1 Colour to match electrical faceplate, or else white if not specified.
      - .2 Blank cover plate to match.
      - .3 Manufacturer same as snap in jack.
    - .3 Stainless steel faceplate, as cover to single or multi position electrical conduit outlet box, with capacity of one, two, three, four, six, ten outlets with flat or sloping face, to suit snap-in jack.
      - .1 Blank cover plate to match.
      - .2 Manufacturer same as snap in jack.
    - .4 Stainless steel faceplate, with two phone mounting lugs, as cover to single position electrical conduit outlet box, with capacity of one outlet with flat face, to suit single keystone snap-in jack.
      - .1 Blank cover plate to match.
      - .2 Manufacturer same as snap in jack.
    - .5 Plastic faceplate, as cover to single position electrical square faced decorator style conduit outlet box, with capacity of one, two, three, four outlets with flat or sloping face, to suit snap-in jack
      - .1 Blank cover plate to match.
      - .2 Manufacturer same as snap in jack.
    - .6 Comply with manufacturer specified for horizontal data cabling.
  - .2 Furniture adapter faceplates, system furniture adapters, modular furniture adapters
    - .1 Plastic faceplate, as snap in mounting plate for single position furniture mounting plate of capacity of one, two, three outlets with flat or sloping face, to suit snap-in jack.
    - .2 Plate form compatible with furniture snap in mounting bracket.
      - .1 Colour to match electrical faceplate, or else black if not specified.
      - .2 Manufacturer same as snap in jack.
    - .3 Same manufacturer as specified for modular and systems furniture.
  - .3 Modular jack
    - .1 Modular jacks, 8P8C, 6P6C, 4P4C suitable for mounting in all faceplates identified, including flush- and surface-mount telecommunications outlet faceplates, modular furniture faceplate adapters, utility service pole adapter plates, floor box adapter plates, conduit poke-through adapter

- plates, rack mount modular patch panels, compatible with shielded panel and shielded cable options.
- .2 Comply with Specification and manufacturer for modular jacks described in section “communications terminal blocks and patch panels”.
- .3 Jacks with colour coded removable identification icon, and modular cable strain relief.
- .12 **Communications Connecting Cords, Devices, and Adapters**
  - .1 **Communications copper patch cords**
    - .1 Factory manufactured and tested patch cords of stranded copper conductor 24 or 28 ga, Unshielded Twisted Pair (UTP), solid or stranded, construction terminated in factory installed RJ45 plugs, of category equal to category of horizontal distribution cabling, of manufacturer equal to manufacturer of horizontal distribution cabling, cords of various length, and colour; diameter 3.8 mm.
    - .2 Patch cord supplied complete with factory test report detailing at least NEXT and electrical length (m)
    - .3 Performance to ANSI/TIA/EIA-1096A, IEC 60603-7, UL1863, CSA C22.2, IEEE 802.3af, 802.3at, temperature range of -40 °C to 60 °C. Polycarbonate housing toUL94V.
    - .4 Manufacturer equal to manufacturer of copper distribution cabling.
    - .5 Provide products as indicated by Type ID on the construct drawings drawn from the table below.

Table 39 - Copper Patch Cords - By Performance

Type ID	Shield	Category	Cond	AWG	Jacket	Pinning	Length (m)
U5-ST24-B-R-210	UTP	5E	stranded	24	CMR	568-B	2.10

- .2 **Communications optical fibre patch cords**
  - .1 Factory manufactured and tested optical fibre patch cords, two-strand terminated duplex LC – duplex LC, cord diameter 1.6 mm, of various lengths and colours. Connectors of low connector insertion / withdrawal force, and high cable retention force; to TIA/EIA-568-c.3, TIA-604-10, ISO/IEC 1101.
  - .2 Factory manufactured and tested optical fibre patch cords, twelve-strand terminated MPO-MPO cord diameter 3 mm, of various lengths and colours. Connectors of low connector insertion / withdrawal force, and high cable retention force; connectors field modified to be male/female, key-up/key down. TIA/EIA-568-c.1, TIA-604-5, ISO/IEC 1101.
  - .3 Performance to OM3, OM4, OS1, or OS2 equal to performance of fixed link cabling.
  - .4 Manufacturer equal to manufacturer of optical fibre distribution or backbone cabling.
- 3 **Execution**
- 3.1 **PREPARATION**
  - .1 Protect cabling during installation against damage caused by later construction or by activities by others.

- .2 In areas exposed to welding, protect cabling against damage due to weld fragments.
- 3.2 **INSTALLATION**
- .1 Communications Equipment Room Fittings
    - .1 Communications terminal blocks and patch panels
      - .1 Install patch panels in racking.
      - .2 Install jacks and connectors in panels.
      - .3 Mount wall mounted components on walls as indicated following manufacturer's recommendations.
      - .4 Protection
        - .1 Install protection modules.
        - .2 Install protection devices on exposed copper communication cables, following manufacturer's recommendations. Bond protection grounding terminal to building ground or electrical safety ground. Do not bond to telecommunications bond.
    - .2 Equipment enclosures
      - .1 Install cabinets, racks, and enclosures. Adjust location on site to align with building, fixtures, flooring. Relocate any cabinet, rack, frame or enclosure within the same room by a horizontal distance of up to 3 m from the location shown without adjustment to Contract Price.
      - .2 Install power distribution strips in cabinets.
    - .3 Communications cable management and ladder rack
      - .1 Suspend overhead cable runway at spacing of supports of 1.5 m or less; use only manufactured accessories; avoid the use of trapeze type supports; finish exposed cut ends with end caps; finish exposed rods with acorn nuts; paint all damaged areas with matching paint.
      - .2 Install cable management accessories; follow manufacturer's recommendations.
  - .2 Communications Cabling
    - .1 General
      - .1 Cables and cable pathways run parallel or perpendicular to building lines.
      - .2 Avoid scraping, denting, crushing, twisting, kinking or otherwise damaging cables before, during, or after installation. Contractor to replace damaged cables without additional compensation.
      - .3 Install all cables in accordance with manufacturer's specifications ensuring that proper installation techniques are observed and that the cable maximum pull-force and minimum bend radius specifications are adhered to.
      - .4 Utilize all indicated and available cable pathways such as slots, sleeves, conduits, cable trays, ducts, raceways and furniture system channels except where otherwise noted to route cable vertically and horizontally through the building. Exercise caution when pulling cables in such pathways to avoid damage to any existing cables and follow manufacturer's maximum pull-force and minimum bend radii.

- .5 Where cables are exposed to risk of being damaged by sharp edges of furniture, cabletray, raceway, etc., protect cables by feeding them through a length of flexible plastic conduit.
- .6 Neatly bundle, secure and wrap all cables. Use only flat, soft hook-and-loop fastening tape. Ensure cable wraps do not deform the cable jacket.
- .7 Where cables are terminated on a patch panel, bundle and dress cables in groups of twelve or twenty-four, each group consisting of cables from a single twelve or twenty-four port patch panel.
- .8 Where cables are terminated on a cross-connect field, bundle and dress cables in groups of twelve or twenty-four, each group consisting of cables from a single cross-connect panel.
- .9 Do not maintain bundles for distances greater than 1 m in cable trays.
- .10 Maintain clearances as indicated in Section 27 05 00.
- .11 Place cable only in conduits and cable tray and other designated cabling pathways. Do not place cable in crevices, cracks or other gaps in the building infrastructure not expressly intended for cabling. Do not run cables on the outside of conduits or piping or building supports or anything not intended expressly for communications cables. Use only protected cable pathways such as formed slots, formed sleeves, conduits, cable trays, ducts, raceways and furniture system channels.
- .12 Avoid scraping, denting, crushing, twisting, kinking or otherwise damaging cables before, during, or after installation. Replace damaged cables without cost to the Contract.
- .13 Pull cables in a continuous run. Do not splice horizontal cables.
- .14 Install cables in accordance with manufacturer's specifications. Ensure proper installation techniques are observed and cable maximum pull-force and minimum bend radius specifications are adhered to.
- .15 Protect cables against risk of damage at edges of furniture, cable tray, raceway, etc. Install cable in flexible plastic conduit.
- .16 Protect cable at pathway transitions by use of flexible plastic conduit or manufactured "waterfall" elements.
- .17 Neatly bundle and secure cables. Use light pressure soft wraps.
- .18 Bundle and dress cables in groups of twelve or twenty-four, at patch panels and within cabinets. Dress cables neatly and orderly within cabinets. Follow manufacturer's recommended practices to ensure performance compliance.
- .19 Support cables within cabinets at rear of patch panel and at intervals of 450 mm.
- .20 Support vertically placed cables by attaching to a support, firmly attached to the building fabric, at intervals of 600 mm.
- .21 Separate voice and data cables. Separate copper and optical fibre cables.
- .22 Maintain cable clearances as described in Section 27 05 00.
- .23 Do not maintain bundles for distances greater than 1 m in cable trays.

- .24 Pass cables at backboard terminations from behind, through holes positioned in the center of the termination mount.
- .25 Do not exceed manufacturer's recommended bending of cable. Maintain a radius of four times cable diameter or 25 mm for copper UTP or FTP or STP, whichever is the greater. Maintain a radius of ten times cable diameter or 30 mm for optical fibre cables.
- .26 Do not untwist exposed pairs at terminations for more than 13 mm.
- .27 Bond to ground all metallic cable strength members and metallic sheaths to manufacturer's specifications.
- .2 Identification
  - .1 Comply with identification instructions described in the Contract drawings or Specification.
  - .2 Apply channel identification labels at each end of cable, on faceplates, faceplate outlets, patch panel outlets, and any point of cable termination.
- .3 Copper backbone cabling
  - .1 Pull all UTP cables in a continuous run. Cable splices will not be accepted.
  - .2 Where voice and data cables are separately identified on the Contract Drawings, separate voice and data cable into distinct bundles.
  - .3 For cables being terminated on a backboard mounted cross-connect field, pass all cables behind backboard in bundles and pass them through holes positioned in the centre of the termination mount.
  - .4 For UTP cables, maintain a minimum bending radius of four times cable diameter or 25 mm whichever is the greater.
  - .5 Use vertical pipe split mesh grips to support the weight of the cable at the top of a vertical cable rise of 4 m or more.
  - .6 Use a minimum of five cable ties per floor to prevent side-to-side movement of the cable.
  - .7 Neatly bundle, wrap, secure and route all backbone cables.
  - .8 Separate backbone copper data cables, backbone copper voice cables and backbone fibre optic cables into separate bundles.
  - .9 Secure cable bundles to vertical and horizontal supports and neatly fasten to plywood backboards, cable tray or termination racks and cabinets.
  - .10 Exercise caution when pulling cables in pathways to avoid damage to any existing cabling and ensuring that the cable manufacturer's installation procedure is followed.
  - .11 Inform Consultant immediately of any backbone cable runs exceeding 800 m for UTP cable, 2000 m for multimode fibre and 3000 m for single-mode fibre.
- .4 Optical fibre backbone cabling
  - .1 Use fibre fan out kit at transition from loose tube to tight buffer.
  - .2 Apply shrink wrap to prevent gel leakage.
  - .3 Pull all optical fibre cables in a continuous run. Fibre splices will not be accepted except as a termination method.

- .4 Follow proper installation and termination practices for optical fibre cabling. Do not kink or exceed manufacturer's restrictions on the optical fibre cable minimum bend radius.
- .5 Maintain a minimum bending radius of ten times cable diameter or 30 mm, whichever is larger.
- .6 Splicing of fibre cables
  - .1 Splices, except those expressly for the purpose of terminating the optical fibre strands and where expressly called for on the Contract Drawings, will not be accepted except by express and written approval by Consultant.
  - .2 Splicing of the cables is permitted only in designated junction boxes, manholes, buildings and in the fibre patch panels.
  - .3 House splices in manholes, junction boxes and the remote buildings in an outdoor splice enclosure.
  - .4 House all splices in the telecommunication closets in splice trays located in or close to the fibre patch panels.
  - .5 Splice fibres using quality fusion type splicing equipment. Splicing equipment is subject to approval by the Consultant. Provide the Consultant with Specification details of the splicing equipment prior to commencing splicing.
  - .6 Remake all splices with a forward transmission loss in excess of 0.3 dB, at no cost to the Contract.
  - .7 Replace the cable or remake at no cost to the Contract, splices in any one link where the mean splice loss exceeds 0.2 dB.
  - .8 Arrange splices neatly in the support enclosure and protect with a suitable splice protector.
  - .9 Splice and terminate all fibres including spares to provide end to end links.
  - .10 Splice and connect individual fibres so that a constant identification scheme of the fibres is maintained throughout the system.
  - .11 Label all fibres in the splice tray with permanent vinyl markers. Label cables according to the identification plan as shown on the Contract Drawings.
- .5 Coaxial cable backbone cabling
  - .1 Pull all coaxial cables in a continuous run. Splices not accepted.
  - .2 Follow manufacturer's installation instructions. Do not kink or exceed manufacturer's restrictions on the cable minimum bend radius.
  - .3 Allow sufficient spare cable for working allowance at each termination.
- .3 Audio-Visual Communications Horizontal Cabling
  - .1 Comply with manufacturer's installation instructions.
- .4 Paging Communications Horizontal Cabling
  - .1 Comply with manufacturer's installation instructions.

- .2 Comply with Division 26
- .5 Antennas Communications Horizontal Cabling
  - .1 Comply with manufacturer's installation instructions.
- .6 Data Communications Horizontal Distribution Cabling
  - .1 Cabling
    - .1 Inform Consultant immediately and prior to installation of cable of any horizontal cable pathway routes exceeding 90 m in length.
    - .2 Do not strap cables to, or lay cables on, any length of conduit, pipe, ventilation duct or other building element not expressly installed for the purpose of cable support.
    - .3 When determining a cable routing pathway, give priority to air handling ducts, fire sprinkler pipes and electrical conduits.
    - .4 Except for cables expressly indicated as SPARE, terminate all pairs of UTP cable and all strands of fibre optic cable at both ends.
    - .5 Terminate all pairs of spare UTP cable in telecommunication closet and store workstation end in ceiling space by coiling neatly and suspending. Do not rest cables on ceilings or air handling ducts.
    - .6 Spare cables to be of sufficient length to permit reaching any point in the room to which they apply.
    - .7 Where practicable and where the maximum allowable cable length is not exceeded, provide 3 m of slack UTP cable and 3 m of slack optical fibre cable at the workstation end of each distribution cable. Neatly coil and store slack in cable tray.
    - .8 Where the telecommunications outlet is mounted on a wall box or floor box or system furniture, provide working slack allowance for UTP cable of 300 mm. Coil neatly and secure in the outlet box.
    - .9 Select least obstructed pathway through modular or system furniture. Where available, use eye-level pathways in preference to base-level pathways.
  - .2 Terminations
    - .1 Terminate cables at connectors in Work area and in telecommunications rooms.
    - .2 Terminate copper backbone cables at IDC blocks or patch panels as indicated on the Contract Drawings.
    - .3 Terminate optical fibre cables at patch panels or surface mount outlet assemblies as indicated on the Contract Drawings. Mount connectors or couplers or cassettes in the fibre mounting shelves or modular assemblies.
    - .4 Terminate coaxial cables at device using connectors prescribed by the device connection.
- .7 Communications Faceplates and Connectors (Jacks)
  - .1 Outlets
    - .1 Install blank cover plates for all unused or abandoned outlet boxes.
    - .2 Mounting heights

- .1 Install telecommunications outlets at elevations indicated on the Contract Drawings; Measure elevations to centre line of outlet.
  - .2 Faceplates
    - .1 Install blank filler plates for all unused modular jack positions on faceplates.
  - .8 Communications Connecting Cords, Devices, and Adapters
    - .1 Turn over patch cords to Owner.
  - 3.3 **RE-INSTALLATION**
    - .1 General
      - .1 Where any part of the Work fails tests and that Work is to be built without physical discontinuity, remove the offending material and install new without increase in cost to the Contract.
      - .2 Where any part of the Work fails tests, repair the fault in a manner to prevent recurrence and re-test.
      - .3 Where any part of the Work fails tests and that Work is to be built without physical discontinuity, remove the offending material and install new without increase in cost to the Contract.
  - 3.4 **FIELD QUALITY CONTROL**
    - .1 General
      - .1 Where any part of the Work fails tests, repair the fault in a manner to prevent recurrence and re-test.
      - .2 Test backbone cables before and after installation.
      - .3 Perform pre-installation testing of Products as detailed in Section 27 08 00.
  - 3.5 **SITE TESTS, INSPECTION**
    - .1 Field Engineer Services
      - .1 Provide Field Engineer for inspection and certification of equipment during installation, testing and commissioning as required.
  - 3.6 **MANUFACTURERS' FIELD SERVICES**
    - .1 Provide manufacturer's representatives to verify installation practices for each part of the Work as may be relevant to all components including wiring and terminations.
  - 3.7 **ADJUSTING**
    - .1 Wireless Access Point Installation and Adjustment
      - .1 Adjust location of wireless access points and wireless access point assemblies by 10 m in any horizontal direction without additional cost to the Owner.
- End of Section



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- 1 General
- 1.1 **SUMMARY**
  - .1 Section Includes
    - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
    - .2 Comply with all sections of the Contract Documents.
- 1.2 **SPECIAL INSTRUCTIONS TO BIDDERS**
  - .1 Attend one briefing session with Engineer and Owner's Representative to establish user population densities, user performance requirements and applications requiring wireless connectivity.
- 1.3 **SYSTEM DESCRIPTION**
  - .1 Comply with scope of system described in the Contract Drawings.
    - .1 Installation of surface or suspended wireless access points at each location indicated on the Contract Drawings.
    - .2 Access point enclosure to comply with requirements of location.
    - .3 Installation of network connection patch cables.
    - .4 Onsite active survey executed by manufacturer's representative to assess.
  - .2 Owner Supplied Equipment
    - .1 Access points furnished and configured by Owner. Performance parameters to Owner's Specification.
    - .2 Network switching and routing equipment for enterprise applications.
    - .3 Network switching and routing equipment for facility and building management related applications.
    - .4 VoIP routing equipment by Owner.
    - .5 Power over Ethernet midspan injection and end point power injection equipment.
- 1.4 **QUALITY ASSURANCE**
  - .1 Where any part of the Work fails tests, repair the fault in a manner to prevent recurrence and re-test.
  - .2 The Contractor shall provide a verification report to confirm data jacks and cables have been installed, terminated and tested.
- 1.5 **AREA CLASSIFICATION**
  - .1 No area in the Work is classified as hazardous.
- 2 Products
- 2.1 **MANUFACTURERS**

- .1 Wireless Access Points and Antenna
  - .1 Cisco
- 3 Execution
- 3.1 **WIRELESS ACCESS POINTS**
  - .1 Commission access point manufacturer to perform active site survey to determine optimum set up and configuration of multiple access points. Coordinate with Owner for user population density and traffic predictions.
  - .2 Comply with installation instructions provided by the manufacturer.
  - .3 Provide mechanical supports to firmly support array.
  - .4 Attach supports to building fabric.
  - .5 In conjunction, cooperation with and witnessed by the Engineer, perform signal strength field measurements using instrumentation recognized and approved by the manufacturer to verify that better than 90% of randomly selected locations exceed the minimum signal level required for the application as indicated in the manufacturer's published reference material.
  - .6 If fewer than 90% test successfully, repeat the test.
  - .7 If fewer than 90% continue to test successfully, refer to the Engineer and manufacturer for recommended recourse.
  - .8 Provide mounting arrangements and install access point for up to an additional 5% of the total number of wireless access points to compensate for areas of limited coverage.
  - .9 Assist Owner to set in place Owner-supplied equipment including switches, routers, and wireless access points.
  - .10 Configuration of same systems by Owner.
- 3.2 **INTERFACE WITH OTHER WORK**
  - .1 Comply with the Contract Documents.
  - .2 Bestow on the Owner the right to execute work on the site before Contract completion.
    - .1 Be governed by terms of this section in circumstances where the Owner is instrumental in providing or facilitating a communications network that is a necessary part of the facility operations and maintenance Building Management System or any other communications system that is necessary for the completion of the Work.
    - .2 Other communication systems will include networks to facilitate without limitation:
      - .1 CCTV and surveillance
      - .2 Intercom
      - .3 Telephone
      - .4 Access control

- .5 Intrusion detection
- .3 Receive, uncrate, set in place and energize network devices furnished by the Owner that are required to facilitate a working Building Management System Ethernet network.
- .4 Coordinate with Owner's technician forces to provide access to equipment and equipment spaces and to enable the configuration of network switching, routing, server and data storage equipment.
- .5 Provide the Owner's technician forces necessary networking configuration parameters that describe building systems as required for the completion of a fully operational Building Management System.
- .6 Provide reasonable protection of the Owner-provided equipment against harm or loss caused by accident or negligence.
- .7 Coordinate with the Owner and establish mutually agreed dates on desired scheduling of delivery and set up of equipment.

End of Section

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- 1 General
- 1.1 **SUMMARY**
  - .1 Section Includes
    - .1 Labour, Products, equipment and services necessary to complete the Work of this section.
    - .2 Common work results as laid out in Section 27 05 00.
- 1.2 **MANUFACTURER'S ATTENDANCE**
  - .1 Provide manufacturer's representatives to verify installation practices for each part of the Work as may be relevant to all components including wiring and terminations.
- 1.3 **FIELD INSPECTION**
  - .1 Provide field Engineer for inspection and certification of equipment during installation, testing and commissioning as required.
- 1.4 **QUALITY ASSURANCE**
  - .1 Where any part of the Work fails tests, repair the fault in a manner to prevent recurrence and re-test.
  - .2 Where any part of the Work fails tests and that Work is to be built without physical discontinuity, remove the offending material and install new without increase in cost to the Contract.
- 1.5 **AREA CLASSIFICATION**
  - .1 No area in the Work is classified as hazardous.
  - .2 Refer to all related Drawings and Specifications in the Contract Documents.
- 1.6 **SYSTEM DESCRIPTION**
  - .1 Voice communications system using network cabling for VoIP services.
  - .2 Telephone system using network cabling for baseband analog and/or TDM and/or POTS voice services.
  - .3 Operating in conjunction with horizontal distribution cabling indicated on Contract Drawings and in Division 27 Specification.
  - .4 System to performance specification set by Owner.
    - .1 Self contained rack mounted telephone switching unit.
    - .2 Switch to provide signal routing for extension-to-extension and extension-to-trunk. Trunk lines as required by system.
    - .3 System to operate with digital TDM desk sets and optionally configurable to VoIP desk sets on set by set basis.
    - .4 Self-contained back-up power supply to provide eight hours survival in event of loss of utility power.
    - .5 Revert to bypass mode after power supply exhausted.

- .6 Provision of two desk set units connected directly to POTS service.
- .7 Desk sets and interconnecting cables supplied and installed by Owner.
- .5 Emergency Telephone Systems
  - .1 Designated telephones connected to incoming carrier trunk services at demarcation point.
  - .2 Wall / desk mounted individual telephone set instruments directly connected to dedicated express inside wiring.
  - .3 Automatic ring down to programmed carrier assigned number.
  - .4 Wall and desk sets supplied and installed by Carrier (Bell Canada).
- .6 Access to paging and zone selection from telephone key pad and from intercom system.
- 1.7 **PAGING**
  - .1 Public paging system operating through speakers mounted within telephone desk set units.
  - .2 Distinctive tones created with following input:
    - .1 Request to enter push button at main entrance
    - .2 One hundred twenty second warning in advance of expiry of intrusion detection system set-back timer
    - .3 Sixty second warning in advance of expiry of intrusion detection system set-back timer
- 1.8 **PRODUCT VENDORS**
  - .1 Manufacturer as specified by Owner.
- 2 Products
- 2.1 **TELEPHONE SWITCH**
  - .1 As specified by Owner.
  - .2 Manufacturer
    - .1 Representative Product: Nortel BCM50
- 2.2 **TELEPHONE DESK SET**
  - .1 As specified by Owner.
    - .1 Representative Product: Nortel
- 3 Execution
- 3.1 **CARRIER SERVICES**
  - .1 Cooperate with Owner and carrier to coordinate Specification and arrangement for installation of incoming trunk line carrier services.

- .2 Inform carrier of emergency telephone ring-down numbers as instructed by Owner.

3.2 **TELEPHONE SWITCH**

- .1 Set up and configuration by Owner.
- .2 Install and configure telephone switch to Owners' specification and satisfaction.

3.3 **TELEPHONE DESK SETS**

- .1 Set up and configuration by Owner.
- .2 Install and configure telephone desk sets to Owners' specification and satisfaction.

End of Section



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1 General

1.1 **SUMMARY**

.1 Section Includes

.1 Labour, Products, equipment and services necessary to complete the Work of this section.

.2 This section describes a portion of the Contract scope of Work. Refer to all related Drawings and Specifications in the Contract Documents for the full description of the Contract scope of Work.

1.2 **GENERAL REQUIREMENTS**

.1 Provide all components indicated on the Contract Drawings including but not limited to supports, bollards, conduits, raceways, device boxes, enclosures, cable, wires, connectors, equipment, controls, devices, controllers, master stations and substations, relays, interfaces, programming and whatever else in order to provide a completely installed and satisfactorily operating intercommunication system as indicated in the Contract Drawings.

.2 Include where applicable and without limitation, electronic switching systems, wiring, wiring conduit and raceways, cabling supports, terminal devices, terminal supporting enclosures, terminal supporting bollards, interfaces to and from other systems as further described and indicated by and in compliance with this Specification and the Contract Drawings.

.3 Confirm that the system specified herein has the capability to meet the design intent, or propose an alternative system, either fully or in part.

.4 Provide any other equipment, labour or material necessary to fulfill the functional and performance criteria of the system whether shown in the Specification or Contract Drawings or not.

1.3 **TERMS OF REFERENCE**

.1 Dimensions and Quantities

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

.2 Quantities or lengths indicated in any of the Contract Documents are approximate only and are not to gauge or limit the Work.

.3 Install systems indicated as continuous on the Contract Drawings without break or interruption. Ensure electrical continuity between metallic components shown as connected.

.4 Make necessary changes to routing of cables and the like to accommodate structural, mechanical, electrical and architectural conditions. Coordinate with other trades and make allowance for conditions that will arise from work in progress under separate contract.

.2 Area Classification

.1 No area in the Work is classified as hazardous.

- .3 Submissions
  - .1 Submit Product data and Shop Drawings in accordance with the Contract Specification.
  - .2 At time of tender submit a complete list of all components.
  - .3 At time of tender submit a time schedule indicating significant milestones. Within five days of Contract Award submit a revised time schedule
- .4 Manufacturer's Attendance
  - .1 Provide manufacturer's representatives to verify installation practices for each part of the Work as may be relevant to all components including wiring and terminations.
- .5 Field Inspection
  - .1 Provide field Engineer for inspection and certification of equipment during installation, testing and commissioning as required.
- .6 Quality Assurance
  - .1 These Specifications supplement the Electrical and Electronic Manufacturers Association of Canada, Canadian Standards Association Standards, Electronic Industries Association, Telecommunications Industries Association standards and recommendations. Conditions of the EEMAC, CSA, EIA, TIA and ISO/IEC standards and recommendations apply unless superseded or modified by this Specification.
  - .2 System compliant with FCC Part 15 Sub Part J approval as accredited by National Bureau of Standards for Emissions and Telecommunications Testing or by other approved and recognized authority.
  - .3 Where requirements of the Specifications exceed referenced standards, the Specifications apply. Where standards differ between authorities, the most stringent applies.
  - .4 Immediately bring to the attention of the Consultant any requirements of the Specifications that are substandard to referenced standards.
  - .5 Avoid using equipment not acceptable to electrical inspection authorities.
  - .6 Where any part of the Work fails tests, repair the fault in a manner to prevent recurrence and re-test.
  - .7 Where any part of the Work fails tests and that Work is to be built without physical discontinuity, remove the offending material and install new without increase in cost to the Contract.

1.4 **SUBMITTALS**

- .1 Comply with submission procedures described in the Specifications Section 01 33 00.
- .2 Comply with use and terms of use of Project Web.
- .3 Shop Drawings

- .1 Submit Shop Drawings for Consultant's review of all component types prior to commencing use of said components. Avoid the use of components for which Shop Drawings have not been issued.
  - .2 Include where applicable:
    - .1 Plan and front elevation of equipment layouts prior to assembling said equipment.
    - .2 Room plan and elevation layouts where different from Contract Drawings.
    - .3 Identification scheme prior to use of said component.
  - .3 Submit functional and wiring diagrams for review showing all interconnections and equipment layouts within the systems and between systems before commencing applicable installation work.
  - .4 Review all Shop Drawings before submitting to Consultant for review for clarity of print and clarity of identification of Products.
  - .5 The review of the Shop Drawings by the Consultant or Owner's Representative does not relieve the Contractor of the responsibility to provide a complete and working system, based on the intent outlined in these documents.
- 4 Operation and Maintenance Data
- .1 Submit Operations and Maintenance Manuals on completion of the Work.
  - .2 Operating and Maintenance Manuals
    - .1 Assemble and submit Maintenance Manuals in accordance with the Contract Specification.
    - .2 Prepare and supply not fewer than six bound copies of a manual incorporating:
      - .1 System block diagrams and functional schematics.
      - .2 Schematic diagrams of all equipment and devices.
      - .3 Complete "as built" wiring diagram showing all device wiring and the connections, including colour codes, cable numbering and terminal numbering.
      - .4 Operating instructions for all supplied equipment.
      - .5 Service manuals for all supplied equipment.
      - .6 Description of system operation.
      - .7 Parts list, using component identification numbers standard to electronics industry noting address, telephone number and contact name of available Suppliers.
    - .3 Submit manuals, including as-built documents, before submitting request to Owner for final acceptance of the system
  - .3 "As Built" Record Drawings

- .1 Identify all device locations and wiring and their connections, including colour codes, cable numbering and terminal numbering.
- .2 Where wiring is underground or under floor or below finished grade, furnish field dimension with respect to building column lines and inverts with respect to finished floor levels or grades.
- .3 Prepare drawings clearly identifying cabling pathways where the cable is not supported along its length by raceway.

1.5 **DESCRIPTION OF SYSTEM**

- .1 Provide a system of scope and capacity as indicated in the Contract Drawings.
- .2 Not all systems described herein necessarily apply to the Contract. Ensure the parameters of the systems indicated on the Drawings govern the Products, scale and features installed. Select the appropriate system or systems from the following:
  - .1 Large scale system
  - .2 Medium scale system
  - .3 Medium scale system with security integration
  - .4 Small scale systems

1.6 **LARGE SCALE SYSTEM**

- .1 System not specified.

1.7 **MEDIUM SCALE SYSTEM**

- .1 System not specified.

1.8 **SMALL SCALE SYSTEM**

- .1 Sub-section applies to systems defined as follows:
  - .1 Fewer than twenty stations.
  - .2 System not requiring features specified elsewhere in Specification.
- .2 Intercommunications system consisting of the following components:
  - .1 Inside wall mounted (flush or surface mount depending on wall type) intercom terminal station. "Hands free" operation with integrated camera, speaker, LED indicator, magnetic hearing loop.
  - .2 External mushroom push button connected to auxiliary contact to engage intercom terminal station
  - .3 IP addressable Desk Mounted Master station with video touch screen, camera, speaker.
  - .4 Wall mounted inside enclosure boxes for intercom terminals located in unfinished areas of the premises as indicated.
- .3 Intercommunications system providing the following features and characteristics:
  - .1 Two-way voice communication.

- .2 "Hands free" mode of operation.
- .3 Identical wiring requirements between stations.
- .4 Every master able to call every other station in the system including other master stations.
- .5 Programmable for pushbutton selection of called station.
- .6 Programming stored in a non-volatile, battery backed RAM.
- .7 Battery back-up for autonomous operation without loss of features for one hour without external power.
- .4 System Characteristics
  - .1 Master station to other station calls placed by selecting individual station button(s).
  - .2 Ability to establish connections between stations by receiving signals created by external computer based control system.
  - .3 Ability to electronically transmit information on status of intercom system, including connected and communicating devices from intercom system to computer based control systems including CCTV controllers and access control systems.
  - .4 Connection completion indication by audible tone at the calling and the called stations to signify completion of the connection without manipulation of controls.
  - .5 Connection cancelled at master.
  - .6 Facility for hands free or handset modes in master unit; local loud-speaker disabled when unit is in handset mode.
  - .7 Single digit and/or single button speed calling individually programmable at each station.
  - .8 Display of calling party's identification number and/or alphanumeric identification or other means of identification of calling party or station at master.
  - .9 Master stations equipped with local MUTE.
- .5 Integration with Security Systems
  - .1 Security system to log time of event, door identification number, and action taken.
- 1.9 **CARE, OPERATION AND START-UP**
  - .1 Provide instruction and demonstrate the use of the system to the Owner in three scheduled training sessions.
  - .2 Provide manufacturer's factory trained service Engineers to instruct:
    - .1 Maintenance personnel in maintenance of system.
    - .2 Operating personnel in the use of system.

1.10 **RELATED WORK**

- .1 Extra low voltage wiring conductors and connections for intercom system as necessary to create a fully operative and functional system.
- .2 Conduits and electrical raceways to create a continuous electrical pathway from intercom terminals to within 900 of cable terminations in equipment room.

2 Products

2.1 **GENERAL**

- .1 Use equipment produced by a manufacturer with a minimum five year period of experience producing similar products and who can refer to similar installations now rendering satisfactory service.
- .2 Equipment of modular design and solid state devices except for electro-mechanical components.
- .3 Reference to model numbers and other information is intended to establish the standards of performance, quality, and appearance which must be met. Where Products are identified by named manufacturers on the Contract Drawings, provide Products manufactured by the named manufacturers.
- .4 Guarantee equipment to be free from defective material and workmanship for a period of one year from date of final acceptance by Owner, except where damage is caused by Owner through accident, abuse, improper operation or neglect. Provide maintenance, pursuant to this guarantee during normal working hours at no expense to the Owner.
- .5 Provide satisfactory evidence of the maintenance of a service organization capable of furnishing adequate inspection and service to the equipment and be prepared to offer a Service Contract for maintenance of the system after guarantee period.

2.2 **CABLING**

- .1 Comply with Sections 27 05 00, 27 11 00, and 27 15 00.
- .2 Supply and install cabling of a type and style required by the original equipment manufacturers so that the system may operate to the best of its published performance specifications.
- .3 Supply and install conduit and electrical raceways for exclusive use by intercommunication systems.

2.3 **INTERCOM SWITCHING SYSTEM – LARGE SCALE**

- .1 System not specified.

2.4 **INTERCOM SYSTEM – SMALL SCALE**

- .1 Inside master: Aiphone IX-MV7-HBLA or equivalent.

2.5 **INTERCOM TERMINAL DEVICES**

- .1 Devices suitable for operation with intercom switching system as indicated on the Contract Drawings. Not all devices listed below are compatible with all intercom switching systems. Select devices according to performance and systems compatibilities.
- .2 Wall Mounted Station – Inside

- .1 Loud speaking hands free operation.
- .2 Brushed metal faceplate, loudspeaker, microphone.
- .3 Approximate dimensions 300 mm x 150 mm.
- .4 Metal back-box for flush wall mounting.
- .5 Black plastic housing or metal back-box for surface wall mounting.
- .6 Video Camera
- .7 Magnetic Hearing Loop
- .8 Re Product – Substations
  - .1 IX-DVFL
  - .2 AXIS A8004-VE c/w accessibility kit (to be used in Police Buildings)

3 Execution

3.1 **LOCATION**

- .1 Install intercom switching equipment in the main computer equipment room or as indicated.
- .2 Verify site conditions before commencing Work. Install bollards in positions indicated.

3.2 **INSTALLATION**

- .1 Install equipment in accordance with manufacturer's instructions.
- .2 Install cable in conduit or electrical raceway. Do not use open or unsupported cabling. Use flexible conduit to enclosed link to exposed device.
- .3 Make splices using insulated crimp type sleeves. Make connections to devices having screw terminals with suitable lugs crimped to ends of conductors. Avoid the use of field soldered connections.
- .4 Provide identification for wiring at outlet boxes and at accessible locations. Abide by the identification conventions as indicated in the Contract; make particular reference to Division 27 Specifications including Section 27 05 53.
- .5 Exercise care during installation to avoid damage to cables and equipment. Replace equipment damaged or marred during installation.
- .6 Permanently and clearly mark in a descriptive manner all switches, connectors, jacks, receptacles, outlets, terminal blocks and cable terminals if not already required by other parts of this Specification.
- .7 Take the necessary precautions to prevent and guard against electro-magnetic and electrostatic hum, to supply adequate ventilation, and to install equipment so as to provide safety for the operator.
- .8 Observe current standards for connecting the shield drain wire of shielded signal cables. Insulate cable shields at their terminated ends with sleeves or heat shrinkable tubing. Protect shield drain wires exiting from cable jacket by PVC or Teflon tubing.



- .9 Connect all audio grounds in the equipment rack to a common point on the rack. Connect the rack to the isolated ground bus bar provided.
- .10 Install power wiring to electrically operated devices. Make electrical connections.

3.3 **INTEGRATION**

- .1 Program intercommunications system to send and receive signals to and from other systems as indicated.
- .2 Provide necessary wiring and connections and make signals available to other systems to enable inter-system communications.

3.4 **TESTS**

- .1 Test entire system after completion of installation in accordance with Owner's requirements. Submit a test report to the Consultant.
- .2 Verify that all equipment is properly installed and secured in place and ensure that all warning labels, covers, etc. are in place. Verify that all wiring is complete and free of all hazards and unintentional shorts. Ensure that all grounding is complete.

3.5 **TRAINING**

- .1 Provide training to the Owner's personnel.

End of Section

1 General

1.1 **SUMMARY**

.1 Section Includes

- .1 Labour, Products, equipment and services necessary to complete the Work of this section.

1.2 **REFERENCES**

.1 Conform to the latest edition of the following:

- |     |                    |   |
|-----|--------------------|---|
| .1  | CAN/ULC-S524       | - Standard for the Installation of Fire Alarm Systems                                   |
| .2  | CAN/ULC-S525       | - Audible Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories |
| .3  | CAN/ULC-S526       | - Visual Signaling Devices for Fire Alarm and Signaling Systems, Including Accessories  |
| .4  | CAN/ULC-S528       | - Standard for Manual Stations for Fire Alarm Systems, Including Accessories            |
| .5  | CAN/ULC-S529       | - Standard for Smoke Detectors for Fire Alarm Systems                                   |
| .6  | CAN/ULC-S530       | - Standard for Heat Actuated Fire Detectors for Fire Alarm Systems                      |
| .7  | CAN/ULC-S536       | - Standard for Inspection and Testing of Fire Alarm Systems                             |
| .8  | CAN/ULC-S537       | - Standard for Verification of Fire Alarm Systems                                       |
| .9  | CAN/ULC-S561       | - Standard for Installation and Services for Fire Signal Receiving Centres and Systems  |
| .10 | ULC S527           | - Standard for Control Units for Fire Alarm Systems                                     |
| .11 | CSA C282           | - Emergency Electrical Power Supply for Buildings                                       |
| .12 | CSA C22.1          | - Canadian Electrical Code  |
| .13 | OBC                | - Ontario Building Code   |
| .14 | ASME A17.1/CSA B44 | - Safety Code for Elevators and Escalators  |

1.3 **SYSTEM DESCRIPTION**

.1 Single Stage Fire Alarm System

- .1 System shall be electrically supervised, zoned as indicated on Drawings and designed so that actuation of any manual pull station, smoke detector, heat detector or group of these devices in a zone shall cause the signal bells to sound throughout building. All magnetic door locks and/or door strikes to be deactivated, cause fans to shutdown as indicated, and transmit signal to fire department. Alarm shall indicate on appropriate zone light at control panel.

- .2 Wiring shall be done in class A configuration such that an open circuit in any initiating device shall not prevent alarms from being received by other devices. Each zone shall have its own alarm and trouble lamp.
  - .3 Complete system to be supervised against failure of operating power, open circuits, and grounds. All supervision is to be maintained on all circuits even in event of a power failure, when system is on battery standby. Any of above causes a Sonalert to sound at main control panel and at each remote annunciator and also light a common trouble lamp in same panels. Sonalert to produce a tone distinct from tone of alarm signals. Provide a silencing switch in main control panel, which, when operated, silences trouble bell but causes trouble lamp to remain illuminated until trouble is cleared, and system returned to normal. Upon return to normal, trouble signal lamp shall be automatically reset to normal.
  - .4 Provide common control panel containing a system reset button, a system silence push button, and an LED test button. It shall not be possible to reset system until all operated initiation devices have been returned to normal. Failure of a lamp on the supervised annunciator causes a common trouble indication and causes annunciator trouble LED to light. The common control also to contain a signal silence push button. This signal silencing push button is used to silence alarm signals at any time but, if a new alarm should occur after it is pressed, all alarm signals shall again sound. When an alarm is received, the zone LED shall flash, until it has been silenced. At this time the LED indicator shall illuminate continuously. Upon receipt of a subsequent alarm, the LED for that zone shall flash, indicating in which zone the latest alarm occurred.
- .2 Two Stage Fire Alarm System
- .1 The system shall be electrically supervised, zoned as indicated on Drawings and designed so that actuation of any manual pull station, smoke detector, heat detector or group of these devices in a zone shall cause signal bells to sound throughout building, all magnetic door locks and/or door strikes to be deactivated, and cause fans to shutdown as indicated. Alarm shall indicate on the appropriate zone light at control panel.
  - .2 On receipt of an alarm from any zone, bells shall ring at twenty strokes per minute. In the event of a real fire, a general evacuation alarm can be initiated by means of a key switch in each one of the double action stations. If original alarm is not acknowledged within five minutes, general evacuation alarm shall sound automatically by means of a timer in control panel. General evacuation alarm consists of bells ringing at one hundred twenty strokes per minute.
  - .3 Wiring shall be done in class A configuration such that an open circuit in any initiating device shall not prevent alarms from being received by other devices. Each zone shall have its own alarm and trouble lamp.
  - .4 Complete system to be supervised against failure of operating power, open circuits, and grounds. Any of the above causes a Sonalert to sound at main control panel and at each remote annunciator and also light a common trouble lamp in the same panels. Sonalert to produce a tone distinct from tone of alarm signals. Provide a silencing switch in main control panel, which, when operated, silences trouble bell but causes trouble lamp to remain illuminated until trouble is cleared and system returned to normal. Upon return to normal, trouble signal lamp shall be automatically reset to normal.

- .5 Provide common control panel containing a system reset button, a system silence push button, and an LED test button. It shall not be possible to reset system until all operated initiation devices have been returned to normal. Failure of a lamp on the supervised annunciator causes a common trouble indication and causes annunciator trouble LED to light. The common control panel also to contain a signal silence push button. This signal silencing push button is used to silence alarm signals at any time but, if a new alarm should occur after it is pressed, all alarm signals shall again sound. When an alarm is received, the zone LED shall flash until it has been silenced. At this time the LED indicator shall illuminate continuously. Upon receipt of a subsequent alarm, the LED for that zone shall flash, indicating in which zone the latest alarm occurred.
- .3 Multiplex Fire Alarm System
  - .1 Supervised, non-coded, annunciated, (single) (two) stage, closed circuit, twenty-four volt AC/DC multiplexed fire alarm (and security) system. (The system shall provide dual channel voice communication and firefighter phone capabilities. Both voice communication system and firefighter phone system shall be an integral part of fire alarm system).
  - .2 The Central Processing Unit (CPU) shall use multiplex communication techniques to receive data from and transmit data to transponders which shall be remotely located throughout facility to minimize wiring costs, simplify design, and allow economical expansion and easy retrofit. (Multiplex communication techniques shall also be used for emergency voice circuits, and firefighter's phones located throughout building.)
  - .3 The CPU shall be microprocessor-based to increase system reliability, speed response to alarm conditions, and reduce cost. CPU response time to alarm conditions shall be no more than four seconds, regardless of system size.
  - .4 Fire alarm stations, thermal detectors, products of combustion detectors, (emergency evacuation speakers, emergency telephones) shall be fully supervised.
  - .5 Upon operation of any manual station or detector, the following will occur:
    - .1 Actuate CPU to cause (signal bells to sound at twenty strokes per minute) (a slow rate tone on emergency evacuation speakers) throughout building. Second stage alarm can be initiated by means of a key switch in each of the double action stations. If original alarm is not acknowledged within five minutes, system automatically enters into second stage alarm which consists of (the bells ringing at one hundred twenty strokes per minute) (a high rate tone on emergency evacuation speakers).
    - .2 Initiate alarm origin on CPU and at graphic annunciator.
    - .3 Shut down air supply and return air fans.
    - .4 Transmit signal to fire department.
    - .5 Deactivate all magnetic door locks and/or door strikes.
    - .6 Activate smoke dampers.

- .6 CPU shall indicate trouble when any fault occurs within the system (or CRT and keyboard).

## 2 Products

### 2.1 **ACCEPTABLE MANUFACTURERS**

- .1 Simplex Grinnell
- .2 Siemens Building Technologies
- .3 Notifier
- .4 Mircom
- .5 Chubb/Edwards

### 2.2 **MATERIALS**

#### .1 Control Panel

- .1 Control panel shall be housed in a (free-standing) (wall-mounted) cabinet of code gauge construction with baked enamel finish, full viewing window and hinged front door cover complete with lock and two keys. Opening cabinet door shall provide access to all operating controls, but will not expose live electrical connections.
- .2 Control panel, with number of zones as shown on zone schedule containing the following:
  - .1 Reset button, LED test button, alarm signal silencing push button, ground fault indicator light, system trouble indicating light, trouble signal silencing button and annunciator trouble indicating light.
  - .2 Relays and control modules as required for door releases, fan shut-down, extinguishing system release and audible alarms.
  - .3 Alarm receiving modules for number of zones as indicated on Drawings. Zone modules shall be capable of handling any type of device including pull stations, smoke detectors, and heat detectors to allow for future changing of devices without changing modules. Each module to contain a trouble alarm indicator.
  - .4 Power supply modules as required.
  - .5 Valve supervision module as required.
  - .6 Signal control modules as required.
  - .7 Fire department connection plug-in module complete with disconnect switch and LED "disconnect" indicator.
  - .8 All modules shall have visual supervision against removal.
  - .9 A standby power module shall be provided consisting of lead calcium sealed batteries connected with sufficient amp hour capacity to operate the alarm devices under supervisory condition with AC power disconnected for twenty-four hours and at the end of this period, operate the alarm devices for thirty consecutive minutes. Note that on battery

standby all building wiring must be supervised, and give an immediate trouble indication on battery backup when any problem occurs within the system. The batteries shall be sealed maintenance free type with expected life in excess of five years. Batteries shall be enclosed in a steel housing. A fully automatic battery charger shall be provided which shall be capable of restoring 90% of a dead batteries capacity within twenty-four hours. The battery shall be protected against excessive discharge by automatically disconnecting battery from system when voltage of battery drops to 60%.

.2 Central Processing Unit (CPU)

- .1 Central processing unit shall come complete with alphanumeric display, keyboard and printer. Alphanumeric display and printer shall be fully operational while system is operating on standby batteries.
- .2 CPU shall be housed in (flush mounted) (surface mounted) (free standing) cabinet with sufficient capacity to allow maximum system expansion and to house alphanumeric display and printer (audio system microphone) (master firefighter phone).
- .3 The CPU electronics shall be microprocessor-based. Basic life safety software shall be retained in erasable programmable read only memory (EPROM). CPU shall have special software available in which to make changes on a temporary basis in control by event programming, and also in custom printer labels. This field editing is to enhance flexibility of the system. CPU shall be equipped with software in order to handle \_\_\_\_\_ monitor points, and \_\_\_\_\_ control points, and have ability to annunciate all of aforementioned points, including an additional \_\_\_\_\_ trouble points dedicated to system supervision. All indicators and software shall be in place within the CPU.
- .4 System shall be multi-channel allowing a minimum of \_\_\_\_\_ monitor points per channel. One or two channels may be used for system. Each channel shall operate independently. Faults on one channel shall not affect operation of the other. System wiring requirements shall be one pair of wires per channel for data communication, two pairs for zoned dual channel audio transmissions, and one pair for a fully supervised and zoned firefighter phone system.
- .5 CPU shall be equipped with a real time output for the purpose of synchronizing clocks.
- .6 CPU shall display both alarm and trouble indication from each fire alarm zone, where each zone can be a device. The system shall indicate the exact location and description of activity.
- .7 As a result of alarm conditions received at the CPU, the system shall have ability to automatically operate specified control points such as tripping municipal box to summon fire department, or stopping exhaust fans or air conditioning units and releasing magnetically held doors and other fire alarm related devices.
- .8 System shall be equipped with a communication input/output "port" to allow use of commercially available remote printers, cathode ray tubes (CRT), and keyboards.
- .9 Multiplex system shall be equipped with standby batteries to provide system operation and vital fire/security protection during commercial power outages. It shall also have provisions to operate an LED annunciator to provide a simple

lamp type status indicator for critical system functions. These annunciators shall be operable from the system communication circuits (same wiring used to communicate with transponders), eliminating the need for special wiring.

- .10 CPU shall be designed for use with transponders. Transponders shall have the capability to interface with all specified peripheral devices, such as smoke and thermal detectors, door holders, (speakers). Communication between CPU and transponders shall be one twisted shielded pair.
  - .11 Voice communication system shall be an integrated dual channel system for use in fire alarm and emergency paging. Voice communication system shall have ability to sound an evacuation tone in one area of building, over that areas' speakers, while at the same time being able to sound a first stage alert tone or voice message to other parts of the building.
  - .12 Voice communication system shall provide intelligible low level reproduction and incorporate one way voice communication to each floor or compartment of building for selected evacuation and/or one way voice communication to all or any combination of floor or compartments for mass evacuation. Wiring to voice communication transponders shall be one shielded twisted pair from CPU to voice transponders.
- .3 Transponders
- .1 Transponder shall be capable of directly running two-wire ionization or photoelectric smoke detectors and shall supervise detector and signalling circuits in accordance with class "A" requirements. Unit shall be a combination of alarm monitor points, control points, supervised signalling circuits, and one detector reset point and shall respond to signal silence and detector reset commands manually initiated at CPU operator's panel.
  - .2 Transponders shall use microprocessor based electronics to ensure reliability. Sensing circuits to peripheral devices shall be supervised to provide an indication of sensing circuit faults. Sensing circuit supervision shall not reduce available system monitor points. Sensing circuits shall be capable of working with normally (open) (closed) contacts and shall detect the following conditions: open line, alarm, normal and ground.
  - .3 Transponders shall contain the zones as indicated on schedules, and shall be used for monitoring fire alarm zones, sprinkler zones, sprinkler tamper zones, (security zones), (and for monitoring and controlling emergency telephone zones), (and paging zones). Transponders shall also be used for controlling door holders, fan shutdown, and damper circuits.
- .4 Demarcation Terminal Box
- .1 A suitable terminal box to be provided as the point of demarcation between the fire alarm control unit and the signal transmitting unit.
  - .2 Alarm, trouble and supervisory contacts shall be extended from the fire alarm control unit to the demarcation terminal box.
- .5 Alarm Initiating Devices
- .1 Thermodetectors:

- .1 Fixed temperature thermal detectors shall be of (fast action fusible) (automatic reset) type, rated at (135°F (57°C)) (200°F (93°C)) (with status LED for visual supervision). (Detector shall be addressable).
  - .2 Thermal detectors operating on rate-of-rise and fixed temperature principles shall be sensitive to a temperature rise greater than or equal to 15°F (8°C) per minute or rate fixed temperature of (135°F (57°C)) (200°F (93°C)) (with status LED for visual supervision). (Detector shall be addressable).
- .2 Smoke detectors:
- .1 Ionization smoke detector shall be self-compensating dual chamber type activated by products of combustion. The unit shall be plug-in, mounted to a twist/lock base complete with solid-state amplifier-switching circuit and status LED for visual supervision. (Detector shall be addressable).
  - .2 Ionization smoke detector shall be self-compensating dual chamber type activated by products of combustion. Detector shall contain internal chamber cover and pre-selected fixed sensitivity for use in high air velocity applications. Unit shall be plug-in, mounted to a twist/lock base complete with solid-state amplifier-switching circuit and status LED for visual supervision. (Detector shall be addressable).
  - .3 Photoelectric smoke detector shall be a photoelectric detection chamber type activated by light scattering of smoke particles. Unit shall be plug-in, mounted to a twist/lock base complete with status LED for visual supervision. (Detector shall have an integral fixed temperature heat detector rated at 135°F (57°C)). (Detector shall be addressable).
- .3 Duct detectors:
- .1 Ionization duct detector shall be dual chamber type with housing and air sampling tubes for detection of combustion products and/or smoke. Provisions shall be made for local or remote indicator lamp and/or auxiliary relay. (Detector shall be addressable).
  - .2 Photoelectric duct detector shall be solid state photodiode type with housing and air sampling tubes for detection of smoke using light scattering. Provisions shall be made for local or remote indicator lamp and/or auxiliary relay. (Detector shall be addressable).
- .4 Manual stations:
- .1 Single action station shall be non-coded (flush) (surface) mounted type consisting of a molded housing with pull-down lever and keylock switch to test and reset. Alarm switch shall be of (N/O) (N/C) sealed contact type and come complete with a normally closed auxiliary contact. (Manual station shall be addressable).
  - .2 Double action station shall be non-coded (flush) (surface) mounted type consisting of a molded housing with (push-in tab) (break glass), pull-down lever action and key lock switch to test and reset. Alarm switch shall be (N/O) (N/C) sealed contact type and come complete with a normally open auxiliary contact. (Manual station shall be addressable).



- .6 Signalling Devices
  - .1 Bells shall be of (single stroke) (vibrating) polarized type, (flush) (surface) mounted, red in colour, for operation on (24V DC) (120V AC) audible circuit supply. Bells shall be complete with (150 mm gong) (250 mm gong) (chimes).
  - .2 (Horns) (Sirens) shall be of polarized type, (plug-in) (flush) (surface) mounted, red in colour, for operation on (24V DC) (120V AC).
  - .3 Speakers shall be 200 mm, of permanent magnet cone type and have an impedance of eight ohms. Speaker shall include a multiple tap transformer (one-quarter, one-half, one, two, and four watts). Frequency response at full rated power shall be 50-80,000 Hz. Baffles shall be fabricated of steel, finished in flat white baked enamel.
- .7 End-of-Line Resistors
  - .1 End-of-line resistors shall be mounted on a stainless steel plate and bear a ULC label.
- .8 Door Holders
  - .1 Door holders shall be magnetic type, (wall) (floor) mounted, with approximately 16 kg holding power, for operation on (12V DC) (24V DC) (24V AC) (120V AC).
- .9 Remote Alarm Indicators
  - .1 Remote alarm indicators shall be (wall) (ceiling) mounted and shall provide remote indication of a specific detector using an electrical connection. Unit shall consist of a red (LED) (lamp) on a mounting plate.
- .10 Remote Test Station
  - .1 Remote test station shall provide testing of a detector and indication of an alarm condition at a remote location. Unit shall consist of a key test switch and a red (LED) (lamp) mounted on a single gang plate.
- .11 Graphic Building Plan
  - .1 Graphic plan to be a wall mounted pictorial representation of the building indicating building outline with fire detection zones. Graphic plan shall indicate separately all levels, with appropriate zones showing exit doors, stairwells and elevators. Graphic plan to be engraved on acrylic material and installed beside annunciator panel depicting proper orientation. Annunciator location to be engraved in red.
- 3 Execution
- 3.1 **INSTALLATION**
  - .1 Conductors shall be solid copper. The minimum size of conductor shall be:
    - .1 16 AWG for individual conductors.
    - .2 18 AWG for integral assembly of two or more conductor cables.
    - .3 14 AWG for control and audible signal circuits. In no case shall the voltage drop exceed 10%.

- .2 All wiring within enclosures to be identified with wire markers and termination on terminal strips. Wiring entering and exiting control enclosures shall be laid on terminal strip. Splicing of wiring is not acceptable.
- .3 Wiring entering or leaving building to be provided with lightning protection. Surge protection to be installed in junction box at floor level. Label box as "fire system surge protection".
- .4 Class A wiring shall be used for all alarm initiating devices.
- .5 Class B wiring shall be used for all notification appliances circuits.
- .6 Power to be provided by 120V AC.
- .7 Provide (EMT) (rigid) conduits with (steel set screw fittings with nylon insulated thread) (rigid coupling) as manufactured by T & B or approved equal. Size conduits to code requirements or larger sizes where indicated.
- .8 Terminal cabinets shall be 460 x 610 mm type "T" with wood back, door within the trim complete with latch and lock.
- .9 Outlet box for audible and visible devices to be a single gang, masonry box unless indicated otherwise and shall be flush mounted so that the top of the device will not be less than 2.3 m above the finished floor level in all areas with finished ceilings. In all other areas, outlet boxes shall be 100 mm square surface mounted 2.3 m above finished floor.
- .10 Wall-mounted visible signal devices shall be installed such that the entire lens is not less than 2 m and not more than 2.4 m above the finished floor.
- .11 Outlet boxes for manual stations shall be a single gang masonry box unless indicated otherwise and shall be flush mounted not less than 1.2 m and not more than 1.4 m above finished floor level to centre of box in all areas with finished ceilings. In all other areas, outlet boxes shall be flush mounted if possible.
- .12 The top of fire alarm annunciator or display and control centre legend or operating control shall be mounted not more than 1.8 m from finished floor level.
- .13 Should interference from obstructions, lamp positions or heat radiating surfaces be encountered in locating any fire alarm device where shown, the device shall be located as near as possible to indicated position, clear of obstacles, to the satisfaction of Consultant.
- .14 Detectors shall be ceiling mounted unless otherwise specified herein, at the highest point where variations in ceiling height exist and shall not be mounted on sides or underside of beams, joists, ducts, open web steel joists or any structure, etc. projecting more than 100 mm below ceiling level.

### 3.2 VERIFICATION

- .1 Manufacturer shall make an inspection of fire alarm equipment, including those components necessary to direct operation of system. Inspection shall comprise an examination of such equipment for the following:
  - .1 Person(s) carrying out verification to be CFAA certified or equivalent.
  - .2 That the type of equipment installed is that designated by the Consultant's Specifications.

- .3 That wiring connections to all equipment components show that the installer undertook to have observed ULC and CSA requirements.
  - .4 The equipment of manufacturer's manufacture has been installed in accordance with manufacturer's recommendations, and that all signalling devices of whatever manufacture have been operated or tested to verify their operation; and
  - .5 That supervisory wiring of those items of equipment connected to a supervised circuit is operating and that governmental regulations, if any, concerning such supervisory wiring, have been met to the satisfaction of inspecting officials.
  - .6 Manufacturer will supply to Contractor reasonable amounts of technical assistance with respect to any changes necessary to conform Work to paragraphs above. During period of inspection by manufacturer, Contractor shall make available to manufacturer, electricians as designated by manufacturer.
- .2 On completion of inspection and when all of above conditions have been complied with, manufacturer shall issue to Consultant:
- .1 A copy of inspecting technician's report showing location of each device and certifying test results of each device.
  - .2 Inspection report to be in the format as laid out in CAN/ULC S537 Appendix C.
  - .3 A certificate of verification confirming that inspection has been completed and showing conditions upon which such inspection and certification have been rendered.
  - .4 Proof of liability insurance for the inspection.

3.3 **DEMONSTRATION**

- .1 Engage a manufacturer's service representative to provide startup service and to demonstrate and train Owner's personnel for the following:
- .1 On procedures and schedules related to startup and shutdown.
  - .2 Silencing of alarms, resetting of control panel.
  - .3 Isolating of individual detectors or areas.

End of Section